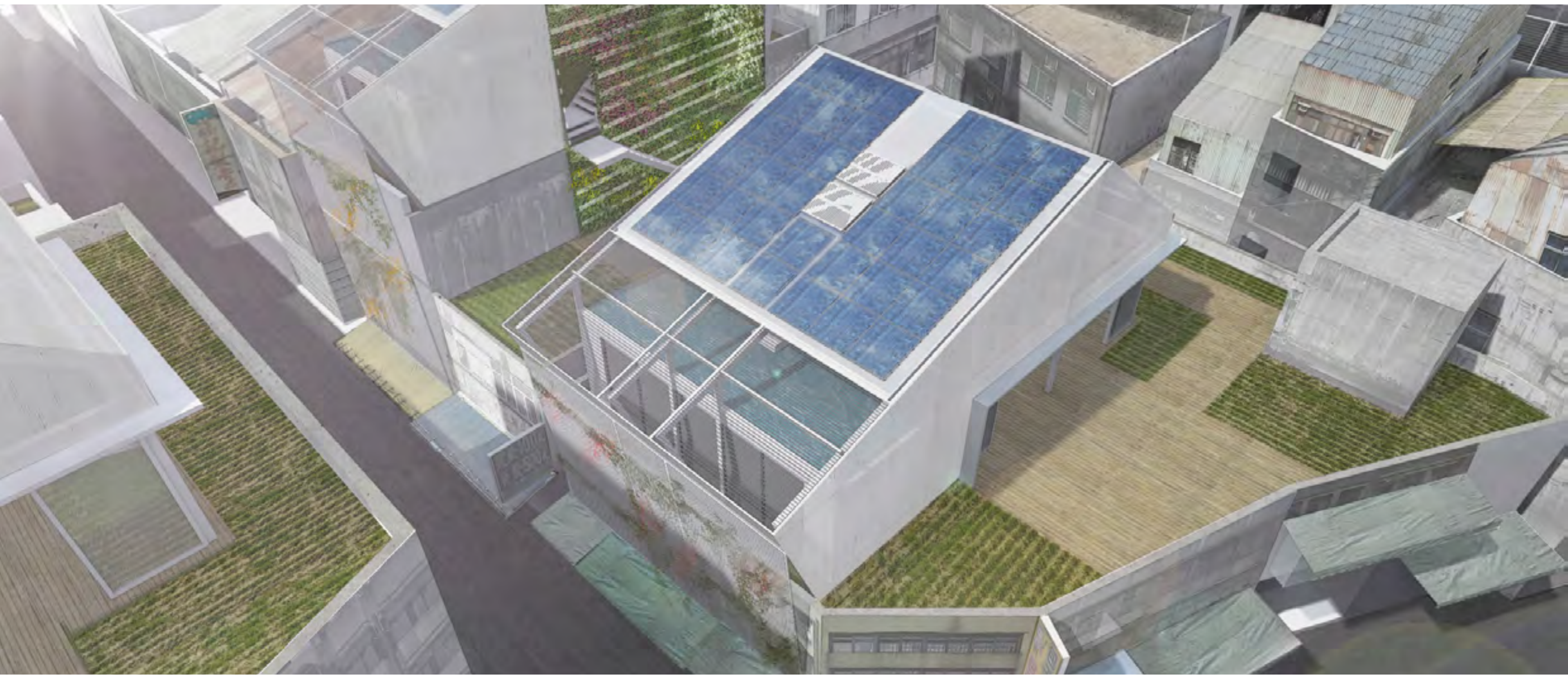

PROJECT MANUAL

Deliverable #4
March 3rd, 2014

NCTUNICODE

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國立交通大學 National Chiao Tung University

Solar Decathlon Europe

ORCHID HOUSE

2. SUMMARY OF CHANGES

SUMMARY OF CHANGES

PROJECT MANUAL ITEMS	STATUS	DATE
COVER SHEET	UPDATED	March 3, 2014
SUMMARY OF CHANGES	UPDATED	March 3, 2014
TABLE OF CONTENTS	UPDATED	March 3, 2014
RULES AND BUILDING CODE COMPLIANCE CHECKLIST	UPDATED	March 3, 2014
CONTEST SUPPORT DOCUMENTS	UPDATED	March 3, 2014
Urban Design, Transportation and Affordability Report	UPDATED	March 3, 2014
Architecture Design Narrative	UPDATED	March 3, 2014
Engineering and Construction Design Narrative	UPDATED	March 3, 2014
Energy Efficiency Design Narrative	UPDATED	March 3, 2014
Innovation Report	UPDATED	March 3, 2014
Sustainability Report	UPDATED	March 3, 2014
Communications Plan	UPDATED	March 3, 2014
DINNER PARTY MENU	UPDATED	March 3, 2014
CONTEST WEEK TASKS’ PLANNING	UPDATED	March 3, 2014
COST ESTIMATE AND PROJECT FINANCIAL SUMMARY	UPDATED	March 3, 2014
SITE OPERATION REPORT	UPDATED	March 3, 2014
HEALTH & SAFETY PLAN	UPDATED	March 3, 2014
DETAILED WATER BUDGET	UPDATED	March 3, 2014
ELECTRIC AND PV DESIGN SYSTEMS INFORMATION	UPDATED	March 3, 2014
CONSTRUCTION SPECIFICATIONS	UPDATED	March 3, 2014
STRUCTURAL CALCULATIONS	UPDATED	March 3, 2014

PROJECT DRAWING ITEMS	STATUS	DATE
GENERAL (GE)	UPDATED	March 3, 2014
ARCHITECTURAL (AR)	UPDATED	March 3, 2014
BIOCLIMATIC ANALYSIS (BA)	UPDATED	March 3, 2014
INTERIOR (IN)	UPDATED	March 3, 2014
STRUCTURAL (ST)	UPDATED	March 3, 2014
FIRE PROTECTION (FP)	UPDATED	March 3, 2014
PLUMBING (PL)	UPDATED	March 3, 2014
SOLAR WATER HEATING (SW)	UPDATED	March 3, 2014
MECHANICAL (ME)	UPDATED	March 3, 2014
ELECTRICAL (EL)	UPDATED	March 3, 2014
PHOTOVOLTAIC SYSTEM (PV)	UPDATED	March 3, 2014
TELECOMMUNICATIONS AND AUTMATIZATION SYSTEM (BAS)	UPDATED	March 3, 2014
SDE INSTRUMENTATION DRAWINGS (ID)	UPDATED	March 3, 2014
SITE OPERATION (SO)	UPDATED	March 3, 2014
HEALTH AND SAFETY (HS)	UPDATED	March 3, 2014
PUBLIC TOUR (PT)	UPDATED	March 3, 2014

3. TABLE OF CONTENTS

TABLE OF CONTENT

4. RUELS AND BUILDING CODE COMPLIANCE CHECKLIST

Table 9: SDE Rules checklist.

Rule Description	Content Requirement(s)	Drawing(s)/ Report(s)
3.2 Team Officers and Contact Information	Team officer's contact information completely fulfilled in Table 1 (SDE WAT)	PR: Page 47
4.3 Lot Conditions and attribution	Drawing(s) showing the storage and unloading areas and corresponding load's calculations	PD: SO-201
4.3 Lot Conditions	Calculations showing the structural design remains compliant even if there is a level difference, and drawing(s) showing shimming methods and materials to be used in case	PM: 14.0
4.4 Footings	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	PD: ST-001
4.4 Footings	Drawing(s) showing the location, contact area and soil-bearing pressure of every component resting directly on the ground	PD: ST-001 PM: 14.0
4.7 Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site and specifications for heavy machinery	PD: ST-201 PM: 9.2.5
5.1 Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	PD: AR-011
6.1 Structural Design Approval	Structural drawings and calculations signed and stamped by a qualified licensed professional	PM: 14.0
6.1 Electrical and Photovoltaic Design Approval	Electrical and Photovoltaic drawings and calculations signed and stamped by a qualified licensed professional	PM: 4.0
6.1 Codes Design Compliance	List of the country of origin codes complied, properly signed by the faculty advisor	PD: 4.0
6.2 Architectural Footprint	Drawing(s) showing all information needed by the Rules Officials to digitally measure the architectural footprint	PD: AR-014
6.2 Architectural Footprint	Drawing(s) showing all the reconfigurable features that may increase the footprint if operated during contest week	PD: AR-041, AR-042 AR-043, AR-044
6.3 Measurable Area	Drawing(s) showing the Measurable Area	PD: AR-017
6.4 Entrance and Exit Routes	Drawing(s) showing the accessible public tour route, specifying the entrance and exit from the house to the main street of La Cité du Soleil®	PD: PT-001, PT-002 AR-051
7.3 PV Technology Limitations	Specifications and contractor price quote for photovoltaic components	PM: 13.3.5 a
7.4 Batteries	Drawing(s) showing the location(s) and quantity of stand-alone, PV-powered devices and corresponding specifications	PD: EL-401 PM: 13.3.5 c
7.4 Batteries	Drawing(s) showing the location(s) and quantity of hard-wired battery banks components and corresponding specifications	PD: AR-051 PM: 13.3.5 c
7.6 Thermal Energy Storage	Drawing(s) showing the location of thermal energy storage components and corresponding specifications	PD: ME-001 PM: 13.3.2 c
7.7 Desiccant Systems	Drawing(s) describing the operation of the desiccant system and corresponding specifications	N/A
7.8 Humidification systems	Specifications for humidification systems and corresponding certifications of the different elements.	N/A
8.1 Containers locations	Drawing(s) showing the location of all the water tanks	PD: PL-001
8.2 Water Delivery	Drawing(s) showing the fill location(s), quantity of water requested at each fill location, tank dimensions, diameter of opening(s) and clearance above the tank(s)	PD: PL-001
8.3 Water Removal	Drawing(s) showing the quantity of water to be removed from each fill location, tank dimensions, diameter of opening(s) and clearance above the tank(s).	PD: PL-001

8.5 Grey water reuse	Specifications for grey water reuse systems	PM: 13.3.2 c
8.6 Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	PM: PL-xxx
8.8 Thermal Mass	Drawing(s) showing the locations of water-based thermal mass systems and corresponding specifications	PD: AR-051, AR-114 PM: 13.2.3 b
8.9 Grey Water Heat Recovery	Specifications for grey water heat recovery systems.	PM: 13.3.2 c
9.1 Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	PD: AR-002
9.2 Watering Restrictions	Drawings showing the layout and operation of greywater irrigation systems	PD: PL-xxx
10.2 SDE Sensors' Location and wire routing	Drawing(s) showing the location of bi-directional meters, metering box, sensors, cables and feed-through to pass the instrumentation wires from the interior to the exterior of the house	PD: ID-001, ID-002
11.2 Use of the Solar Decathlon Europe Logo	artwork, and content of all communications materials, including signage	PM: 5.7.4
11.3 Teams' sponsors & Supporting Institutions	Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage	PM: 5.7.5
11.4 Team Uniforms	Drawing(s) showing the artwork, content and design of the team uniform	PM: 5.7.4
12.4 Public Tour	Drawing(s) showing the public tour route, indicating the dimensions of any difficult point, complying with the accessibility requirements	PD: PT-001 PM: 5.7.3
20.0 Contest 6: Drying Method	Drawing(s) showing the clothes drying method and the place where the clothes will be dried.	PD: AR-022
20.0 Contest 6: House Functioning	Appliances and corresponding technical specifications.	PD: IN-401 PM: 13.2.5
36.5 Photovoltaic systems design	Specifications of PV generators, inverters, wiring, cables, protections, earthing systems, interface with the electricity distribution network	PD: PV-001,PV-002 PV-011,PV-021 PM: 13.3.5
36.5 Photovoltaic systems design	Inverters' certificates	PM: 13.3.5 b
36.5 Photovoltaic systems design	Maintenance plan for PV generators, supporting structure, inverters, wiring, cables, protections, circuit breakers in case of fire and earthing system. Fire protection systems for PV DC wiring	PM: 13.3.5
36.5 Photovoltaic systems design	The corresponding table "design summary" must be filled out	PM: 13.3.5
51.3 Fire Safety	Specifications for Fire Reaction of Constructive elements, extinguishers and fire resistance of the house's structure.	PM: 13.4
51.3 Fire Safety	Drawings showing compliance with the evacuation of occupants' requirements and fire extinguishers location	PD: FP-001,FP-002
51.4 Safety against falls	Specifications of compliance with the slipperiness degree classes of floors included in House tour	PM: 13.5
51.4 Safety against falls	Drawing(s) showing compliance with conditions	PD: AR-101
	for uneven flooring, floors with different level, Restricted Areas stairs, Public Areas Staircases, Restricted Areas Ramps and Public Areas Ramps	PD: AR-101, AR-361 PT-001, PT-002
51.4 Safety for avoiding trapping and impact risk	Drawing(s) showing compliance with conditions for avoiding trapping and impact risk	PD: AR-307
51.4 Safety against the risk of inadequate lighting	Specifications for level of illumination of house tour areas light fittings	PD: EL-401
51.5 Accessibility for People with Disabilities and Special Needs	Interior and exterior plans showing the entire accessible tour route	PD: PT-001
51.6 Structural Safety	Specifications for the use of dead loads, live loads, safety factors and load combinations in the structural calculations	PM: 14.0

51.7 Electrical and PV Systems	Complete the “Electrical System Design PV Chart and Checklist” Rule 48.	PM: 12.0
51.7 Electrical and PV Systems	Specifications of the wiring, channels, panels and protections of the electrical installation	PM: 12.0
51.7 Electrical and PV Systems	One-line electrical diagram and drawings showing the grounding, execution and paths	PD: EL-501, EL-502 EL-503

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Certificate of Compliance

I certify that the Orchid House project complies Taiwanese Building Code issued by Taiwan Construction and Planning Agency Ministry of the Interior (CPAMI)

Signed by: Benjamin Tang

Printed Name: Benjamin Tang

Title: Faculty Advisor

Date: 2014.03.03

5. CONTEST SUPPORT DOCUMENTS

5.1 Urban Design, Transportation and Affordability Report

Objective

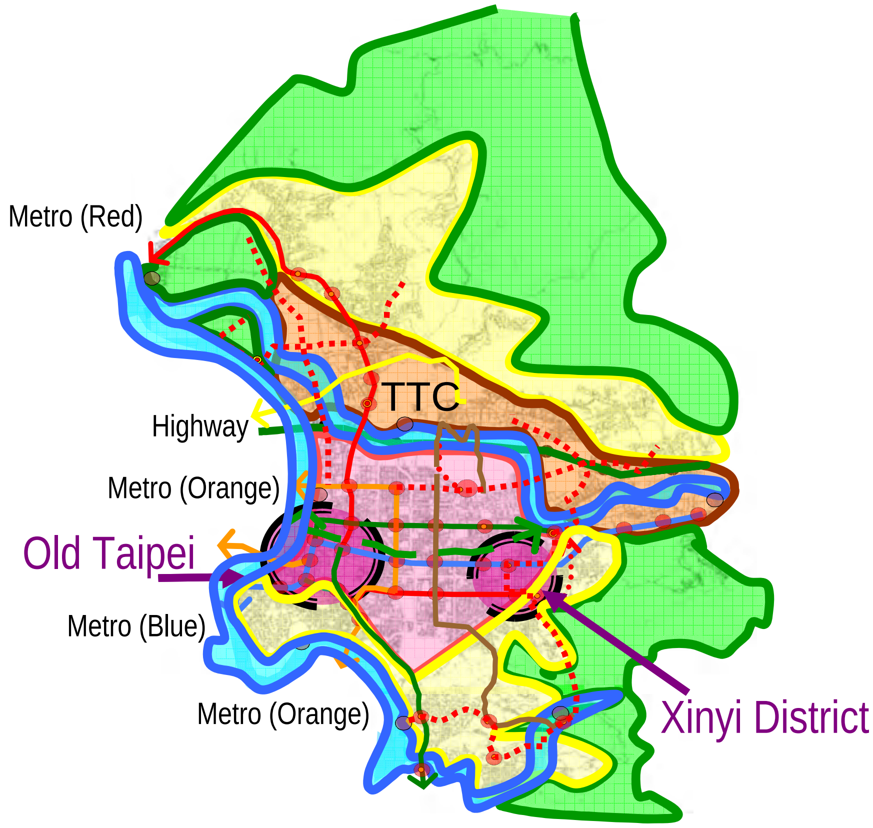
Settled in Qing Dynasty in 1709, Taipei city started as a trade port and economic center (the Old Taipei) in Northern Taiwan and stretch outward till what it looks like today as a metropolitan. Area of the City proper is 271.7 sq. km., in which 47.8% is urban areas and 52.2% is non-urban areas. Taipei's rich, drastic natural environment is full of wind, water, mountains, and forests.

Population of Taipei city is 2.68 million with average density of 9,890 populations per sq. km. In urban area, it is 18,000 populations per sq. km! Population would reach 7.01 million when counting the whole metropolitan area including New Taipei City and Keelung. Due to differences in geographic location, economic development of its districts, Taipei's population is not evenly distributed. In 2010, the aging index of Taipei has reached 94.1%.

Four main themes of urban development, based on the 2010-11 Annual Report, Dept. of Urban Development, Taipei City Government:

Achieving Sustainable Urban Development: eco-friendly development, low-carbon, energy-saving policies, and encouraging green industry.
Building a Beautiful Waterfront City: increase water-accessibility by newly developed facilities and parks along the riverbanks and water edges.
Urban Renewal to Attract Industry: designating renewal zones, shifting capacity, and reviewing zoning ordinances to attract vendors and industries. As well as establishing Urban Regeneration Stations (URS), which turn idle spaces into vessels for people to create, to learn and to share with others.
Innovative and Efficient Execution: conduct urban development innovatively and efficiently, instead of relying on policy arguing and facing complains from citizens.

Current spatial development of Taipei city is supported by dual-core and multi-axis strategies .



Dual-core:
West core is mainly the Old Taipei city, including the Main Station, President Hall, and Ximending.

East core is the newly developed district including Taipei City Government, shopping malls, and various business and entertainment centers.

Multi-axis:
Public Transit Network: Taipei Metro, E-Bus and U-Bike together constructed a convenient transportation network where most of the city blocks are within 10-minutes walk or bike from bus stop or metro station.

Taipei Technology Corridor (TTC): a 768.5-hectare, 20-kilometer long corridor of hi-tech parks along the Keelung River next to the urban cores serves as a hub of numerous technology headquarters.

Cultural Industry: in addition to museums and galleries, a network of creative parks and art villages has been established as an important part of the city's cultural facility.

Waterfront Space: parks, sports and recreational facilities on the green belts along the riverbanks provide ample space for rich activities.

Some successful cases in Taipei's urban renovation that can be taken as references by Orchid House:

Case 1: Urban Regeneration Station (URS)

In 2000s, a number of public-owned vintage buildings were renovated and transformed into the Urban Regeneration Station (URS). On one hand, it creates a platform for new urban forum and public participation; on the other hand, it reuses and revitalizes the surrounding old communities by bringing in new activities such as workshop, exhibition, gathering, experimental events and social interactions. Activities were mostly initiated by young professionals. URS has brought new life into old streets and communities and became one of the most successful urban renewal projects by far

Case 2: World Design Capital 2016

In pursuit of the World Design Capital 2016, Taipei city had gone through a series of major transformation in its policies and master plans. In addition, in 2012, Taipei City Government began to actively bring its different departments together through meetings with designers and experts. A series of survey, case studies and workshops for officials and designers have conducted to introduce design thinking to its operations. Design had become one of its categories in its public procurement procedures and related budgets have greatly enlarged. An international event arose fundamental change in

Crises and Opportunities

Vacancy and Equilibrium of Density

Economic change and differences in district development cause impact to population unevenly distributed in the city and some part of the city would vacant, even abandoned. In last decade, Taipei City had established art villages and URS to reactivate certain vintage communities and streets, which had successfully brought back economic to the areas. But for some part of the city the problem remain. For example in Ximending, upper floors of many buildings are still abandoned while business and activities only happen on street level.

If URS, an urban acupuncture strategy, can bring new life and energy back to old community, a new way of intervention such as Orchid House (or part of it, to be embedded into existing buildings) can be a bold opportunity to the old district.

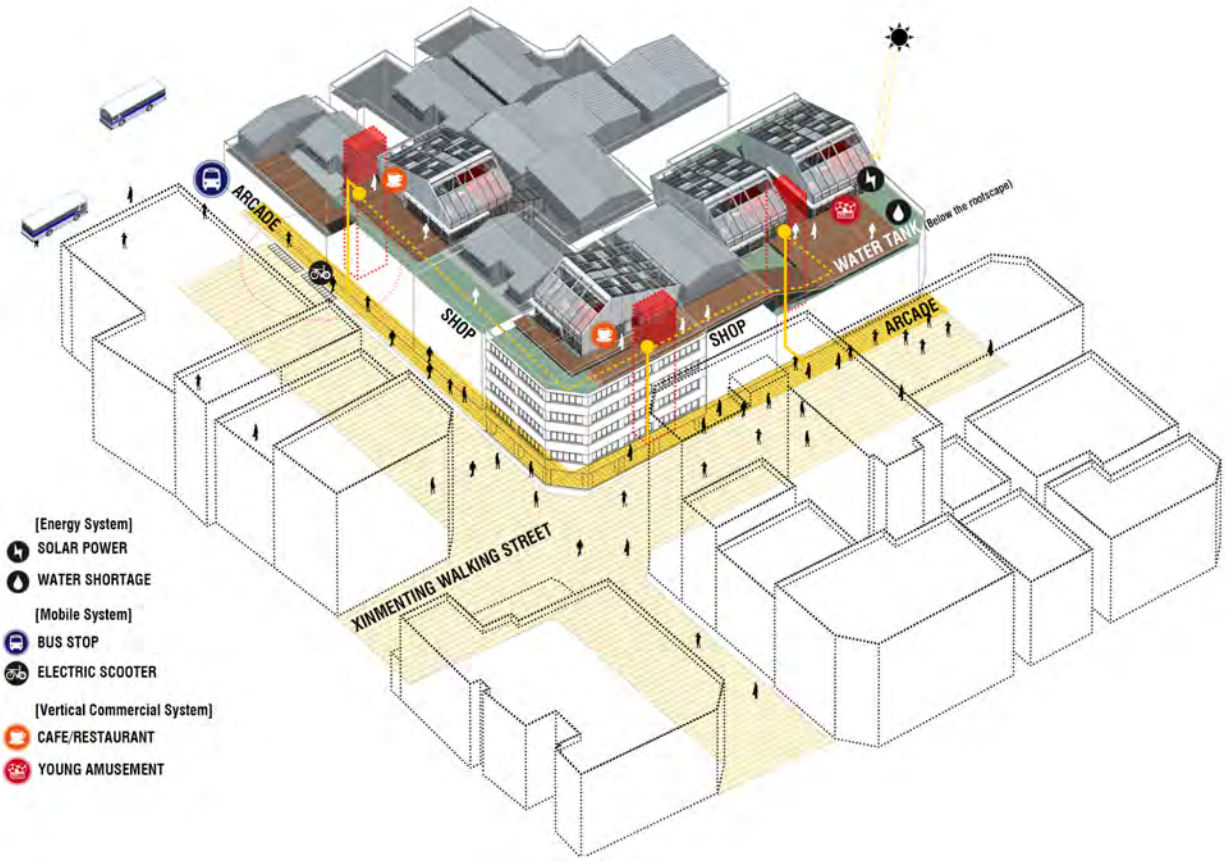
Rooftop as New Urban Space

For most of the Taiwanese building, especially in the city, rooftop is usually a forgotten space with minimal activities, if not none, which seem to be irrelevant to our daily life. Some rooftops become the backstage for “unappealing” facilities, such as AC/Ventilation outdoor units, water tanks, pipes and cables (Figure 5), while some become the expansion of our living space. Because of the demands of gaining more living space, most of the rooftops in Taipei were renovated by owner illegally for private or rental purposes. It’s an inevitable struggle between the average citizen, developers, and government, because most of the Asian cities were developed bottom-up by the people, while modern Western cities were mostly designed top-down by the authority.

If we treat rooftop as the new ground for urban space rather than a disease to remove, it could be a new hope to many urban issues.

5.1.1 Urban Design Strategies

The Orchid House team believes that a long term vision for a city must be built from what's within. We carefully select five sites which can critically represent housing development history as well as urban conditions in Taipei.



From west side of Taipei to the east, our sites encompasses those historical houses built during Qing dynasty, which manifested the heyday of all the commercial activities due to the proximity to the main river for transporting goods to those modern housing buildings built during 60's and 70's at heart of modern Taipei Of those buildings, modern living referenced from western cities, was originally portrayed through all clear defined building systems and ideal proportion of outdoor and indoor spaces. Most importantly, their scale in relation to urban context. As time progressed, original building structures can no long suffice ever growing city density and changes of population and its associate demographic structure. Fostered by not strictly reinforced covenant and building regulations then, illegal additions beginning to sprawl all over these buildings. As a result of this, both the residents and their living conditions faced critical challenges. Below we identified 5 critical common flaws of buildings located in these representative sites:

1)Dilapidated waterproof on the roof posed potential leaking problems.
2)Newly-added building equipment (i.e. water tank, solar panels, etc) not being integrated aesthetically and functionally to the existing buildings.
3)Illegal room additions to the roof are not built with public safety and durable tectonics.
4)The valuable outdoor spaces on the roof especially for a high-density city were long being deprived.
5)Many dated piping and building electrical systems not being properly laid out and repaired.

In response to five critical issues above, our Orchid House proposal aims to solve all these urgent issues at once with not only what's being carefully designed in the house but also the outdoor spaces shaped and enclosed by the new structure. We envisage a reclaimed civic space on the roof can offer a valuable social and economic engine to a new Taipei. Collectively, we plan to apply our roof design to all the 5 sites in a phased fashion. By carefully understanding demographics and existing activities within them respectively, the outcome of the Orchid House will not merely a standalone addition to our skyline. They will form into clusters, interdependent social and economic ecosystem not only within but across communities. Most critically, our proposal will become an integral part of the old communities. Finally, they will trigger transformation of old neighborhood to create a unique lifestyle for each one, whereby both newcomers and existing residents can emotionally identify with their own living environment and ultimately a sustainable urban renewal outcome can be arrived.

Urban Development Phasing

The Orchid House's vision toward Urban Design including the following three phases and each phase takes 3-5 years:

Phase 1: Inserting the Dots & Fill in the Vacancies. 1 to 2 Orchid Houses are built on selected spots in vintage communities, where young professionals are invited to stay, to live, to work, and to foster innovative activities and to catalyze revitalization. Orchid House provides housing and/or hub for the young professionals, and supplies alternative energy and resources for the communities. This is by following the URS model to perform the Urban Acupuncture.

Phase 2: Connecting the Dots & Bridging the Gaps. More Orchid Houses are built in the vintage communities and also on the connected lines between communities. More young professionals or entrepreneurs are invited (or by application) to live in. The network of Orchid Houses will contribute more alternative energy to local facilities and charging stations for green mobility.

Phase 3: Spreading the Dots & Multiplex the Effects.

Furthermore, building Orchid House means new development on the rooftop or partial adoption in the building. It could be a renovation of existing rooftop structure, or embedding functional parts of Orchid House into upper floors in a building. By this way, citizens will have more choices to adopt solutions providing by this project

5.1.2 Market Viability of the Project

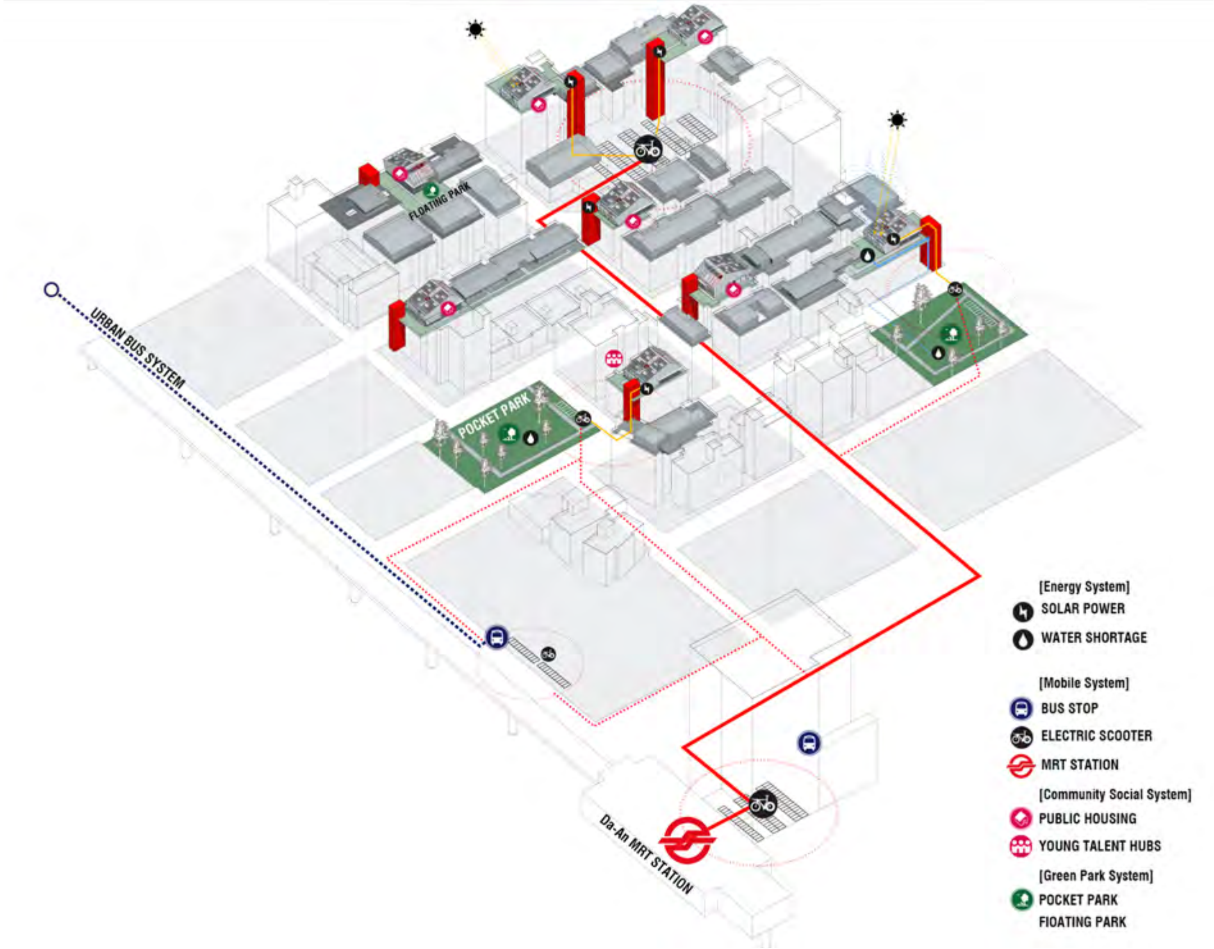
Seeing the soaring real estate price in Taipei city have posed a critical challenge for recent college graduates and youngsters to optimally allocate their income to attain a quality living in the city, our city government has started building youth housing which is slated to open by 2016. The sizes of this dwelling units range from 24m2, 42 m2, and 72m2. In order for the unique housing proposal responding to the most urgent social matter not to be fluctuated in price with the real estate market and thus youth's interest of living would be sacrificed, the newly built housing will only offer rental option. To make it more affordable, it runs at a discount of the market rate, ranging from 70% to 80%.

Our proposed roof addition through Orchid House, will not only coincide with the governmental policy in place, we also aim to optimize it by connecting to other resources both from the city and central government and leverage the unique conditions that the five representative sites can offer.

In 2013, our Ministry of Economic Affairs, initiated a Star-Up Taiwan plan. The goal is to assist young professionals build their businesses. Acknowledging that to realize a business concept, a business ecosystem needs to be built in a given environment. Appropriate industry know-how and ideas across various disciplines should be exchanged and facilitated so that a start-up idea can attain necessary funding and be commercialized.

Our team seeks to provide a platform through Orchid House cluster plan that would extend and combine the above mentioned two governmental efforts. With that, first, young professionals having ideas to start a business will be able to work and live in our Orchid House clusters. Secondly, with below the market rate rent, their disposable income will be increased and thus able to allocate their savings to partially fund their entrepreneurship endeavors. Thus the sense of business ownership and commitment can be strengthened. Thirdly, the sense of community and family bond can be created via properly designed communal spaces. Therefore, on the work front, all the Orchid House cluster residents will be able to co-work and support necessary knowledge. On the living front, the not-yet-married youngsters will be able to form a pseudo family relationship to look after each other which would also enhance a healthy living. Lastly, the initially heavy reliance on outside funding can be lessened through revenues generated through the newly developed businesses within the Orchid House clusters.

U - BIKE
Cafe Shop
Bus Stop
Eletronic Bike Stop
Park
SDE Site
Bus Stop
Walk 10Min.
850 M
750 M
Walk 12Min.
Walk 8Min.
600 M
MRT Station



FLOATING PARK
URBAN BUS SYSTEM
POCKET PARK
Da-An MRT STATION
[Energy System]
SOLAR POWER
WATER SHORTAGE
[Mobile System]
BUS STOP
ELECTRIC SCOOTER
MRT STATION
[Community Social System]
PUBLIC HOUSING
YOUNG TALENT HUBS
[Green Park System]
POCKET PARK
FlOATING PARK

By combining the prerequisites of the two plans (Youth Housing and Start-Up Taiwan), we have outlined the criteria of our potential target customers as following:

1)**Age group**: between 20-45 year old.
2)**Education**: Those who have completed entrepreneurship related certified courses for at least 30 hours provided by local universities, government sponsored or enterprise organized institutions.
3)**Expertise**: Primarily cultural or IT related fields.
4)**Ownership**: those intend to start a business must register as an owner of the new venture 1 year after moving in. If they fail to register, they will have to pay back the rent at the market rent and move out.
5)**Income level**: individual annual income below €30,000 or family income below €50,000.
6)**The lease length**: minimum 3 years, maximum 5 years.

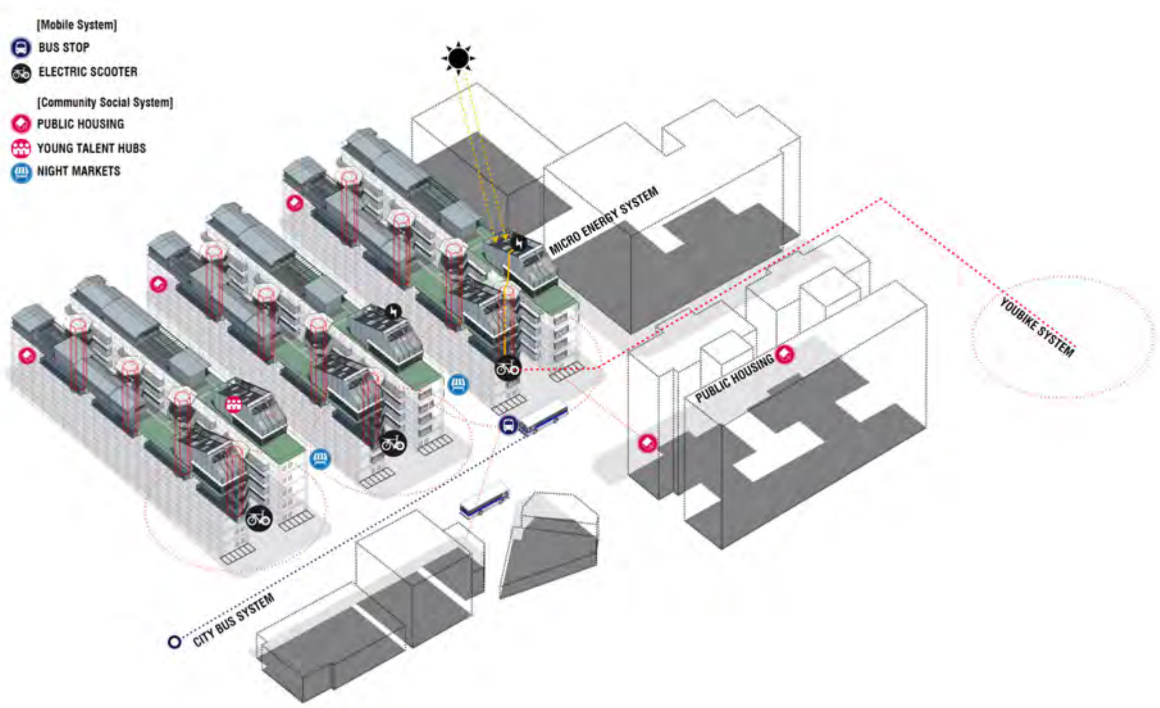
Vision:
The overall vision for Orchid House plan at urban scale is to:
First, aiming to create new economic engine during the process of Taipei city renewal.

Second, we hope to further cultivate Taiwan's major country's development direction investment in Cultural and Creative industry with the support of the already matured IT industries.

Thirdly, making the Orchid House plan as part of Taipei as 2016 World Design Capital event.

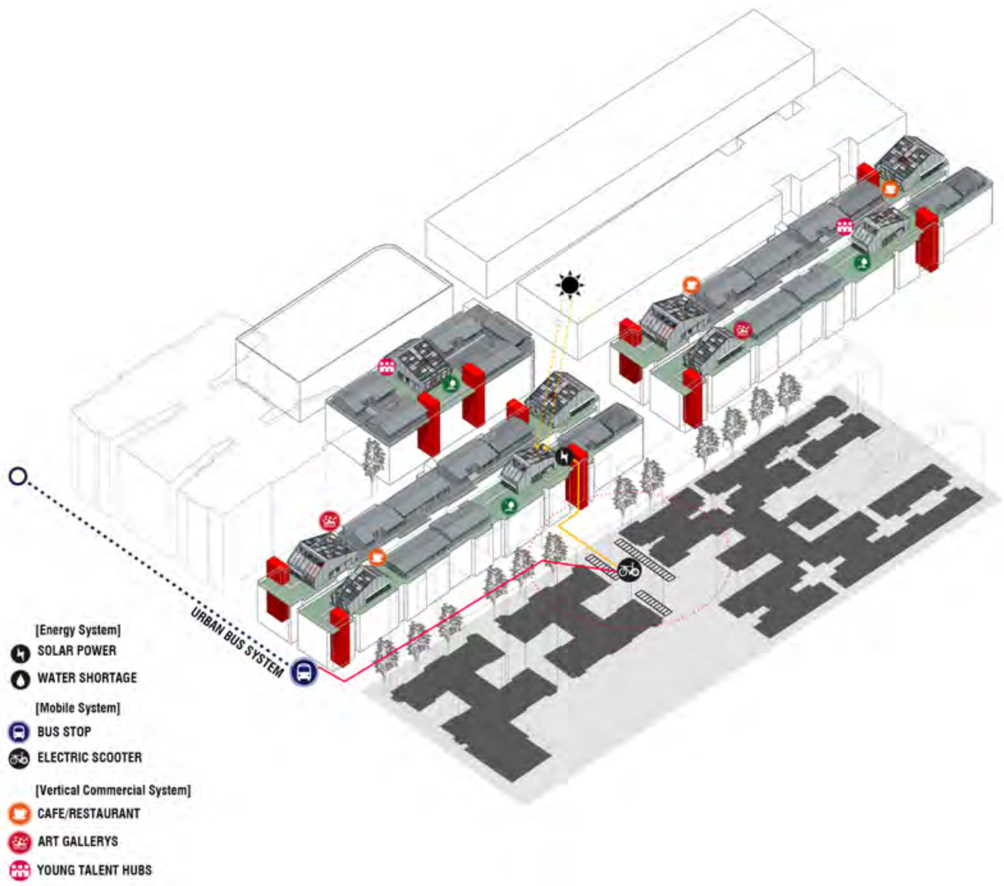
5.1.3 Individual or collective housing building characteristics

5.1.3 Individual or collective housing building characteristics
The proposed Orchid House set forth in Architecture section will serve as a prototype. Based on the available lot sizes and specific building conditions, i.e. the shapes of the roof, the locations of the existing elevator or stairway shafts, mechanical rooms, access to the street level, we will form Orchid House into clusters which are inspired by Taiwanese traditional courtyard style housing setup. With properly designated proportion (50% residential, 25% open green area, and 25% circulation space) of outdoor spaces relevant to indoor sizes, we believe that newly created common areas will vastly transform mostly isolated and independent city life. This arrangement also speaks to the need of co-working and co-living lifestyle to foster new businesses being materialized.



In the five selected sites, the buildings used to exemplify our Orchid House Cluster and the economic generating concepts are mix-use in type. Strong commercial activities at street level signify the themes that long help the neighborhoods develop their own characteristics. Bringing the new economies and existing commercial activities together would help the newly developed communities at the roof level arrive a self-sufficient status, which would encourage socializing between the old and new residents but also minimize the traveling costs which often seen as an issue in newly developed area in Taipei. We understand that building hardware such as physical construction for a city is much easier than ensuring the success of complementary commercial activities. By leveraging the economic energies of the existing sites would not only avoid erasing any given characteristics of the areas but also reduce the living expanses of these young professionals.

One key argument of Orchid House is to regain the ownership of the roof right for the civic use. Roof-top is typically the most valuable space in real estate sense in most metropolitan cities. On that level, one is able to appreciate the city views that cannot be attained at the street level or even any public parks in the city. In Orchid House's long term vision, we ultimately want to build a city that a quality living is affordable to everyone. Compared to other major cities in green coverage and the size of civic park area, Taipei cannot be considered high (Taipei 8% comparing with Tokyo 28%, Singapore 11.1%, and New York City 21%). By regaining and recreating the rooftop for civic use, we are able to increase the quality and quantity of outdoor living with specific characteristics. An ideal proportion and well-articulated outdoor spaces will be shared by the new comers, as well as the existing residents. We believe that this is a great incentive for the existing home owners to let out the roof space. Because compared to most newly developed residential communities in Taipei, 30% of the property ownership is allocated to public facilities. In our proposal, the existing home owners not only need not to pay for these high quality outdoor facilities on the roof superseding that of typical new communities, but also they are able to have a share of rental income from young professionals.



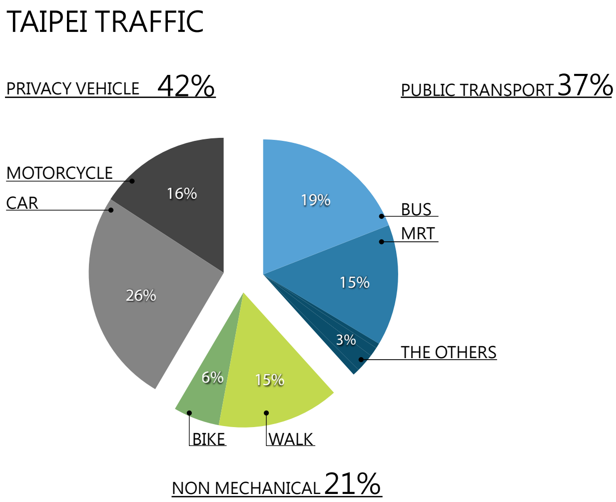
Of the buildings in our five sites, some have elevators, some only have stairways. The new population will not increase the traffic within the building by a lot. That said, we will have the existing shafts and stairways shared by the existing and new.

In order to install Orchid House and newly created outdoor spaces among them, the waterproofing and insulation will be taken into consideration while the new construction takes place.

5.1.4 Transportation and Mobility Characteristics

Since the inception of Ubike system in November 2012 in Taipei, the issued membership has been over 130,000. Including all12 administrative districts of Taipei City, there are 158 rental spots. By February 2014, there are 11.5 million passengers having used Ubike. Based on the population in Taipei, 2.6 million, on average, each resident have ridden Ubike over than 4 times.
This recently installed urban transportation has proven successful.

Now all the major MRT (The Taipei Metro System) stations in Taipei have Ubike spots installed. In all our five exemplified sites, the walking distance from the proposed housing to MRT stations ranges from 3-18 mins. We plan to install Ubike stations at the street level of all 5 sites, with that, the travel time from young professional's residence to the critical network of city transportation system(MRT) will be under 5 mins, which will further enhance young professional's mobility efficiency. In addition, we also proposed to have electric motorcycle (detailed in Architecture section) to work coinciding with Ubike stations. With these two vehicles offered at the same station, residents will have the flexibility to choose either one based on the travel distance.



In one of our sites, Ximending, the pedestrian walk ways were introduced to avoid the conflict of car traffic which used to impede shopping and city strolling experience. With integration of Orchid House clusters and public transportation system, we plan to preserve and enhance the city strolling experience of these exemplified neighborhoods. Due to the long history of these sites, the originally planned street width does not have the capacity to hold high volume car traffic while maintaining an enjoyable walking experience. Our proposed mobility solution will guarantee efficient mobility while the inherent characteristics of the sites and their street life can be further enhanced without generating any additional carbon emission.

5.1.5 Affordability

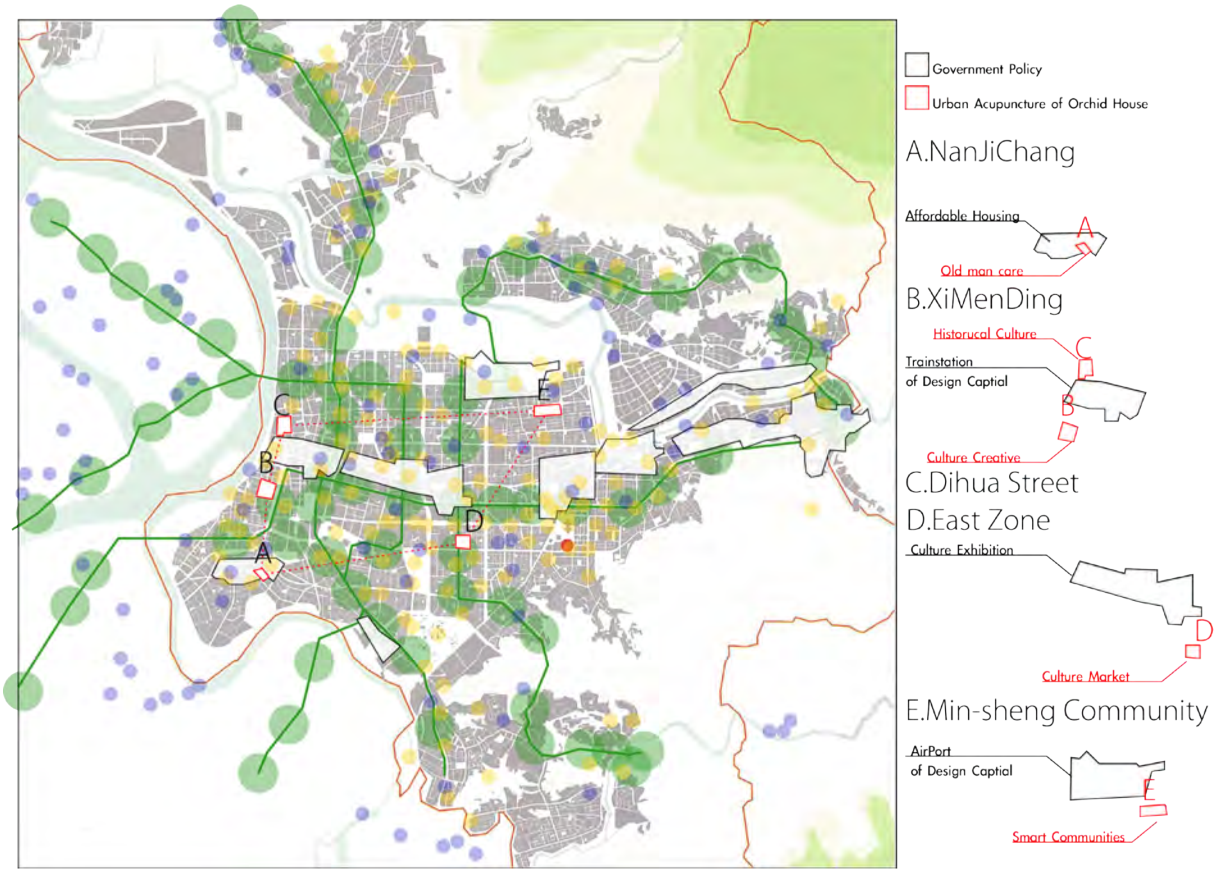
The concept of our business model will be built in a phased plan; a typical life cycle for one site is 10 years. Initially the project will heavily rely on outside funding to implement the Orchid House Cluster to a proper economies scale. With the size of the implementation, we want to ensure that the new economies built by the new comers, other rental incomes and sales of electricity will be able to offset the need of outside funding. The goal is to ensure that starting from the 2nd site (out of five), the proportion of funding sources from government will be reduced and even further from the 3rd site onward. Ultimately a self-sustained economic model can be attained. After the first 2 sites fully completed, we will be able to provide a proven business model to advocate for the Orchid House concept to others. By then, the Orchid House will be adapted in greater Taipei city and even other major cities in Taiwan, including Kaohsiung and Taichung and so on. We will run a financial pro-forma project evaluation at a later stage.

Phase(Goals)	Phase 1	Phase 2	Phase 3	Phase 4
Funding Source (%)	(2yr) No new residents yet	(2yr) 1st exemplified site complete, 1st cohort move in. In the 2nd yr complete business registration	(3yr) By the end of 3rd yr, most of new economies reach a mature stage and start to profit. No new residents yet	(3yr) Net profit from all sources of incomes from the 1st exemplified site will be sufficient to significantly reduce government funding. Ready to build Orchid House at the 2nd Site.
Government	30 %	20 %	5 %	10 %
Resident	30 %	10 %	5 %	25 %
ESCO	40 %	30 %	20 %	5 %
Rental income from Orchid House tenants	N/A	20 %	20 %	20 %
Electricity Sales	N/A	20 %	30 %	0 %
Orchid House new economies	N/A	N/A	20 %	40 %
Total	100 %	100 %	100 %	100 %

5.1.6 Appendix

5 sites description

Taipei city is located in a basin at north Taiwan. Tamsui River and Keelung River flow through and there are 12 districts (graph) in the city now. It is the most important city in Taiwan, not only in that the government of the Republic of China (ROC) is located there, but also in that it has a key position in transportation, as the master station of all long-distance buses, trains, and high-speed trains There is a domestic/international (to Asia city) Song-Shan Airport in the downtown. In order to keep the smooth of traffic in Taipei, there are many bridges and expressways that connect Taipei City and New Taipei City, where many people commute from every day.



Taipei was not developed officially until the end of the Qing Dynasty in the 1880's. There were immigrants from China, most of whom reside in Bangka and Da-Dao-Cheng, which are now in the Wan-Hua and Ta-Tong District of west Taipei. The development of Taipei started in this western area. The rule of the Qing Dynasty was followed by a Japanese occupation (1895-1945), then by the current ROC. The population was growing, so the city was expanded from the west towards the east, such as Da'an District and Song-Shan District. The latest developed district is Hsin-Yi District.
Different cultures and governances have affected Taipei's infrastructure, life styles and building types. There are historical and modern areas in the city and old and new cultures sometimes co-exist in one area. Following the 5 sites of Taipei below, one can find that Taipei is a city with diversity.

Di-Hua Street

Di-hua Street is located in the Da-Dao-Cheng area of Da-Tong District, south-west Taipei. The street is close to Da-Dao-Cheng Wharf of Tamsui River. It is about 800 meters long and is parallel to the River. It is now a historical business area.

The street was constructed during 1850s (Qing Dynasty) by Quanzhou-originating immigrants from China. Throughout the 19th century, Di-hua Street has been an important centre for commerce in Taiwanese products and produce such as Chinese medicinal herbs, fabrics, camphor, and Taiwanese tea. In 1891, the first railroad of Taiwan was completed and passed through Da-Dao-Cheng area. The products could easily transport to the mouth of Tamsui River and export to China, and vice versa. Though the railroad was demolished later, Di-Hua Street has been an important business street until now. The fabric market, Chinese herb stores, and Chinese New Year's Market are very famous in nowadays. Di-Hua Street remains one of the most commercially active areas in Taipei.

The architecture has been under preservation and conservation efforts by the city. The typical building in Di-Hua Street is side by side shop houses. The houses are built along with the river. From Qing dynasty to Japan governed period, there are 3 different types of shop house: the traditional Fukien-style, Western-style, and Japanese Baroque-style.

The traditional Fukien-style houses are about 15-18 meters in depth and about 5.5 -6 meters in width. There are usually arcades in the front and courtyards in the middle of the houses. (Traditional shop house graph) The house could be divided to 3 sections. The front part is usually a shop, followed by storage and living spaces in the middle and back side. The shop houses are usually 1 story with wood windows and slope roof.

The first Western-style house was built in Di-Hua Street because Da-Dao-Cheng area was assigned to be the foreigner residence area in Qing Dynasty. It affected the elevation and decoration of the shop houses. The houses are usually 2 stories with parapet decoration in roof. The Japanese Baroque-style house was popular in Taishō and Shōwa period. The luxurious decorations were one of the characteristics of them.

Ximen-ding

Ximen-ding is an area in the Wan-hua District of Taipei. It is an important bus transfer station of west Taipei and there is metro Ximen station right here. It takes less than 10 minutes from Ximen-ding to Taipei railroad station by bus.

Ximen-ding was constructed and named by Japanese in the beginning of twenty century, which is the time when Taiwan was governed by Japan. Ximen Ding was outside the western-gate of old Taipei City Wall. Ximen means western-gate in Chinese. The word "Ding" is origin from Japanese and means a neighborhood. It is the first place where was constructed by urban planning in Taiwan at that time. By the urban planning of Japanese, Ximen-ding was constructed according to Asakusa area of Tokyo and was designed to be a business area.

Until 1980's Ximen-ding has been the most popular area in Taipei and was known by the theaters and fashions. Due to the development of east Taipei later, Ximen-ding lost its place during 1985-2000. It is the metro and new urban planning which brings Ximen-ding back to the stage after year 2000. It is now famous of the Ximen-ding Pedestrian Area, teenager's fashion and culture, shopping mall, and lots of movie theaters (Pictures of the commercial areas).

Due to the Japanese urban planning, Ximen-ding was divided into many small blocks. Each block has a courtyard in the center and was surrounded by shop houses. The shop houses are usually 3-4 stories and the upper floors are living spaces. However, many upper floors of the shop house are rent for business use nowadays. The small blocks also create many corner shop houses which are very common in Ximen-ding (Pictures of shop house in the corner). These corners are usually good spot for business.
Ximen-ding has been developed for a long time, so there are many elders who live alone here and they are the main residents of Ximen-ding. Each day there is also many young population and tourists visit Ximen-ding. The old and young populations are co-exist in Ximen-ding and keep their own culture well.

Nan-Ji-Chang

Nan-Ji-Chang is a community in the Zhong-Zheng District of Taipei. It located at south-west Taipei and at a distance from city downtown.

Nan-Ji-Chang was originally military base for temporary air station during Japanese governed period. After World War II, the ROC military took charge of it and several military communities were developed there. In 1949, the ROC government retreated from China to Taiwan. It resulted in lots of people migrated to Taipei. There were not enough spaces for those people, most are military, and their residences were temporary. The government was urged to solve the situation and Nan-Ji-Chang was chosen to be the site for resettled tenements.

The first stage was completed in 1963 and followed by the second and third ones. The typical resettled tenement is 4-5 story old apartments. The units inside are 26-40 square meter and are designed for 1-2 persons per unit. Due to the limited spaces inside, the spiral stairs are put outside and between 2 opposite apartment buildings' backside. (Pictures of apartment and spiral staircases) The staircase was an important public space and unique characteristic of Nan-Ji-Chang. In addition, the small unit was not enough for a family when they have children. In order to get more spaces, the illegal rooftop additions are very common here. Though the tenements and spiral staircases are constructed in order, the additions and small pathway between the tenements are created in an organic way. It is like the Kowloon Walled City in Hong Kong.

In 1960's, Nan-Ji-Chang community was getting to the largest one where there were more than 1200 families. It was overcrowded and most young population left here for living. Nowadays, the residents in Nan-Ji-Chang Community are mainly elders. They are the owner of the tenements, but many of the owners are dead or the ownership is unclear. In addition, there are small business activities owned by the inhabitants, such as barber shop, beauty shop, and food vendors. (Pictures of beauty shop or Nan-Ji-Chang night market) The unclear ownership and the business activities are the issues which obstruct Nan-Ji-Chang's renewal.

Min-Sheng Community

Min-Sheng Community locates in Song-Shan District of Taipei, which is about in the center of Taipei. The major public transportation is bus and there are complete bus networks. The community is next to the Song-Shan Airport which is the only airport in Taipei and in the downtown.

The construction of Min-Sheng Community was supported by the loan of the “US aid fund” which was an agreement between ROC and United State government after World War II. It was created by collective urban land consolidation and coordinated development, and was the first US-style community in Taiwan. The community was well designed according to US standard from road, public spaces, parks, to living spaces. It has been considered a high quality neighborhood and a perfect model of community in Taipei.

The typical building in Min-Sheng Community is five-story duplexes apartments with a vertical public staircase in the middle. The community is organized well due to collective urban land consolidation and coordinated development. The roads are arranged by cross shape. There is a traffic circle in the center and every road is divided road with spacious sidewalks. (Pictures of street) Twenty-five parks are distributed over the neighborhood, which means there is always a park nearby a duplexes apartment. (Pictures of apartments and parks)The area ratio of park to the community is 1 to 10. This is an important characteristic of Min-Sheng Community. The green belts bring the countryside scenery to the city. Min-Sheng Community is a residential area and the population here is mainly comfortable to wealthy families. The complete public spaces such as swimming pool, tennis field, parking lot, and parks, combine with spacious living spaces make most families settle down here.

Da'an District

Da'an District is at south Taipei. It is an area combined the cultural and educational area, residential area, entertainment area, shopping area and food service. In the north area, there are department stores and restaurants. In the south area, there are schools and universities. The traffic circulation in this district is designed as check board pattern. Ren'ai Road is a famous boulevard in Da'an District and it is the broadest way in Taipei. The order and arrangement of sidewalks, vehicles ways, roads, and

lanes are systemic planning. Citizens live, work, dine, study, and shopping here. Ren'ai road and Ren'ai road traffic circle (Pictures of the boulevard) nearby areas represent not only Da'an District but also Taipei life-style nowadays.

Da'an District includes all kind of building types and it represents contemporary Taipei. Four or five-story walk –in apartments are very common in this area. These apartments usually locate in the lane but not by the noisy roads. Unlike the shop house or row house which commercial activities are at first floor or nearby, the residential area is more isolated from commercial area in this district. There are also new high-rise buildings here and most are offices or commercial spaces. The historical buildings in Da'an District are mostly residences of celebrities or buildings of schools which results from its educational and residential area characteristics.

The complete commercial and educational conditions attract comfortable to wealth family to move in. The population is the most in Taipei. The first metro line passes through this area and now it has the most concentrated metro network in Da'an District. There is a unique 26 hectares metropolitan park "Da'an forest park" (Pictures) in this area. It is considered the "lung of Taipei" and also an important space for art and culture activities. As Min-Sheng Community, there are parks all over the neighborhood and the green and sporty spaces of the campuses in the area are usually open to citizens. Da'an District earns its reputation of high living qualities neighborhood by the complete living function and facilities.

5.2 Architecture Design Narrative

General Concept

The Orchid House is as much a physical dwelling structure as a mindset for living. Team UNICODE hopes to use the Orchid House to revive Taiwan by focusing on urban centers. Urban areas in Taiwan, particularly the capitol city, Taipei, have high population densities and a random assortment of architecture – many buildings are old with rundown facilities. Furthermore, as in all urban cities but even more so because of the particularly high population density, commuter traffic causes extreme congestion, uses a lot of energy, and creates large amounts of pollution. Reviving the city would include not only renovating buildings and improving the residents' quality of life, but also promoting creativity and sustainability.

Current attempts in Taiwan for large-scale societal change stem from the government, but not all of its laws and regulations are popular with the people – government attempts at urban regeneration, in particular, have a bad reputation and is associated with government requisitioning and demolition of homes. With this in mind, Team UNICODE plans revive the community bottom-up, from a grassroots level. Without relying solely on government channels, Team UNICODE will implement the Orchid House on building rooftops in the city to fix the cityscape and to catalyze change in the community.

Connect the new and old

Team UNICODE drew inspiration from Taiwanese traditions and melded them with technological and design innovations to create the Orchid House. The Orchid House is designed in the studio style with an open floor plan that allows for various types of living styles. Our design is meant to be placed on a rooftop and integrated with the original building, and will update pre-existing building infrastructure in the installation process. The Orchid House will improve the quality of living for all occupants, whether it is through renovated infrastructure, the addition of an elevator, providing a communal space for all occupants to meet and socialize, or general improvement of urban conditions. A vertical green core in the rooftop structure brings the taste of nature to the urban setting and refreshes the city skyline.

Orchid House Urban strategy

One stand-out quality of the Orchid House is its versatility. The Orchid House has a flexible design that allows for three distinct configurations – a long I shape, a doubled C shape, and the prototype L shape. There is a variety of building-types in Taipei, even within the row-house and duplex categories, and the flexibility of the Orchid House design accounts for that. But the Orchid House is also versatile because it can help form the urban city grid, as an integral part of the transportation system. In the future, a network of Orchid Houses spread around the city will provide charging stations for electric motorcycles, cutting down on traffic pollution and promoting a more sustainable mindset.

Orchid House Prototype

For the SDE 2014 competition in France, team Unicode aims to bring 1 L-shape prototype to Versailles. It has one bedroom with a large common terrace and rooftop space, which is commonly placed on top of a corner block as it is typically square shaped. This prototype will display an improved life style that is suitable for Taiwanese culture and building structure.

5.2.1 Architectural and Urban Concepts

Urban Issue

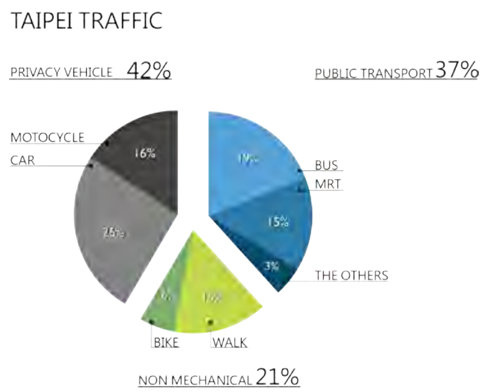
As the capital of Taiwan, Taipei offers more job opportunity that draws young people to the city. However, these people need to live outside of the Taipei city and commutes to work. The statistics shows that most of the home owners have purchased the property when the land value was low, and the real estate has increased so much that in the popular area, it cost about € 4,800 per square meter. The population statistics shows a generation gap, as the real estate increased uncontrollably, resulting most young professionals to reside outside of Taipei. This problem aggravated the carbon footprint while commuting to work.

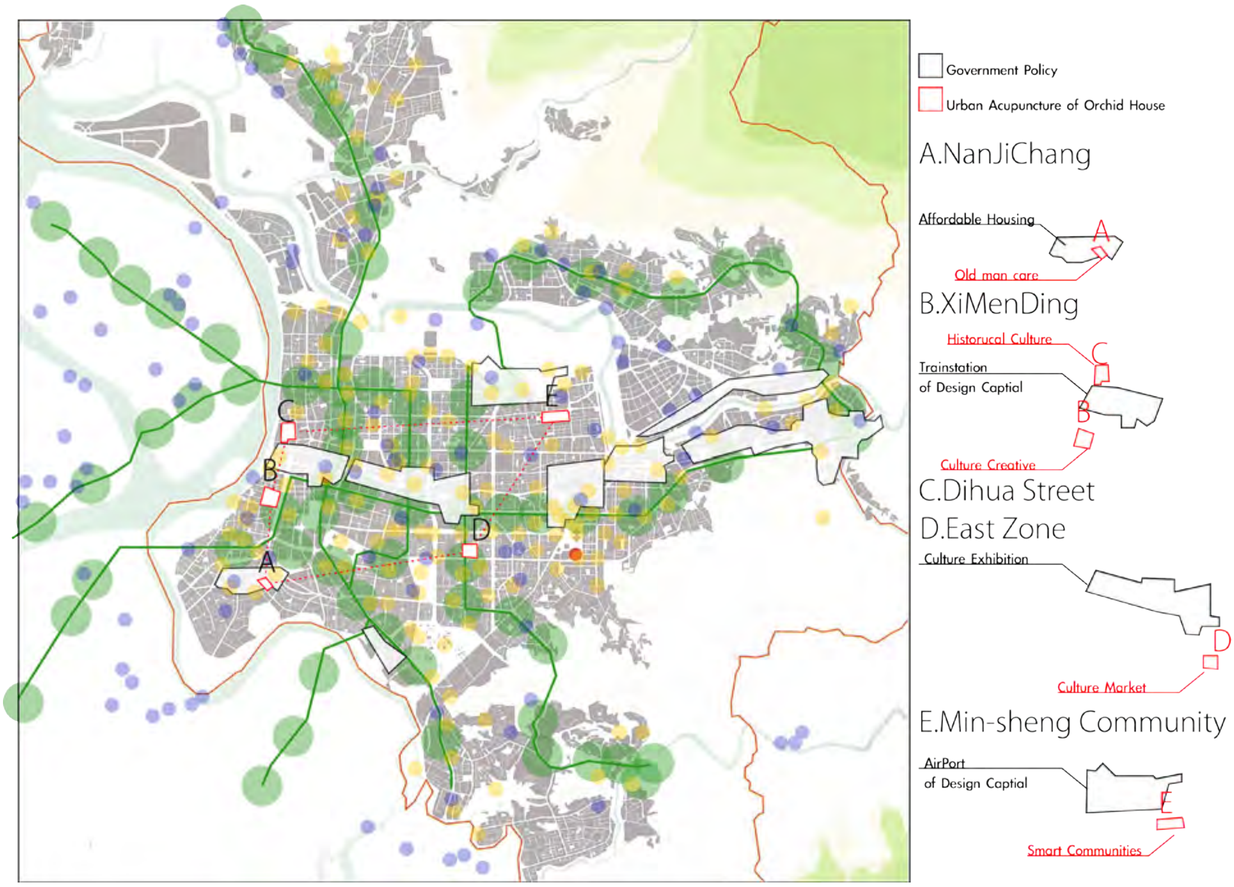
Environmental Control

The Taiwanese have dealt with the problem of space mostly by expanding upwards instead of spreading out horizontally. This rapid development has damaged our living environment. With its geographical condition, Taipei basin traps heat and moisture easily and has serious flooding problems. Therefore, the goal of Orchid House project is to reduce storm water run off, retain rain water and reduce heat island effect. The angled roof serves as solar collector, it also harvest rain water for irrigation. The rain water is collected in the water tanks underneath the building, where it's cool and won't have direct sun exposure. To further utilize the rooftop area, Orchid house opens up 15% of site to be green plantation. It helps to reduce the burden on the city sewage system and the heat island effects.

Mobility in the City

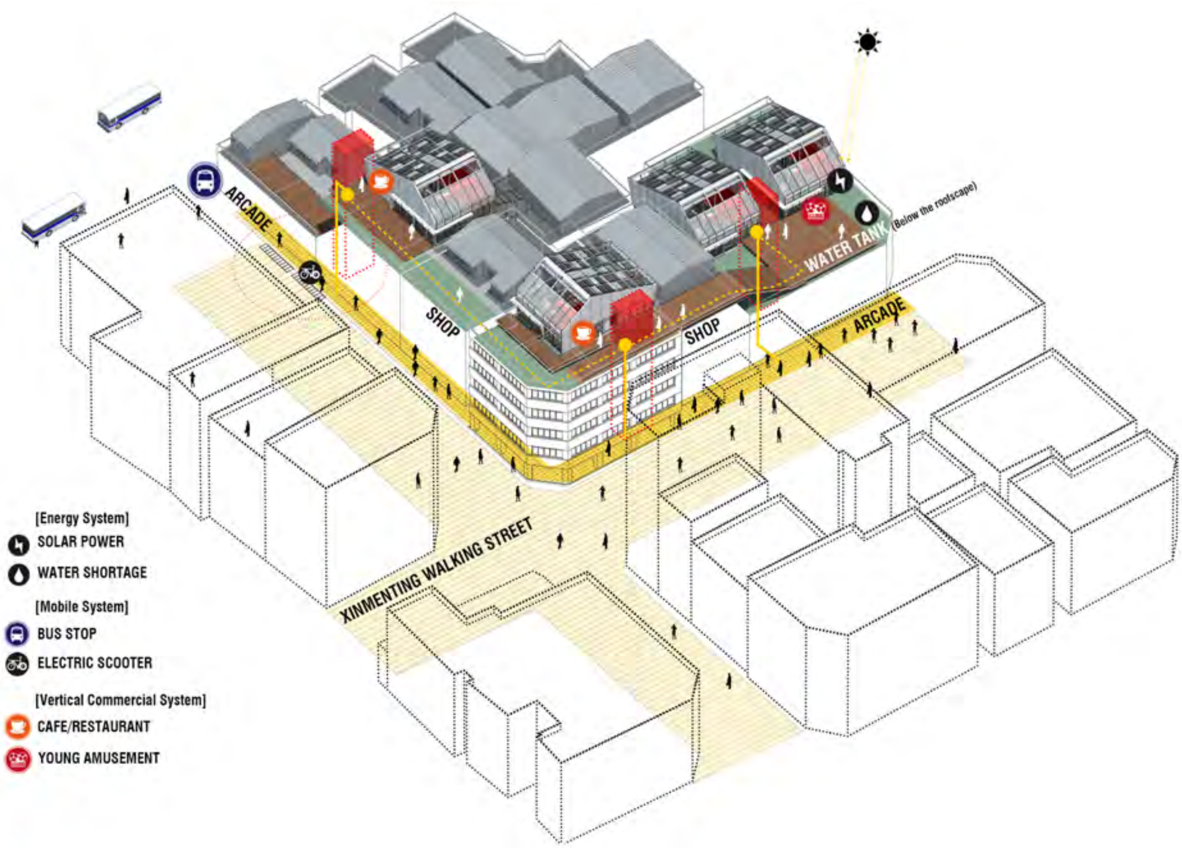
There are around 8.8 million motorcycles and 4.8 million cars on Taiwan's roads. The key to a mature urban ecosystem is to reduce pollution and land developments from automobile use. However, any new implementation in the urban scale is costly, therefore, our strategy of enhancing the infrastructure system is to effectively combine the new EBike stations to the existing metro system, bus stations, and the UBike stations. For those who need to travel within 5 kilometers distance, they can easy access to public transportation systems such as buses, UBike and EBike stations. People who need to travel more than 5 kilometers shall use the Metro Stations.





The Development of Taipei

Since Taipei's metro system is not yet mature, it is more likely that people will continue using motorcycle to commute. Therefore, with the electricity generated by the Orchid House roofs, we propose the Ebike system. EBike is electric vehicles which adapts to the existing UBike system, with chargers for motorcycle, and users can simply check out the Ebike the same way they rent UBike. Orchid House offers a new solution to the transportation means rather than individual vehicles and will help on CO2 deductions.



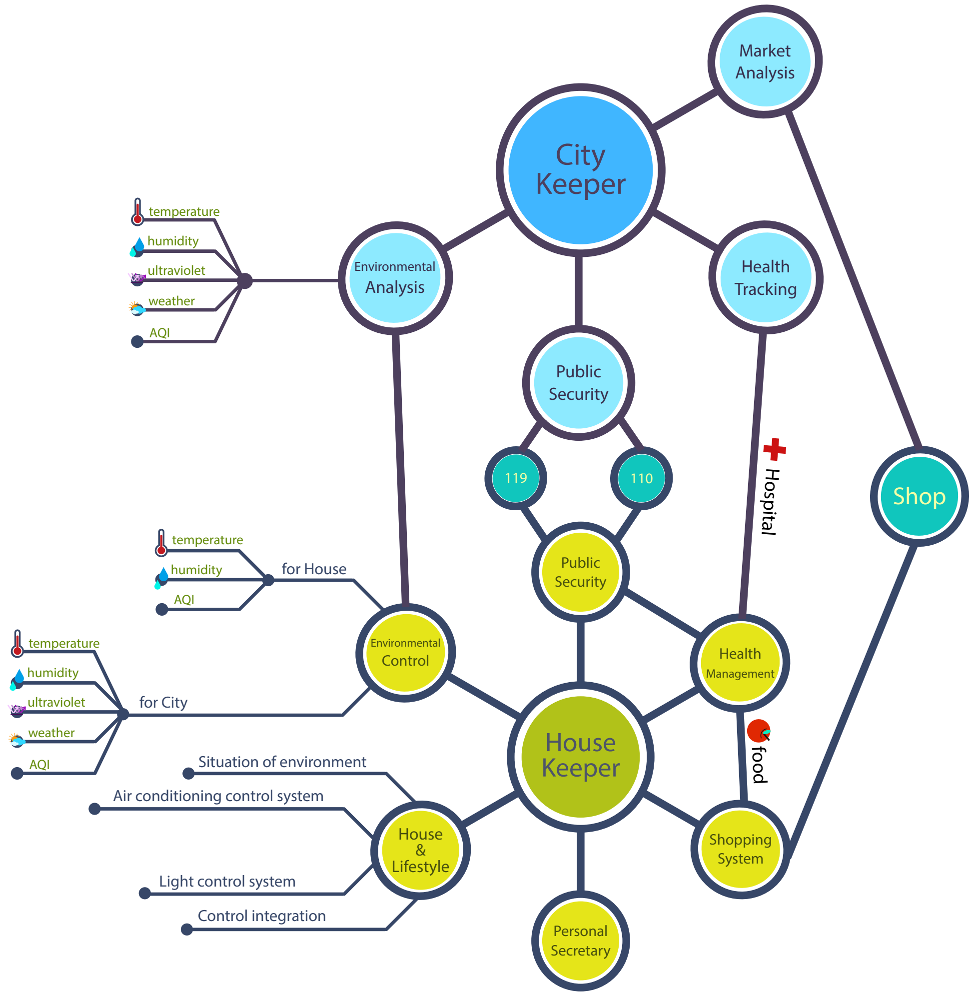
Location Of U Bike Rental Spots.

Taipei U Bike System

House Keeper System

Each Orchid House has an automated system, call the “House keeper”. This tablet is an information center that connects to the transportation system and sensor stations, so the tenants can easily receive the real-time data. (image of house keeper) Users can easily track the schedules of trains, subways and buses. They can also view the availability of UBike and EBike rental. The house keeper also manage the indoor comfort, including heating, cooling and lighting systems. The sensor stations gathers data concerning the city, such as air quality and light pollution, and these house keeps can turn into a “city keeper”, and link information nation-wide.

Orchid House is a lot more than just a house. It is a vision to a new lifestyle and a more sustainable future.

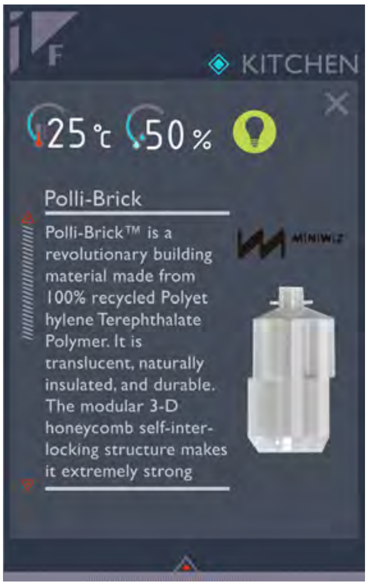


House Automated System

Easy guiding system to access information about the building material and design concept

Control lighting, create different atmosphere in the house

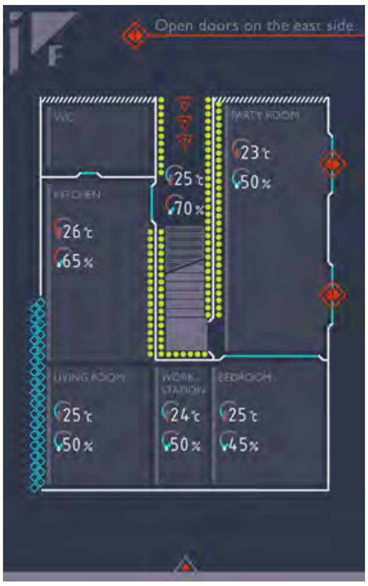
Display real-time temperature and humidity level.

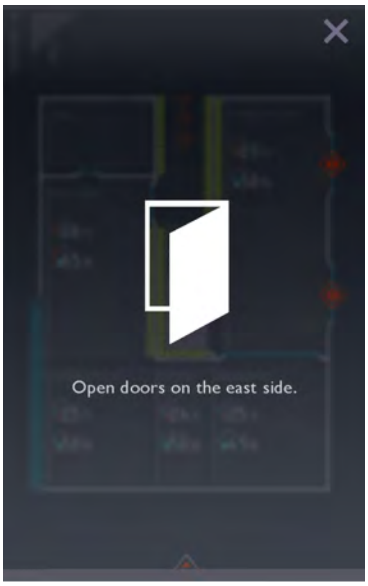


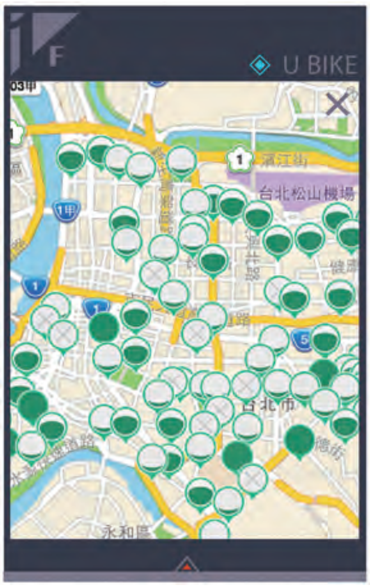
Map of conditions of all openings and affected areas

The alarm system will turn on and display on the screen when the temperature too high or too low

Easy access to the public transportation







2.3 *Interactive Scenario*

Integrate house's equipments , sensors ,communications,consumer electronics products and computer .Computer can calculate the best solution for the house, automatically controlled air-conditioning, lighting ,energy and other equipment, even health care , energy saving and carbon reduction.

Living room

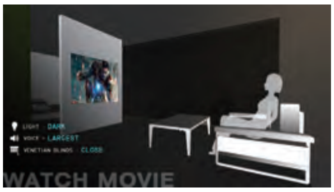
General

Action Program: LED lights / Curtains open/ Audio equipment turns off

Watching movie

When DVD player turns on or channel stay in Movies , system will ask the user if change into movie mode or not.

Action Program: LED dimming / Curtains close / Sound volume up



Watch TV

When TV turns on and the channel doesn't stay in movies .

Action Program: LED lights / Curtains open / Sounds volume moderate

Party

Infrared sensors sensing numbers of people are more than usual or sound sensors sensing laughing sound.

Action Program: LED lights change color / Curtains close / Sound volume up

Restaurant and Kitchen

General

Cooking Mode

Bedroom

General

Action Program: Turn on the light / Curtains open

Sleeping

Infrared sensors sensing the height of human (posture : lying) ; Pressure sensors sensing the weight on each sensor point of bed.

Action Program: Turn off the light / Curtains close

Waking up

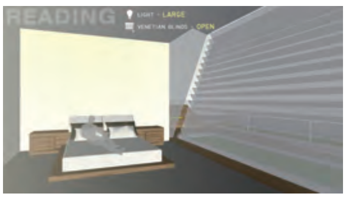
Set a time to get up , clock rings.

Action Program: LED lights / Curtains open / Sounds volume moderate

Reading

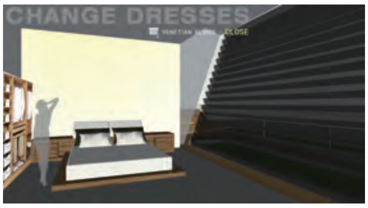
Infrared sensors sensing numbers of people are more than usual or sound sensors sensing laughing sound.

Action Program: LED lights change color / Curtains close / Sound volume up



Getting dressed

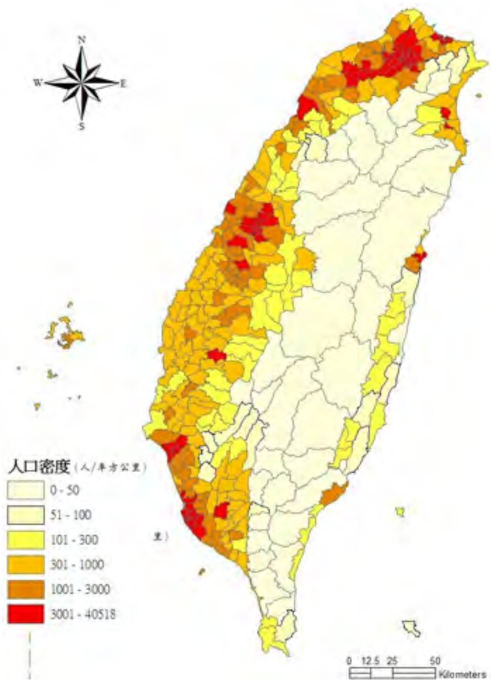
Open the closet , sensor is activated
Action Program: Curtain close



Garden

Collecting plants information

Inferred harvest time , Reminds resident to watering the plants when the humidity of soil is too low .



Population Deusity In Taiwan

Population Growth

This population growth results in the lack of living space and sufficient public amenity, and cause middle classes moving toward the periphery, even outside of city. The majority of these people are young professionals who just graduated from collage whom have worked a few years, and they are not able to afford a house yet. However, most of them works in the city center and commute, and caused major traffic congestions with millions of cars and motorcycle. Consequently, the city is left with a high carbon dioxide pollution, and the decrease living quality.

Network of commuting

When examining the statistics for different cities, the study was conducted by the Ministry of Transportation and Communications have found that a car commuter in Taipei City spends an average of NT$13,777 per month, and it can be reduced to NT$1,973 per month if taking public transport. Despite the potential savings, the study found that more than 60 percent of commuters in Taipei would not consider switching from motor vehicles to public transport systems, because many counties and cities have yet to develop a mature public transport network system.
(image of traffic jam)

Since the commuters will be more likely to keep their own vehicles, the Orchid House project aimes to integrate the city issue and helps to ease the congestions and air pollution.

Traffic Condition In Taiwan

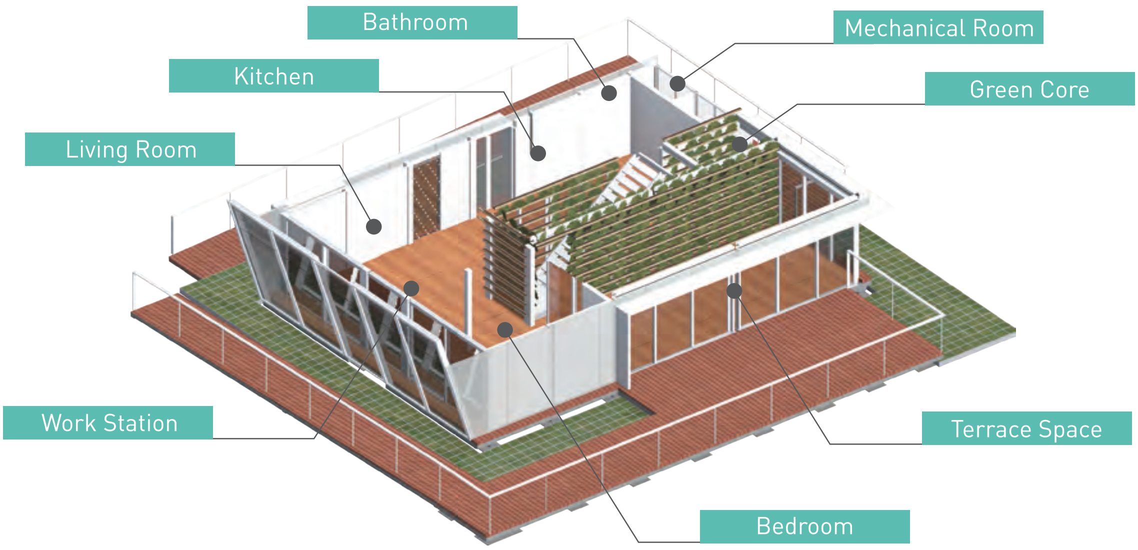
Orchid House Urban Concept: a solution for generation gap

With this worrisome urban situation, Team Unicode want to address the issue of sustainablilty and affordable housing under the extreme urban context. Our proposal is to develop a concept that adapts to the existing environment, envision a new lifestyle, which can link to an ecosystem of itself.

Taipei has face some serious problems such as generation gap, as younger people can not afford the rent and turn to the periphery of city. This has created a social impact, and our goal is to draw the energy back to the city. However, most middle classes living in Taipei have roommates, and the average living space is around 16.8 m^2 per person. In the Orchid house, the usable area per person has increased to 28 m^2, including some common space to share. It provides the young professionals a higher quality of living environment, which becomes a platform for them to live and work in the unit.

The Orchid House Program: a space for young professionals

The young professionals are selective people that went through team Unicode's application to enjoy the benefit of living in the Orchid House. Thus, the Unicode team propose a 5-year program, so the young professionals have their chance to persue deams. The selected tenant will also join exposition to share their experience living in a green environment, and pass on the (concept) of sustainability to the next groups of tenants.



Architectural strategy

Taipei Context - Ximending

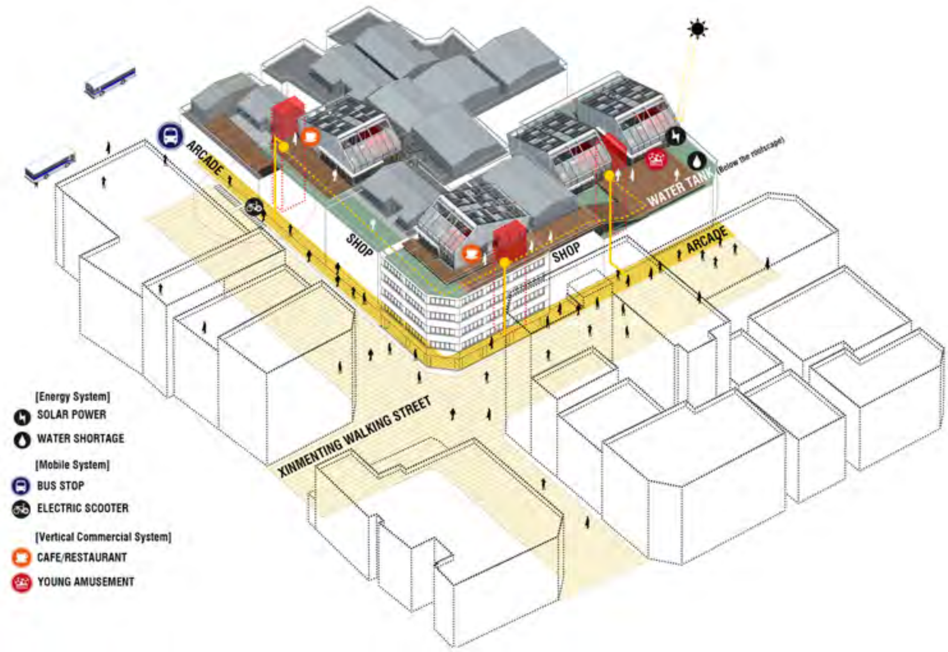
The development of Taipei city has begun right outside of the "west gate " of Taipei city, thus resulted in the city's unbalanced distribution of old buildings and new construction toward the est. After extensive research of the 5 sites, we have found that Ximending district to be the most potential site of Orchid House.

It is composed of 4-5 story buildings with a chessboard street pattern, planed during the Japanese colonialization as a business district. The historical significance and modern values has formed an interesting cultural blend, and became a perfect place for young adults to gather, exchange information, and share ideas.

www.taiwan.net.tw

forum.pchome.com.tw

Before 1980, Ximending was considered one of most fashionable and expansive district of Taipei, but it experienced a short period of decline between 1985 – 2000, as Taipei city development progressed eastward. Fortunately, with the newly planned MRT (subway) system at the year of 2000, Ximending enters the phase of recovery. Under the masterplans of Taipei City Government, all storefronts and street-side benches were renovated, and more economic activities have been added. Furthermore, the street's illumination has been improved and more cultural groups and street performers have stationed in the area. The beauty of history and the youth culture interacts here and has become a great mix, resulted an exciting place to be. With young consumer as main target, Ximending becomes the most internationalized zone in Taiwan, and attracts a large number of oversea tourists to experience the real Taiwanese culture.



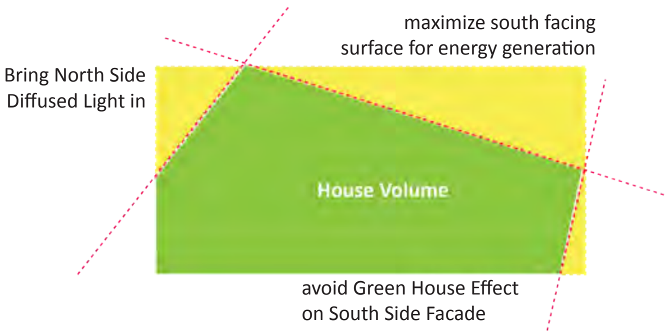
Orchid House will be constructed on top of these old buildings, to recreate rooftop spaces, enhance building structure and revitalize surrounding neighborhood. With the addition of Orchid House, we are estimating another 30 years of life time to be added to the existing buildings. (proposed blocks of Taipei)

Massing Development

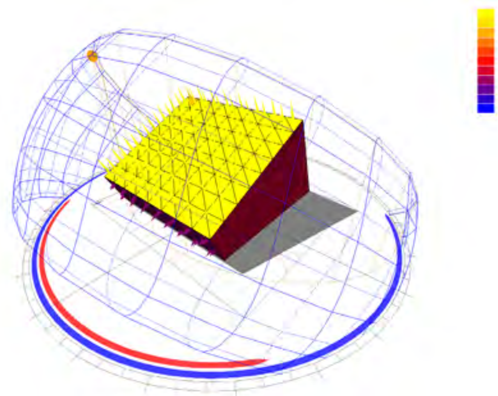
Taiwan suffers from visually unpleasant illegal rooftop structures that are made with metal sheets, and our solar house is an opportunity to solve this problem, along with other social issues and to promote sustainable living. NCTU/UNICODE takes the essence of this natural ecosystem, and regenerates new principles of housing design. The four principles are:

- Adaptable for a rooftop structure
- Functions as a micro eco-system
- Conserves and generates resources
- Combines both passive and active strategies

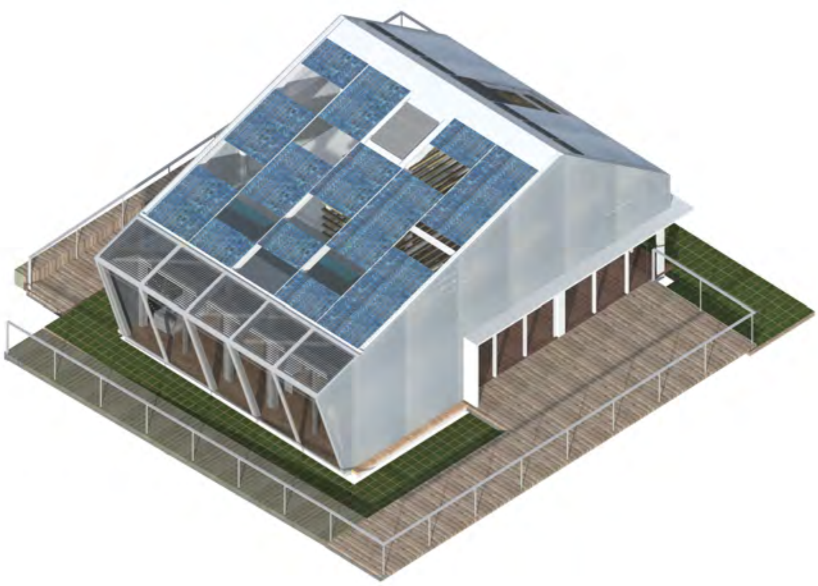
The geometry of the house begins with a rectangular box, which is then angled to maximize the performance of the house and reduce the heating and cooling loads. Orchid House is inspired by local Taiwanese orchid green-houses and provides a large housing unit made of a small conditioned space (56.92 m^2), surrounded by a larger envelope (147.2 m^2).



Massing Development



Ecotect Solar Radiant Analysis



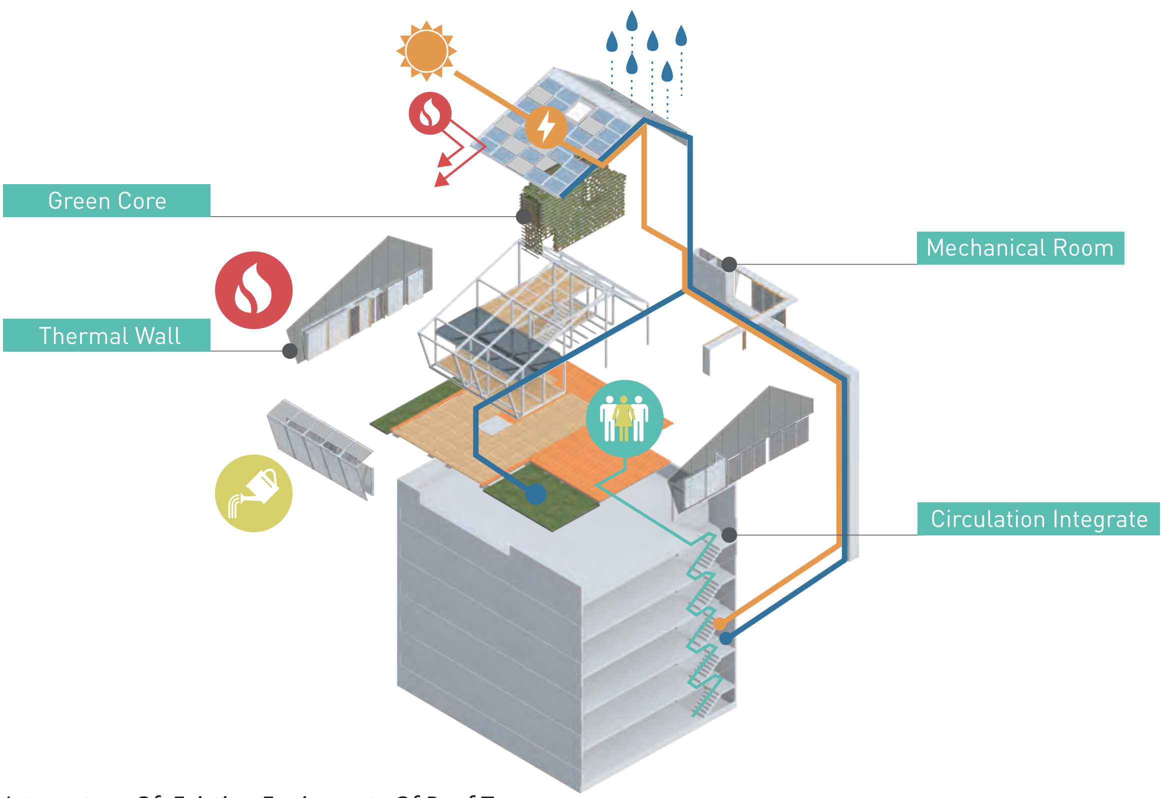
3D Model Of Prototype

Building Integration

The collective housing system of the Orchid House does not only add a new addition to the house, but also creates a chance to revamp the old building equipment, extend the building's life time. During the 1990s, Taiwanese economy is quite prosperous and it encouraged investors to develop the city. However, it was done under the pressure of time and money, thus, a lot of construction was rushed and done poorly. Most of the 15 to 20-year old building already have the problems of rusted pipes and insufficient electrical wires, that leads to clogging the sewage pipes, and dangerous electric overload condition. Therefore, it is recommended to change the water and electric equipment every 20 years.

Taipei Housing Condition

Furthermore, leaking rooftop is another major reason that shortens building life cycle. Being an island, Taiwan has a lot of rainfall with high salt content in the air. Before placing the Orchid House, we must first improve the waterproofing on the rooftop to prevent leakage.



Integratron Of Existing Equipments Of Roof Top

Housing Type

Orchid House project proposes 2 types of housing plans to allow diversity in user groups.

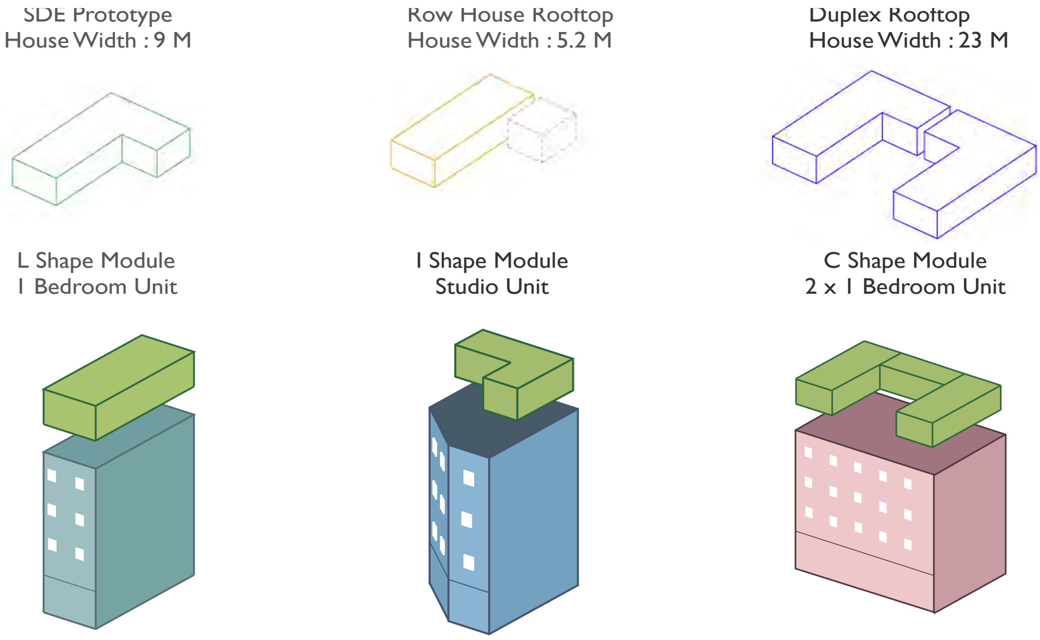
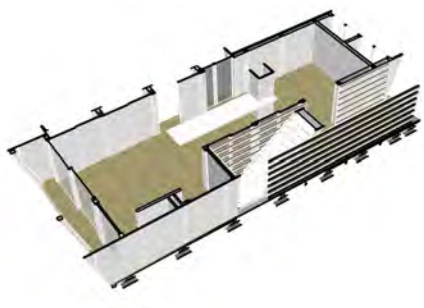


Diagram of row house and duplex roof top configurations

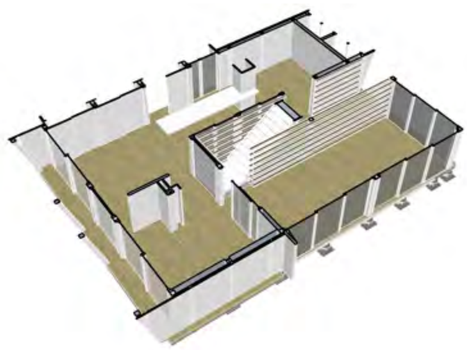
I-shape module

Most of the young professionals in the city will only need a studio space with cheaper rent. It is designed for 1 to 2 people, with a full kitchen and a restroom. The I-shape dwelling can easily fit in the 7-meter wide row house.



L-shape module

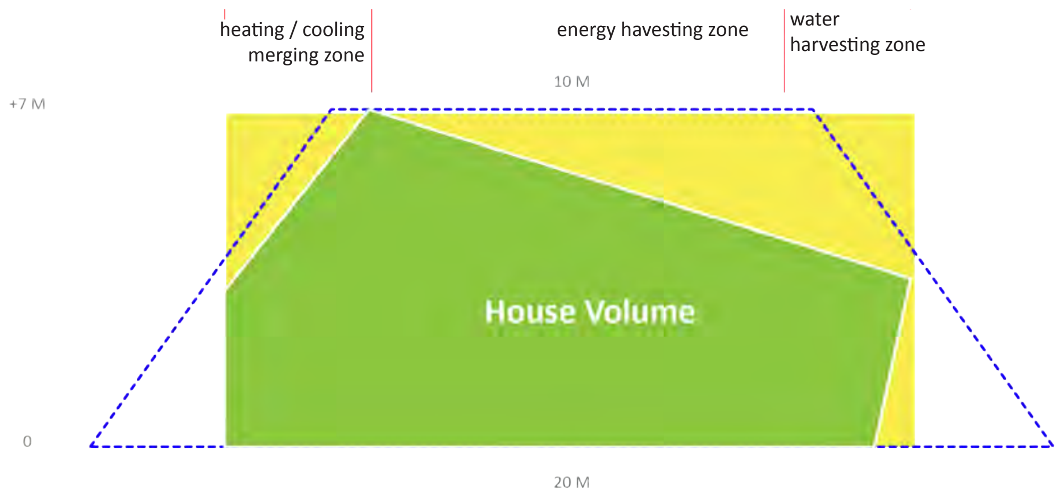
This one bedroom apartment is designed to host 2 roommates or a couple, who live and work in the unit. The module can adapt to the 14-meter wide corner building. The second floor mezzanine space provides extra space for office or laundry space.

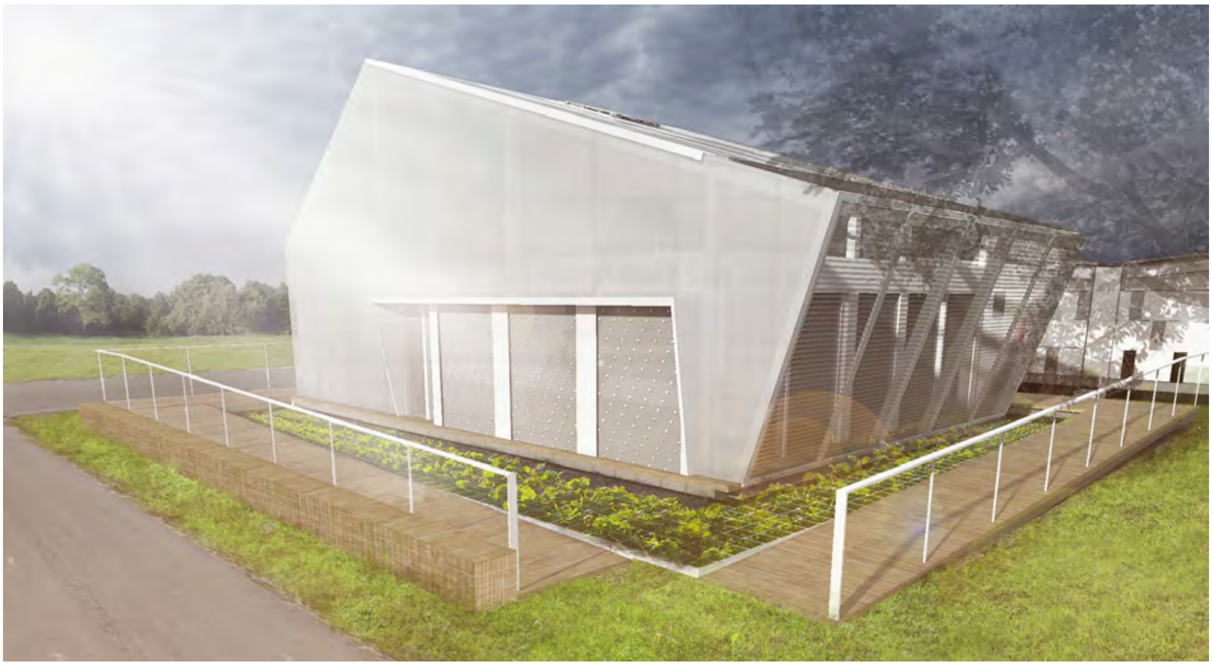


Prototype

In the SDE 2014 competition, Orchid House has taken the L-shape module and modified it to fit in the Versailles competition site. (image of the solar envelope) Ground floor include an L-shape living area, with a common terrace for all residence. This common space give back all tenants a place to gather, meet, and social. Residence can use the space freely and host events, which is how rooftops should be used. The mezzanine level is a smaller area for exercise or laundry.

The Orchid House brought to Versailles is part of the entire Orchid Villa, as we envision it to be an urban project.

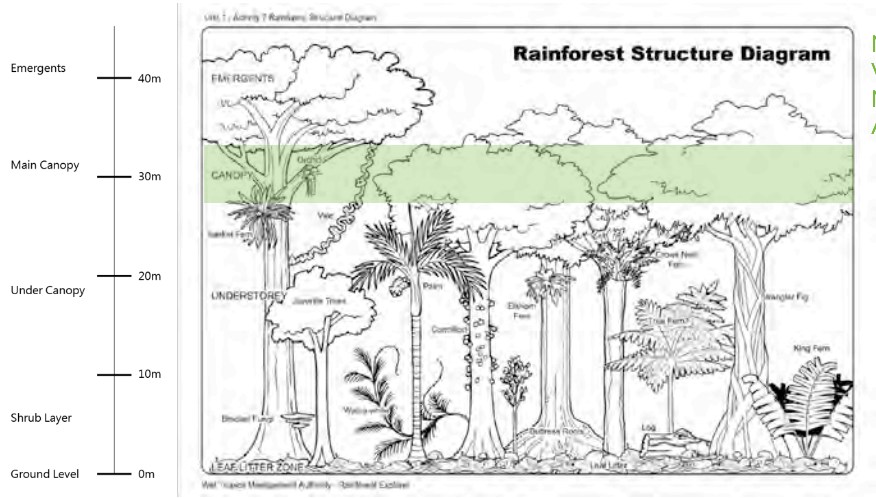




South West View at La Cité du Soleil®

Orchid House

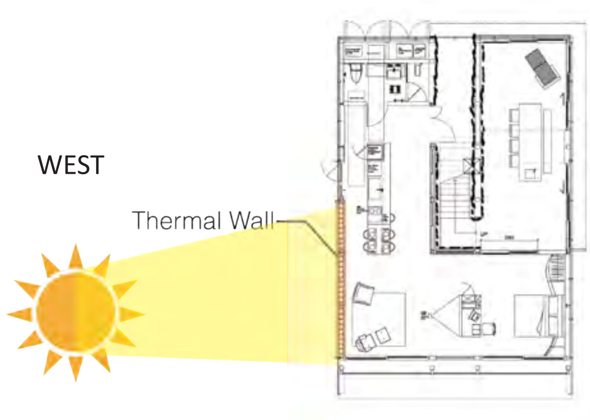
In the tropical forests of Taiwan, orchid plants flourish by living on tall trees, nourished by the perfect balance of indirect sunlight and run-off rainwater. It has inspired us to design a solar house which can be placed on the rooftops of existing houses in Taipei, which collects energy, retain water resource and provide more green plantation. Also, in the traditional Taiwanese rooftops, people often use the additional space to plant orchids. Our project gives the space back to tenants to continue their habits.



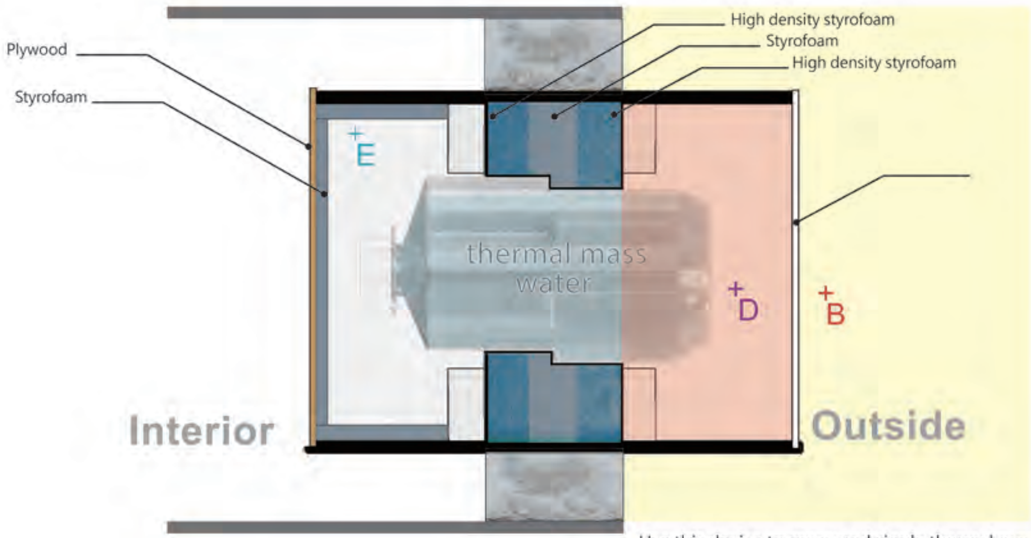
No direct sunlight
Well ventilation
No excessive water
Appropriate temp. & humidity

Thermal mass

To adapt to the cold climate in Versailles, we have designed a thermal mass in the west façade near the living space. These polli-bricks are made with recycled plastics, stack as bricks and filled with water. The thermal mass absorbs heat during the day, and release radiant heat at night, keeping the interior space warm even when it is cold outside.

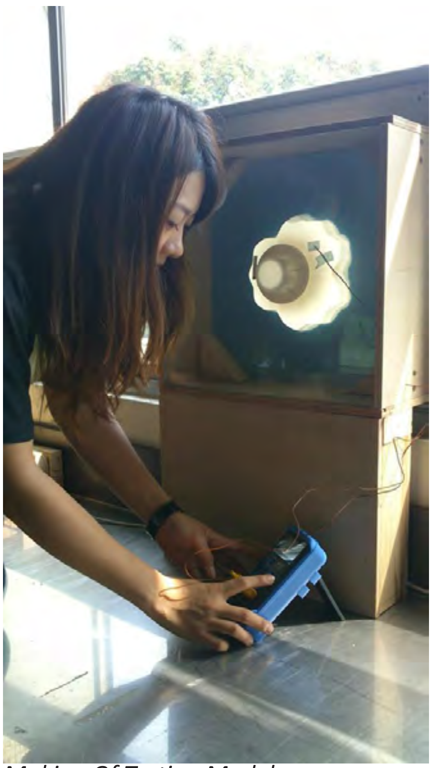


Polli-Brick

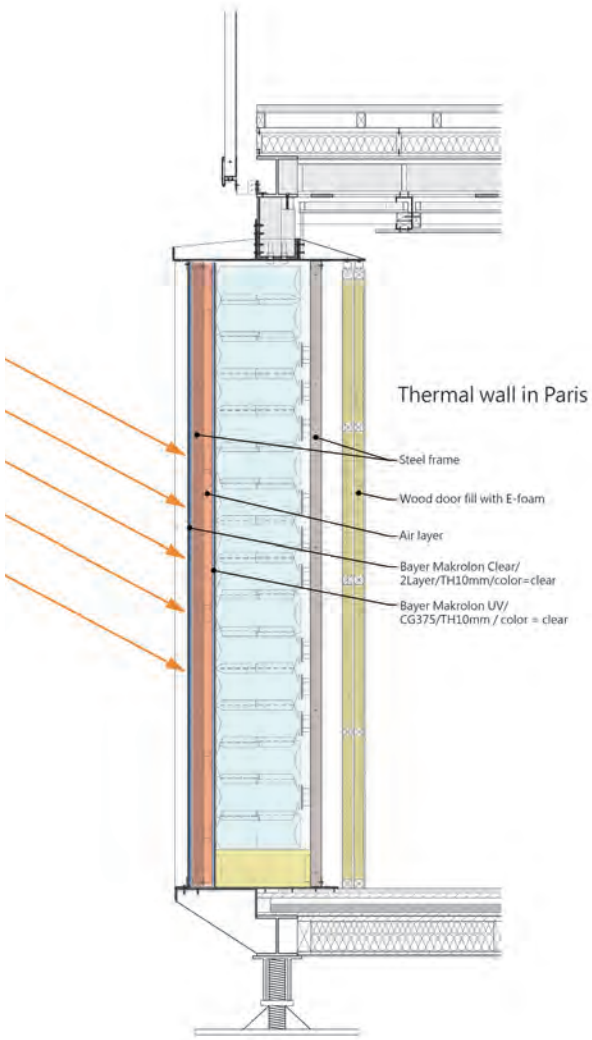


Use this device to measured single thermal mass unit temperature change in 3days and the relationship between indoor and outdoor temperature changes.

Thermometer

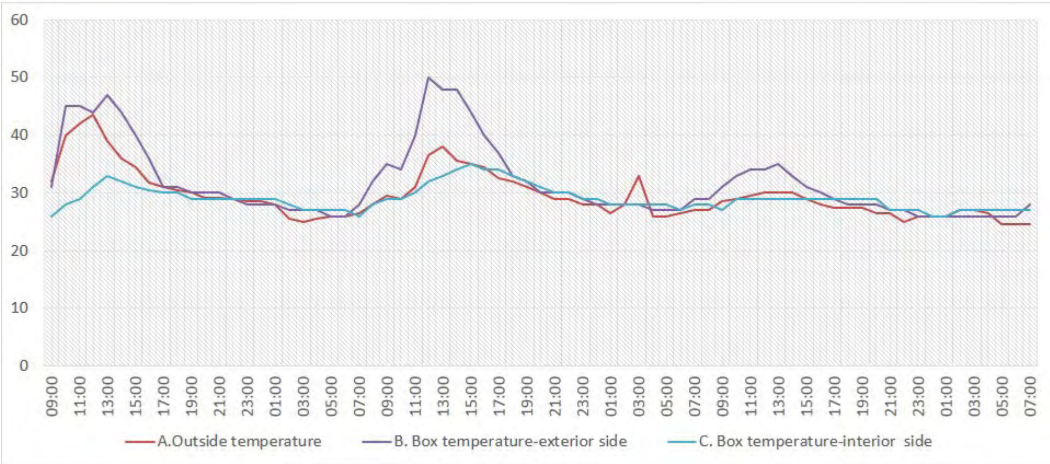


Making Of Testing Model



Section Detail Of Thermal Maee

Polli-Bricks temperature records
2013/10/07-09



Polli-Bricks Filled With Water

1 To 1 Prototype Of Water Thermal Mass

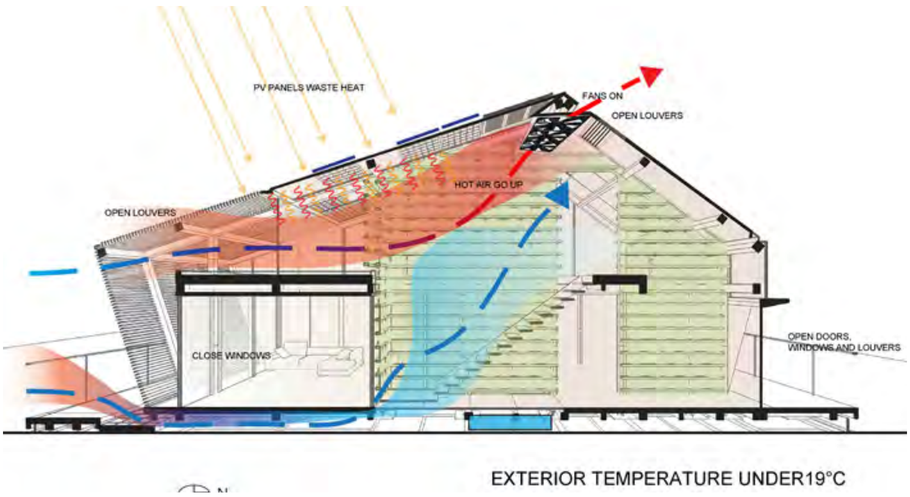
Water Wall

Water wall is commonly seen in Taiwan, as an evaporative cooling strategy. On the mezzanine level of Orchid House prototype, a water wall is installed and will be turned on when the temperature between the double skin rises above 27 degrees Celsius. Together with the water wall, a row of fans on the ceiling will create an air draft and draws hot air out and create the chimney effect.

1.2 Green Core

The Orchid house is composed with three main volumes such as the exterior envelop, L shape living area, and green core. Green core does not only enhance the verticality of exterior envelop to connect ground level and mezzanine level, but also act as green chimney to promote passive cooling effect in the house.

There will be a few hundreds of orchid flower planted at this green vertical garden during the Solar Decathlon Europe 2014. Our design recreates a vegetation on the rooftop and give back green space to the tenants.



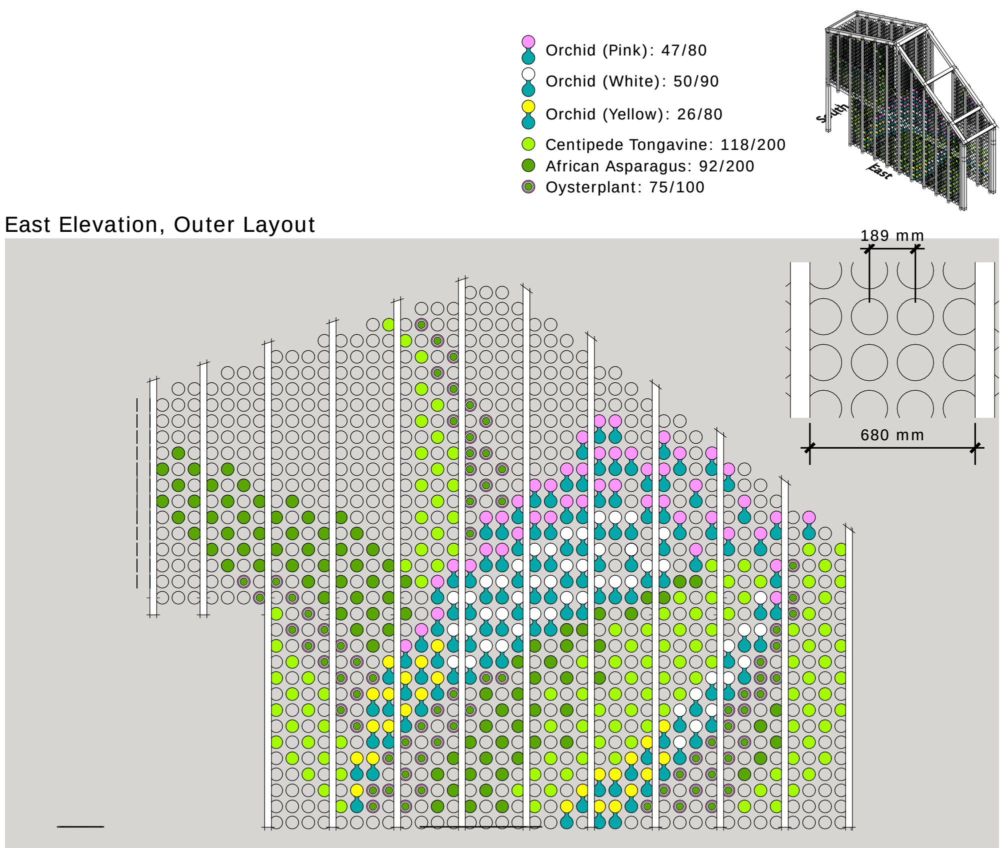
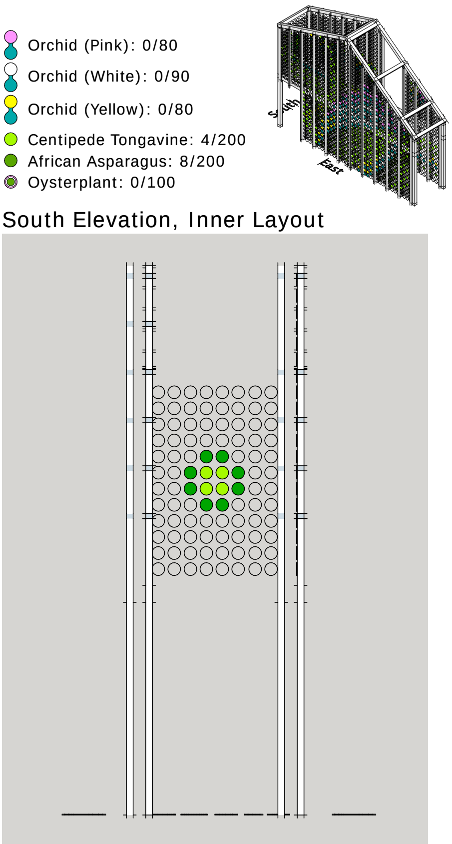
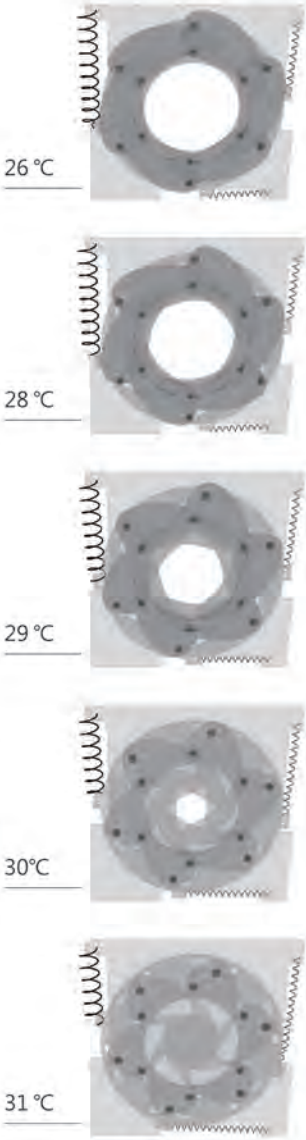


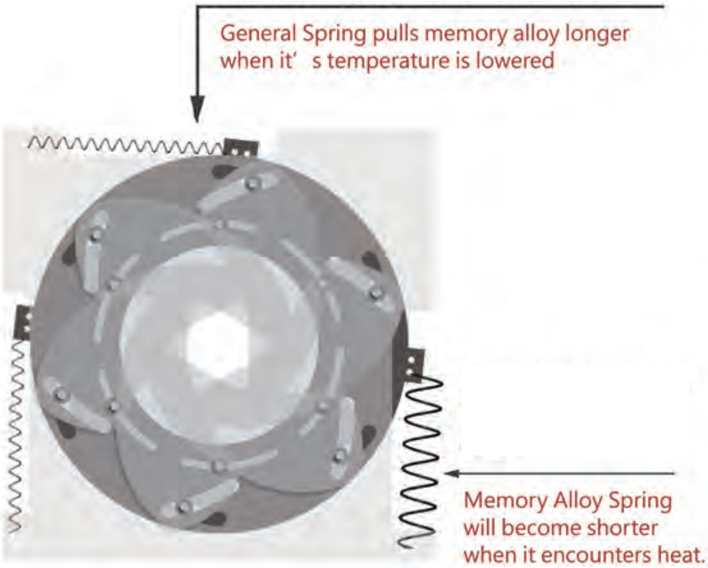
Figure 1.2.2 Green Core View



Smart Skin

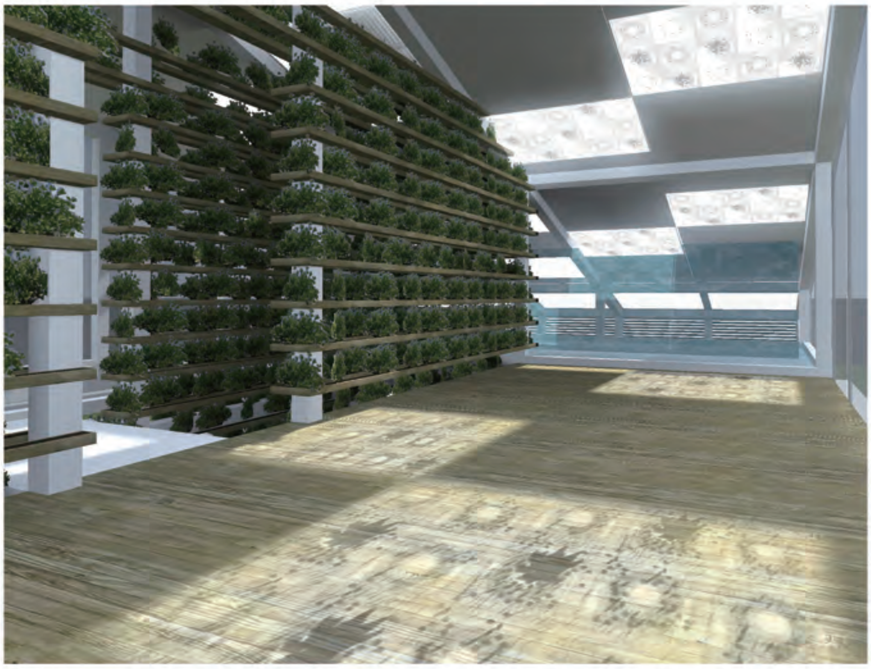
The Smart Skin Unit is a mechanism design, Makes the size of opening change because of the environment climate, It's a part of building's envelope. We use Shape Memory Alloy Spring to drive the mechanism. When the tempereture is higher, Smart Skin will be closed to block the light and heat. When the environment tempereture is lower, opening will become bigger. Shape Memory Alloy is a meterial which will become shorter when it encounters heat. Smart Skin can adjust climate and light without using electric.





零件:
Components

1 To 1 Prototype Of Water Smart Skin

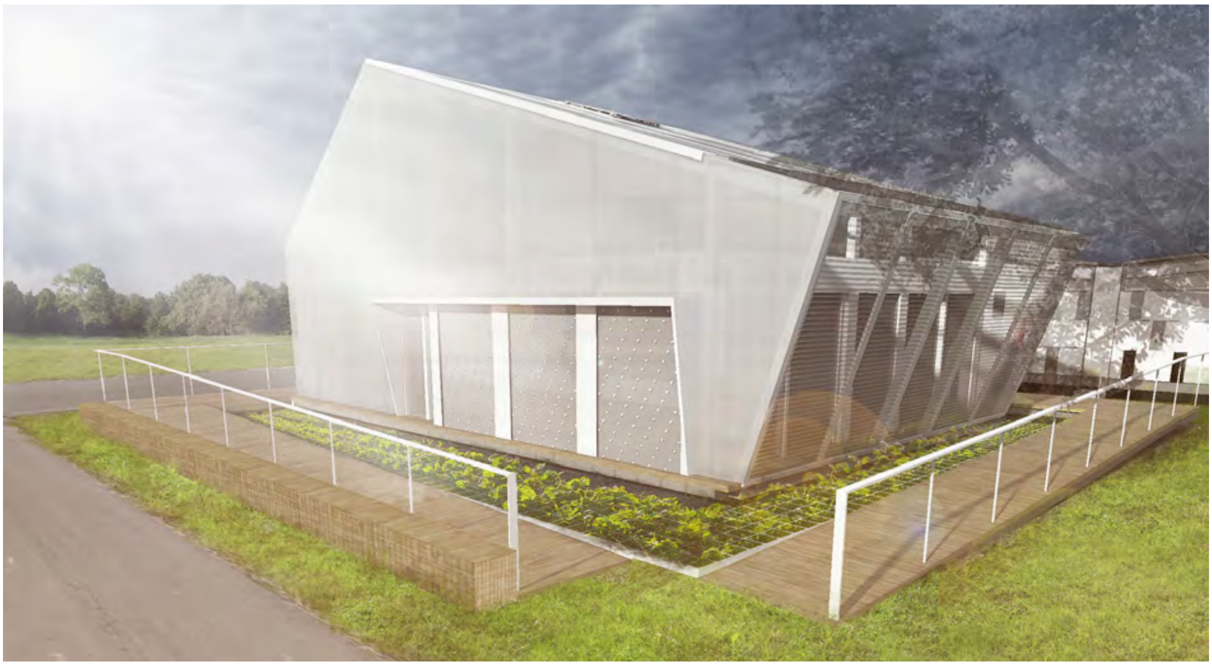


Architectural and Urban Concepts

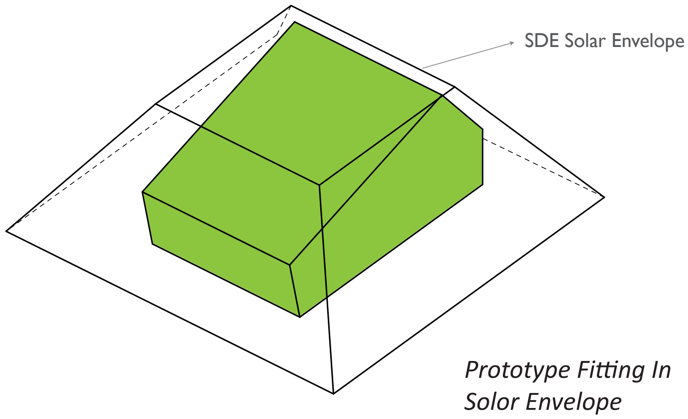
The architectural design solution of Orchid house responds to the urban issues of current Taiwanese metropolitan cities, such as the national capital city Taipei. Taipei, one of the most fast growing cities in far eastern cities, faces many unsolved problem such as heat island effect, excessive amount of storm water run-off, and energy shortage. Thus the Orchid House will address these issues by providing innovative and forward thinking design, which is inspired by the wild orchids grow right underneath the canopy level.

The NCTU/UNICODE will combine many sustainable technologies and innovative design solution to create the Orchid House, the first self-sufficient solar house ever built in Taiwan to compete Solar Decathlon Europe 2014.

Painting Of Orchid Chang-Shuo Wu



South West View at La Cité du Soleil®



Space Organization

The house is composed of several prefabricated rectangular frames. The open plan organization allows flexible division, and creates a flow of movement in the house. In the order of entering the house, there are 3 main functions: kitchen, living room and bedroom. This setting separates the public shared space and the private living zone. A workstation with storage space keeps the bedroom intimate.

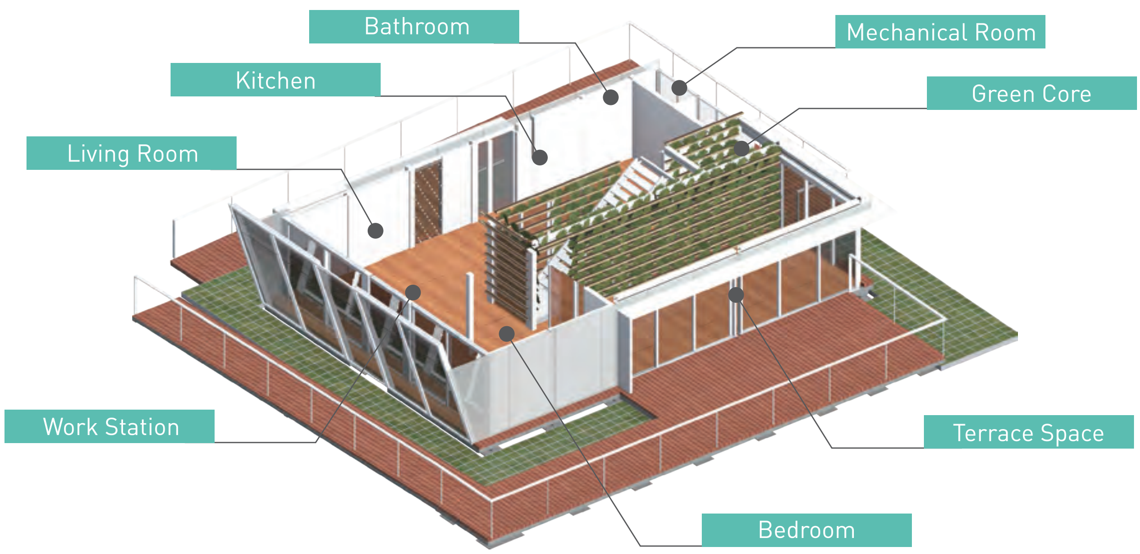
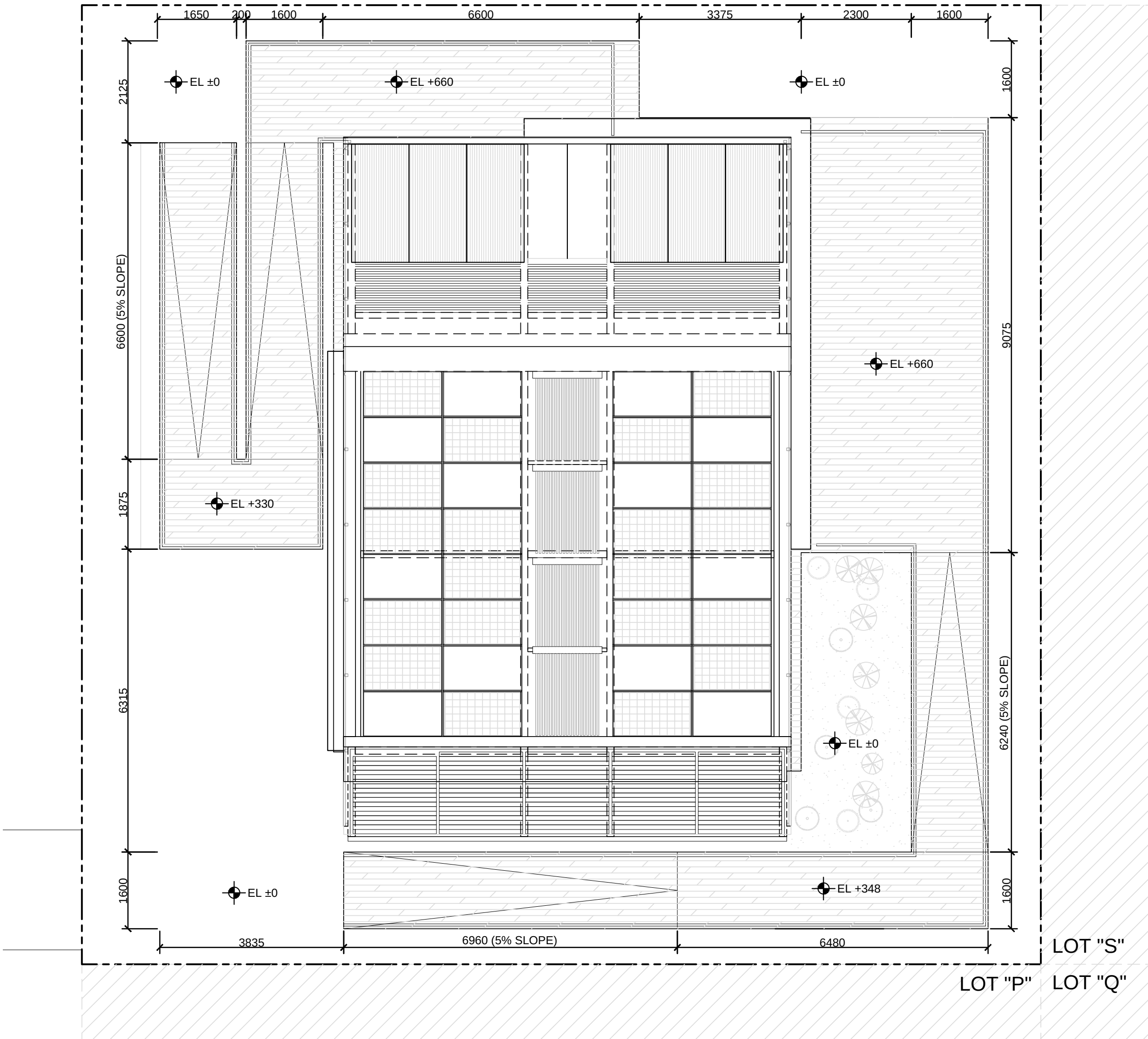


Figure 1.2.1 Orchid House Programming

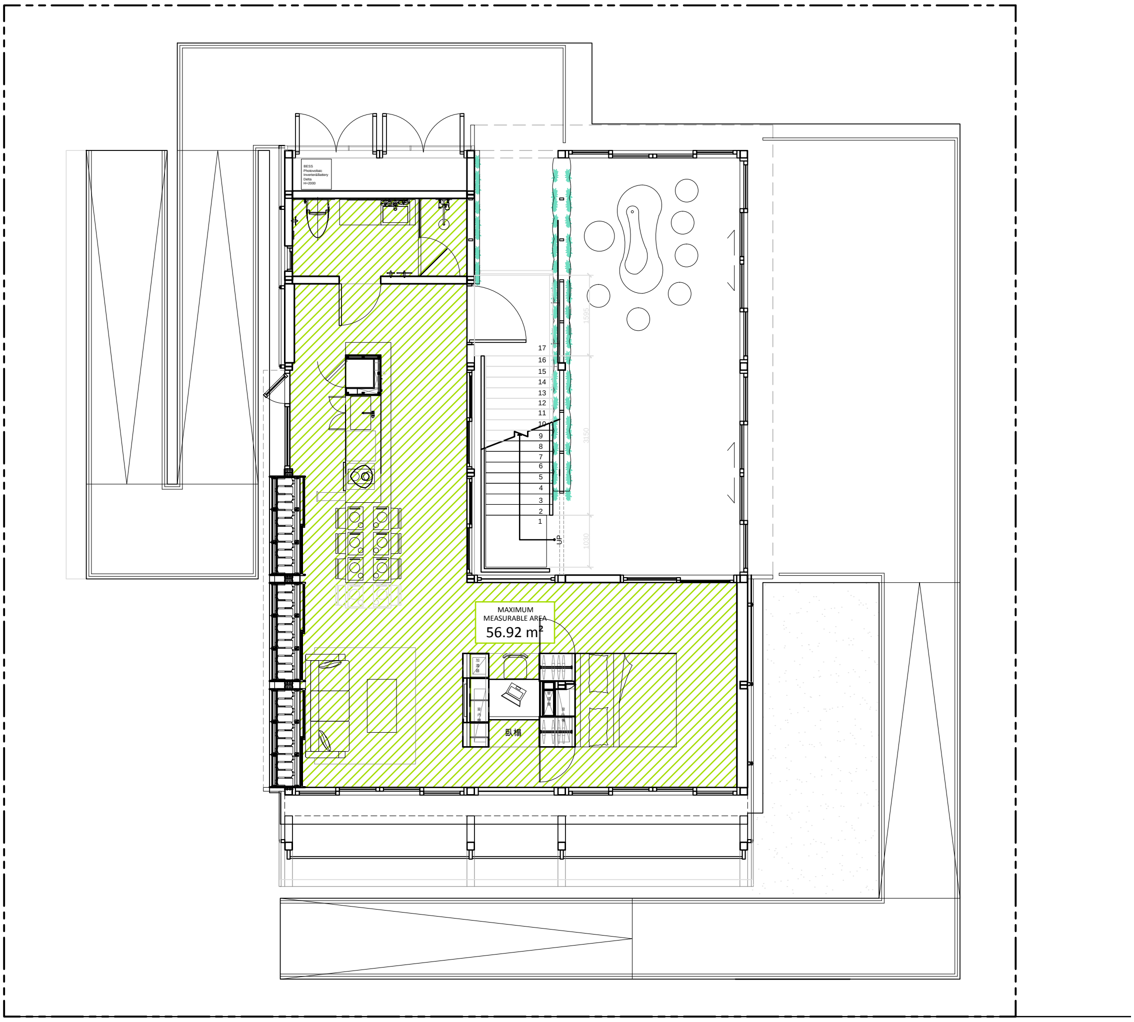

PAR
S3
UNI
ROM
S2
LUC
BUC
S1
OTP
DEL
ATC
BAR
PLT
FNX
SHU
REC
KMU
DTU
ROF
CUJ

Site Plan

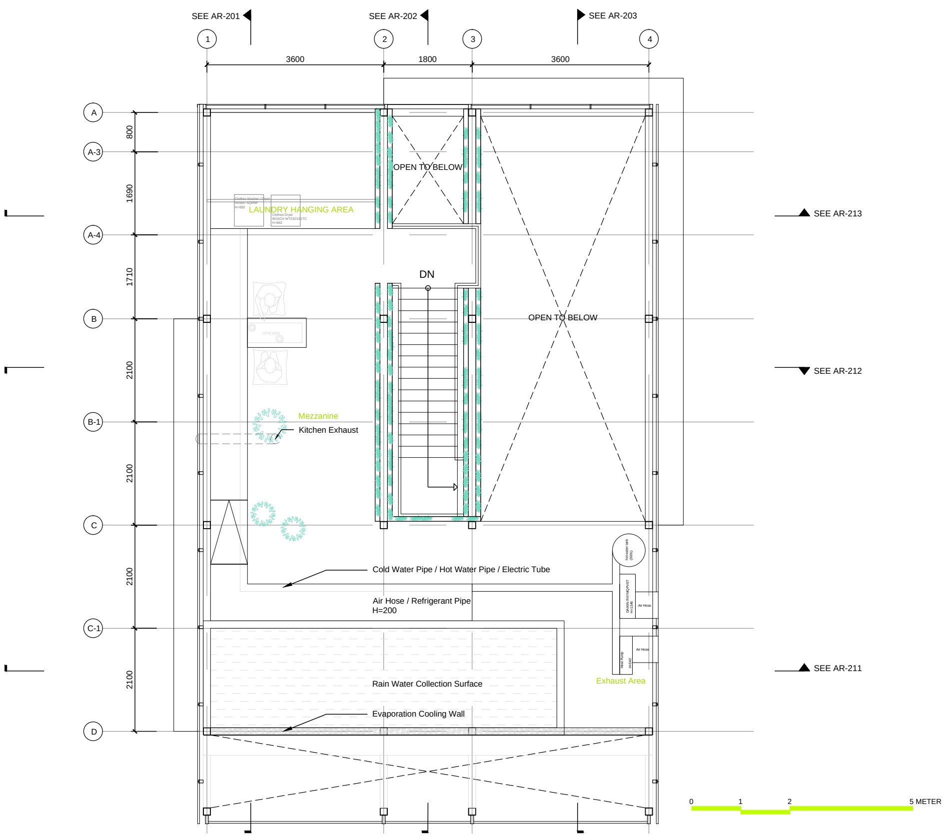


1650
200
1600
6600
3375
2300
1600
2125
EL ±0
EL +660
EL ±0
1600
6600 (5% SLOPE)
9075
EL +660
1875
EL +330
6315
EL ±0
6240 (5% SLOPE)
1600
EL ±0
EL +348
1600
3835
6960 (5% SLOPE)
6480
LOT "S"
LOT "P"
LOT "Q"

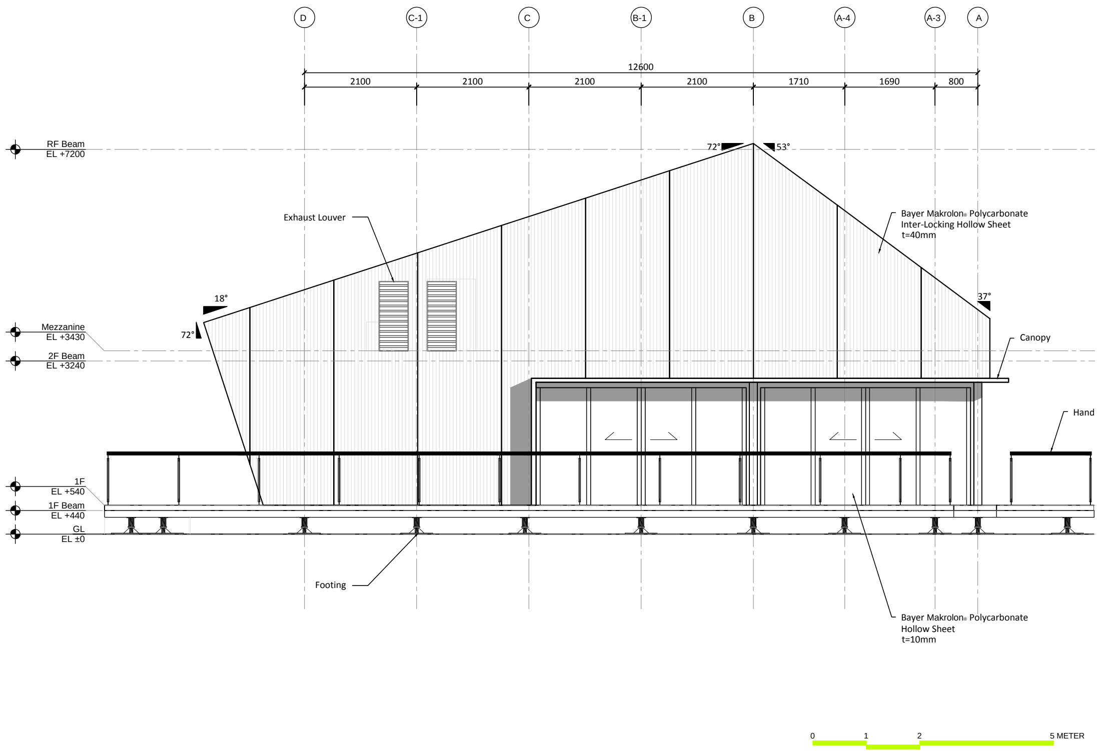
Roof Plan



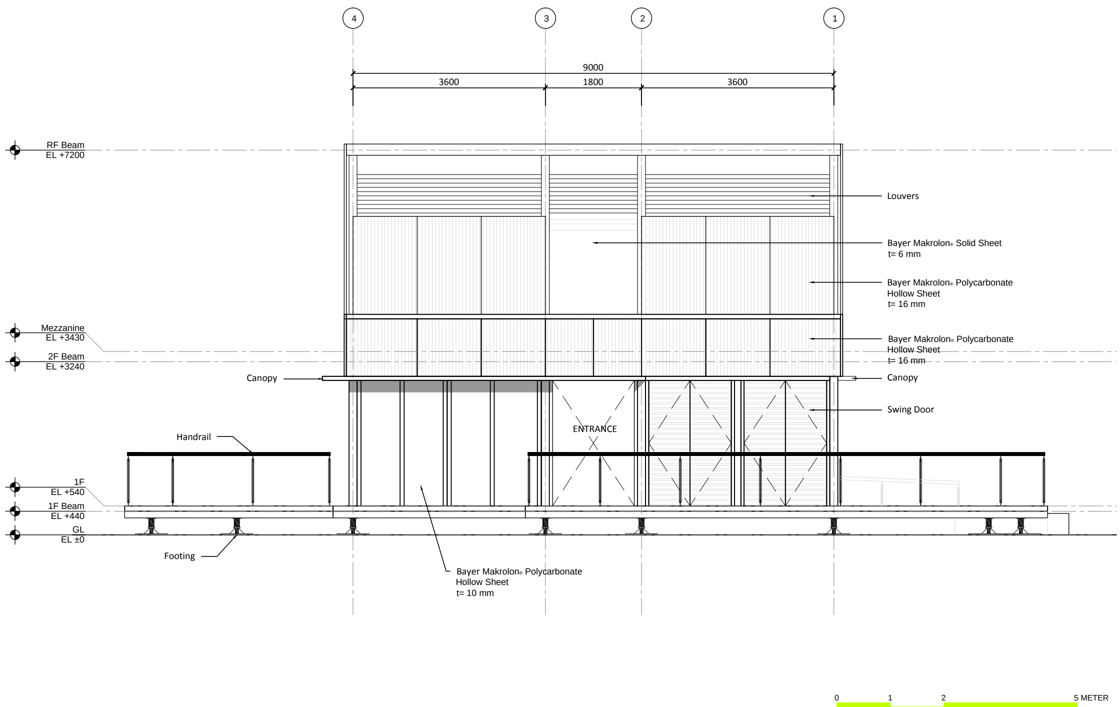
Ground Floor Plan



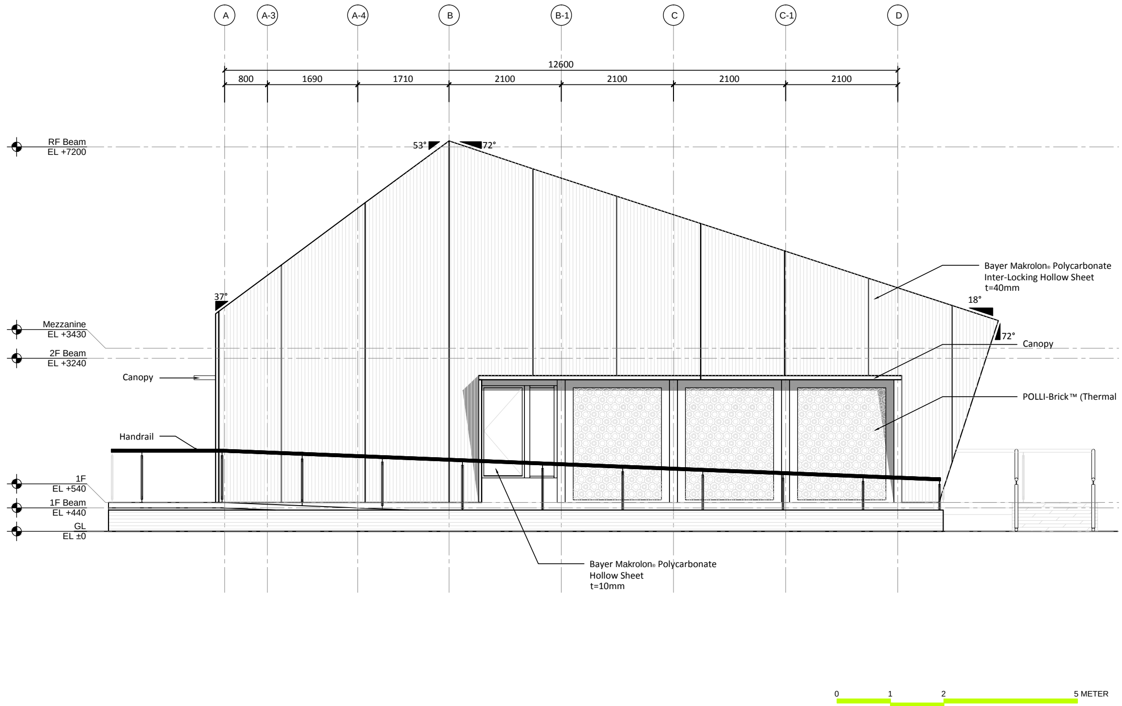
Second Floor Plan



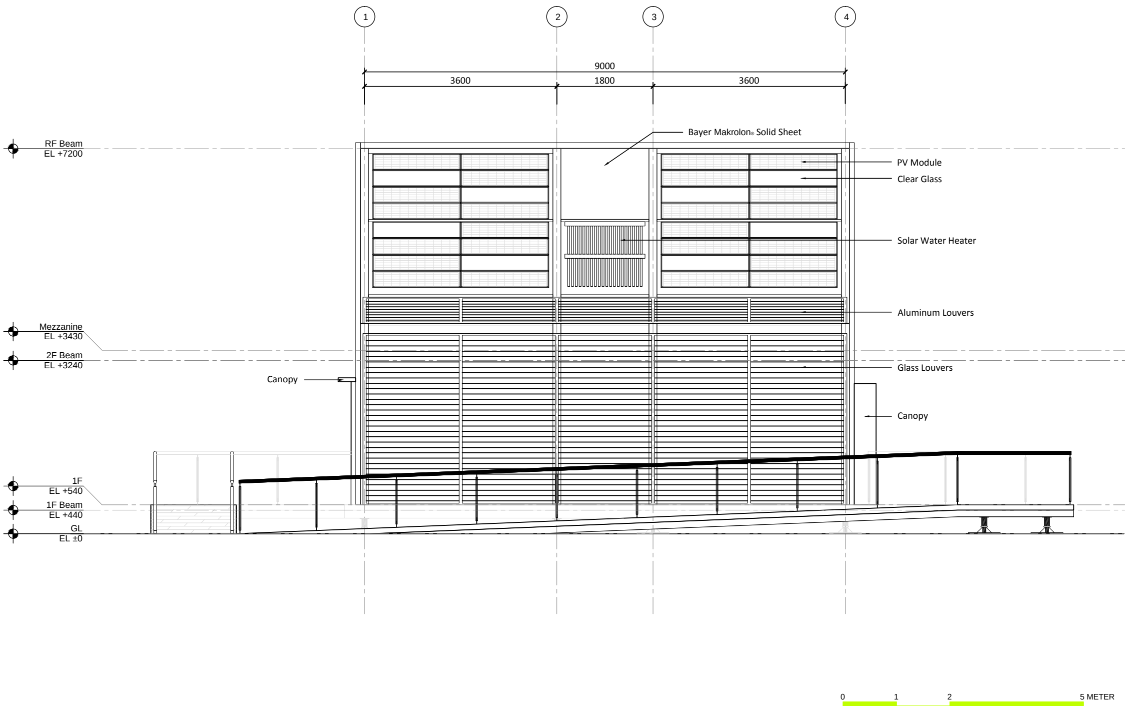
East Elevation



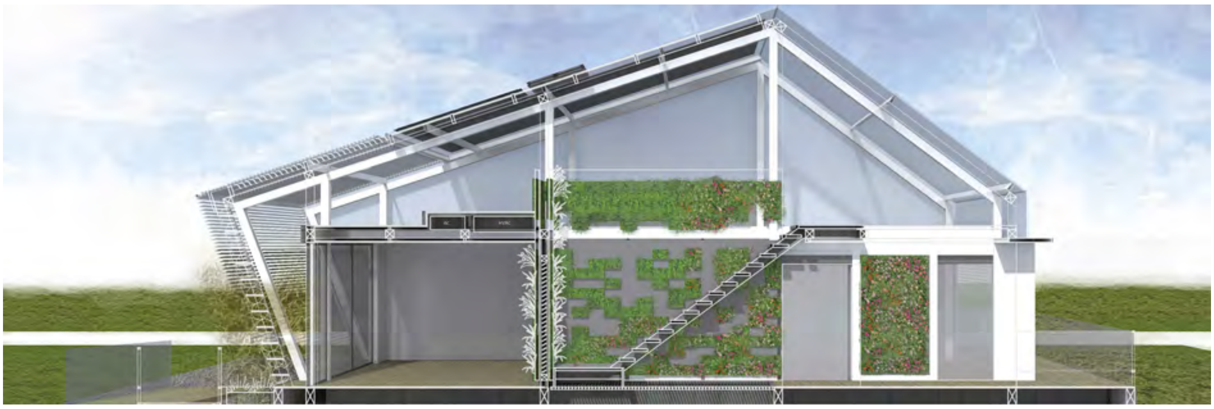
South Elevation



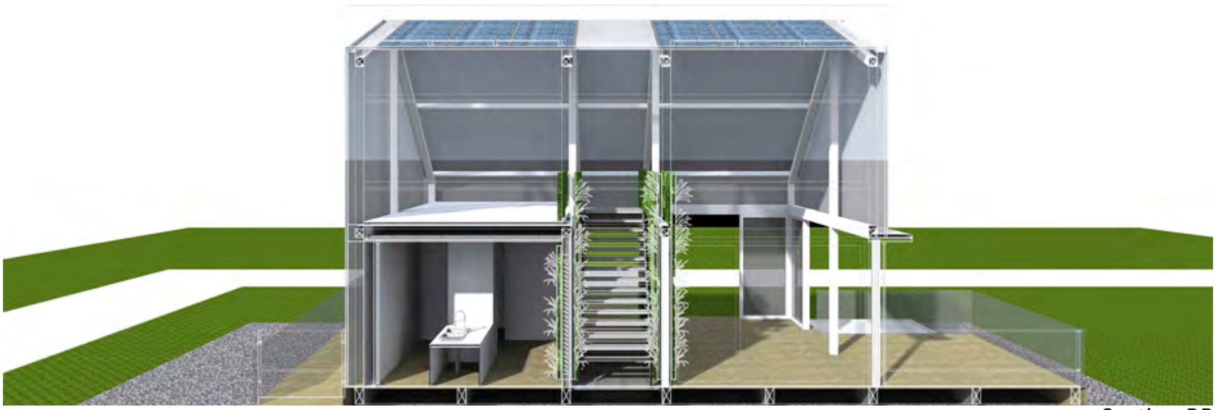
West Elevation



North Elevation



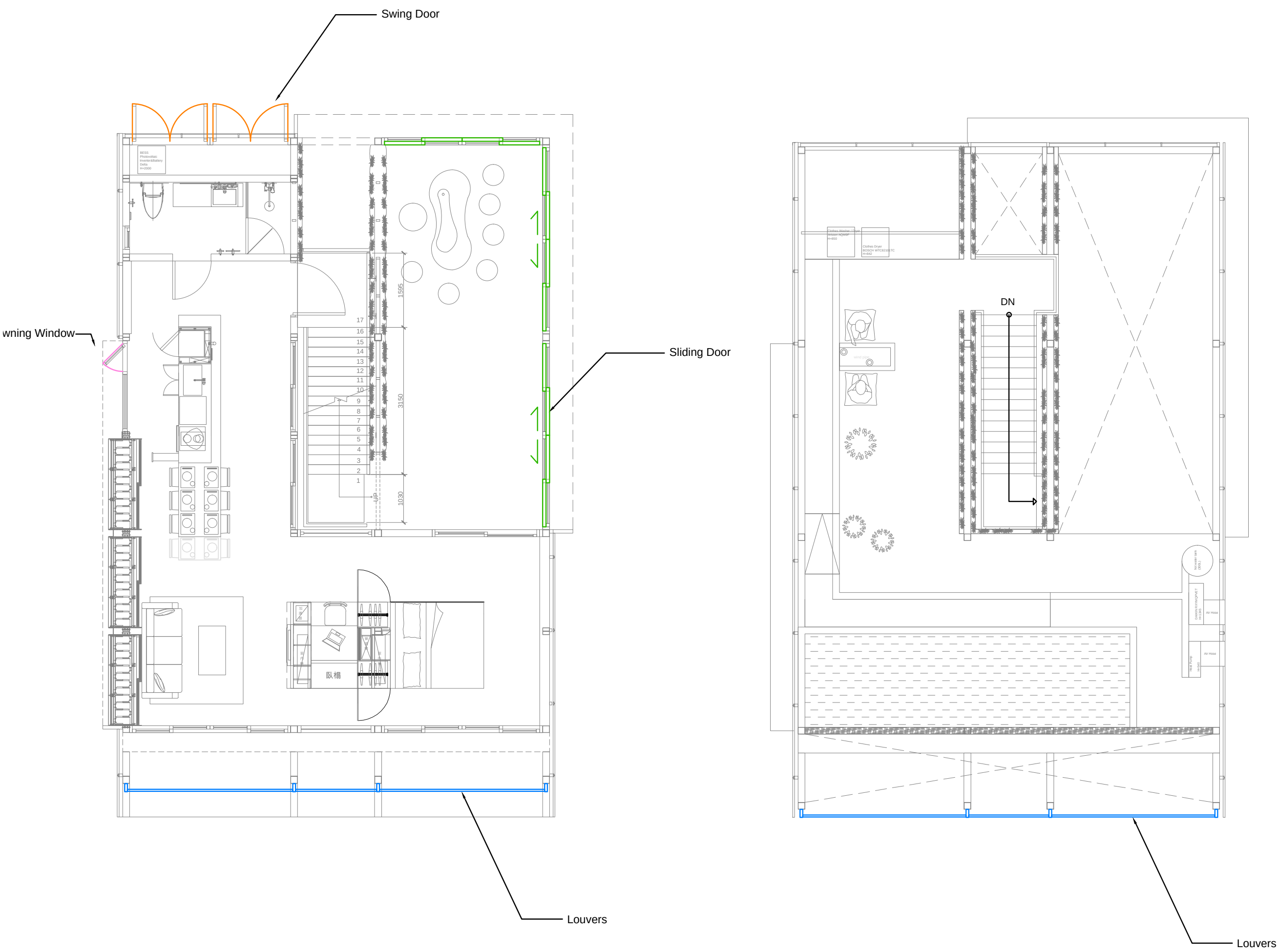
Section AA



Section BB

5.2.2 Reconfigurable Features

The façade of Orchid House is mostly covered by translucent Bayer Makrolon 40mm material to bring diffused natural light into the interior space. However, there are some portion of façade to be reconfigured with the passive design strategy .



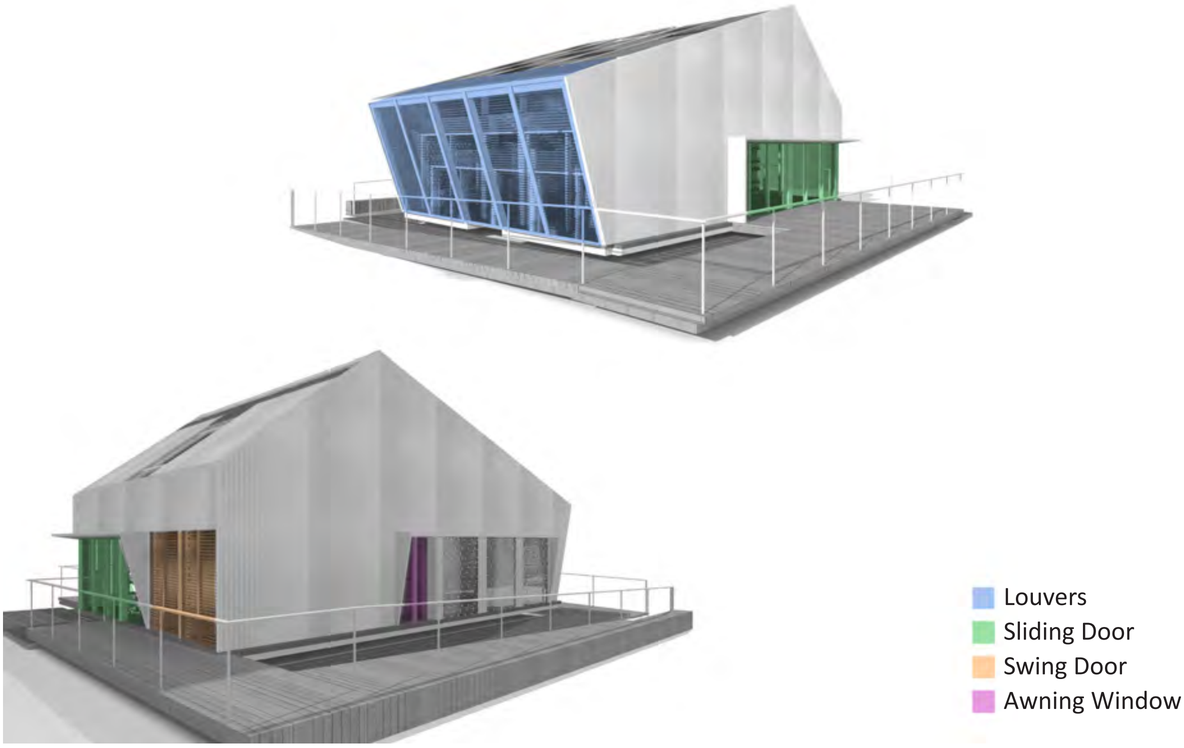
Footprint Calculation

House: 120.4 M²
Canopy: 8.7 M²
Louvers: 17.8 M²

Total: 147.2 M²

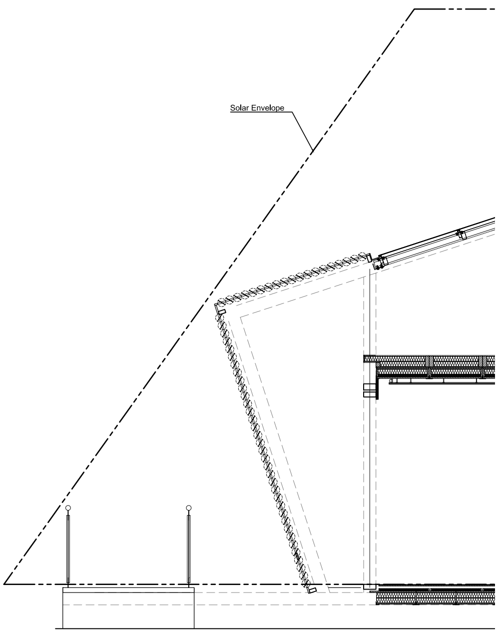
East side sliding doors

The large flat-rail sliding doors are allocated on the east side of Orchid House. When those doors are open, the tea terrace space is connected with outside deck to be able to host larger size of event without any physical boundary. These sliding door also opens up to showcase the green vertical wall to the outside.

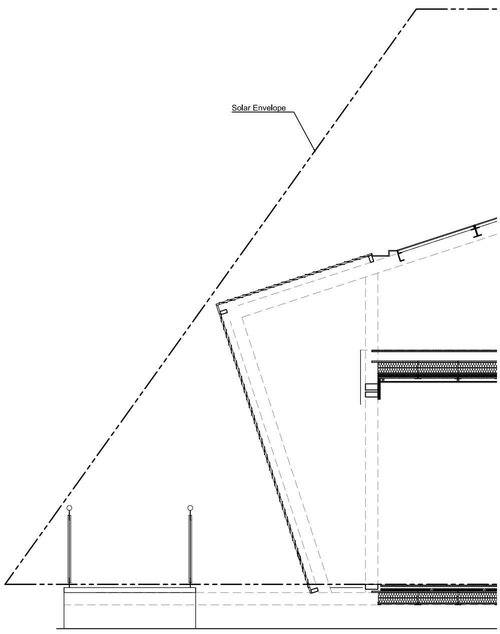


South Side Louvers

South side of Orchid House is covered by automatic glass louvers. During the summer, louvers are opened to draw natural ventilation. The wind will be filtered by the water wall allocated above of L shape living module for cooling and eventually exhausted by the fan at the highest point of mezzanine level. However, in winter time, the louvers are closed to create greenhouse effect and let in lower angle sunlight during the day.

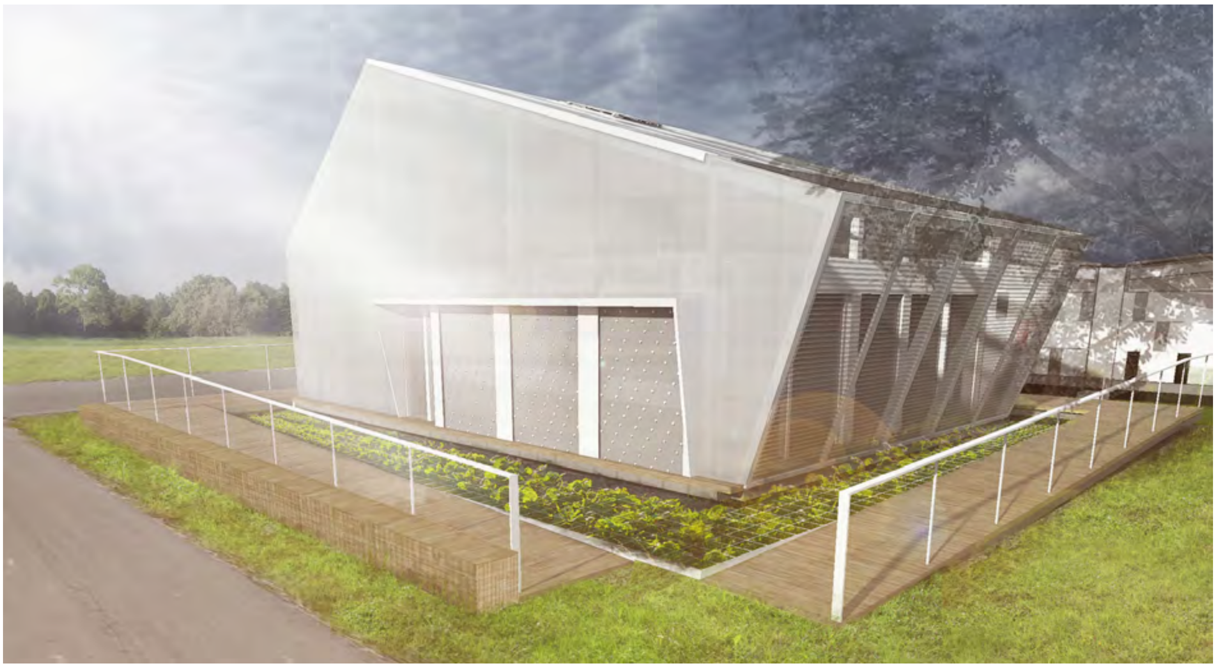


Louver Open

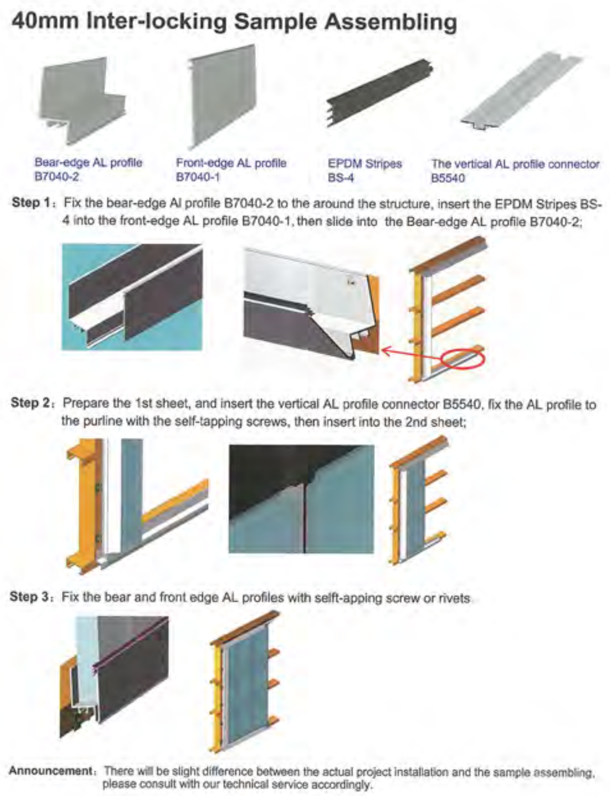


Louver Close

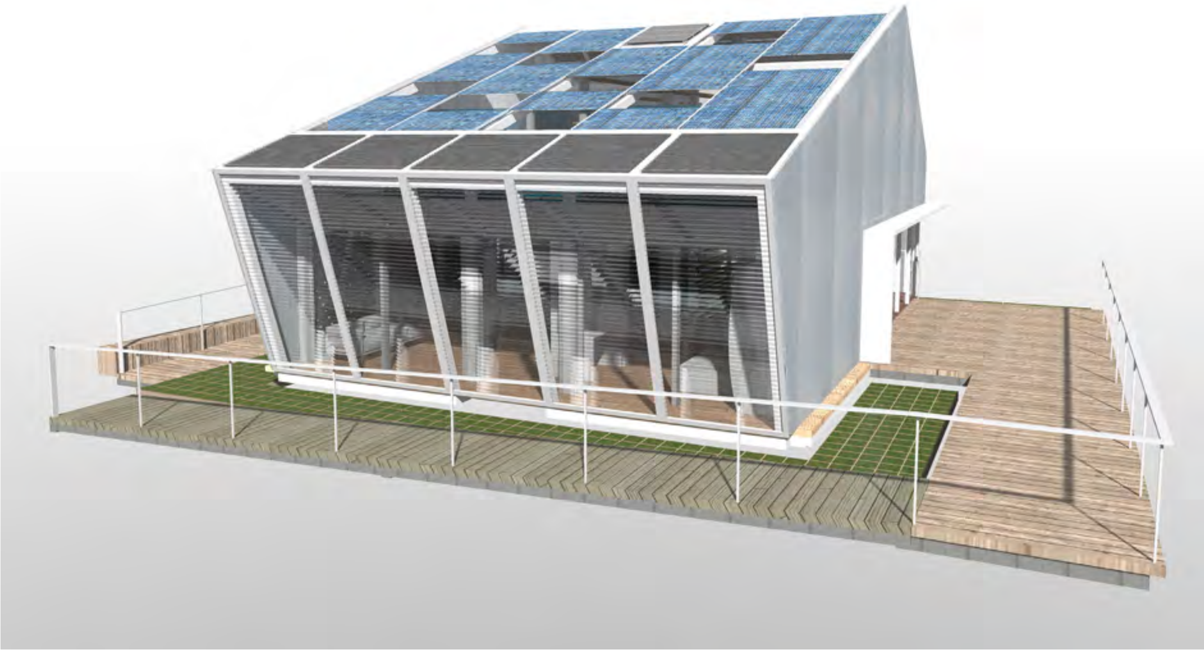
Exterior Design



Policarbonate material

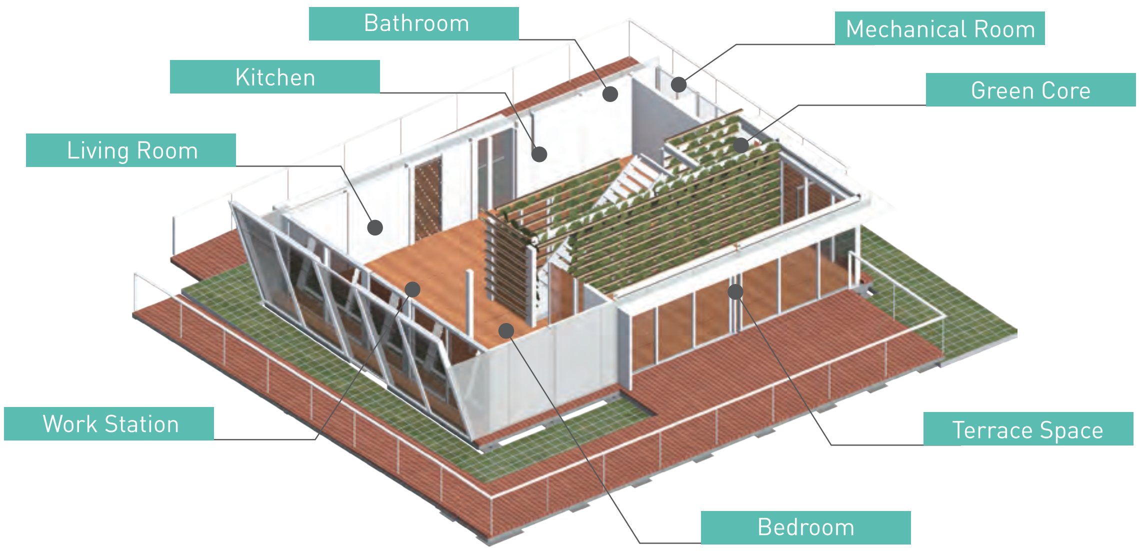


North East View



South East View

2.2 Interior Design



Space Organization

View from Living Room

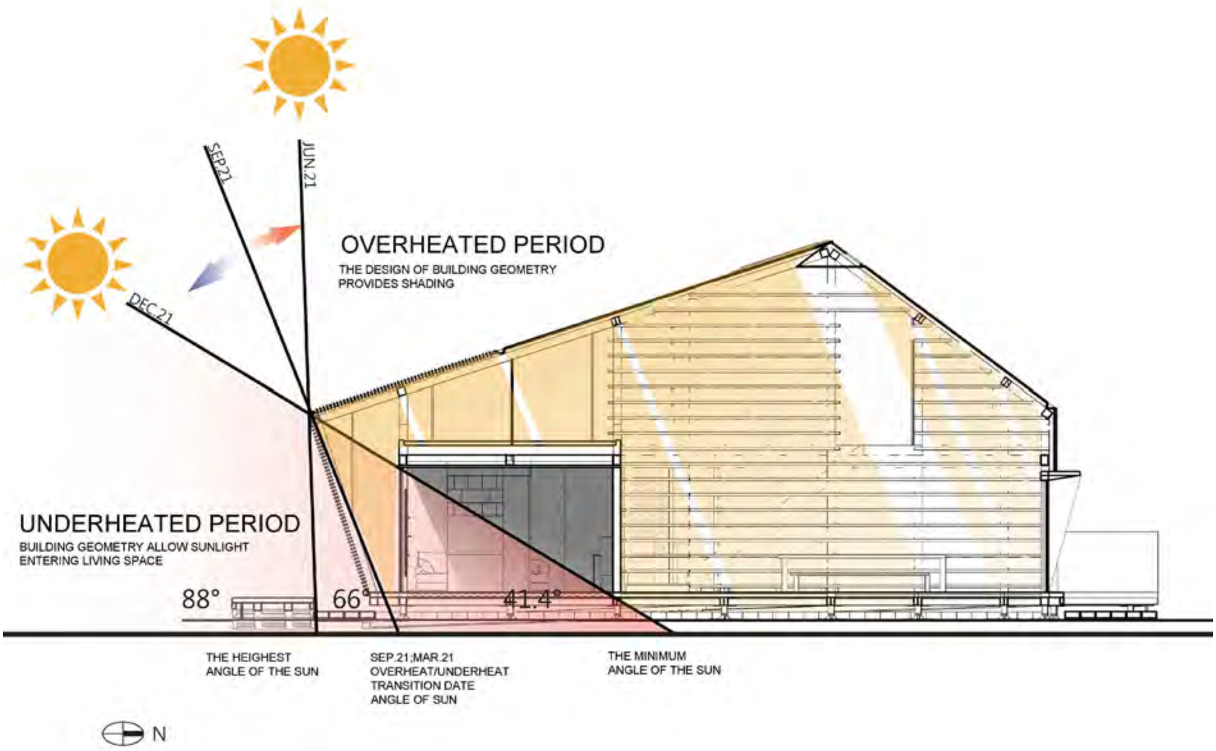

View from the mezzanine level


Tea Terrace View

5.2.3 Lighting Design Narratives

Natural lighting

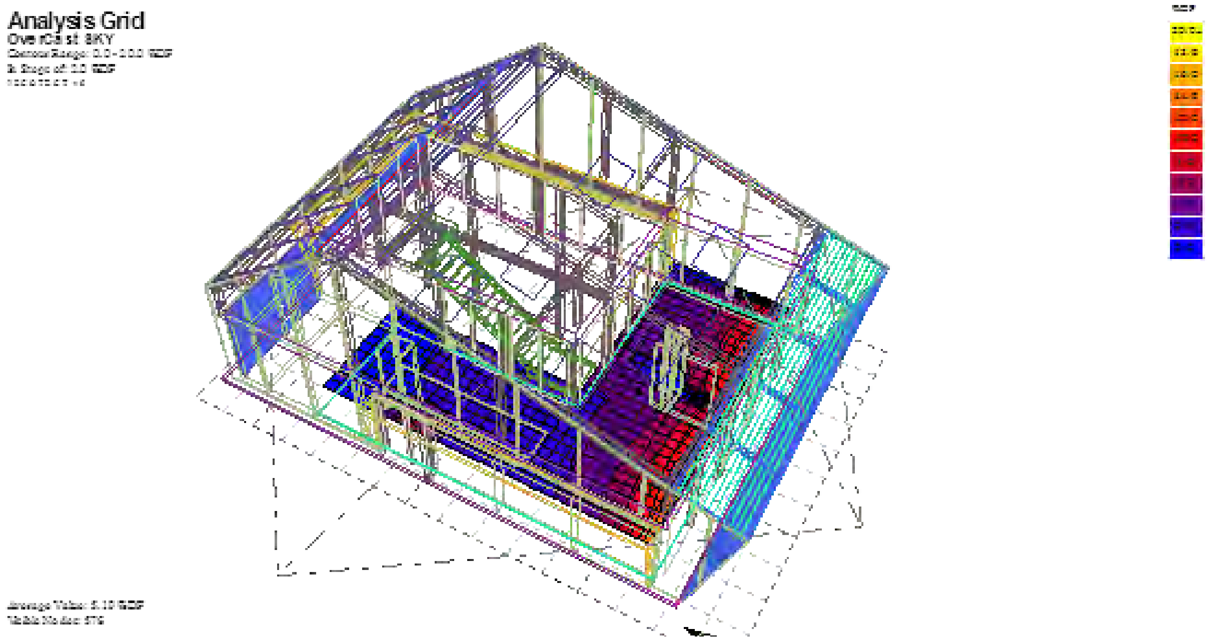
Orchid House has a unique double skin design that brings the perfect amount of natural light into the space. By introducing a glass laminated solar panel system, natural lighting can filter through the space. The second layer of skin inside is made with high transparency low-E glass to allow the maximum amount of indirect light into the living space. The staircase to the mezzanine level separates the living room and kitchen, and draws more natural light into the house. The west and north façades both have clerestories, to create a more dramatic lighting condition. Lighting analysis will be included in the later deliverables.



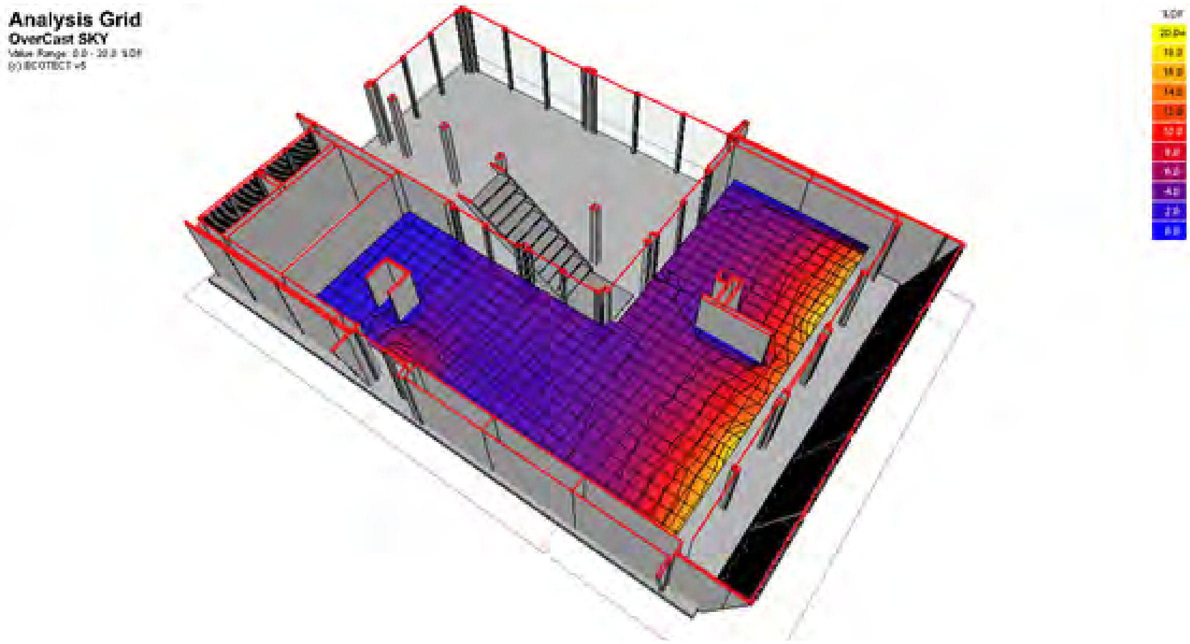
Sun angle analysis in Taiwan

Simulation tools

To simulate daylight and artificial lighting, we have worked with our consultant SGS (Société Générale de Surveillance), Taiwan branch, and use the Ecotech software to estimate the lighting condition. (image of daylight factor) With the large south opening, Orchid House is well illuminated during the day with an average lux of 1745. The CIE model analysis at an over cast day, our average daylight factor is at 5.19%.

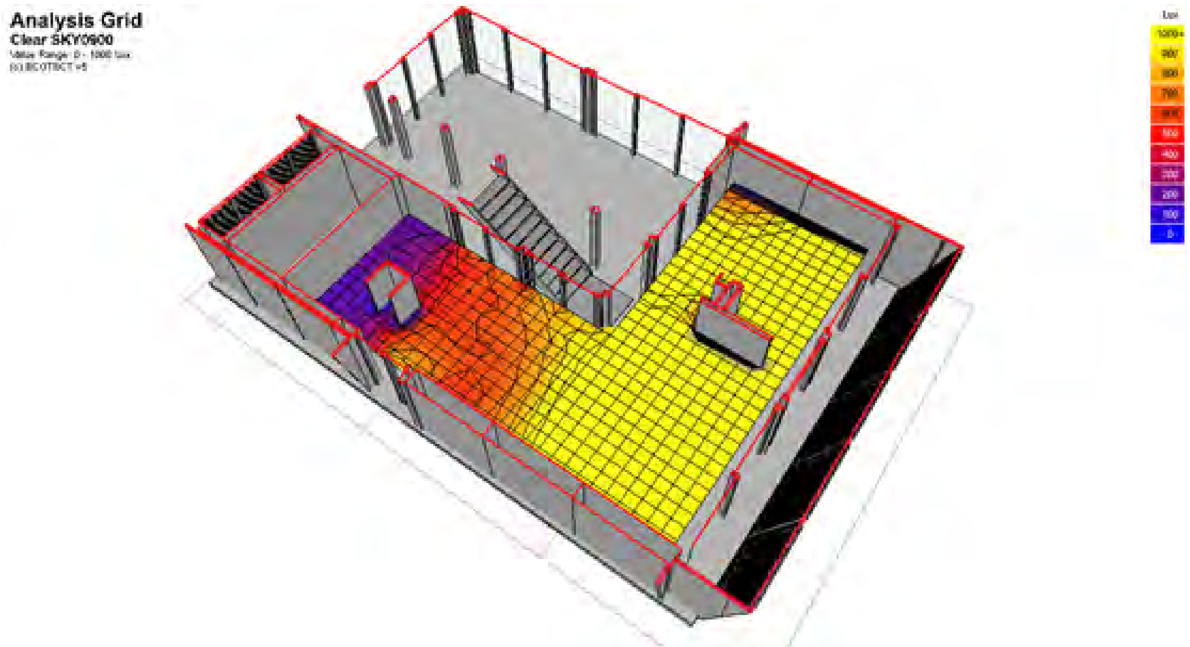


Ecotect simulation model profile

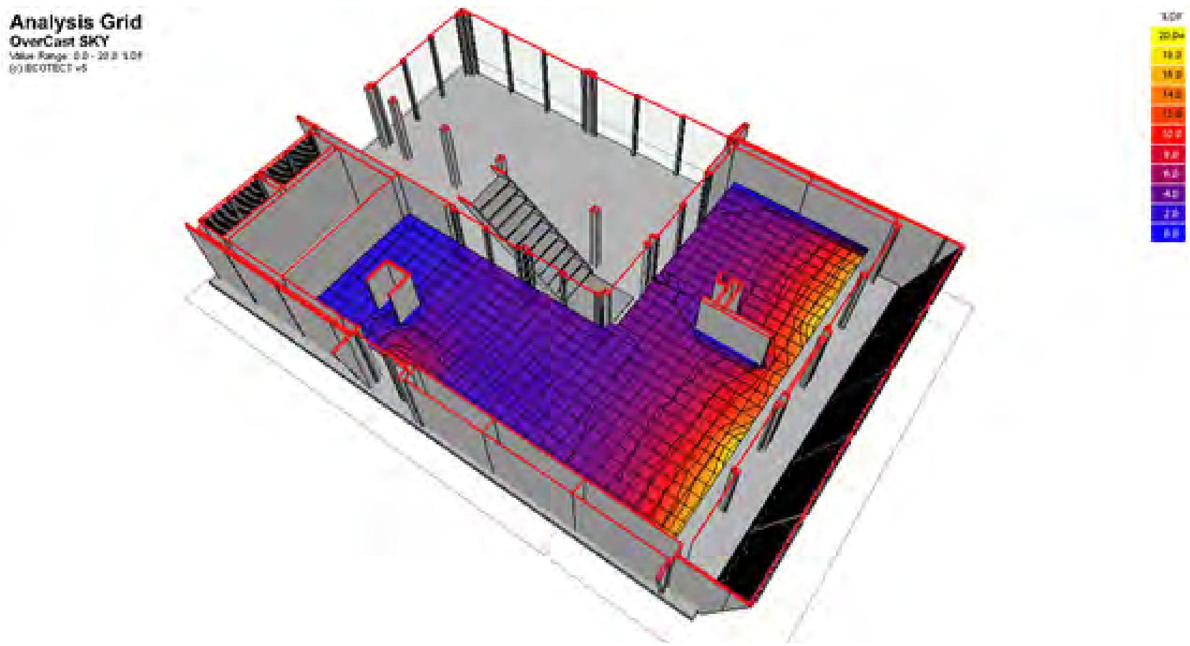


Interior daylight factor - OverCast sky
Average Value = 5.19% DF

*simulation software : Ecotect & Desktop Radiance



Sep 09:00 Interior illuminance - Clear sky
Average Value = 1745.02 Lux



Sep 15:00 Interior illuminance - Clear sky
Average Value = 4368.73 Lux

Artificial lighting

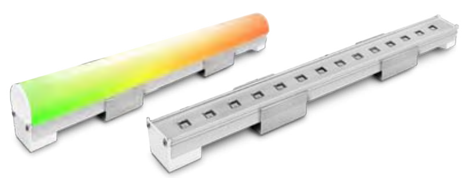
General
From the energy perspective, the optimal use of daylight is to control the dimming or extinguishing of electric lighting system when space lighting is supplemented by natural light transferred through fenestration in the building envelope.

The electric lighting system is also controlled by the dimming or on/off switching to fit the desired room atmospheric conditions.

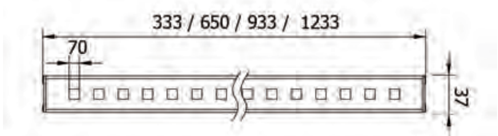
Lighting Controls for Energy Saving
- There are two ways to reduce lighting energy use through controls:
- Turn lights off when not need
- Reduce lighting power to minimum need

Control Options
- Automatic daylighting sensors to control the luminaries in the daylighted zone
- Ceiling-mounted motion sensors with manual override switches
- Programmable time controller with manual override switches

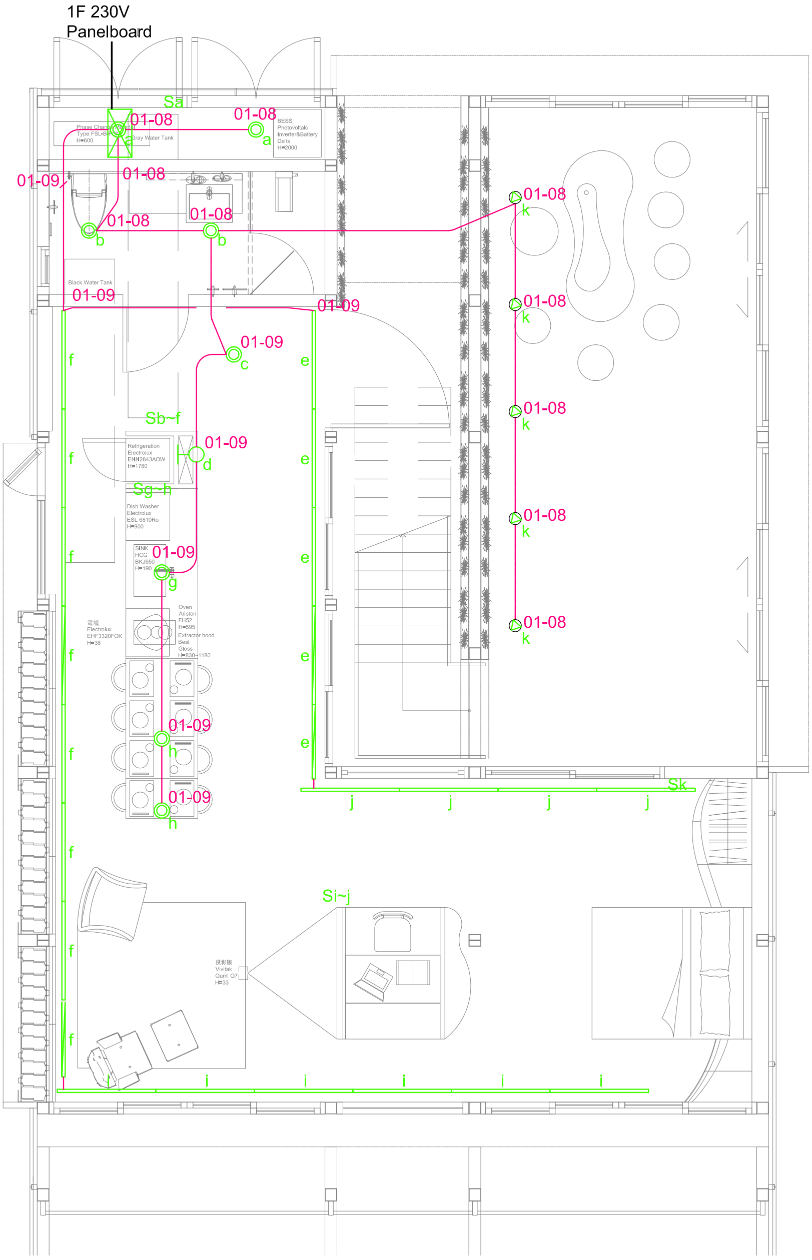
Delta Electronics LED Light source
To replace compact florescent light bulbs, Delta Group, NCTU/UNICODE's main partner, offers a new solution to illuminate the house. Unlike most LED bulbs available on the market today that use thermal dissipation fins as structure for the body, Delta's LED bulb has eliminated the heatsink fin structure while retaining optimized product performance and lifetime. Selective features are dimming, different light emission angles, 90% recyclable material constitution, and a long life of 40,000hours under normal operating conditions.



	◎ BFDA-C	◎ BFDA-W
燈光顏色	RGB	暖白
消耗功率 (W)	3 / 6 / 9 / 12	3 / 6 / 9 / 12
輸入電壓 (V)	DC 24V	DC 24V
輸出流明 (lm)	75 / 150 / 225 / 300	164 / 328 / 492 / 656
發光角度 (°)	120°	120°
環境溫度 (˚C)	-20~+40	-20~+40
防塵防水等級	IP66	IP66
控制介面	DMX(PSS)	TRIAC
重量 (kg)	0.5 / 1.0 / 1.5 / 2.0	0.5 / 1.0 / 1.5 / 2.0
尺寸 (mm)	333x37x25 / 650x37x25 933x37x25 / 1233x37x25	333x37x25 / 650x37x25 933x37x25 / 1233x37x25



Delat Electronics LED Strip Light



Lighting Plan

SYMBOL & LEGEND	
	Delta DIPT-3106 / 1.2Wx6 AC 100~240V, Wall mounted
	Delta BFDA-W / 12W(1233x37) AC 100~240V, Wall mounted
	Delta BFDA-W / 9W (933x37) AC 100~240V, Wall mounted
	Delta BWPT-112R / 1.2Wx3 AC 100~240V, Wall mounted
	Delta DRPT-509AD / 1.2Wx9 AC 100~240V, Recess mounted
	Delta BUPR-005 / 1.2W AC 100~240V, Recess mounted
	Floor Lamp / 1.2W A60 /DF 10W AC 100~240V / E2
Sa	Lighting Switch single-cut
S3a	Lighting Switch double-cut
	230V Electrical Panelboard
----	Branch Circuit (concealed in Ceiling or Wall)
	Branch Circuit (Exposed on Wall)

NOTE

LOOP NUMBER

01-03 —— CIRCUIT NUMBER

└—— PANEL NUMBER

PANEL NUMBER

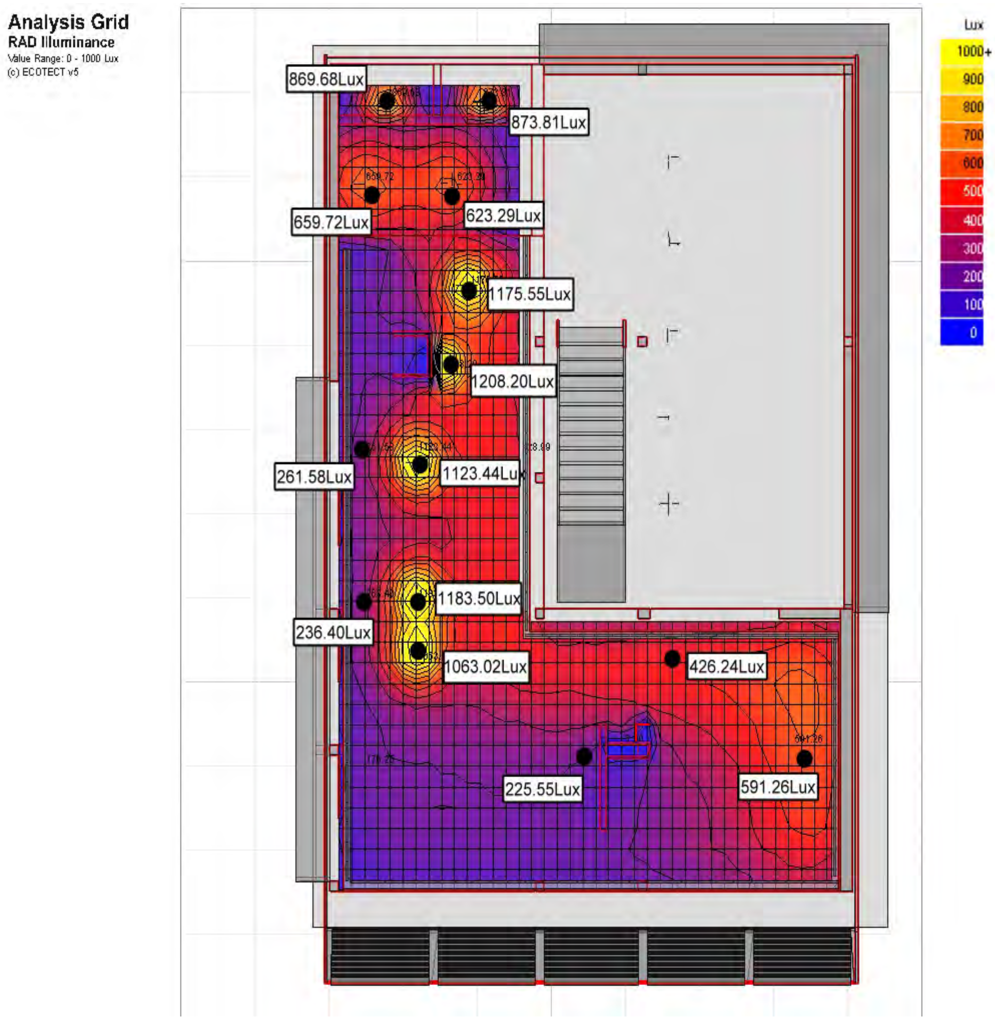
01-- 1F 230V Panelboard

02-- 2F 230V Panelboard

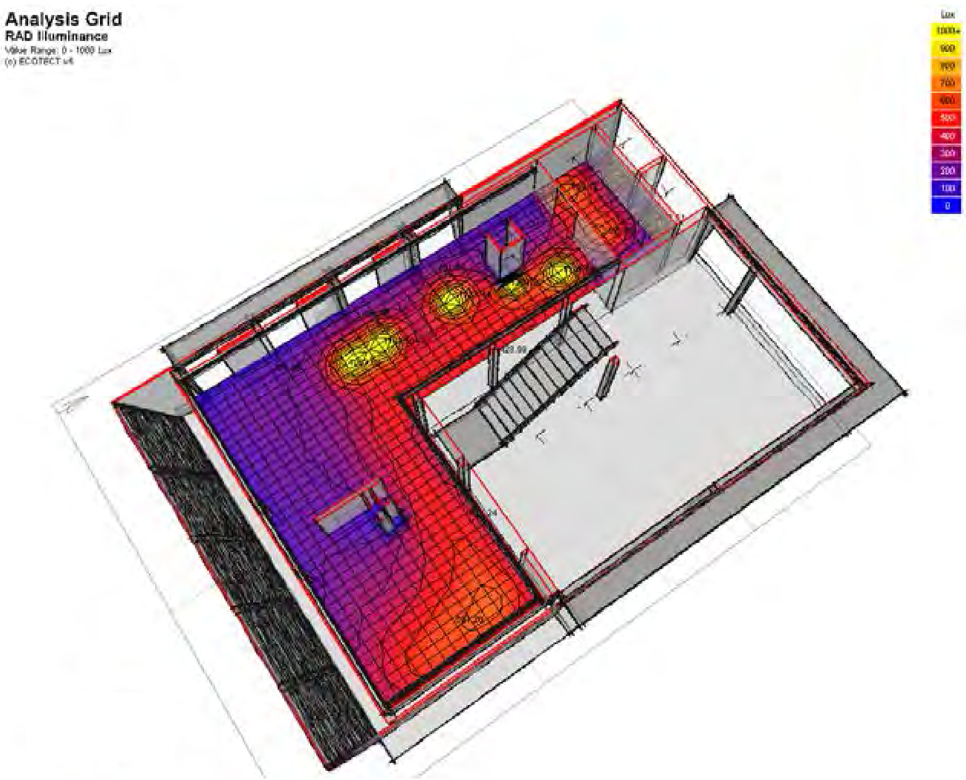
Interior Lighting Simulation

From the result of simulation, the average lighting level in the mesurable area is 358.77 Lux, which meets the 200 Lux value required by SDE organization. The areas which is closer to the window, we have placed indirect lighting to illuminate, to create a more gental lighting effect.

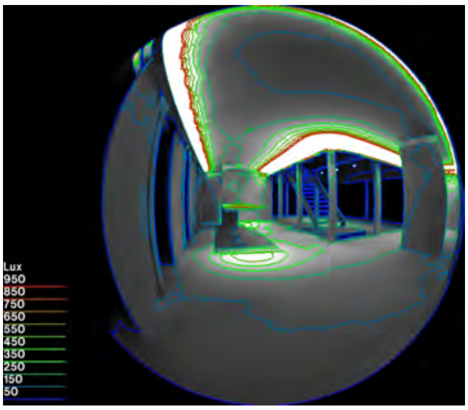
Simulation result is as following:

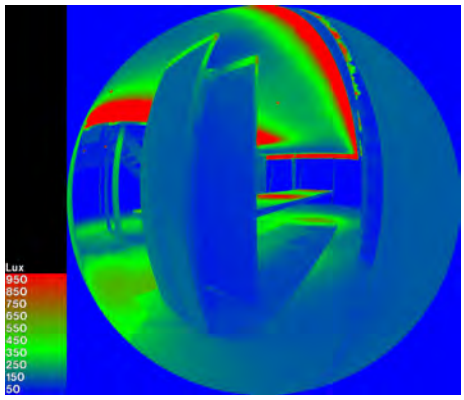


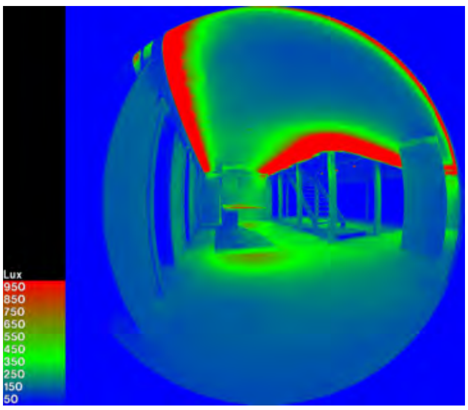
Simulation Result of Interior Lighting

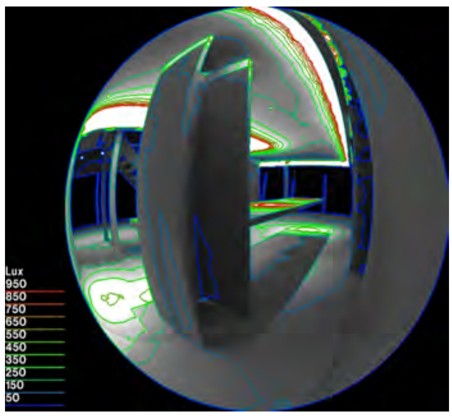


Interior Lighting Distribution









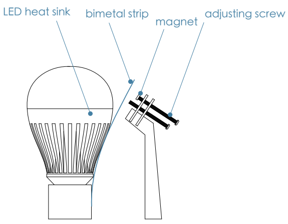
The Blossom of Sensitivity

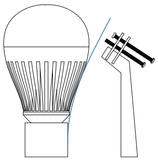
Inspiration of lighting design

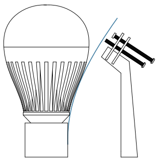
For the Orchid House, we have specially designed a lighting fixture which can open up and close automatically without electricity. It moves gentally and simulates living creature.

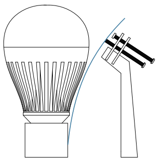
fabricate issues

- errors in process of assembling
- errors in screws and other ready-made components
- errors in thickness of material acrylic
- errors in laser cutting

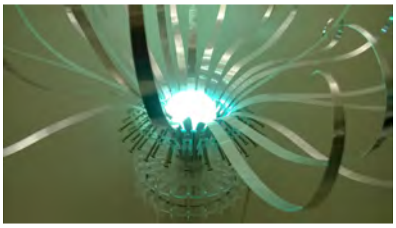


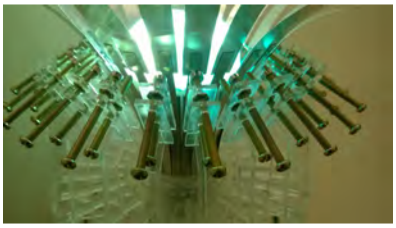


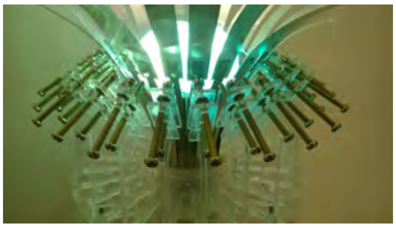


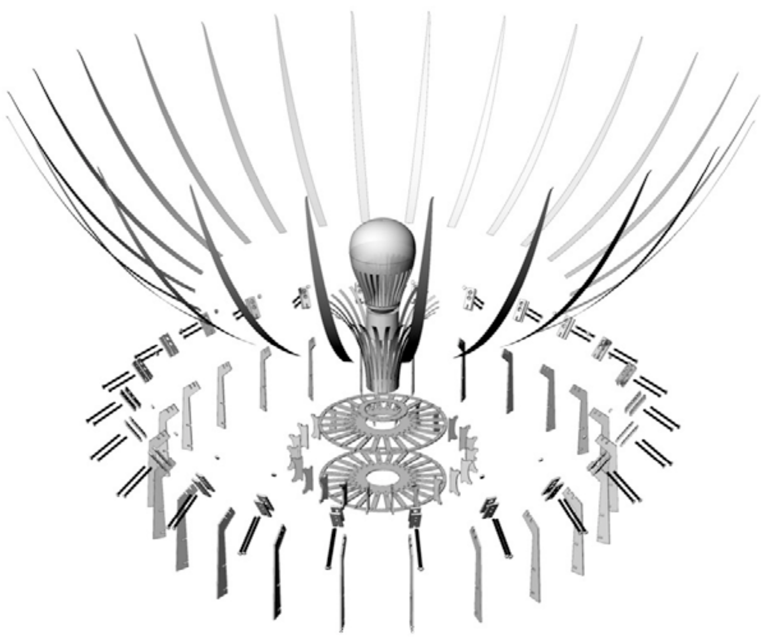


Prototype of Lighting Fixture



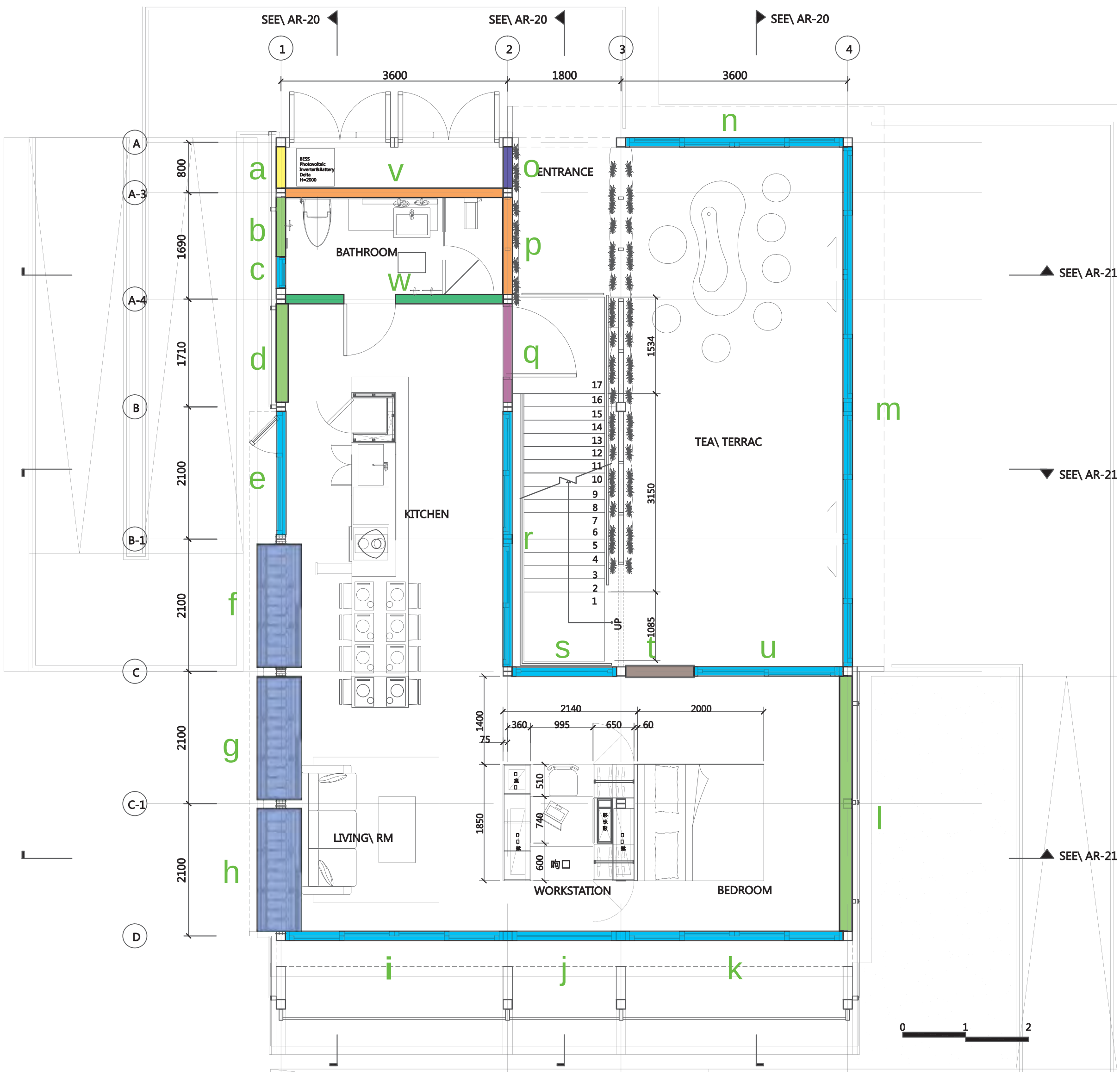


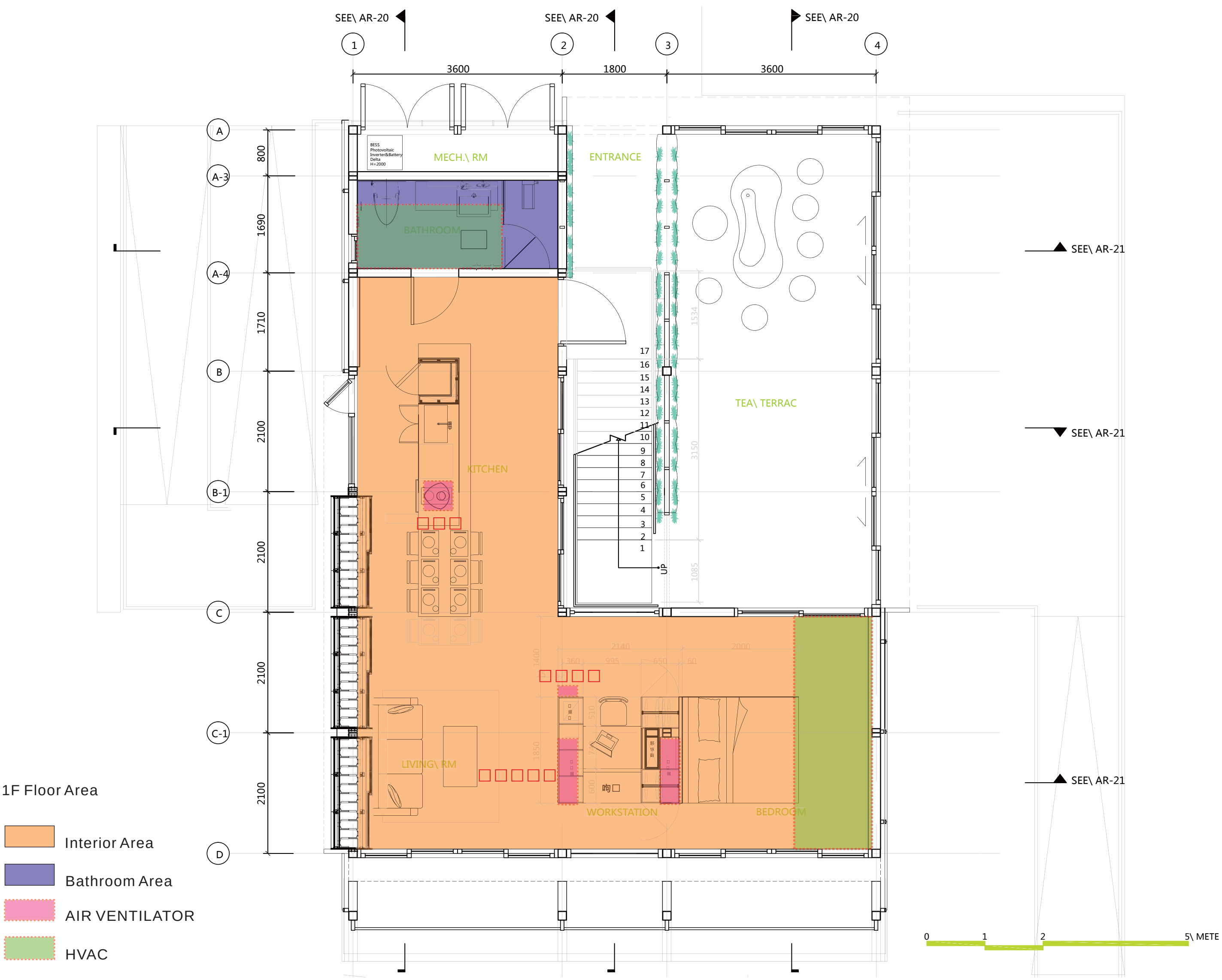




Acoustic Design

The interior faces of walls are designed to provide sufficient absorption and minimize reverberation time. The sound absorption is achieved by the combination of vibrating panels and thick porous material. The interior side of walls and ceilings are covered with plywood with air space behind it. The plywood with air space may sufficiently increase sound absorption in low frequencies. eFoam insulation material behind the airspace provides sound absorption in high frequency.





Unit Mark	Sound level dBA
Heat Pump (Outdoor Unit)	52
Heat Pump (Indoor Unit)*2	39/34
Heat Reclaim Ventilation	28.5
Heat Pump 01	42
Dehumidifier	63
Refrigeration / Freezing	39
Clothes Washer	51
Dryer	65
Dishwasher	41
Extractor hood	66

Reverberation Time

The absorption coefficients and the reverberation time of the interior materials are listed on the table below:

				Absorption coefficient						Absorption(sabin)					
KITCHEN	COMPONENTS	MATERIALS	AREA	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz
	Floor	Plywood	55.0	0.28	0.22	0.17	0.09	0.10	0.11	15.40	12.10	9.35	4.95	5.50	6.05
	Ceiling	Plywood	55.0	0.28	0.22	0.17	0.09	0.10	0.11	15.40	12.10	9.35	4.95	5.50	6.05
	wall	Plywood	40.0	0.28	0.22	0.17	0.09	0.10	0.11	11.20	8.80	6.80	3.60	4.00	4.40
	windows	Plolycarbonate	42.0	0.11	0.26	0.15	0.14	0.04	0.04	4.62	10.92	6.30	5.88	1.68	1.68
LIVING ROOM	Air, Sabins per 1000m3		135.3	0.04	0.09	0.26	0.46	0.92	2.58	0.05	0.12	0..35	0.62	1.24	3.48
	Area, ave. coef,. total sabins		55.2	0.2428	0.2288	0.1656	0.1009	0.0869	0.0947	46.67	44.04	32.15	20.00	17.92	21.66
	Reverberation time (sec.)			T=KV/A Sabine						0.50	0.50	0.70	1.10	1.20	1.00
	Eyring's coef.			0.2156	0.2045	0.1526	0.096	0.0832	0.0903						

5.3 Engineering and Construction Design Narrative

When making the engineering and construction design for the roof top add-on Orchid House of present time Taipei, both the Orchid House and the existing building must be included as consideration factors. The island of Taiwan sits on the Circum-Pacific Seismic Belt as well as the major paths of north Pacific typhoons. Earthquakes and typhoons are the major disasters on this island. As a result, lateral force resistance is as important as gravity load resistance in structural design.

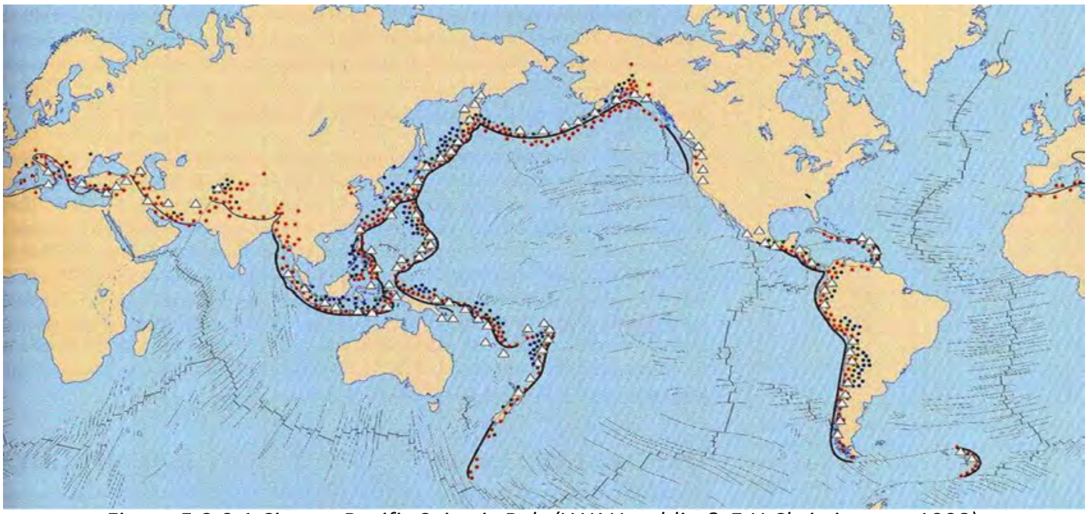


Figure 5.3.0.1 Circum-Pacific Seismic Belt (W.K Hamblin & E.H Christiansen, 1998)

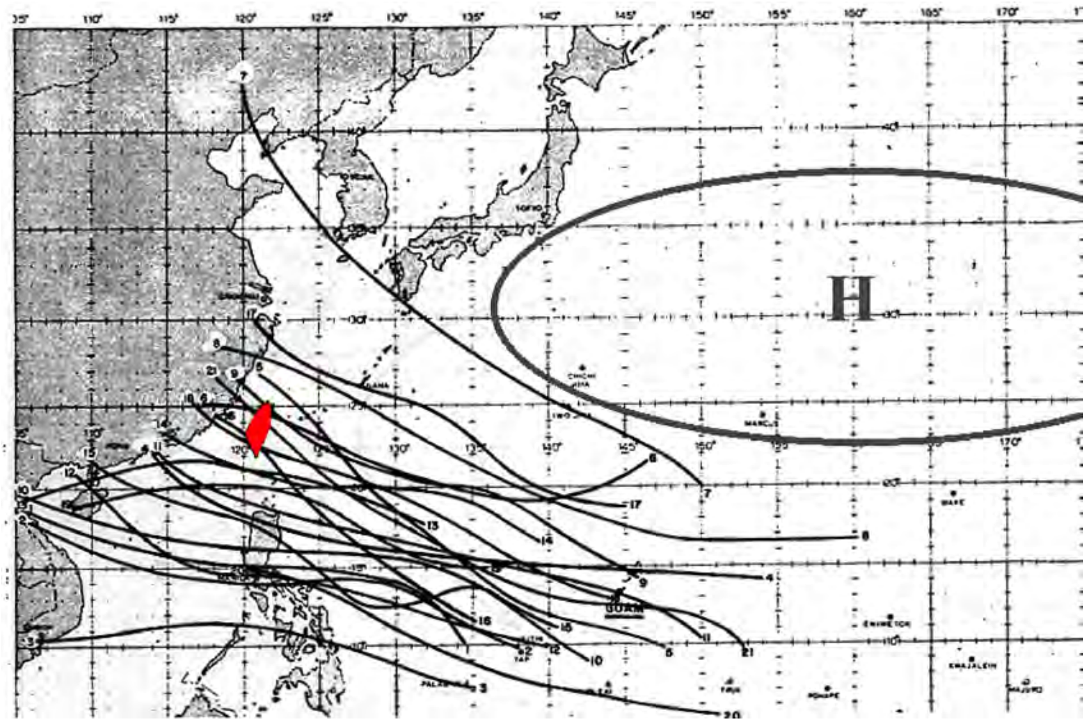


Figure 5.3.0.2 Major paths of West Pacific typhoon ("tropical cyclone Motion and Surrounding Parameter Relationships", John E George, 1975)

The traditional row houses are mainly constructed by reinforced concrete. The rigid post-beam structure of concrete is suitable to resist both gravity and lateral forces. Taiwan Island is rich in cement and that makes concrete a preferred and sensible local construction material.

However, modern buildings in Taiwan tend to see more steel construction. The main reason is to reduce the dead load and construction time. The quality of steel construction is also more reliable than pour in site concrete construction. The recycled steel has been widely applied on the architectural construction on this island. The add-on roof tops commonly seen in Taipei are mainly of steel construction. The reason is to avoid adding too much weight to the existing building structure.

Heat island effect has been a major problem in Taipei just like most of the modern industrialized metropolis. High population density, air pollution, automobile smog, hard urban paving, rapid rain water drainage system all contribute to Taipei's heat island effect. Geographic condition also enforces this effect. Taipei city is located on the Taipei Basin. The surrounding mountains reduce the wind flows which trap the heat in this city.

Flood in the typhoon season is another major disaster in Taipei. Rain water from the tropical storms always brings more water than the city drainage system can handle. To make matter worse, the rivers in this city are shallow and steep, so water does not stay in the city for long. During the dry season, water shortage is another problem people have to face every year. Therefore, keeping the rain water in the city for reuse would be an effective strategy to extend the city's sustainability.

http://teia.e-info.org.tw/e-info/2298

5.3.1 Structural Design

1. Introduction

The Orchid House's engineering design features an integrated set of systems which is highly efficient in sustaining the comfort factors of the house. Similar to the orchid's natural eco-system, the engineering systems work in a coherent way to increase the efficiency of sunlight and water usage. By choosing recyclable materials such as steel framing and using the pre-fabrication technique, the structure can be erected quickly to save time and energy. The structure system utilizes steel framing with floor and wall infill. This system allows the house to be constructed on different sites with the same framing and different infill which fits its local condition. The steel manufacturer of the Orchid House is Tung Ho Steel Enterprise Corporation whose products are 100% recycled material.

2. Joint System

The joint system is composed with the Ordinary Moment Resistant Frame method, which has lower ductility for strong seismic resistance. The Ordinary Moment Resistant Frame allows uncomplicated production and short construction time, at the same time pass the stiff regulation for seismic proofing in Taiwan. Thanks to the low ductility of the Ordinary Moment Resistant Frame, the Orchid House will require no structural bracing that would easily disrupt the continuity of space as well as increasing the construction complexity.

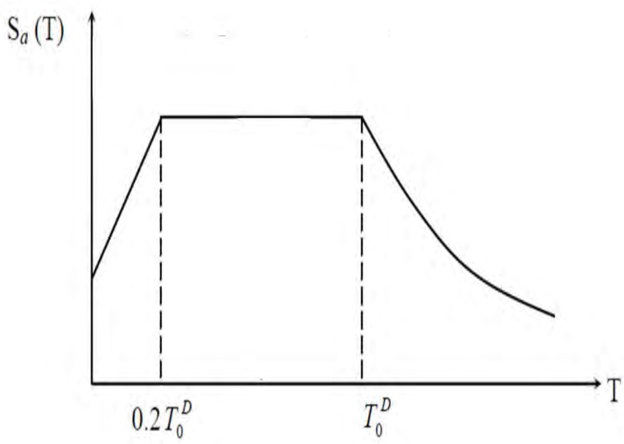


Figure 5.3.1.2a Earthquake Load in Taiwan

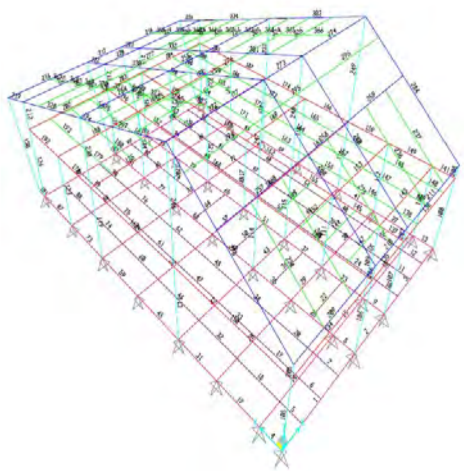


Figure 5.3.1.2b Structural Diagram

3. Prefabrication

All of the structural components are prefabricated at a factory near the Taipei City and transported to the construction site, which means no need for the on-site welding joints or the landfill trash during the construction. Most of the connections will be joined by bolts and nuts, which can be done without special equipment or skill to build the structure. The modules are designed to be transported by trucks and standard containers as standard shipping. This prefabricate methods are applied when the Orchid House is added on to the existing building rooftops in Taipei City to reduce construction cost and time. It is also suitable when the Orchid house is shipped to France by standard containers.

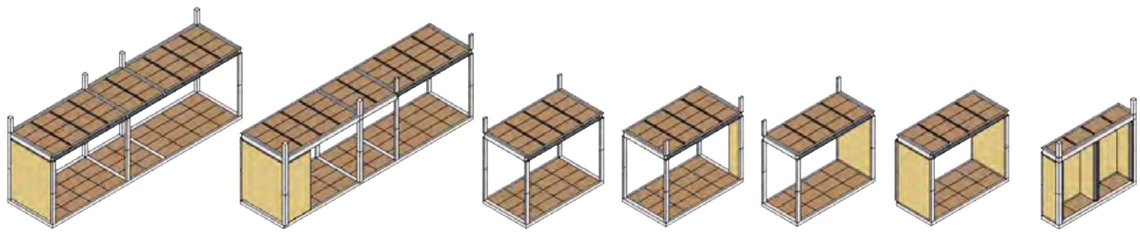


Figure 5.3.1.3 Modules

4. Foundation

The foundation of the Orchid House is designed to fit on top of the existing local building structure in Taipei. The system extends the existing building's structural grid and requires the Orchid House to extend from it. On the roof tops of the existing buildings, reinforce bars are inserted into the existing concrete columns, and then concrete bases with reinforcement are poured on site to serve as the footing of the Orchid House. Some screw stems are extended from the footing; and steel plates welded at the bottom of the house's columns connect the house to the footings. As a result, the load of the Orchid House will be transferred from the house's steel system to the existing concrete structure that it sits on.

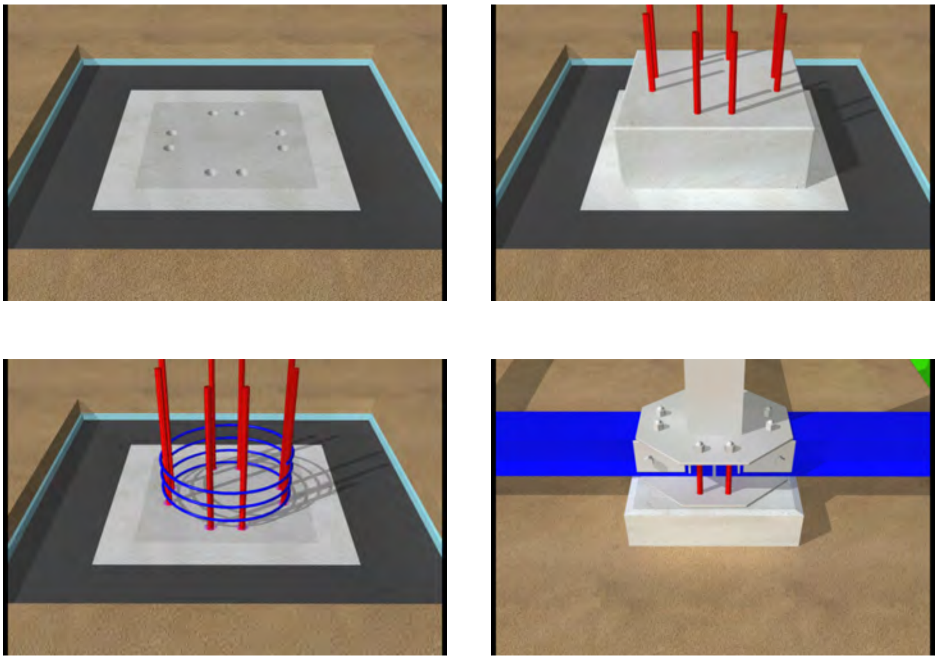


Figure 5.3.1.4a Structural connection between the Orchid House and existing building

5. Footing

The Orchid House's foundation is also specially designed for the uneven ground condition in Versailles, France and also the existing rooftop in Taiwan. The footing utilizes the sand box with steel adjustable foot for easy leveling without expensive tools or special knowledge. This leveling method also helps shorting the overall construction time and cleaning after the competition. The Orchid House is supported by this 28 special footing and expected to assemble within half a day on site.

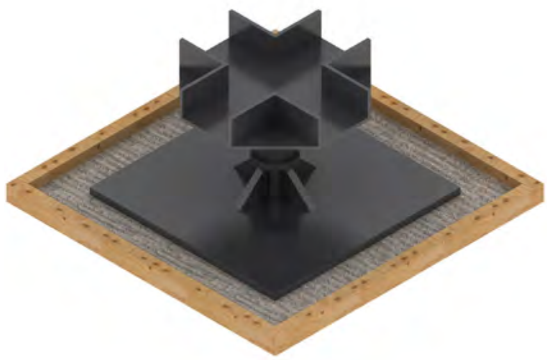


Figure 5.3.1.4b Adjustable Footing in Versailles Site

The construction of the Orchid House in Versailles has a different site consideration. The prototype Orchid House's foundation is specially designed for the uneven ground condition. The footing utilizes the sand box with steel adjustable foot for easy leveling without expensive tools or special knowledge. This leveling method also helps shorting the overall construction time and cleaning after the competition. The Orchid House is supported by 28 special footings and can be assembled within a half day on site.

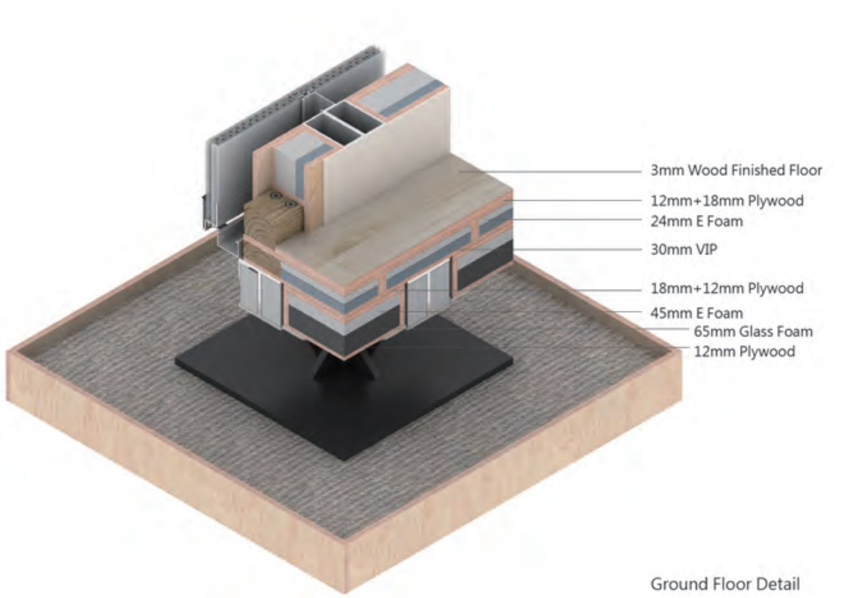


Figure 5.3.1.4b Adjustable Footing in Versailles Site

5. QR code management

The QR code will be used for all the structural components marked in the factory while they are manufactured for the construction management. The QR code does not require any expensive or special device for reading, but just the usual mobile device, such as a smart phone or tablet PC with camera. The information technology team of NCTU UNICODE will develop special application for the construction management.

Figure 1.5.1 QR CODE

5.3.2 Constructive Design

1. Introduction

Innovative combinations of passive and active technologies can reduce a considerable amount of energy and material waste. The Orchid House's design uses a light-weight construction, with an insulated envelope that re¬duces mechanical load. The material selection for the Orchid House is mainly targeting the products manufactured in Taiwan with sustainability production process, especially for the structure, architectural finishes, façade material, and the interior furniture installation.

2. Wall System

The typical exterior walls of the Orchid House are designed to minimize its thermal conductivity. The exterior walls are constructed with several layers. Makrolon® polycarbonate on the outermost layer provides the unified exterior look. Two layers of plywood add its stiffness. 72mm of eForm provides necessary thermal resistance for Taiwan's condition. The inner most layer is plywood. The total thermal conductivity for the typical exterior wall is 0.15W/m2K.

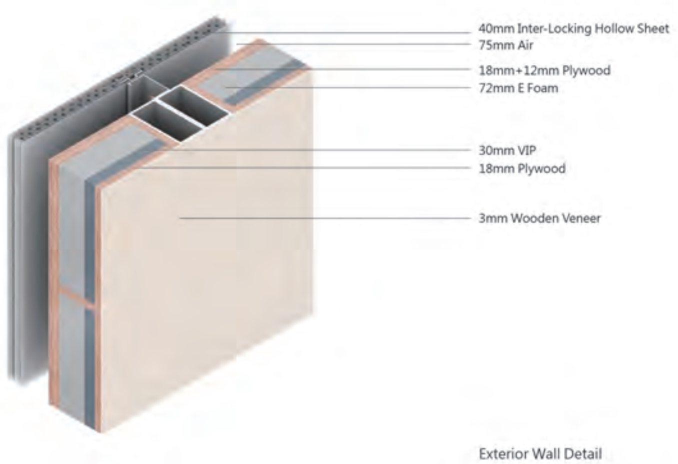


Figure 5.3.2.2 Wall System Diagram in Taipei

	Insulation Type	Thickness (mm)	Thermal Conductivity (W / m*K)	Thermal Transmittance (W/m2k)	Thermal Resistance (m2K)/W	AREA (m2)
Wall	Exterior Air Film				0.05	
AR-341	Polycarbonate	40	0.044	1.1	0.9091	
	Air	75	0.024	0.32	3.125	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	12	0.13	10.83333333	0.0923	
	E Foam	72	0.0379	0.526388889	1.8997	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	3	0.13	43.33333333	0.0231	
	Interior Air Film				0.15	
TOTAL:		238		0.153230057	6.52613	

3. Glazing

The Orchid House façade will be covered with Makrolon® polycarbonate 40mm Low-E coated Interlocking sheet from Bayer Material Science. This material is also inserted in window frames to provide lighting and transparency. This Inter-locking system allows the façade material to be easily transported and installed with durability and added resistant value to the Orchid House envelop. Makrolon® polycarbonate is also 100 % recyclable, making it inherently sustainable.

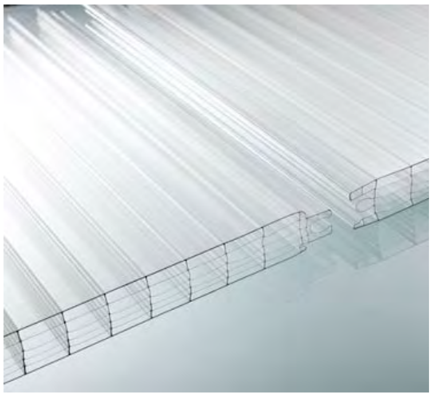
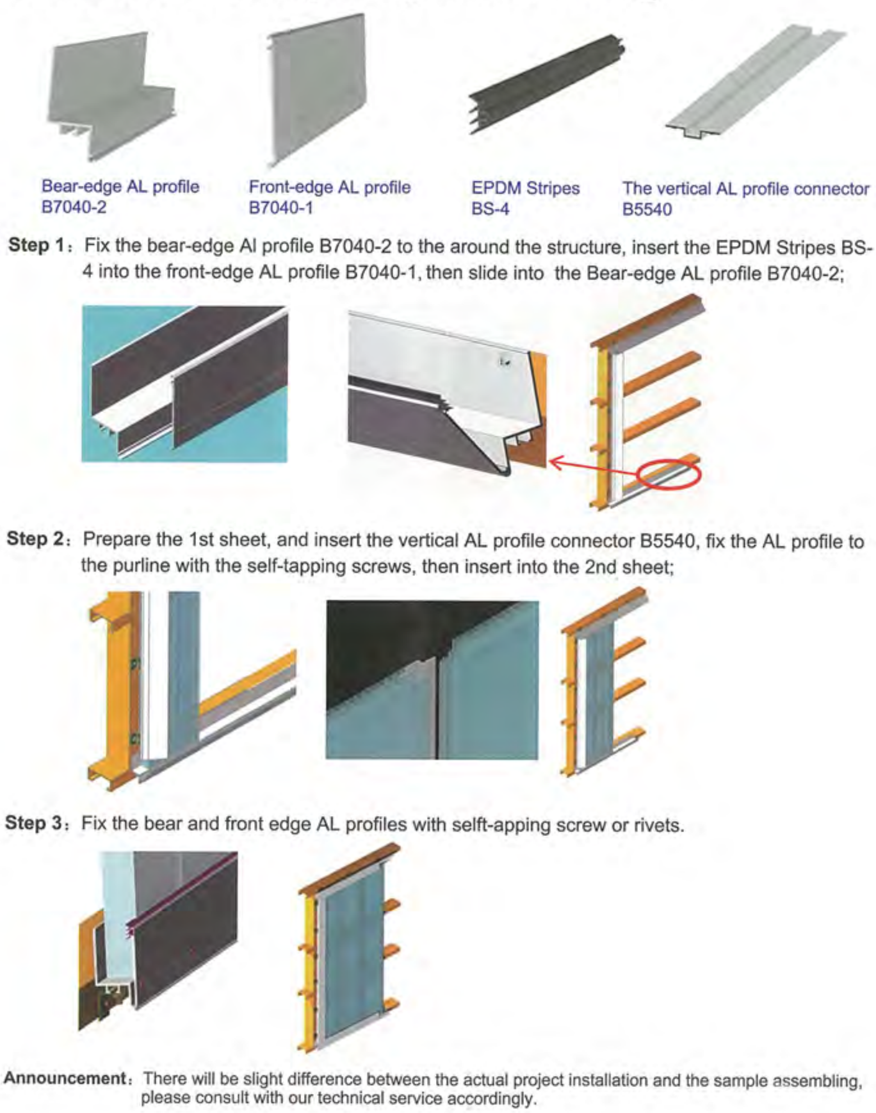


Figure 5.3.2.3 Makrolon® Polycarbonate Sheet

40mm interlocking panel assembly



4. Window Frame

The Orchid House incorporates large size sliding doors on the south and east side façade. YKK AP's aluminum window frame and door sash are chosen for its air and water tight detail. YKK AP window frame's water tightness is measured at 1000 Pascal (Pa), which is almost twice as that of the normal window frame installed in Taiwan. YKK AP window frame also contributes to noise deduction. It is rated as the T-2 class in sound deduction performance level, which reduces noise level from 80~75 dB outside to 50~45 dB inside.

Figure 5.3.2.4 YKK AP Aluminum Frame Detail

5. Floor System

The floor system of the Orchid House is designed to achieve the same goal of reducing thermal conductivity just like the walls and roof. The floor is constructed with UA wood floor on the top and 24 mm of eForm underneath it. Two layer of plywood enforce the structure of the floor. 45mm of eForm and 65mm of Glass Form supported by a layer of 12mm plywood provide thermal resistance. The total thermal conductivity for the floor is 0.28W/m2K.

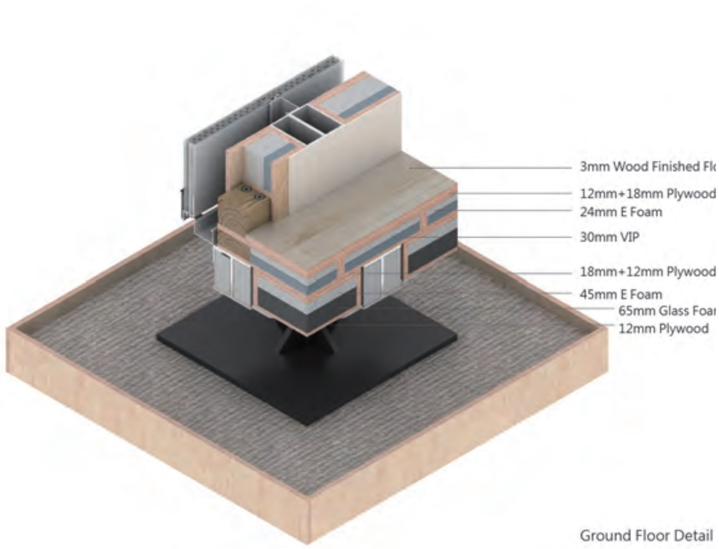
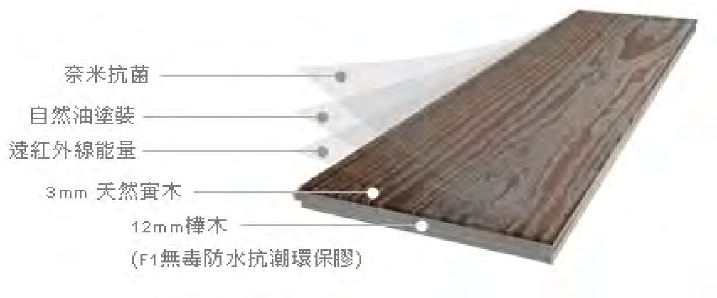


Figure 5.3.2.5a Floor System Diagram

Most of the Orchid House interior wood finish material is the selected FSC certified product from UA Wood Floor Inc. UA Wood Floor Inc. is the biggest wood flooring manufacturer in Taiwan and their production process makes their products recyclable and sustainable. UAPR Premium Collection Products especially utilize Nano technology coating to eliminate defection of wood surface and, while it emits low VOC, to last much longer than typical wood flooring.



	Insulation Type	Thickness (mm)	Thermal Conductivity (W / m*K)	Thermal Transmittance (W/m2k)	Thermal Resistance (m2K)/W	AREA (m2)
Floor (1F Deck) Deck M-Area Panel AR-321 	Interior Air Film				0.15	
	Plywood	16	0.13	8.125	0.1230769	
	Plywood	18	0.13	7.222222222	0.1384615	
	E Foam	24	0.0379	1.579166667	0.6332454	
	Plywood	12	0.13	10.83333333	0.0923077	
	Plywood	18	0.13	7.222222222	0.1384615	
	E Foam	45	0.0379	0.842222222	1.1873351	
	Glass Foam	65	0.0711	1.093846154	0.9142053	
	Plywood	12	0.13	10.83333333	0.0923077	

Table 5.3.2.5 Floor System Technical Report

6. Roof System

The interior roof consists of UA wood floor on the top. Air space and waterproof plastics prevent water leakage. 11mm of eForm and 65mm of Glass Form provide thermal resistance. Two layers of plywood to support the upper portion of the roof. 100mm eForm and 12mm of plywood fill up the space between steel beams. 28mm of eForm and 9mm plywood go underneath the structural beams. The lowest layer of the roof is a plywood ceiling. The total thermal conductivity of the roof is 0.09W/m2K.

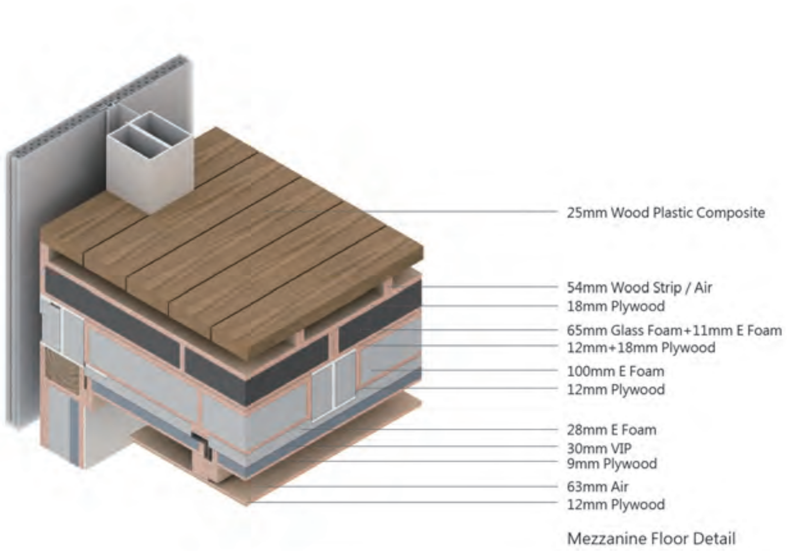


Figure 5.3.2.6 Roof System Diagram

	Insulation Type	Thickness (mm)	Thermal Conductivity (W / m*K)	Thermal Transmittance (W/m2k)	Thermal Resistance (m2K)/W	AREA (m2)
Roof (2F Deck) Deck M-Area Panel AR-322	Interior Air Film				0.15	
	Plywood	25	0.13	5.2	0.19231	
	Air	54	0.024	0.444444444	2.25	
	Waterproof Plasti	2	0.03	15	0.06667	
	Plywood	18	0.13	7.222222222	0.13846	
	E Foam	11	0.0379	3.445454545	0.29024	
	Glass Foam	65	0.0711	1.093846154	0.91421	
	Plywood	12	0.13	10.83333333	0.09231	
	Plywood	18	0.13	7.222222222	0.13846	
	E Foam	100	0.0379	0.379	2.63852	
	Plywood	12	0.13	10.83333333	0.09231	
	E Foam	28	0.0379	1.353571429	0.73879	
	Plywood	9	0.13	14.44444444	0.06923	
	Air	63	0.024	0.380952381	2.625	
	Plywood	12	0.13	10.83333333	0.09231	
	Interior Air Film				0.15	
TOTAL:		429		0.093995539	10.6388	

7. Wood Deck

The east side outdoor deck of Orchid House as well as the west and south side slopes will be covered by Wood Plastic Composite (WPC) provided by HaunSu Tech Corporation. WPC panel is composed of 50 % of High Density Polyethylene (HDPE) and Polypropylene (PP) with 25 % of Wood fiber and 25 % of Glass fiber. Almost half of HDPE and PP comes from recycled plastic in Taiwan and Japan.

Figure 2.5.1 WPC Panel

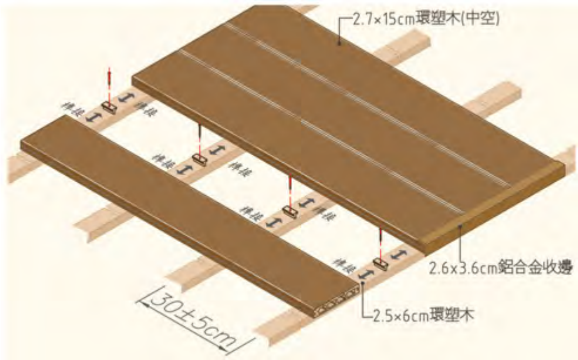


Figure 2.5.2 WPC Panel Installation

8. Thermal Wall

A thermal wall is designed for the west side of the orchid House. The POLLI-BRICK™ is chosen for the thermal mass solution. The POLLI-BRICK™ is a 100% post-consumer carbon neutral air insulated curtain wall system from MINIWIZ; however, the POLLI-BRICK™ will be filled with water for the thermal mass application. Team NCTU UNICODE has conducted intensive research of POLLI-BRICK™ at the lab for this new application to prove its functionality. The result shows that the thermal wall efficiently lower the daytime temperature and raise the night time temperature. A computational simulation is also provided to predict its performance year round. The bottles are held together and fixated to a transparent acrylic sheet on their exterior side.

Figure 5.3.2.8a POLLI-BRICK™

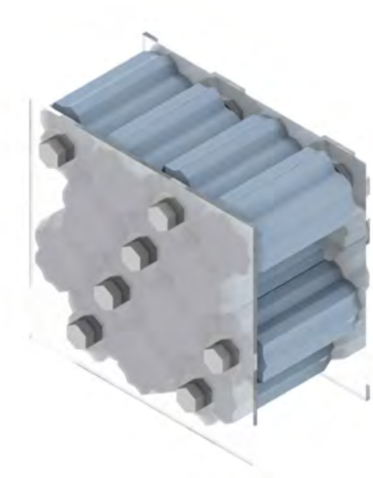


Figure 5.3.2.8b Thermal Wall Detail

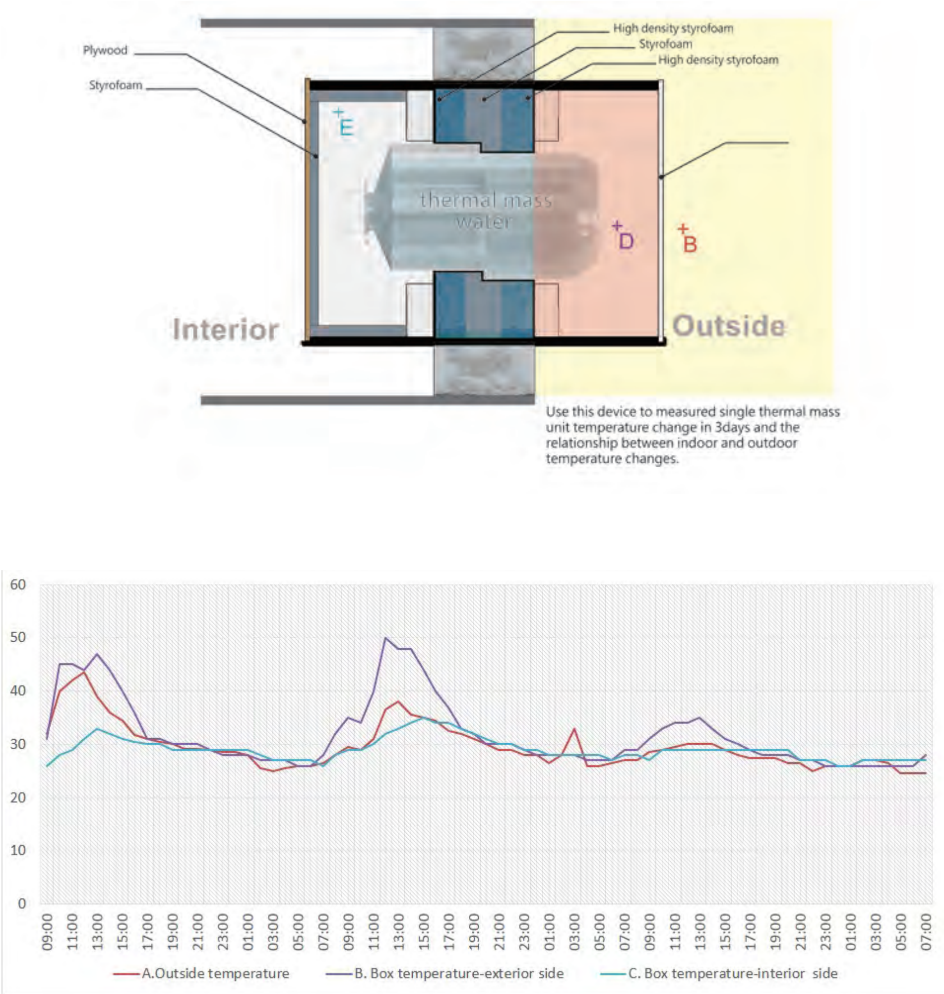
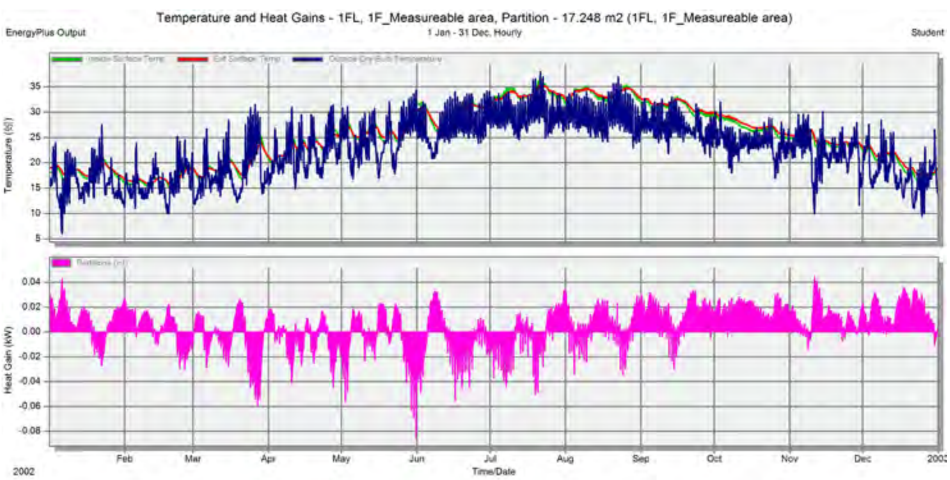


Figure 5.3.2.8c Thermal wall experiment diagram



9. Interior Wall System

The wall between kitchen and bathroom is designed with high thermal resistance value because of the different thermal conditions. The kitchen is air conditioned while the bath room is not. In order to prevent conductivity heat transfer between these two rooms, the interior wall is constructed with eForm insulation. The exterior faces of the wall are plywood. The total thermal conductivity value of the interior wall is 0.29W/m2K.

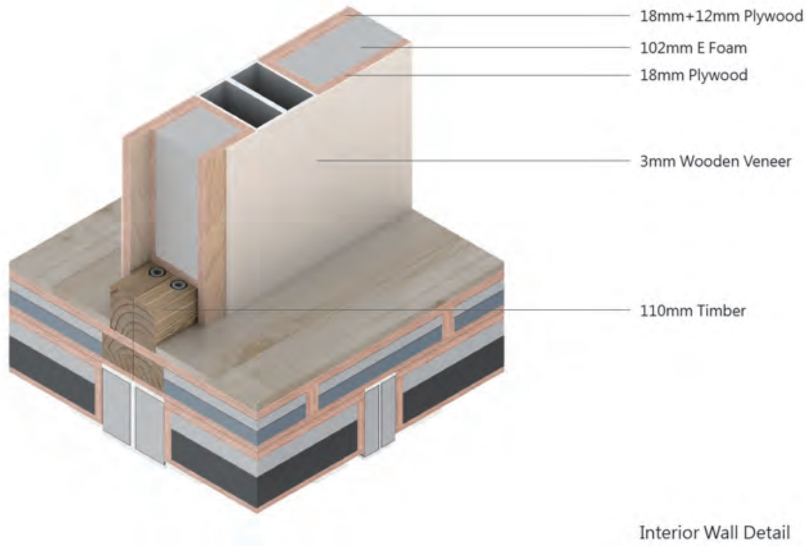


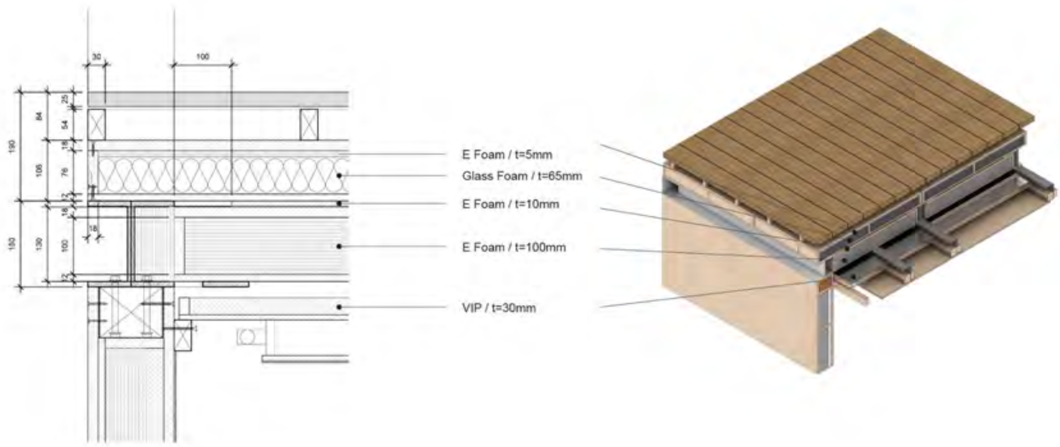
Figure 5.3.2.9a Interior Wall System Diagram

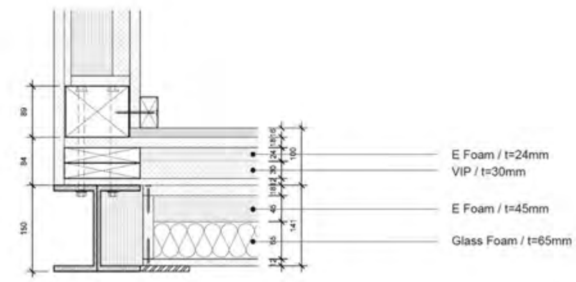
	Insulation Type	Thickness (mm)	Thermal Conductivity (W / m*K)	Thermal Transmittance (W/m2k)	Thermal Resistance (m2K)/W	AREA (m2)
Wall (Interior)	Interior Air Film				0.15	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	12	0.13	10.83333333	0.0923	
	E Foam	102	0.0379	0.371568627	2.6913	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	3	0.13	43.33333333	0.0231	
	Interior Air Film				0.15	
TOTAL:		153		0.295543159	3.3836	

Figure 5.3.2.9b Interior Wall System Technical Report

10. Thermal Insulation

Two insulation materials are used in the Orchid House in Taipei. For the thermal and acoustics solution, the insulation material of very unique recycled glass foam is selected, which could deliver STC ≧ 42dB (ASTM E413). This insulation material will be installed inside the wall, above the ceiling as well as underneath the flooring to reduce thermal heat loss and improve acoustic performance.





Another insulation material used in the Orchid House is call eForm. It is manufactured from non-toxic raw materials with pollution free process. It is also recyclable and reusable. The structural elements of the insulation panels in different layers are staggered. The purpose is to prevent the heat bridge occurs.

Figure 5.3.2.10a Glass Foam Insulation

Figure 2.7.2 Orchid House Partition Wall

During the contest in Versailles, The prototype of the Orchid House will add Vacuum Insulation Panels (VIP) to its exterior walls, roof and floor. The thermal conductivity of VIP is as low as 0.007 W/m2K. The additional VIP layer lowers the conductivity of the wall to 0.12 W/m2K, the floor to 0.13W/m2K, and the roof to 0.07W/m2K. The VIP is not used in local condition because of its high cost and also because of the hot and humid climate of Taipei. Building in Taipei does not need such a low conductivity value. Extremely low conductivity value in building walls will limit the conductivity heat loss in hot season when air conditioning is not operating, which is not energy efficient.

Figure 2.7.2 Orchid House Partition Wall

	Insulation Type	Thickness (mm)	Thermal Conductivity (W / m*K)	Thermal Transmittance (W/m2k)	Thermal Resistance (m2K)/W	AREA (m2)
Wall AR-341	Exterior Air Film				0.05	
	Polycarbonate	40	0.044	1.1	0.9091	
	Air	75	0.024	0.32	3.125	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	12	0.13	10.83333333	0.0923	
	E Foam	72	0.0379	0.526388889	1.8997	
	VIP	30	0.007	0.233333333	4.2857	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	3	0.13	43.33333333	0.0231	
	Interior Air Film				0.15	
TOTAL:		268		0.092491118	10.812	
Floor (1F Deck) Deck M-Area Panel AR-321	Interior Air Film				0.15	
	Plywood	16	0.13	8.125	0.1230769	
	Plywood	18	0.13	7.222222222	0.1384615	
	E Foam	24	0.0379	1.579166667	0.6332454	
	VIP	30	0.007	0.233333333	4.2857143	
	Plywood	12	0.13	10.83333333	0.0923077	
	Plywood	18	0.13	7.222222222	0.1384615	
	Air	40	0.024	0.6	1.6666667	
	E Foam	50	0.0379	0.758	1.3192612	
	Plywood	12	0.13	10.83333333	0.0923077	
	Exterior Air Film				0.05	
TOTAL:		220		0.115081381	8.6895029	
Roof (2F Deck) Deck M-Area Panel AR-322	Interior Air Film				0.15	
	Plywood	25	0.13	5.2	0.19231	
	Air	54	0.024	0.444444444	2.25	
	Waterproof Plastics	2	0.03	15	0.06667	
	Plywood	18	0.13	7.222222222	0.13846	
	E Foam	11	0.0379	3.445454545	0.29024	
	Glass Foam	65	0.0711	1.093846154	0.91421	
	Plywood	12	0.13	10.83333333	0.09231	
	Plywood	18	0.13	7.222222222	0.13846	
	E Foam	95	0.0379	0.398947368	2.50660	
	Plywood	12	0.13	10.83333333	0.09231	
	E Foam	28	0.0379	1.353571429	0.73879	
	VIP	30	0.007	0.233333333	4.28571	
	Plywood	9	0.13	14.44444444	0.06923	
	Air	63	0.024	0.380952381	2.625	
	Plywood	12	0.13	10.83333333	0.09231	
	Interior Air Film				0.15	
TOTAL:		454		0.06760141	14.7923	

Figure 5.3.2.10c Technical Report of Orchid House in Versailles

11. Furniture

For the interior furniture, most fabric covered pieces are selected for reducing reverberation by absorbing the sound. These pieces of furniture are manufactured in Taiwan of local resources with warm modern Taiwanese life style as well as environmental considerations.

12. Reverberation Time

The interior faces of walls are designed to provide sufficient absorption and minimize reverberation time. The sound absorption is achieved by the combination of vibrating panels and thick porous material. The interior side of walls and ceilings are covered with plywood with air space behind it. The plywood with air space may sufficiently increase sound absorption in low frequencies. eForm insulation material behind the airspace provides sound absorption in high frequency. The absorption coefficients and the reverberation time of the interior materials are listed on the table below:

				Absorption coefficient						Absorption(sabin)					
KITCHEN	COMPONENTS	MATERIALS	AREA	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz
	Floor	Plywood	55.0	0.28	0.22	0.17	0.09	0.10	0.11	15.40	12.10	9.35	4.95	5.50	6.05
	Ceiling	Plywood	55.0	0.28	0.22	0.17	0.09	0.10	0.11	15.40	12.10	9.35	4.95	5.50	6.05
	wall	Plywood	40.0	0.28	0.22	0.17	0.09	0.10	0.11	11.20	8.80	6.80	3.60	4.00	4.40
	windows	Plolycarbonate	42.0	0.11	0.26	0.15	0.14	0.04	0.04	4.62	10.92	6.30	5.88	1.68	1.68
LIVING ROOM	Air, Sabins per 1000m3		135.3	0.04	0.09	0.26	0.46	0.92	2.58	0.05	0.12	0..35	0.62	1.24	3.48
	Area, ave. coef,. total sabins		55.2	0.2428	0.2288	0.1656	0.1009	0.0869	0.0947	46.67	44.04	32.15	20.00	17.92	21.66
	Reverberation time (sec.)			T=KV/A Sabine						0.50	0.50	0.70	1.10	1.20	1.00
	Eyring's coef.			0.2156	0.2045	0.1526	0.096	0.0832	0.0903						

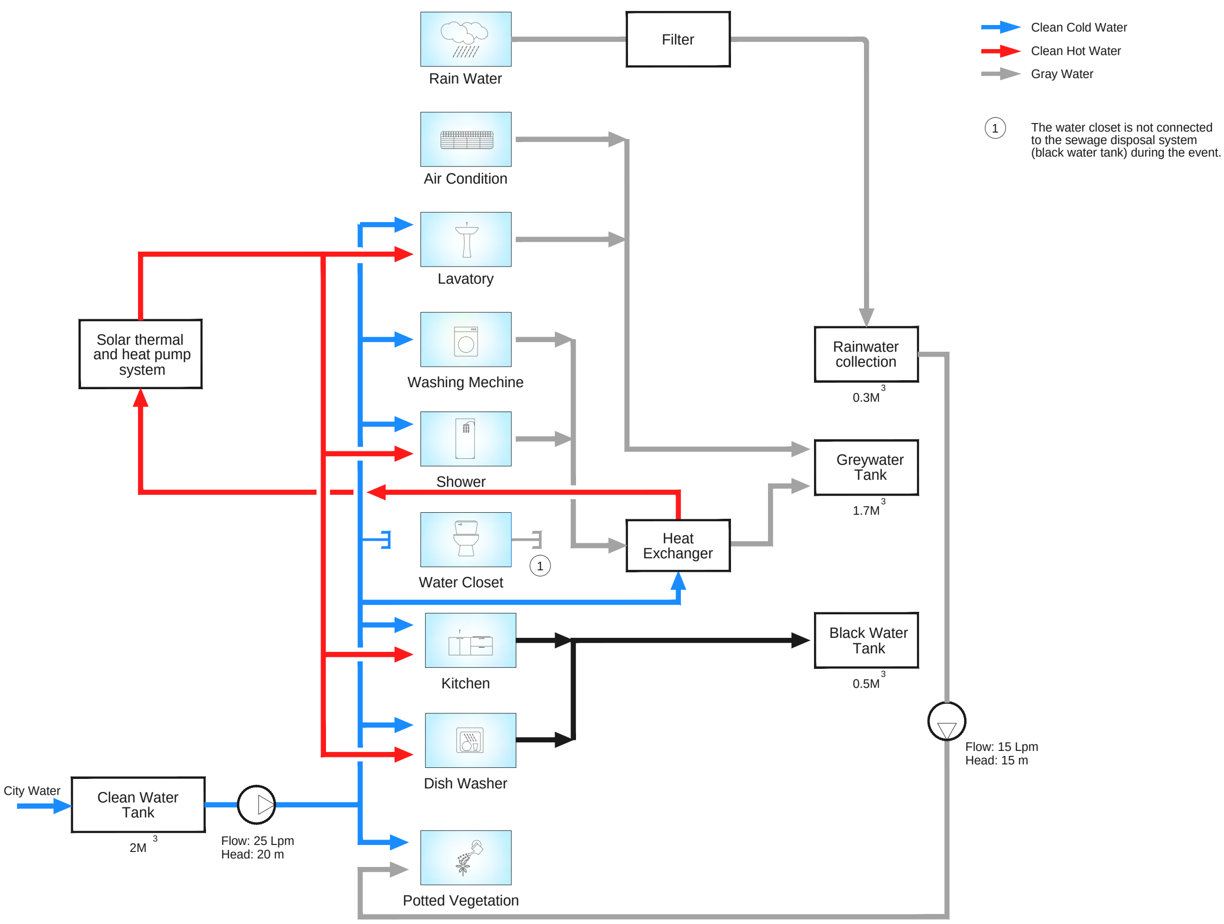
5.3.3 Plumbing System

1. General Description

The plumbing system consists of cold water supply (city water) system, domestic hot water (DHW) system, greywater system, drainage system and rainwater havesting system.
The plumbing system design must not only meet the basic requirements of hygiene, but also achieve the other goals of water conservation and high energy efficiency.

2. Design Criteria

The design and installation of plumbing system shall meet the related Codes and Regulations of Taiwan. For Orchid House EN FRANCE, the relevant rules like RULE 8 and RULE 51.8 and requirement are met.



Schematic Diagram Orchid House in Taiwan

3. Detailed Description of the Plumbing Systems

a. Cold Water Supply System

i. Orchid House Taiwan
The cold water supply is interconnected with the building's city water supply system.

ii. Orchid House EN FRANCE
The cold water is delivered by the Solar Decathlon Organization Europe to the cold water tank underneath the floor. The cold water is supplied to use points by a pressure boostingunit. The use points include the plumbing fixtures, dishwashing, cloth washing and grey water makeup.

iii. Cold Water Needs

Use	Unit Consumer	Cycles / Day	Need in Litres
Water Closet	Person		
Full		2	2 × 3 = 6.0
Half		10	10 × 1.5 = 15.0
Shower Head	Person	2	2 × 50 = 100.0
Hand Sink	Person	12	12 × 9 = 108.0
Kitchen Sink	Family	2	2 × 18 = 36.0
Dishwashing	Family	1	1 × 6.5 = 6.5
Cloth Washing	Family	1	1 × 46 = 46.0
Gardening	Family	1	-
Total			**317.5**

iv. Major Equipment
The cold water tank is molded of FRP in one piece in rectangular shape with the stor age capacity of 2100 L.

Pressure boosting unit is a stainless pump equipped with a buffer tank to maintain a constant supply pressure. The flow is 30 lpm with the booster pressure set at 1.5 kg/cm2.

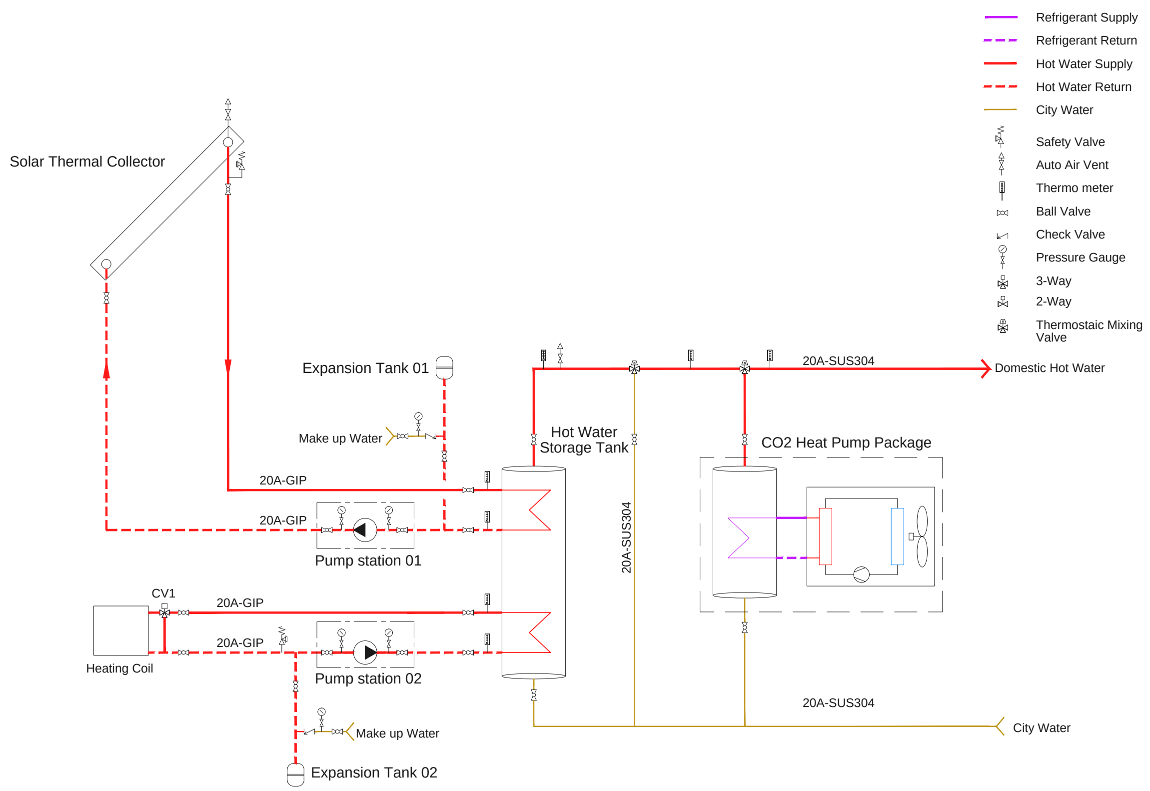
b. Domestic Hot Water System

i. The domestic hot water system (DHW) is supplied from the hot water storage tank which is a part of solar thermal system. The thermostatic 3-way mixing valves regulate the hot water temperature by mixing the hot water coming from the hot water storage tanks with the cold water to 55°C. The DHW is supplied to shower head, hand sink, kitchen sink, dishwashing and cloth washing.

ii. Hot Water Needs

Use	Unit Consumer	Cycles / Day	Need in Litres (°C)
Shower Head	50.0	2	100 (40°C)
Hand Sink	9.0	12	108 (35°C)
Kitchen Sink	18.0	2	36 (55°C)
Dishwashing	6.5	1	6.5 (50°C)
Cloth Washing	46.0	1	46 (45°C)
Use	**Unit Consumer**	**Cycles / Day**	**Need in Litres (°C)**
Shower Head	50.0	2	100 (40°C)
Hand Sink	9.0	12	108 (35°C)
Kitchen Sink	18.0	2	36 (55°C)

Dishwashing 6.5 1



c. Graywater System

i. Graywater system is actually one kind of drainage system, which is collecting the wastewater water from shower, hand sink, HVAC condensation, and cloth washing machine in the greywater tank underneath the floor.

ii. The case in France prohibits the reuse of greywater other than for gardening. But in Taiwan, the greywater is reused for the toilet (water closet), gardening, and cloth washing after the treatment process.

iii. The wastewater coming from the shower and washing machine flow through a heat exchanger before being collected in the grey water tank.

iv. The pressure boosting unit supplies the greywater to the use point – the automatic gardening system. The automatic gardening system connects to two water sources – greywater and rainwater harvesting system. The two sources are selected manually.

v. Major Equipment

The cold water tank is molded of FRP in one piece in rectangular shape with the storage capacity of 2100 L.

The pressure boosting unit is a stainless pump equipped with a buffer tank to maintain a constant supply pressure. The flow is 15 lpm with the booster pressure at 1 kg/cm2.

d. Drainage System

i. Orchid House Taiwan

The drainage system in Taiwan is the waste main collecting the drainage from water closet, kitchen sink, and dish washing machine, and then drains by gravity to the building's central drainage system.

ii. Orchid House EN FRANCE

Drainage system is collecting the wastewater from kitchen sink and dishwashing machine in the black water tank underneath the floor. During the competition the water closet is not connected to the black water tank. The black water also receives the overflow from the neighboring greywater tank.

iii. The black water tank is molded of FRP in one piece in rectangular shape with the storage capacity of 600 L.

e. Rainwater Harvesting System

i. Rainwater harvesting is a system by which, the rainwater that collects on the roofs is collected in a tank underneath the floor, and used for gardening and cleaning.

ii. The rainwater harvesting system consists the following:

Roof catchment
Gutter
Down pipe and first flush pipe
Storage tank

iii. For the case of Orchid House EN FRANCE, the rainwater is used for watering the potted plant.

iv. For the case of Orchid House Taiwan, the rainwater combined with greywater after treatment is used for gardening, water closet, cleaning and wash machine.

v. Estimating gardening water demand during competition:

The water demand of each potted orchid during the competition is 30 litres.
The number of orchid pots is 500.
Demand = 0.06 litres/pot × 500 pots = 30 litres

vi. Major Equipment

The storage tank is molded of FRP in one piece with the storage capacity of 300 L.
The pressure boosting unit is a stainless pump with a buffer tank to maintain a constant supply pressure. The flow is 15 lpm with the booster pressure at 1 kg/cm2.

f. Tank Installation

i. Cold water storage tank

Capacity : 2100 L
Size : 1.00 × 7.00 × 0.3 M
Location : Under the tea terrace floor
Access : The fill opening, instruments for control, and the boosting unit is accessed from above the floor, refer to PL-001

ii. Rainwater storage tank

Capacity : 300 L
Size : 0.70 × 1.50 × 0.3 M
Location : Under the tea terrace floor
Access : The boosting unit and instruments for control is accessed from above the floor, refer to PL-001

iii.Greywater tank

Capacity : 1800 L
Size : 1.00 × 6.00 × 0.3 M
Location : Under the tea terrace floor
Access : The fill opening is accessed from above the floor, refer to PL-001

iv. Black water tank

Capacity : 600 L
Size : 1.20 × 1.80 × 0.3 M
Location : Under the outside floor
Access : The fill opening is accessed from above the floor, refer to PL-001

5.3.4 Electrical System Design

a. The specification of electrical system are as follows:

- System single phase, 2-Wire
- Nominal Voltage 230V
- Frequency 50HZ
- Short Circuit current 10KA
- Rated current of maximum 63A

b. Design characteristics for residential appliance and equipment circuits

Description	Load (W)	Volts (V)	Wire	Circuit Breaker	Number of outlet	Notes
Refrigeration	308	230	3-2.5 mm^2	16A	1	
Oven	3500	230	3-4 mm^2	20A	1	
Diswasher	2110	230	3-2.5 mm^2	16A	1	
Cooking	1800	230	3-6 mm^2	25A	1	
Clothes Washer	1400	230	3-2.5 mm^2	16A	1	
Clothes Dryer	1000	230	3-2.5 mm^2	16A	1	
Extractor Hood	260	230	3-2.5 mm^2	16A	1	
Clean Water Pump	540	230	3-2.5 mm^2	16A	—	Equipment will be direct connected
Gray water pump	270	230	3-2.5 mm^2	16A	—	Equipment will be direct connected
Bathroom & Tea Terrace Receptacle	—	230	3-2.5 mm^2	16A	3	
Living Room & Workstation Receptacle	—	230	3-2.5 mm^2	16A	2	TV and Computer
Floor Receptacle	—	230	3-2.5 mm^2	16A	4	For general use
VRV	2760	230	3-6 mm^2	16A	—	Equipment will be direct connected
HRV	100	230	3-2.5 mm^2	16A	—	Equipment will be direct connected
CO2 Heat Pump	1340	230	3-2.5 mm^2	16A	—	Equipment will be direct connected
Mezzanine Area Receptacle	—	230	3-2.5 mm^2	16A	3	For general use
Pump Station 01	550	230	3-2.5 mm^2	16A	—	Equipment will be direct connected

c. Branch-circuit Voltage Drop
The design will support compliance to code maximum voltage drop criteria of 3 percent for all branch circuits.
The formula of voltage drop for two-wire, single-phase circuits, as follows:
VD = 2*L*I*R(We are assuming the cosθ = 1.0, inductance negligible)
VD = Drop in circuit voltage
L : one-way length of circuit
I = Current in conductor
R = resistance per meter of conductor
The result of branch-circuit voltage drop is as follows table.

Source	load	Power (W)	Voltage (V)	Current (A)	Wire	Resistance (Ω/km)	Length (M)	VD	
								(V)	%
1st panel board	Refrigeration	308	230	1.3	3-2.5mm^2	7.410	18	0.36	0.16
1st panel board	Oven	3500	230	15.2	3-4.0mm^2	4.610	21	2.95	1.28
1st panel board	Dishwasher	2110	230	9.2	3-2.5mm^2	7.410	19	2.58	1.12
1st panel board	Cooking	3000	230	13	3-6.0mm^2	3.080	21	1.69	0.73
1st panel board	Clothes Washer	1400	230	0.6	3-2.5mm^2	7.410	22	0.20	0.09
1st panel board	Clothes Dryer	1000	230	4.3	3-2.5mm^2	7.410	24	1.55	0.67
1st panel board	Hood	260	230	1.1	3-2.5mm^2	7.410	24	0.40	0.17
1st panel board	Lighting	651	230	2.8	3-2.5mm^2	7.410	30	1.26	0.55
1st panel board	Lighting	360	230	1.6	3-2.5mm^2	7.410	30	0.70	0.3
1st panel board	Lighting	690	230	3	3-2.5mm^2	7.410	40	1.78	0.77
1st panel board	Lighting	8.4	230	0.4	3-2.5mm^2	7.410	40	0.22	0.09
1st panel board	Lighting	519	230	2.3	3-2.5mm^2	7.410	40	1.34	0.58
1st panel board	Automation	1000	230	4.3	3-2.5mm^2	7.410	10	0.64	0.28
1st panel board	TV& PC Receptacle	900	230	3.9	3-2.5mm^2	7.410	30	1.74	0.76
1st panel board	Clean water pump	540	230	2.3	3-2.5mm^2	7.410	10	0.52	0.23
1st panel board	Rain water pump	270	230	1.2	3-2.5mm^2	7.410	20	0.43	0.19
1st panel board	General receptacle	900	230	3.9	3-2.5mm^2	7.410	30	1.74	0.76
1st panel board	General receptacle	900	230	3.9	3-2.5mm^2	7.410	20	1.16	0.50
2nd panel board	VRV	2760	230	12	3-6.0mm^2	3.080	26	1.92	0.84
2nd panel board	HRV	100	230	0.4	3-2.5mm^2	7.410	15	0.10	0.04
2nd panel board	CO2 Heat Pump	1340	230	5.8	3-2.5mm^2	7.410	26	2.24	0.98
2nd panel board	General receptacle	900	230	3.9	3-2.5mm^2	7.410	30	1.74	0.76
2nd panel board	PUMP Station 01	550	230	2.4	3-2.5mm^2	7.410	26	0.92	0.40
2nd panel board	PUMP Station 02	550	230	2.4	3-2.5mm^2	7.410	26	0.92	0.40
2nd panel board	Circulation Fan	480	230	2.1	3-2.5mm^2	7.410	24	0.74	0.32
2nd panel board	Water wall Pump	373	230	1.6	3-2.5mm^2	7.410	24	0.58	0.25

d. Grounding system
1. The TT grounding system is designed for the electrical system – the utility only provides a “neutral conductor”, and the House must set up the grounding (or “protective earth”) conductor separately
2. he exposed conductive parts are connected to ground by direct electrical connection. Residual Current Devices (RCDs) are installed on the main and each branch
3. Double insulated (or reinforced insulated) according to IEC, class II is applied to the entire outdoor installation (i.e. lighting fixtures, conductors, splices and terminal strip)

5.3.4 Electrical System Design

a. The specification of electrical system are as follows:
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- Frequency 50HZ
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Diswasher	2110	230	3-2.5 mm^2	16A	1	
Cooking	1800	230	3-6 mm^2	25A	1	
Clothes Washer	1400	230	3-2.5 mm^2	16A	1	
Clothes Dryer	1000	230	3-2.5 mm^2	16A	1	
Extractor Hood	260	230	3-2.5 mm^2	16A	1	
Clean Water Pump	540	230	3-2.5 mm^2	16A	—	Equipment will be direct connected
Gray water pump	270	230	3-2.5 mm^2	16A	—	Equipment will be direct connected
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Pump Station 01	550	230	3-2.5 mm^2	16A	—	Equipment will be direct connected

Source	load	Power (W)	Voltage (V)	Current (A)	Wire	Resistance (Ω/km)	Length (M)	VD	
								(V)	%
1st panel board	Refrigeration	308	230	1.3	3-2.5mm^2	7.410	18	0.36	0.16
1st panel board	Oven	3500	230	15.2	3-4.0mm^2	4.610	21	2.95	1.28
1st panel board	Dishwasher	2110	230	9.2	3-2.5mm^2	7.410	19	2.58	1.12
1st panel board	Cooking	3000	230	13	3-6.0mm^2	3.080	21	1.69	0.73
1st panel board	Clothes Washer	1400	230	0.6	3-2.5mm^2	7.410	22	0.20	0.09
1st panel board	Clothes Dryer	1000	230	4.3	3-2.5mm^2	7.410	24	1.55	0.67
1st panel board	Hood	260	230	1.1	3-2.5mm^2	7.410	24	0.40	0.17
1st panel board	Lighting	651	230	2.8	3-2.5mm^2	7.410	30	1.26	0.55
1st panel board	Lighting	360	230	1.6	3-2.5mm^2	7.410	30	0.70	0.3
1st panel board	Lighting	690	230	3	3-2.5mm^2	7.410	40	1.78	0.77
1st panel board	Lighting	8.4	230	0.4	3-2.5mm^2	7.410	40	0.22	0.09
1st panel board	Lighting	519	230	2.3	3-2.5mm^2	7.410	40	1.34	0.58
1st panel board	Automation	1000	230	4.3	3-2.5mm^2	7.410	10	0.64	0.28
1st panel board	TV& PC Receptacle	900	230	3.9	3-2.5mm^2	7.410	30	1.74	0.76
1st panel board	Clean water pump	540	230	2.3	3-2.5mm^2	7.410	10	0.52	0.23
1st panel board	Rain water pump	270	230	1.2	3-2.5mm^2	7.410	20	0.43	0.19
1st panel board	General receptacle	900	230	3.9	3-2.5mm^2	7.410	30	1.74	0.76
1st panel board	General receptacle	900	230	3.9	3-2.5mm^2	7.410	20	1.16	0.50
2nd panel board	VRV	2760	230	12	3-6.0mm^2	3.080	26	1.92	0.84
2nd panel board	HRV	100	230	0.4	3-2.5mm^2	7.410	15	0.10	0.04
2nd panel board	CO2 Heat Pump	1340	230	5.8	3-2.5mm^2	7.410	26	2.24	0.98
2nd panel board	General receptacle	900	230	3.9	3-2.5mm^2	7.410	30	1.74	0.76
2nd panel board	PUMP Station 01	550	230	2.4	3-2.5mm^2	7.410	26	0.92	0.40
2nd panel board	PUMP Station 02	550	230	2.4	3-2.5mm^2	7.410	26	0.92	0.40
2nd panel board	Circulation Fan	480	230	2.1	3-2.5mm^2	7.410	24	0.74	0.32
2nd panel board	Water wall Pump	373	230	1.6	3-2.5mm^2	7.410	24	0.58	0.25

d. Grounding system

1. The TT grounding system is designed for the electrical system – the utility only provides a “neutral conductor”, and the House must set up the grounding (or “protective earth”) conductor separately
2. he exposed conductive parts are connected to ground by direct electrical connection. Residual Current Devices (RCDs) are installed on the main and each branch
3. Double insulated (or reinforced insulated) according to IEC, class II is applied to the entire outdoor installation (i.e. lighting fixtures, conductors, splices and terminal strip)

5.3.5 Photovoltaic and Other Electric Solar Systems Design

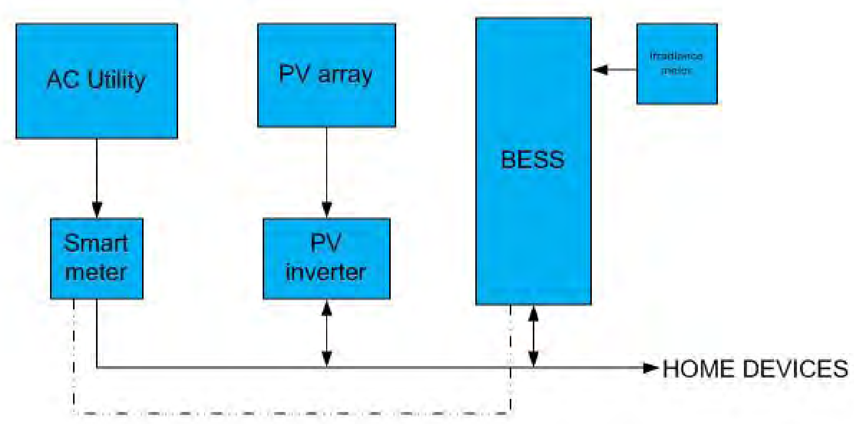
a. The specification of electrical system are as follows:
- System single phase, 2-Wire
- Nominal Voltage 230V
- Frequency 50HZ
- Short Circuit current 10KA
- Rated current of maximum 63A

A. General description of the Photovoltaic system
The photovoltaic system is a Building Integrated Photovoltaic (BIPV) design. The system contains 20 pcs of 250 Wp multi-crystalline standard type solar module with aluminum frame. 10 modules are connected in serial to form one string and two strings are connected in parallel to form the whole PV array.

PV array is then connected to a 5 kW string inverter. This Solivia 5 kW inverter then transfers the DC power to AC power and injects the AC power into the AC circuit of the house.

A Battery Energy Storage System (BESS) is also connected to the AC circuit. The BESS contains controller and battery bank to store power as well as output battery power to the AC circuit for load. With power meter installed and communicate with the BESS, BESS provides the following charging-discharging functions:
1. STANDBY MODE - no energy absorbing or dispatching
2. ABSORB - Watt power absorbing from grid (battery charging)
3. DISPATCH - power dispatch to the grid

The BESS will also provide information about actual Battery State Of Charge (SOC) and energy counters (absorbed from the grid and dispatched to the grid). A schematic diagram is shown as below:
A more detail BESS description can be found in PM 36.6.



PV array acts as the main power source for this house. In the day time, excess power will charge the BESS and BESS will act as the main power source in peak loading hours.

Module specification under STC is as below:

GENERAL SPECIFICAITON	
Model Name	D6P250B3A
Maximum Rating Power (Pmax)	250 W
Module Efficiency	15.3 %
Open Circuit Voltage (Voc)	37.33 V
Maximum Power Voltage (Vpm)	30.34 V
Short Circuit Current (Isc)	8.69 A
Maximum Power Current (Ipm)	8.24 A
Dimension	1650 mm (L) x 990 mm (W) x 42 mm (D)
Weight	18.3 kg / 42.0 lbs
Solar Cell	60 multicrystalline 6” silicon cells (156 mm x 156 mm)
Front Glass	tempered solar glass, 3.2mm thickness
Cell Encapsulation	EVA (Ethylene-Vinyl-Acetate)
Back Cover	Composite film, white
Junction Box	IP 65 rated
Frame	Anodized aluminum frame, original or black
Mechanical Load	5400 Pa, Max. wind speed: 197 km/h (safety factor 3)
Maximum System Voltage	IEC: DC 1000 V / UL: DC 600 V
Series Fuse Rating	15 A
Operating Temperature	-40 to 85 °C
Nominal Operating Cell Temp.	44.1 °C ± 2°C
Temperature Coefficient of I_{sc}	0.046 % / °C
Temperature Coefficient of V_{oc}	-0.313 % / °C
Temperature Coefficient of P_{max}	-0.420 % / °C
CERTIFICATION	
Certification	IEC 61215 / IEC 61730, UL 1703, CE, MCS, CEC

2. Inverter:

The string inverter used in the photovoltaic system is a 5 kW high efficiency solar inverters for the European market. The advantages of this inverter are:
(1) Usable with all commercially available solar modules (mono, poly, amorphous).
(2) Wide input voltage range
(3) Suitable for indoor and outdoor applications (IP65)
(4) Peak efficiency of 96 %
(5) Full output power up to 55 °C
(6) 10 years guarantee after online registration
The technical data of the inverter (MODEL: Solivia 5.0) is:

DC INPUT	
Maximum PV power	6000 Wp
Nominal power	5500 W
Voltage range	125 ... 600 V
Full power MPP range	150 ... 480 V
Nominal current	15.7 A @ 350 V
Maximum current	36.6 A
AC OUTPUT	
Nominal apparent power	5000 VA
Voltage range	184 ... 264 V
Nominal current	22 A
Nominal frequency 50 Hz	50 Hz
Frequency range	45 ~ 65 Hz
Power factor	adjustable 0.8 cap ~ 0.8 ind
Total harmonic distortion (THD)	< 5 % @ nominal apparent power
GENERAL SPECIFICATION	
Max. efficiency	96.0 %
Efficiency EU	94.7 %
Operating temperature	-25 ~ +60 °C
Full power without derating	-25 ~ +55 °C
Humidity	0 ~ 95 %
Size (L x W x D)	512 x 410 x 182 mm
Weight	31 kg
Cooling	Convection
Communication interfaces	2 x RJ45 / RS485 + 1 x USB A
DC disconnector	Integrated

Display	3 LEDs, 4-line LCD
Protection degree	IP65
Safety class	I
Configurable trip parameters	Yes
Insulation monitoring	Yes
Overload behavior	Current limitation; power limitation
Safety Specification	
Over voltage protection	253 V < 200ms disconnection time
Under voltage protection	195 V < 200 ms disconnection time
Over voltage protection	50.2 Hz < 200 ms disconnection time
Under voltage protection	47.5 Hz < 200 ms disconnection time
Certification	
Anti-islanding protection / Grid regulation	VDE 0126-1-1/A1; UTE C15-712-1; France/Islands (60 Hz); RD 661/2007; RD 1699/2011; CEI0-21; Synergrid C10/11 (July 2012); EN 50438; G59/1-2; VDE-AR-N 4105; VFR 2013; VFR 2014
EMC	EN61000-6-2; EN61000-6-3; EN61000-3-11; EN61000-3-12
Safety	IEC62109-1 / -2; EC conformity

3. Battery:

48 V, 125 Ah batteries are chosen to store photovoltaic power for use of the load. Nominal operation voltage of the battery bank is 48 V. Battery bank and battery inverters are positive grounded. In our BESS we use many telecom components and that positive grounding is a common practice in such systems. However, grounding of the positive conductor is optional as DC voltage is used only inside of the BESS. The enclosure grounding is a must. Residual Current Device (RCD) is in place for protecting indirect contact.

4. Cables and Wiring method:

Modules in series connection is made as connect wires from the positive terminal of one module to the negative terminal of the next module. 10 modules are in series connection to form one string. Two strings are connected in parallel as connect wires from the positive terminal of one module of the first string to the positive terminal on the module of second string.

Each module has two No. 12 AWG type standard 90°C sunlight resistant output cables each terminated with plug & play connectors according to IEC 60189.. The cable is suitable for applications where wiring is exposed to the direct rays of the Sun. We recommend that all wiring and electrical connections comply with the National Electrical Code (NEC). A PV module interconnection is a 90°C wet-rated conductors. Wire type is using USE-2 single conductor cable for exposed applications.

Inverter is connected to AC switch panel using 16mm2 PVC wire and then connect to grid also with 16mm2 PVC wire.

5. Protection:

Protection devices in the DC site include DC fuse, surge protector (SPD) and DC switch. All these 3 devices are mounted in a DC box. The DC fuse protects module from reverse current to damage the module and it is design to match module's series fuse rating. The surge protector is also to protect module from surge to damage module. The DC switch is design to protect installer or maintenance technician when module/s is/are connected or disconnected from DC circuit.

Protection device in the AC site includes No Fuse Breaker (NFB). The electricity panel which the photovoltaic is connected the grid has main NFB and also surge protector for AC line protection.

6. Earthing system:

Modules are grounded between module frame and the designed supporting H beam. The H beam is then connected to the steel square pipe of the main structure. Grounding wire is in 14 AWG. For the AC side, inverter grounding is connected to a grounding bus in AC switch panel and then common grounded to the main panel. Details can be found in drawing.

7. Interface with the electricity distribution network

The PV system is connected to main panel. A breaker is installed for protection. Detail can be found in drawing.

C. Maintenance plan

All work in commissioning and maintenance of a system should be performed by a qualified technician.

Module glass should be cleaned periodically, or when it's dirty. Use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used to remove sticky dirt. Check the electrical and mechanical connections regulatory to verify they are clean, secure and undamaged.
Please refer to manual document of PM#4, 5.3.8 of rule 36.8 for detail maintenance plan.

5.3.6 Electrical Energy Balance Simulation

A. Introduction

The estimation of the electrical production is based on widely used photovoltaic simulation software, named PVSYST. The whole simulation starts from building up a photovoltaic module array model, input weather data includes solar irradiance and environment temperature, followed as input solar module specification, inverter specification and other setting, then PVSYST will present power generation data.

Using photovoltaic system as power generator benefits the environment for reasons of:

i. The source for power generator is from solar irradiance, which is free and without the limita tion, also not to generate waste during power generation process.
ii. Solar module life can reach to at least 25 years. As module is composed with glass, silicon based cell, aluminum and other chemical based material such as EVA. Some of the material can be recycled and hence reduce to waste.
iii. Inverter generally can last around 10 years before some components have to be replaced (for example, capacitor). This reduces electronic waste.

The benefit to the environment of using a photovoltaic system as the main power source is that it is a renewable energy which does not produce any CO2 during power generation in system lifetime of at least 20 years. Also, the photovoltaic system can be installed on top of existing buildings so that the system does not need to occupy land for system installation.

B. List of the electric loads

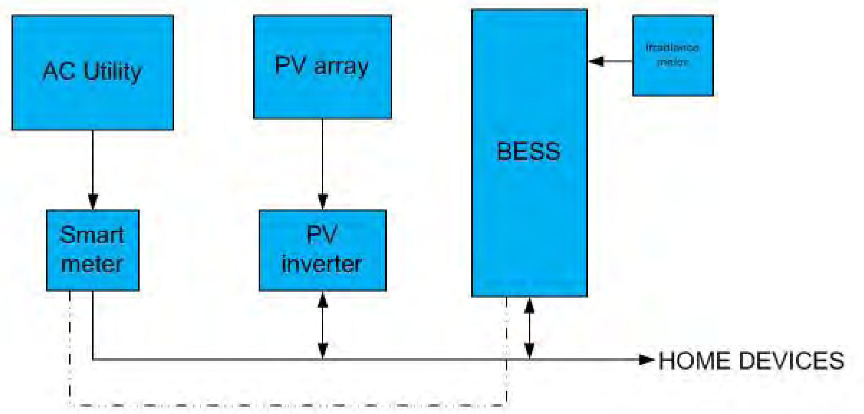
Item	Product Name	Manufacturer / Model Name	Specification	Max. Power (W)
Appliances	Refrigerator/ Freezing	MIELE KFN37452 i DE	R: 170 L F: 57 L	308
	Clothes Washer	MIELE W 664	46L	1400
	Clothes Dryer	Bosch WTW84381FF	112L	1000
	Cooking	MIELE Domino CS 1112E	2 heating plates 1200W/600-1800W	1800
	Oven	MIELE H2161 B CLST	56 L	3500
	Extractor Hood	Best Gloss	630 m3/h	260

	Dishwashing	MIELE G6995 SCVi K20	8 place settings Max. Water Temp. ：70℃	2110
Devices	TV	JVC LT-HA52U	27.5 inch	29
	Notebook	ASUS Transformer AiO P1801	18.4 inch	180
HVAC	Variable Refrigerant Volume	DAIKIN RXYMQ4PVE		2760
	Heat Reclaim Ventilation	DAIKIN VAM150GJVE		100
	CO2 Heat Pump	Panasonic HE-C30EQS		1340
	Pump 01	Wlo		550
	Pump 02	Wilo		550
Plumbing	Clean Water Pump	GRUNDFOS		540
	Rain Water Pump	GRUNDFOS		270
Lighting	Kitchen	Tons T8 LED	LED 20W	93.6
	Living Room	Tons T8 LED	LED 20W	62.4
	Workstation & Bedroom /	Tons T8 LED	LED 20W	63.6
	Tea Terrance &Mech. RM.	Tons ODL-005/1.2W	LED 1.2W	28.4
	Mezzanine	Tons T8 LED	LED 20W	36.8

C. Photovoltaic (and other electric solar) system description

1. Photovoltaic System

The photovoltaic system consists of 20 pcs of 250 Wp multi-crystalline solar modules, a 5 kW inverter and a Battery Energy Storage System (BESS). The system is modular and configurable. A schematic diagram of this photovoltaic system is shown below.



The photovoltaic system is designed with following features:

i. Single phase grid connection at 230 V/50 Hz
ii. Battery capacity of 5.76 kWh
iii. Max battery charging power of 5.8 kW
iv. Max power dispatched to grid of 4.68 kW

In this photovoltaic system, a module array is connected to a string inverter and the BESS is connected to a home grid by single phase connection. The essential role plays a system controller that must communicate to a smart meter in order to read and minimize energy consumption from utility grid.

Module used in this photovoltaic system is with multi-crystalline cells. Module maximum output power at 1000 W/m2 irradiance and 25oC temperature is 250 Wp.

Inverter used in this photovoltaic system is string type with maximum DC input power of 6 kWp and nominal AC output power of 5 kVA.

2. BESS (Battery Energy Storage System)

Battery Energy Storage System is designed to store energy from grid of PV plant when the energy is available and cheap and dispatch the energy back to the grid when it is expensive or power demand is high. The system is equipped with single 1-phase connection to the grid that is used for energy absorption or dispatch. The system can be controlled from higher level controller that decides about operating mode, depending on data analysis about actual power consumption, electricity price, etc.

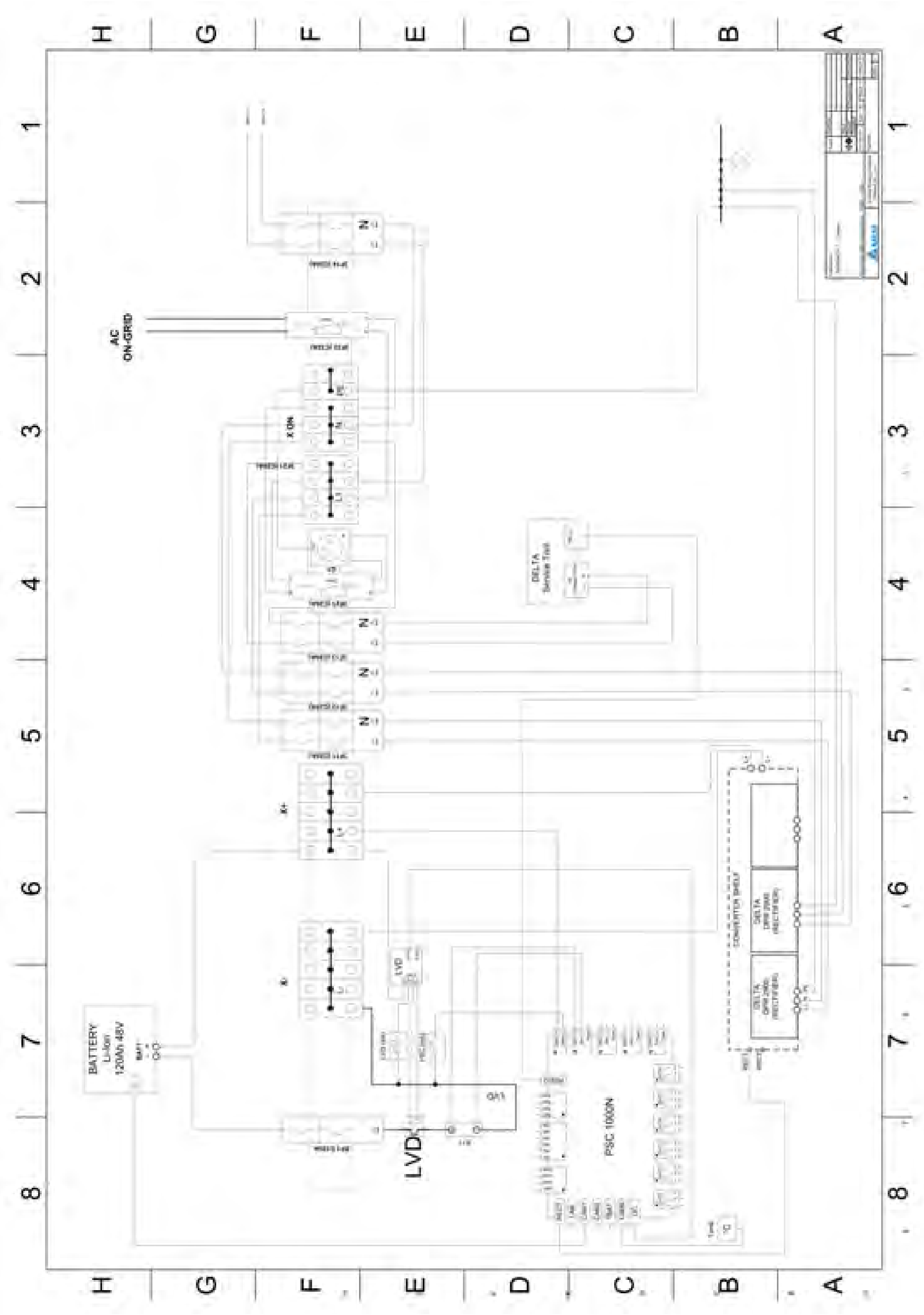
The system can operate in several modes:

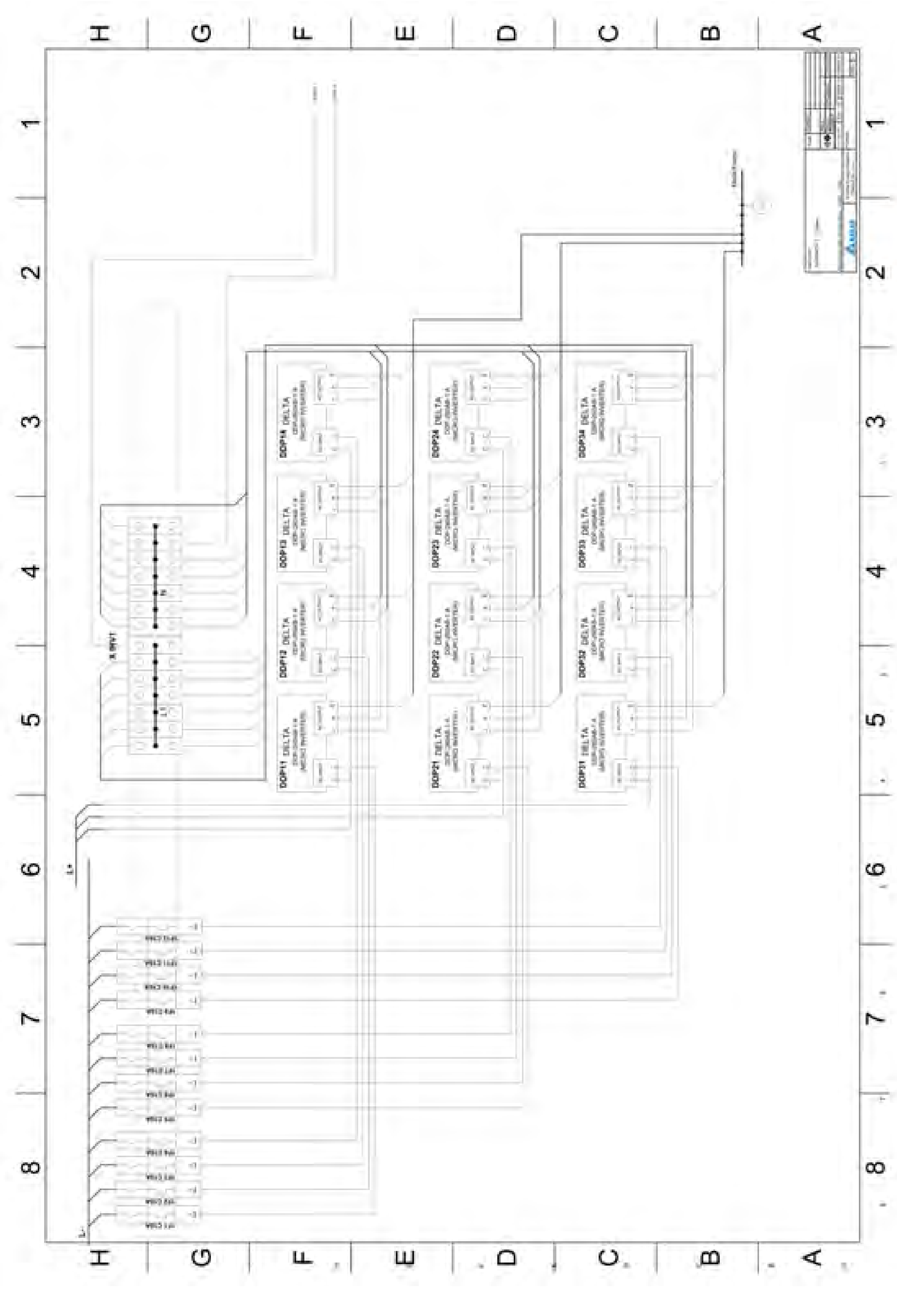
i. "STANDBY" – the system does not absorb nor dispatch the energy, battery SOC level remains the same.
ii. "RECOVERY" – the system is charging the battery to float level using both: rectifiers (from grid) or PV chargers (if equipped).
iii. "ABSORB" – the system is absorbing the energy from grid at programmed power level, charg ing the battery.
iv. "DISPATCH" – the system is dispatching the energy to the grid at programmed power level, discharging the battery.
v. "BALANCE" – the system is automatically balancing the power at the AC grid connection to minimize energy consumption from grid (AC power sensor is required).
vi. "OFF" – the system is OFF because of low battery voltage
vii. "EOFF" – the systems is in emergency power OFF mode (service required)

Battery bank chosen in the BESS system is from DENSIS of 48120T model, which is nominal 48 V 120 Ah battery bank to form a total 5,760 Wh battery storage capacity. The battery bank voltage range is 42~58.5V with standard permanent charge/ discharge current of 0.5C. The maximum permanent charge/discharge current is 1C. Operating temperature range of the battery bank is 0oC~60oC. The DENSIS 48120T catalog and battery MSDS is attached. (PM#4_4.3_DENSIS 48120T Battery Bank.pdf , PM#4_4.3_MSDS Battery.pdf)

The picture of the BESS system and is shown below.

The schematic drawing of the BESS system is shown below:





3. Module Grounding

All module frames and mounting racks must be properly grounded in accordance with respective national electrical code and local authority.

A bolt, screw, or other parts used for bonding purposes within a module or panel shall not be intended Bonding will be by a positive means, such as clamping, riveting, bolted or screwed connectors, welding, soldering or brazing. If the bonding means depends upon screw threads, two or more screws, or two full threads of a single screw must engage the metal.

The array frame will be grounded in accordance with NEC requirements for grounding solar electrical system. The module frame also be properly grounded.

The grounding wire must be properly fastened to the module frame to ensure good electrical contacts. Grounding wires must be connected to the module frame at one of these locations.
All grounding hardware (nuts, bolts, washers, screws, etc.) must be stainless steel unless otherwise specified (it should use corrosion-proof fixing material).

The grounding wire is larger than 12 AWG and multi conductor and rated of 105°C and 600V.

4. Earthing

As shown in drawing PV-031, the DC side grounding, inverter grounding, BESS grounding as well as AC side grounding are all connected together to the grounding terminal which located in the AC switch panel. The grounding terminal is then connected to an earthing rod if there is no AC ground is available from SDE. Solar modules are all grounded between module frame and supporting metal structure. The DC array grounding conductor selected is XLPE-LSHF 16 mm2 wire and its calculation is 1.56×Isc ×2=1.56×8.69 A×2=27.11 A

5. Protection against Electric Shock

To protect electric shock, all equipments are grounded. Module frame is also grounded to the building structure. Besides grounding protection, ELCB is selected for breakers and it will shut off the power if electric leakage is larger than 30 mA for 0.1 second. Hazard labels are also applies to panels and equipments to alert operator. Only trained professional member is allowed to operate DC and AC panels.

6. DC side drop in voltage calculation

Drop in voltage is less than 3% at Impp STC on DC side – calculation is as below
[Calculation by Vmp and Imp]

i. Module: Vmp=30.34 V ; Imp=8.24 A ;
Temp. Coeff. of Vmp=-0.127 V/oC ; Temp. Coeff. of Imp=0.038 A/oC
ii. Voc @ 50oC=Vmp(STC)+(50 oC-25 oC)*(ΔVmp/oC)=30.34+25*(-0.127)=27.165 V
iii. Isc @ 50oC=Imp(STC)+(50 oC-25 oC)*(ΔImp/oC)=8.24+25*(0.038)=9.19 A
iv. solar cable 4 mm2 resistance R50=5.69 Ω/km
v. Module cable length is 1 m, 10 modules in series and hence the total cable length is 10 m
vi. Distance between module string to inverter L2=25 m
vii. solar cable 4 mm2 voltage drop VDV=2*R50*(L1+L2)*Imp=2*5.69 Ω/km*35 m*9.19 A=3.66 V
viii. Module series Voc-string=10 pcs*Vmp=10*30.34 V=303.4 V
ix. DC circuit voltage drop percentage VDV%=VDV/Voc-string*100%=3.66/303.4*100%=1.206%

[Calculation by Voc and Isc]

i. Module: Voc=37.33 V ; Isc=8.69 A ;
Temp. Coeff. of Voc=-0.117 V/oC ; Temp. Coeff. of Isc=0.004 A/oC
ii. Voc @ 50oC=Voc (STC)+(50 oC-25 oC)*(ΔVoc/oC)=37.33+25*(-0.117)= 34.405 V
iii. Isc @ 50oC= Isc (STC)+(50 oC-25 oC)*(Δ Isc /oC)= 8.69+25*(0.004)= 8.79 A
iv. solar cable 4 mm2 resistance R50=5.69 Ω/km
v. Module cable length is 1 m, 10 modules in series and hence the total cable length is 10 m
vi. Distance between module string to inverter L2=25 m
vii. solar cable 4 mm2 voltage drop VDV=2*R50*(L1+L2)*Isc=2*5.69 Ω/km*35 m*8.79 A=3.501 V
viii. Module series Voc-string=10 pcs*Voc=10*34.405 V=344.05 V
ix. DC circuit voltage drop percentage VDV%=VDV/Voc-string*100%=3.501/344.05*100%=1.017%

So using both Vmp-Imp or Voc-Isc to calculate DC voltage drop, the results are all within 3%.

7. Wiring for PV system

DC array conductor selection calculation is: 1.56×Isc ×2=1.56×8.69 A×2=27.11 A

J. Description of the tools used for the simulations

The photovoltaic power generation simulation tool used in this case is PVSYST. PVSYST is a PC software package for the study, sizing and data analysis of complete photovoltaic systems. It deals with grid-connected, stand-alone, pumping and DC-grid (public transport) photovoltaic systems, and includes extensive databases, as well as general solar energy tools.

For grid-connected systems, and especially for building integration, this level will be architect-oriented, requiring information on available area, PV technology (colors, transparency, etc), power required or desired investment.

In project design, it aims to perform a thorough system design using detailed hourly simulations. Within the framework of a "project", the user can perform different system simulation runs and compare them. He has to define the plane orientation (with the possibility of tracking planes or shed mounting), and to choose the specific system components. He is assisted in designing the PV array (number of PV modules in series and parallel), given a chosen inverter model.

In a second step, the user can specify more detailed parameters and analysis fine effects like thermal behavior, wiring, module quality, mismatch and incidence angle losses, horizon (far shading), or partial shadings of near objects on the array, and so on.

Results include several dozens of simulation variables, which may be displayed in monthly, daily or hourly values, and even transferred to other software. The "Loss Diagram" is particularly useful for identifying the weaknesses of the system design. An engineer report may be printed for each simulation run, including all parameters used for the simulation, and the main results.
The simulation calculates the distribution of energies throughout the year. Main results are:

i. The total energy production [MWh/y] is essential for the evaluation of the PV system's profitability.
ii. The Performance Ratio (PR [%]) describes the quality of the system itself.
iii. The specific energy [kWh/kWp] is an indicator of production based on the available irradiation

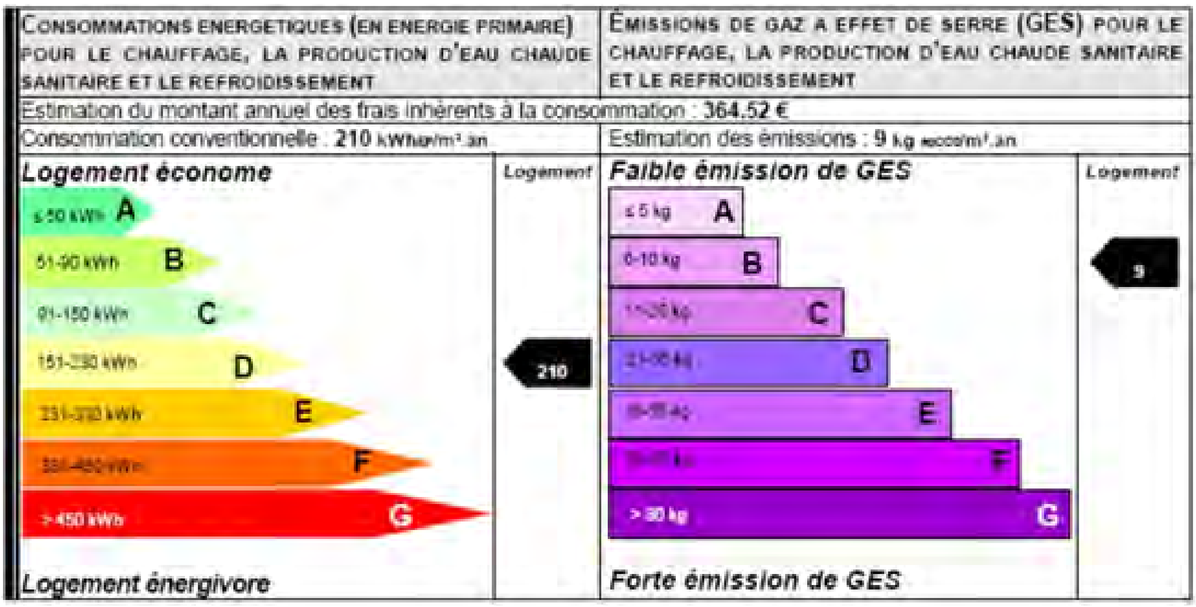
E. Results of the simulations

1. The Annual and Monthly Energy Balance Analysis

The annual energy consumption of the Orchid house in Versailles is 5926kWh. The electrical energy generated by its PV array is 4842.40kWh. The annual consumption of electricity from city grid is 772.34kWh. The NCTU/UNICODE has to improve the performance of the house to achieve our goal of electricity balance between consumption and generation.

		The General Evaluation Period- 8 Days																	
Item	End Use Breakdown	6/25	6/26	6/27	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11	TTL
Total Electricity Consumption (kWh)		24.6	17.5	40.7	25.3	22.2	22.3	31.4	33.3	40.8	29.5	31.0	20.6	18.1	25.6	25.6	18.1	19.5	446.2
Appliances	Refrigerator/Freezing	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	30.6
	Clothes Washer	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	4.3
	Clothes Dryer	1.7	3.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	29.7
	Cooking	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	13.6
	Oven	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	18.3
	Hood	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.8
	Dishwashing	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	37.4
Devices	TV	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	7.5
	DVD/Projector	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	3.4
	Notebook	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	7.7
	ipad	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Lighting	Kitchen	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	3.7
	Living Room	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	8.0
	Workstation/Bedroom	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	7.1
	Bathroom	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.7
HVAC	Cooling /Heating/Ventilation	13.0	4.3	29.1	13.8	10.6	10.7	19.8	21.8	29.2	18.0	19.4	9.0	6.5	14.0	14.1	6.5	7.9	247.6
Plumbing	Domestic Water Pump	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	13.8
	Gray Water Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
	Water Wall Pump	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	7.9
Total PV Generation (kWh)		33.5	36.5	37.3	33.0	36.1	5.1	28.3	11.7	34.2	17.0	14.8	16.0	8.3	11.7	18.2	28.0	29.0	398.7
Total Reverse to Grid Power (kWh)		10.0	21.8	10.4	7.4	17.5	0.0	4.6	0.0	6.7	0.0	0.0	2.5	0.0	0.0	0.0	11.9	11.9	104.5
Total Grid Consumption (kWh)		0.4	0.0	8.7	0.8	0.1	17.2	6.7	21.6	12.8	12.5	16.2	6.3	9.8	13.9	7.4	0.8	0.2	135.3
Net Power Consumption from Grid (kWh)		9.6	21.8	1.7	6.6	17.4	-17.2	-2.1	-21.6	-6.1	-12.5	-16.2	-3.8	-9.8	-13.9	-7.4	11.2	11.6	-30.8

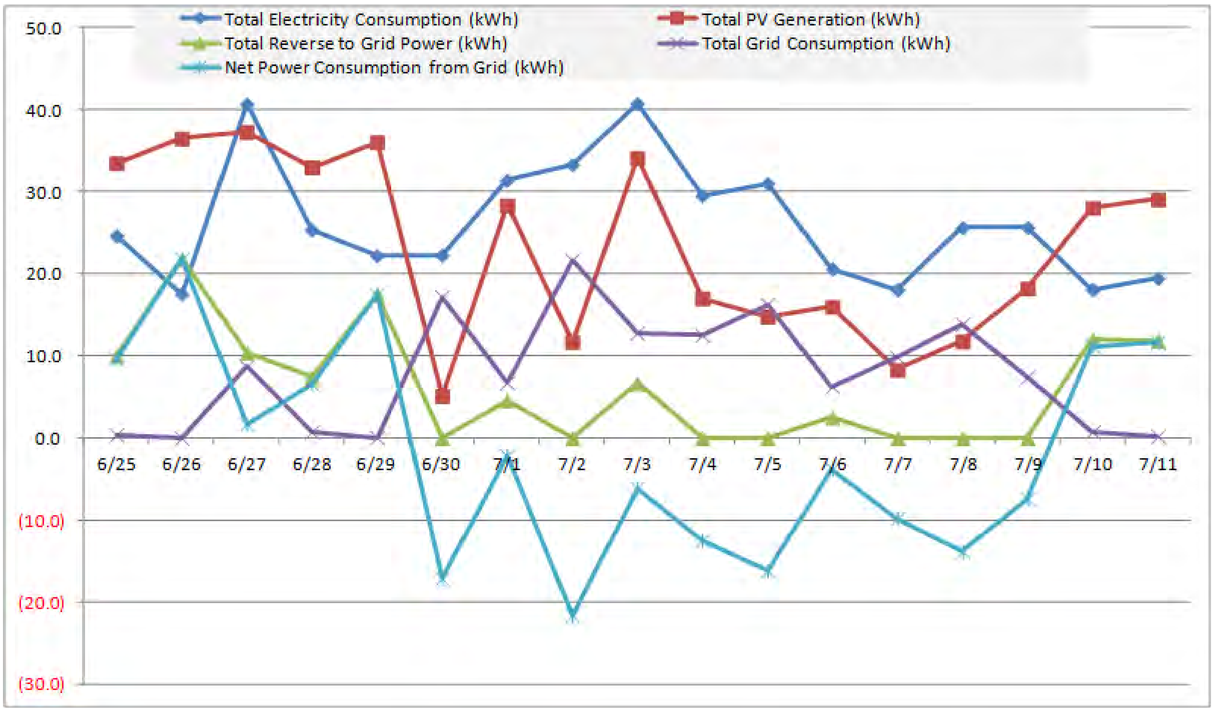
The Energy usage Intensity (UEI) of the Orchid house without PV generators is 5926kWh/164.45m2 = 36.04 kWh/ m2. With the electricity provided by its PV array, the EUI of the Orchid house is as low as 4.7 kWh/ m2. To compare with the Energy performance certificates (EPCs), the Orchid House is an A rated building.



2. The Energy Balance of the Competition Period

The electrical energy balance simulation result shown that due to weather condition, PV energy is low on 6/30, 7/2, 7/4~7/9 and hence cause net grid power usage is 30.8 kWh. If weather status, especially solar irradiance is similar to 6/25~6/37, the whole system can reach zero grid power consumption and even reverse PV power will send back to grid. Electrical energy balance simulation result is below:

		The General Evaulation Period- 8 Days																	
Item	End Use Breakdown	6/25	6/26	6/27	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11	TTL
Total Electricity Consumption (kWh)		24.6	17.5	40.7	25.3	22.2	22.3	31.4	33.3	40.8	29.5	31.0	20.6	18.1	25.6	25.6	18.1	19.5	446.2
Appliances	Refrigerator/Freezing	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	30.6
	Clothes Washer	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	4.3
	Clothes Dryer	1.7	3.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	29.7
	Cooking	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	13.6
	Oven	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	18.3
	Hood	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.8
	Dishwashing	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	37.4
Devices	TV	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	7.5
	DVD/Projector	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	3.4
	Notebook	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	7.7
	ipad	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Lighting	Kitchen	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	3.7
	Living Room	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	8.0
	Workstation/Bedroom	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	7.1
	Bathroom	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.7
HVAC	Cooling /Heating/Ventilation	13.0	4.3	29.1	13.8	10.6	10.7	19.8	21.8	29.2	18.0	19.4	9.0	6.5	14.0	14.1	6.5	7.9	247.6
Plumbing	Domestic Water Pump	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	13.8
	Gray Water Pump	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
	Water Wall Pump	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	7.9
Total PV Generation (kWh)		33.5	36.5	37.3	33.0	36.1	5.1	28.3	11.7	34.2	17.0	14.8	16.0	8.3	11.7	18.2	28.0	29.0	398.7
Total Reverse to Grid Power (kWh)		10.0	21.8	10.4	7.4	17.5	0.0	4.6	0.0	6.7	0.0	0.0	2.5	0.0	0.0	0.0	11.9	11.9	104.5
Total Grid Consumption (kWh)		0.4	0.0	8.7	0.8	0.1	17.2	6.7	21.6	12.8	12.5	16.2	6.3	9.8	13.9	7.4	0.8	0.2	135.3
Net Power Consumption from Grid (kWh)		9.6	21.8	1.7	6.6	17.4	-17.2	-2.1	-21.6	-6.1	-12.5	-16.2	-3.8	-9.8	-13.9	-7.4	11.2	11.6	-30.8



F. Energy Payback and CO2 Reduction

i. Energy recovery time

In Taipei, Taiwan, simulated yearly PV output energy is 5,540 kWh/year, simulation report is shown below.

140217_交大台北_5kWp

Balances and main results

	GlobHor kWh/m2	T Amb oC	GlobInc kWh/m2	GlobEff kWh/m2	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
January	80.0	18.20	93.0	89.9	374.1	350.8	12.31	11.54
February	71.0	18.60	77.7	75.1	313.8	292.8	12.37	11.54
March	103.0	20.20	107.1	103.7	434.3	407.4	12.41	11.64
April	123.0	23.00	122.8	118.8	491.0	463.0	12.24	11.54
May	141.0	25.60	135.6	131.0	529.7	499.9	11.96	11.28
June	162.0	27.30	151.9	146.8	585.9	554.9	11.80	11.18
July	186.0	29.00	176.1	170.6	669.5	636.0	11.64	11.06
August	166.0	28.70	163.8	158.7	625.7	593.4	11.69	11.09
September	146.0	27.80	152.5	147.9	581.9	551.2	11.68	11.06
October	121.0	26.00	134.2	130.0	522.3	493.9	11.92	11.27
November	85.0	22.80	98.3	95.0	390.9	367.4	12.18	11.45
December	74.0	20.00	86.9	84.1	351.5	329.3	12.38	11.59
Year	1458.0	23.96	1499.9	1451.6	5870.8	5540.1	11.98	11.31

Legends:				
	GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
	T Amb	Ambient Temperature	E_Grid	Energy injected into grid
	GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
	GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

The simulation is made with PVSYST simulation software based on Taipei's irradiance and temperature data shown in the above table.

Electrical energy input of manufacturing PV system is 2,525 kWh/kWp (according to report of IEA-PVPS-T10-01:2006). So, for this 5 kWp designed PV system, the energy consumed for building this PV system is:

Total energy input while manufacturing PV system: 2,525 kWh/kWp×5 kWp=12,625 kWh

So the energy pay-back time of this system is:

Energy Pay-Back Time (EPBT): 12,625 kWh÷5,540 kWh/year=2.279 year

In Paris, PV power simulation based on local temperature and irradiance data is shown below:

140217_交大巴黎_5kWp

Balances and main results

	GlobHor kWh/m2	T Amb oC	GlobInc kWh/m2	GlobEff kWh/m2	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
January	24.0	4.60	31.5	30.0	134.2	120.3	13.05	11.70
February	43.0	4.70	54.6	52.3	237.9	220.3	13.35	12.36
March	76.0	7.00	86.3	83.0	373.9	349.3	13.26	12.39
April	114.0	9.80	122.1	117.7	519.3	488.7	13.02	12.25
May	140.0	13.50	143.3	138.3	600.9	565.5	12.84	12.08
June	153.0	16.30	154.6	149.4	638.6	602.0	12.64	11.92
July	163.0	18.90	166.4	160.7	673.7	636.5	12.39	11.71
August	139.0	19.00	147.9	142.9	602.7	569.3	12.47	11.78
September	96.0	16.00	108.5	104.7	452.9	426.3	12.77	12.02
October	59.0	11.80	72.0	69.1	306.9	285.4	13.05	12.13
November	32.0	7.30	43.8	41.7	187.1	170.9	13.08	11.95
December	20.0	5.10	27.0	25.6	114.3	101.7	12.98	11.55
Year	1059.0	11.21	1157.9	1115.5	4842.3	4536.2	12.80	11.99

Legends:
GlobHor Horizontal global irradiation
T Amb Ambient Temperature
GlobInc Global incident in coll. plane
GlobEff Effective Global, corr. for IAM and shadings
EArray Effective energy at the output of the array
E_Grid Energy injected into grid
EffArrR Effic. Eout array / rough area
EffSysR Effic. Eout system / rough area

In the same calculation formula with simulated PV power in Paris, So the energy pay-back time of this system is:

Energy Pay-Back Time (EPBT): 12,625 kWh÷4,536 kWh/year=2.783 year

ii. CO_2 emissions

i. CO_2 emission saving associated to the PV panels' production

The CO_2 per kWh emission is 0.636 kg in Taiwan. According to report of IEA-PVPS-T10-01:2006, electrical energy for PV module manufacturing is in total of 2,296 kWh/kWp, so for this 5 kWp system in Taiwan, Total CO_2 emission for PV module manufacturing is:
0.636 kg/kWh×2,296 kWh/kWp×5 kWp=7,301.28 kg
Generally, PV system service life time is around 20 to 25 years, so in this PV system's life, the total CO_2 reduced is:

0.636 kg/kWh×5,540 kWh/year×20 year=70,468.80 kg

So from the two calculations of above, the 20 years of net CO_2 emission reduction of the 5 kWp system in Taiwan is 63,167.52 kg (70,468.8 kg-7301.28 kg).

By the same calculation formula, the 20 years of net CO_2 emission reduction of the 5 kWp system in Paris is 50,396.64 kg (57,697.92 kg-7301.28 kg).

0.636 kg/kWh×4,536 kWh/year×20 year=57,697.92 kg

ii. CO_2 emission saving associated to a year of system functioning

For Taipei, Taiwan, as shown in above, simulated yearly PV system output power is 5,540 kWh, converted to CO_2 emission saving of a year PV system functioning is:

0.636 kg/kWh×5,540 kWh/year×1 year=3,523.44 kg

By the same calculation, for Paris, the CO_2 emission saving of a year PV system functioning is:

0.636 kg/kWh×5,540 kWh/year×1 year=2,884.89 kg

iii. CO_2 emission associated to energy balance in Taiwan

In Taiwan, estimated power generated by PV system per year is 5540.1 kWh/year. Estimated power usage per year is 7151.1 kWh/year. So the energy balance in Taiwan of one year is -1,611 kWh/year (estimated yearly energy produced by PV power deduct estimated yearly power consumption). So the CO_2 emission under the circumstance of yearly energy balance in Taipei, Taiwan is:

1,611 kWh/year×0.636 kg/kWh=1,024.6 kg

By the same calculation, in Paris, the estimated yearly PV power generation is 4,536 kWh/year and the estimated yearly power consumption is 7,326.6 kWh/year, so the energy balance in Paris of one year is:

0.636 kg/kWh×(7,326.6-4,536) kWh/year=1,774.82 kg

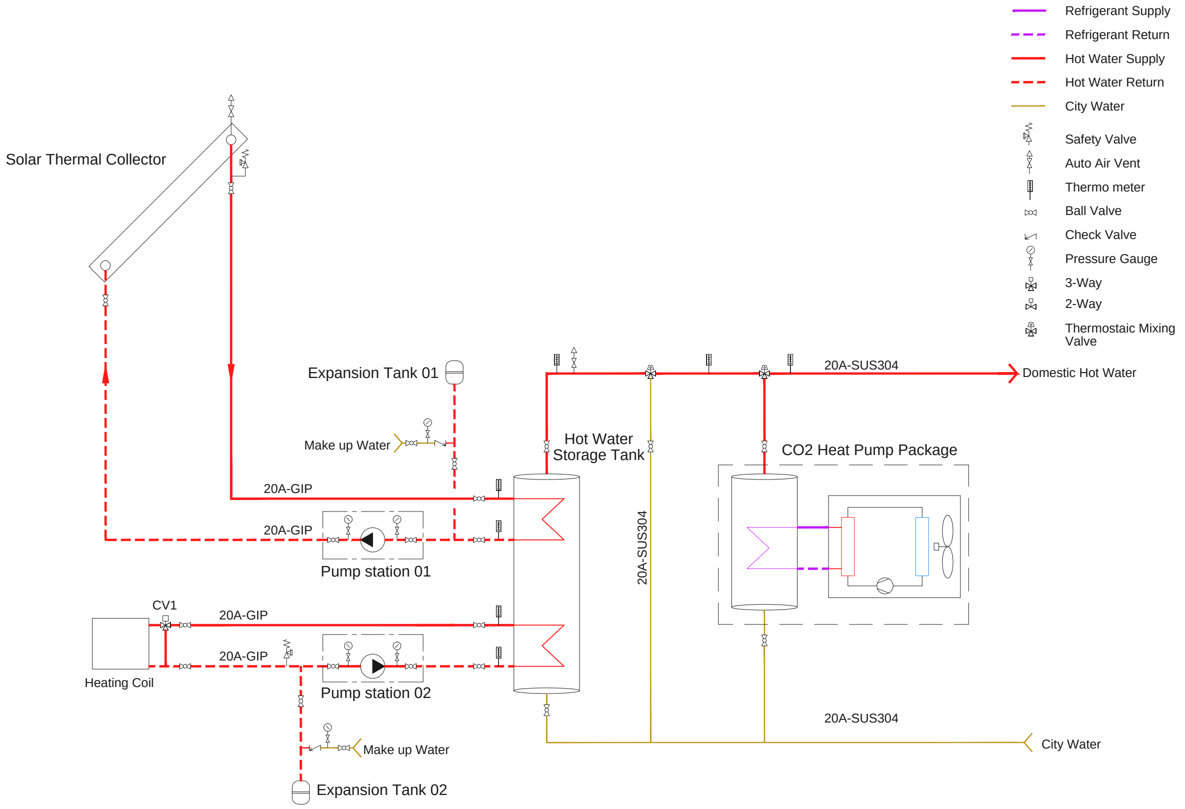
5.3.7 Solar Thermal Design

1. General Description

The solar thermal system is to recover the heat from solar radiation. The heat is used for the domestic hot water and space heating. The system comprises solar collectors, hot water storage tank and pump stations. Because the solar thermal energy can't satisfy the thermal demands year-round independently, an auxiliary heat generator – air-to-water heat pump – is included.

The system for charging the solar thermal store tank includes an internal heat exchanger for solar feed. In the store the hot water temperature can be as high as 90°C, which can be limited to a set maximum draw-off temperature of 60°C by means of thermostatic three-way mixing valve.

The backup for the solar thermal system is provided by the air-to-water heat pump equipped with a storage tank. When the thermal energy stored in the solar thermal store tank is depleted, the backup warm water of 60°C will blend with the then cool domestic water from the solar thermal storage tank to produce the minimum 52°C hot water by means of a thermostatic three-way mixing valve.



2. Design Criteria

- The solar thermal system is part of overall energy plan including the passive solar system, ac tive solar system, HVAC system, and other high performance strategies.
- In addition to the domestic water heating, the solar thermal system is also to augment the space heating to increase the performance of solar thermal system.
- The solar thermal energy takes precedence over the heat pump to heat both the domestic hot water and space heating, but the heat pump will only backup the domestic hot water requirement.
- Nevertheless, the back-up heat pump can still be able to cover all the demands from domestic hot water independently.
- Considering the protection against possible legionellosis, the hot water temperature can achieve 60°C occasionally.

3. Hot Water Need Estimation

Domestic Hot Water System Needs

Use	Draws / Day	Litres / Each Draw (°C)	Need Per Day
Shower Head	2	50 (40°C)	100.0
Hand Sink	12	9 (35°C)	108.0
Kitchen Sink	2	18 (55°C)	36.0
Dishwashing	1	9.8 (50°C)	9.8
Cloth Washer	1	100 (45°C)	100.0
Total			**353.8**

The thermal energy required to heat the domestic hot water is 12.1 kwh per day, which is based on the cold water supply of 15°C.

4. Energy Balance of Solar Thermal System

The analysis of solar thermal system using the simulation tool TRANSYS for both Orchid House Taiwan and France is shown in Appendix A, B, on page 1-4 .

5. Major Equipment

Solar Collectors

i. Type : Evacuated Tube

ii. Characteristics

Quantity : 4

Absorber shape : Cylindrical

Gross Collector area : 13.6 m2

Efficiency constant : η0 = 0.734

@ G = 8000 w/m2 a1 (w/m2k) = 1.529

a2 (w/m2k) = 0.0166

iii. Materials

Casing / Manifold : Aluminum (Extruded)

Absorber + Coating : Aluminum + ALN/SS – ALN/CU

Flowed through element : Copper pipe

Glazing : Borosilicate glass (outer tube)

Insulation : Mineral Wool + Polyurethane

Heat transfer fluid : Water

Hot Water Storage Tank

i. Type : Indirect cylinder twin coil vessel

ii. Capacity, liters : 300

iii. Features :

Two smooth copper tube indirect coils

Thermo glazing and dual magnesium anodes for corrosion protection

High-grade thermal insulation

Heat Pump

i. Type : Air-to-water heat pump

ii. Refrigerant : Carbon Dioxide

7. Accessibility of the Installation for Maintenance Task

The hot water storage tank and pump stations are located in the machine room on ground floor, which is accessible from the outside of house via the porch.
The heat pump is located outdoors on the mezzanine, which is accessible from the inside of the house.

8. Effectiveness of the Insulation

Solar water supply and return piping :
EPDM rubber insulating material of 25mm thickness with UV protective jacket.
Hot water storage tank :
90mm thick flexible polyurethane foam.
Domestic hot water piping :
25mm thick polyurethane foam.

9. Control System

Hot water storage tank loading

i. When the temperature at the lower area of the tank (T2) is 8°C less than the temperature at the collector (T1), the pump (P1) is switched on. If the temperature difference falls below 3°C, the pump is switched off

ii. When the temperature at the lower area of tank reaches the set maximum temperature, the charging process is stopped automatically.

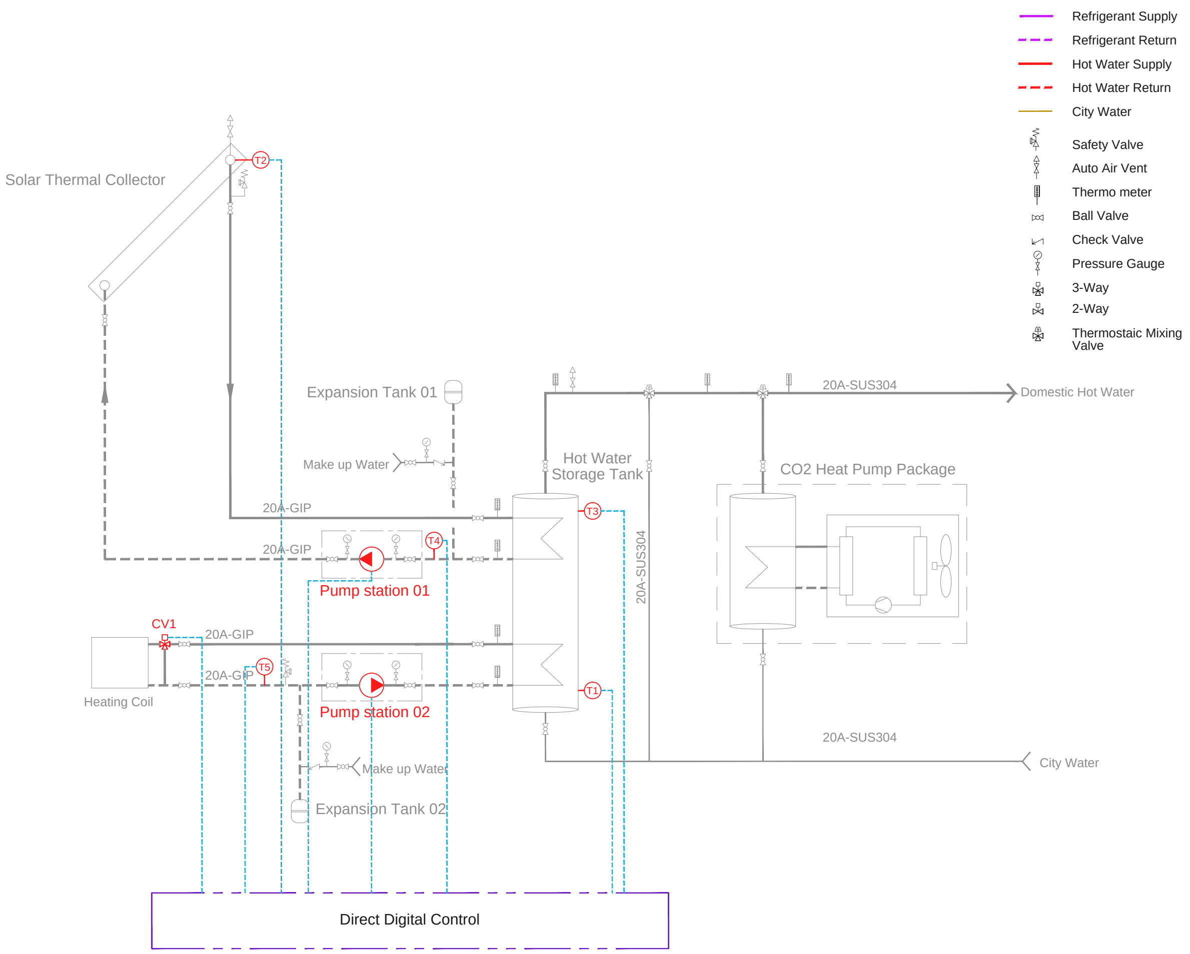
iii. During the period of high insolation, the provision for protecting the pump (P1) from overheating is provided – stopping the pump's operation.

Heat pump operates
When the temperature at the higher area of the tank (T3) is lower than the set temperature, the heat pump system switched on.

Space heating process

i. When the space heating process is actuated, the circulation pump (P2) operates. When the temperature at the lower area of the tank (T3) is below 40°C, the pump (P2) is switched off.

ii. The room temperature sensor switches on/off the control valve (CV1) to control the room temperature within the designated range.



9. Cost of the Installation

The total cost for the solar thermal system is at about 17,680 USD. The itemized estimation is as follows.

Item	Description	Cost (USD)
1	Solar collectors	6,500
2	Heat pump	5,600
3	Hot water storage tank	600
4	Pump stations	680
5	Control	2,600
6	Piping material	1,100
7	Labor	600
	Total	**17,680**

The contribution of solar thermal system is its yearly solar yield of 6200 kwh/a which is estimated by TRANSYS shown on Appendix B page 1-4 .

5.3.8 Building Integrated Solar Active Systems

1. Aesthetical Integration:

Modules used in this system are designed as part of the building southern side roof. As its un-transparency, the roof modules block direct sunlight to the house while absorbing sun radiation to generate power for the house. Modules and transparent glasses are arranged in a way that natural light is still a main light source The module's blue appearance forms a beautiful surface of the roof, with the arrangement of transparent glasses, it becomes a fascinating chessboard like roof.

2. Constructive Solution:

Module, H beam and supporting square pipe composite a module unit. The module unit is designed to directly attach to the house roof structure of square steel pipe tightly using screws and nuts. Within module unit, gap between module to module and module to glass will be dispensed with Silicon epoxy to seal the gap and provides water resistance. Gap between module units is also sealed with Silicon epoxy to provide water resistance. Details of the module unit mounting can be found in the drawing.

3. Energy Balance positive impact:

The photovoltaic system is the only electrical power generation system of this house. The power generated by this system provides the electricity to the house load, including appliance power load and HVAC cooling power load.

4. Additional properties:

Modules of the photovoltaic system are part of the northern side roof. Module units function as roof to provide water resistance, shade of direct sun light. However, solar modules are not ideal material for thermal insulation not noise protection.

5. Maintenance:

All work in commissioning and maintenance of a system must be performed by a qualified PV technician.
i. Structural: Structural maintenance (mostly inspection) of the photovoltaic system is required periodically like all other building materials. The inspection should be made on (1) if any rusted or corrosion material observed; (2) if any bolt is loosen; (3) if structural foundation is still OK.

ii. Module: Generally, as module can withstand wind or snow load up to 5,400 Pa and the roof is tilt, there is not much specific maintenance work has to be performed. However, as the module surface cleanliness is a key to solar module power conversion, a quarterly based module surface cleaning is required. Use water and a soft sponge or cloth for module surface cleaning. A mild, non-abrasive cleaning agent can be used to remove sticky dirt. Modules have bypass diodes integrated in the junction box and are wired in parallel with series string. In the unlikely event of diode failure, it is recommended to contact with the installer or module vendor for module replacement.

Great care should be exercised to ensure that corrosion caused by the grounding means is avoided. Corrosion can increase the resistance of the grounding connection on the module, or can even cause the grounding connection to fail entirely. Corrosion can be caused by the effects of weather, humidity, dirt and so on. Corrosion can also be caused when two dissimilar metals contact each other (galvanic action).

iii. DC: Routine functional inspection of DC switch, DC fuse and surge protector should be carried out. Insulation resistance also should be checked periodically. Use thermal imager to check on all connection points and the DC panel.

iv. Inverter: Visually check on wiring and connector to see if they are fixed well and no damage. Also check on the environment of the inverter to see if the air flow is blocked. Check to see if the inverter is abnormally hot and making any noise.

v. BESS: Battery needs to be replaced once the charging/discharging efficiency is getting too low. Checked on all connectors to see if they are tightly connected.

vi. AC: Check on ELCB, NFB, fuse, surge protector to see they are functional OK and check connection bolt and nut to see if they are tightly fastened. If available, use thermal imagers to check on all connection points as well as the whole AC panels.

vii. Maintenance Plan List

Routine maintenance of the PV system should be performed and recorded. Below is a recommended check table for routine maintenance.

Item	Area	Method	Inspection Criteria	Period	
				Q	Yr
1	Module	visual inspect	Surface cleanliness	v	
		visual inspect	Cell crack	v	
		visual inspect	Bubble under glass		v
		visual inspect	Junction BOX intact		v
		visual inspect	Wire & pipe is intact		v
		visual & tool	Grounding wire and nut is well fastened		v
		tool	String series voltage within specification		v
		tool	Bolt & nut is tightly fastened		v
2	Inverter	visual inspect	Case corrosion or damage		v
		visual inspect	Wire & pipe is intact		v
		visual and touch	Connector is intact and tightly connected		v
		visual inspect	Ventilation path is clear		v
		visual inspect	Noise, vibration, smell or over heat		v
		visual inspect	LCD display intact		v
3	AC Panel	visual inspect	Case corrosion or damage		v
		visual inspect	Label, warning sign is missing		v
		visual inspect	Drawing is in place		v
		visual inspect	Any water or insect inside the panel		v
		visual inspect	Wire & pipe is intact		v
		visual & tool	Breaker, fuse, SPD is intact		v
		tool	Bolt & nut is tightly fastened		v
		visual inspect	Duct and cover is intact		v
		tool	Insulation resistance is within specification		v
		visual inspect	Panel inside cleanliness		v
4	DC panel	visual inspect	Case corrosion or damage		v
		visual inspect	Label, warning sign is missing		v
		visual inspect	Drawing is in place		v
		visual inspect	Any water or insect inside the panel		v
		visual & tool	Breaker, fuse, SPD is intact		v
		tool	Bolt & nut is tightly fastened		v
		visual inspect	Duct and cover is intact		v
		tool	Insulation resistance is within specification		v
		visual inspect	Panel inside cleanliness		v
		visual inspect	No corrosion or rust		v

visual and touch	Tightly fixed		v
tool	B Bolt & nut is tightly fastened		v
visual inspect	All equipment is intact		
visual and touch	Connector is intact and tightly connected		
visual inspect	Wire & pipe is intact		
visual inspect	Ventilation path is clear		
visual & tool	Battery efficiency and is intact		
visual inspect	Check on average power generation	v	
visual inspect		v	

5.4 ENERGY EFFICIENCY DESIGN NARRATIVE

Taiwan is an island in the South East Asia on the Pacific Rim at a latitude of 23 to 24 degree north, which sits right on the Tropic of Cancer. Taipei City is at the north tip of the island and its latitude is 24 degree north. The sub-tropical climate brings high humidity to Taipei's long hot summer and short cold winter. The high temperatures coupled with the high humidity make summers in Taiwan very uncomfortable. Our summer extends from early May to late September. Winter and spring are the raining seasons here. Autumn months are pleasant with the right temperatures and slightly high humidity. However, the comfortable spring and autumn are very short. March and April are the spring months while October and November are the autumn months.

The passive design strategies for Taiwan's hot and humid summer are somewhat complicated. The major strategy is to provide shading while increasing ventilation. Shading will cut down the heat gain from the solar radiation. Ventilation is to reduce humidity by lifting moisture from the air. It also increases thermal comfort through evaporative heat loss.

The cold and humid winter also presents a design challenge. The design strategy is to increase indoor temperatures with solar radiation. Preventing heat loss is another strategy for winter comfort. Adding proper insulation materials may reduce heat loss in winter.

Power supply is another issue people are facing in Taiwan. The nuclear disaster from the Fukushima tsunami has led to the rise of an anti-nuclear movement in Taiwan. The power supply of Taipei is mainly from two nuclear power plants near Taipei, with a third nuclear plant under construction. All these three plants are on the same earthquake zone; and the distance from the closest nuclear plant is only 20 kilometer to the center of Taipei. Alternative power sources have been a quest to this city.

5.4.1 Technology Project Summary

Section I: Technology Project Summary of the Orchid House in Taipei

1. Project Dimemtions	Data		Location of detailed information
Gross area (m^2)	116.66 m^2		PM/Appendix A
Net floor area (m^2)	71.30 m^2		PM/Appendix A
Conditioned Volume (m^3)	206.06 m^3		PM/Appendix A
2. House envelope			
Insulation types and thickness (m)	Glass Foam	0.065 m	PM/5.3.2
	eFoam		PM/5.3.2
Walls area (m^2) and Thermal Transmittance (W/m^2K)	32.19 m^2	0.15 W/m^2.K	PM/Appendix A
Floor area (m^2) and Thermal Transmittance (W/m^2K)	60.54 m^2	0.28 W/m^2.K	PM/Appendix A
Roof area (m^2) and Thermal Transmittance (W/m^2K)	60.54 m^2	0.09 W/m^2.K	PM/Appendix A
Glazing area (m^2) and Thermal Transmittance (W/m^2K)	32.10 m^2	0.75 W/m^2.K	PM/Appendix A
Glazing Solar Gain (SHGC)	77%		
HVAC System			
Heating system	HVAC Cooling And Heating		PD/ME-011
Energy Production Equipemnt	Heat Pump		
Type	Variable Refrigerant Flow		
Model	RXYMQ4PVE		
Heating Capacity	12.5 KW		
Heating Efficiency	Cop: 3.82		
Cooling Capacity	11.2 KW		
Cooling Efficiency	Cop: 3.79		
Thermal Unit	Room Heating And Cooling		PD/ME-011
Type	Wall Mounted Type		
Model	FXAQ40MAVE		
Refrigerant (Type)	R-410A		
Heat Recovery Ventilation or Energy Recovery Ventilation	Room Active Vention		PD/ME-012
Type	Heat Reclaim Ventilation		
Model	VAM150GJVE		
Efficiency	Cooling 66% (Enthalpy) Heating 72% (Enthalpy)		

4. Domestic Hot Water		
System (Type, capacity)	Domestic And Space Heating (Indirect cylinder Twin Coil Vessel, 300 L)	PM/36.7-5.3.7
Solar thermal Collectors	Domastic Hot Water And Heating	PM/36.7-5.3.7
Type	Evacuated Tube	
Area (m^2)	13.6 m^2 (Gross Collector Area)	
5. Electrical Energy production		
PV Modules (Type)	Multi-Crystalline standard module	PM/5.3.5
PV panels area (m^2)	32.67m^2	PM/Appendix C
Installed PV power (kWp)	5kWp	PM/5.3.5
Estimated energy production (kWh/year)(include the information of all PV types)	5540kWp/year	PM/Appendix C
6. Energy Consumption		
Estimated energy consumption (kWh/year)	7151.1kWh/year	
Energy electrical consumption per conditioned	42.14kWh/year per m^2	
Energy Use Characterization (% of total energy consumptiion)		
vHeating (%)	0.82% 58.5kwh	
Cooling (%)	24.02% 1718kwh	
Ventilation (%)	12.89% 922kwh	
Domestic Hot Water (%)	11.17% 799kwh	
Lighting (%)	4.59% 328.02kwh	
Appliance and Devices (%)	46.59% 3331.58kwh	
7. Energy Balance		
Estimated energy balance (kWh/year)	-1611kWh/year	PM/5.3.6
Estimated CO2 emission (Tn/year) (include the calculation in the Project manual and indicate its location here)	1024.596Tn/year	PM/5.3.6
8. List of Singular and Innovative material and systems		
Liquid thermal mass		PM/5.4.2
High R-Value insulations: Glass foam, EFoam and Vacuum Insulated Panel		PM/5.4.2
Solar thermal System's Configuration		PM/5.6.2
Relative Humidity Control		PM/5.6.2
Battery Energy Storage System (BESS)		PM/5.3.6

Section II: Technical Project Summary of the Prototype Orchid House in Versailles

1. Project Dimemtions	Data	Location of detailed information
Gross area (m^2)	116.66 m^2	PM/Appendix A
Net floor area (m^2)	71.30 m^2	PM/Appendix A
Conditioned Volume (m^3)	206.06 m^3	PM/Appendix A
2. House envelope		
Insulation types and thickness (m)	Glass Foam 0.065 m	PM/5.3.2
	eFoam	PM/5.3.2
	VIP 0.03 m	PM/5.3.2
Walls area (m^2) and Thermal Transmittance (W/m^2K)	32.19 m^2 0.09 $W/m^2.K$	PM/Appendix A
Floor area (m^2) and Thermal Transmittance (W/m^2K)	60.54 m^2 0.12 $W/m^2.K$	PM/Appendix A
Roof area (m^2) and Thermal Transmittance (W/m^2K)	60.54 m^2 0.07 $W/m^2.K$	PM/Appendix A
Glazing area (m^2) and Thermal Transmittance (W/m^2K)	32.10 m^2 0.75 $W/m^2.K$	PM/Appendix A
Glazing Solar gain (SHGC)	77%	
HVAC System		
Heating system	HVAC Cooling And Heating	PD/ME-011
Energy Production Equipemnt	Heat Pump	
Type	Variable Refrigerant Flow	
Model	RXYMQ4PVE	
Heating Capacity	12.5 KW	
Heating Efficiency	Cop: 3.82	
Cooling Capacity	11.2 KW	
Cooling Efficiency	Cop: 3.79	
Thermal Unit	Room Heating And Cooling	PD/ME-011
Type	Wall Mounted Type	
Model	FXAQ40MAVE	
Refrigerant (Type)	R-410A	
Heat Recovery Ventilation or Energy Recovery Ventilation	Room Active Vention	PD/ME-012
Type	Heat Reclaim Ventilation	
Model	VAM150GJVE	
Efficiency	Cooling 66% (Enthalpy) Heating 72% (Enthalpy)	

4. Domestic Hot Water		
System (Type, capacity)	Domestic And Space Heating (Indirect cylinder Twin Coil Vessel, 300 L)	PM/5.3.7
Solar thermal Collectors	Domastic Hot Water And Heating	PM/5.3.7
Type	Evacuated Tube	
Area (m^2)	13.6 m^2 (Gross Collector Area)	
5. Electrical Energy production		
PV Modules (Type)	Multi-Crystalline standard module	PM/5.3.5
PV panels area (m^2)	32.67m^2	PM/Appendix C
Installed PV power (kWp)	5kWp	PM/5.3.5
Estimated energy production (kWh/year) (include the information of all PV types)	4536.2kWh/year	PM/Appendix C
6. Energy Consumption		
Estimated energy consumption (kWh/year)	7326.6kWh/year	
Energy electrical consumption per conditioned (kWh/year per m^2)	44.50kWh/year per m^2	
Energy Use Characterization (% of total energy consumptiion)		
Heating (%)	15.55% 1139kwh	
Cooling (%)	4.60% 337kwh	
Ventilation (%)	12.01% 880kwh	
Domestic Hot Water (%)	17.89% 1311kwh	
Lighting (%)	4.48% 328.02kwh	
Appliance and Devices (%)	45.47% 3331.58kwh	
7. Energy Balance		
Estimated energy balance (kWh/year)	-2790.4kWh/year	PM/5.3.6
Estimated CO_2 emission (Tn/year) (include the calculation in the Project manual and indicate its location here)	223.232Tn/year	PM/5.3.6
8. List of Singular and Innovative material and systems		
Liquid thermal mass		PM/5.4.2
High R-Value insulations: Glass foam, EFoam and Vacuum Insulated Panel		PM/5.4.2
Solar thermal System's Configuration		PM/5.6.2
Relative Humidity Control		PM/5.6.2
Battery Energy Storage System (BESS)		PM/5.3.6

5.4.2 Comprehensive Energy Analysis and Discussion Report

Section I – Influence of Energy Analysis on House Design and Competition Strategy

1.0 Introduction

The Orchid House utilizes both sunlight and water to ensure optimal living conditions and create minimal waste. Natural light is harnessed not only to generate electricity from the roof photovoltaic panels, but also to regulate indoor temperatures through the thermal mass wall. Water efficiency is maximized through the use of a water-curtain wall, greenhouse cooling and drip irrigation systems. In addition, solar radiation is used to heat water which can be used domestically or used to radiate warmth when run through thermal piping under the panels of the floor.

In order to maximize energy efficiency, NCTU/UNICODE performed energy simulation and set numerous parameters to test the integrated home systems. Using Building Information Modeling, a baseline model of the Orchid House was created to the study the relationship between the envelope and the measurable area. This model was then used to predict the following building properties:

- Internal gains and cooling load within the structure to optimize HVAC system and additional cooling devices
- Annual electricity demand
- Orchid House performance during competition week

1.1 Energy Analysis Objectives

The objective of energy analysis is to evaluate and aid design decisions in both the schematic design and design development stage. At each stage, different tools are used to simulate the physical environment and performance of the building.

1.1.1 Schematic Design Stage

Using climate analytical tools, the team analyzed Taipei's local climate for various annual properties such as temperature, humidity, wind speeds, wind direction, solar exposure and other helpful information. By breaking down the data into seasonal proportions, the team was able to integrate green building strategies such as building rotation, shading devices, natural ventilation and other passive design utilizing these natural forces to achieve optimal thermal comfort, natural lighting and energy efficiency.

1.1.2 Design Development Stage

As building materials, building and HVAC systems, lighting and other appliances are included into the design, more sophisticated energy models can be used to simulate the annual energy consumption of the building based on Taipei's climate and occupancy behavior. Simulated models accurately depict fluctuations in Orchid House's interior temperature, humidity, lighting, heat gain and loss, cooling load, energy load and other parameters, which are then used to adjust and balance design strategies for further optimization.

1.2 Energy Analysis Methodology

Energy Analysis is performed using Green BIM (Building Information Modeling) where the design model is created using BIM software and then transferred to supplementary simulation software to simu-

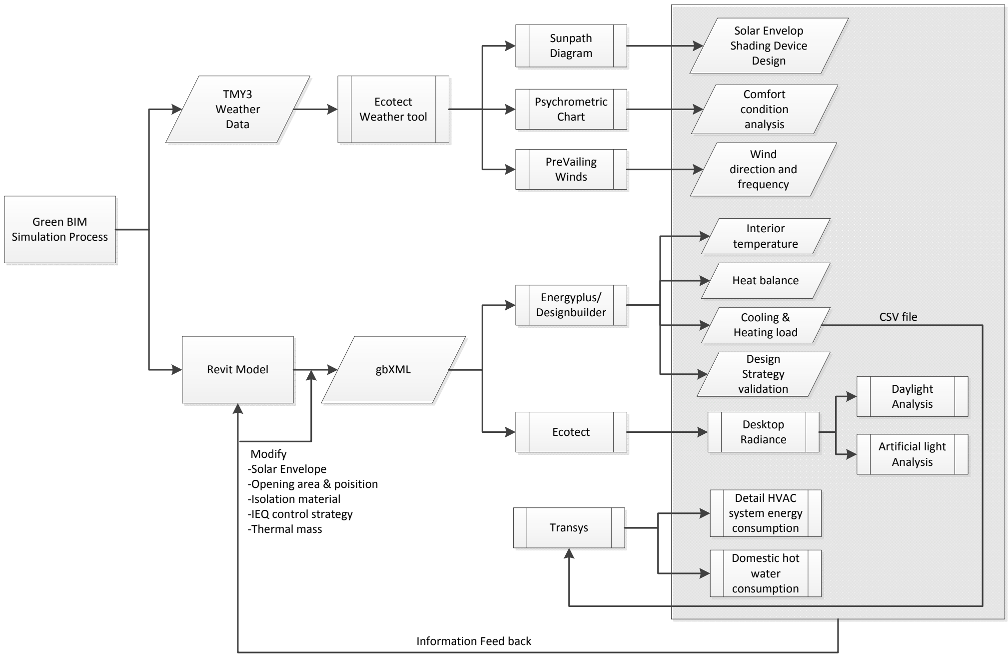


Figure 5.4.2.1.1a The workflow between BIM model and simulation software during the Green BIM simulation process

late environmental conditions and energy use.
1.3 Climate Data and Weather Analysis
The latitude of Taipei is 24 degree north. The sub-tropical climate brings to Taipei long hot and humid summer and short cold and humid winter. The high temperature backed with the high humidity makes summers in Taiwan very uncomfortable. Winter and spring are the raining seasons here. Autumn months are pleasant with the right temperature and slightly high humidity. Taiwan experiences prevailing southeast winds in summer and northeast winds in winter.

1.3.1 Taipei Seasonal Climate Analysis

Taipei winter occurs throughout the months of December to February with an average temperature of 17oC. While severe cold fronts can cause indoor temperatures to reach as low as 7oC, strong solar radiation during the winter can also raise outdoor temperatures to 28~30oC. Conversely, during the summer months of June to September, Taipei experiences the warmest of temperatures. Due to the unique topographical formation of Taipei, in the shape of a basin, warm air becomes trapped between the atmosphere and the surrounding mountains. When compounded with solar radiation and frequent rain, the climate conditions during this time are hot and humid. As a result, the moths of June to September experience the highest demand for mechanical cooling and building energy use.

During the spring and autumn seasons (March to May and September to November respectively) of Taipei, climate conditions are mild with temperatures ranging between 17~25oC. However, during days with strong solar radiation, outdoor temperatures can often reach temperatures above 30oC causing large temperature fluctuations between day and night. The occurrence of these transitional seasons where daytime temperatures are high accompanied by low temperature evenings allows for the design considerations of daytime shading devices and evening passive ventilation strategies. Figure 1.2.2 describes the various monthly climate fluctuations of Taipei.

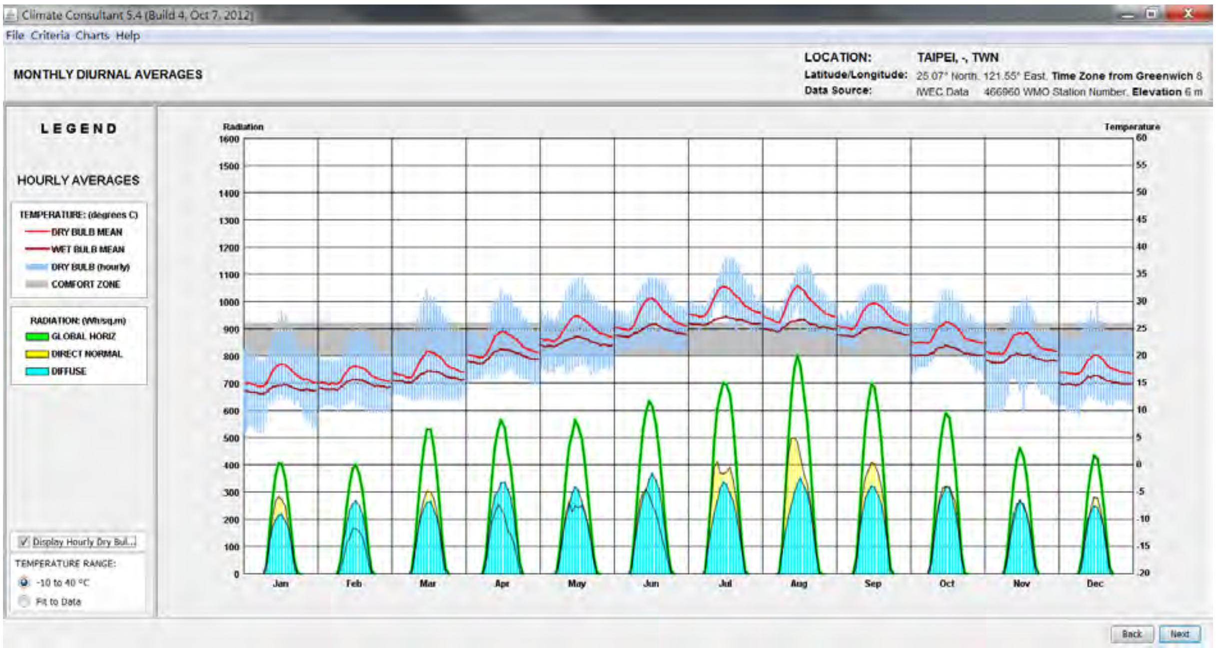


Figure 5.4.2.1.1b Monthly climate fluctuation data for Temperature, Humidity, and Solar Radiation.

1.3.2 Cooling Degree Hour and Heating Degree Hour Analysis

Typically, a large magnitude of cooling degree hours and heating degree hours represent climates that demand higher building energy consumption, and provides a reference for energy conservation design considerations. Table 1.3.1 shows the cooling degree hours and heating degree hours using Taipei weather data, when indoor temperature conditions are set between 18~26 oC. It is apparent that, in Taipei climate, cooling degree hours far exceeds heating degree hours. This also shows the lack of the need for mechanical cooling during winter months.

Month	Heating Degree Hours (ºC.hr)	Cooling Degree Hours (ºC.hr)
Jan	1780	169
Feb	1515	134
Mar	1155	800
Apr	75	1696
May	7	3480
Jun	0	5044
Jul	0	6953
Aug	0	6518
Sep	0	4885
Oct	3	2696
Nov	238	1847
Dec	1022	446
Total	5795	34668

Table 5.4.2.1.1a Monthly Heat Degree Hour and Cooling Degree Hour analysis for Taipei climate

1.3.3 Wind Speed and Direction Analysis

From the prevailing winds analysis shown in Figure 1.3.2, the Taipei basin predominantly experiences east winds on a monthly basis. Again, the unique topographical features of Taipei cause wind to behave in a more conformed behavior (funneling northeast winds in the winter and mitigating southeast winds in the summer), with the exception of summer where mild southwest winds also influence climate conditions.

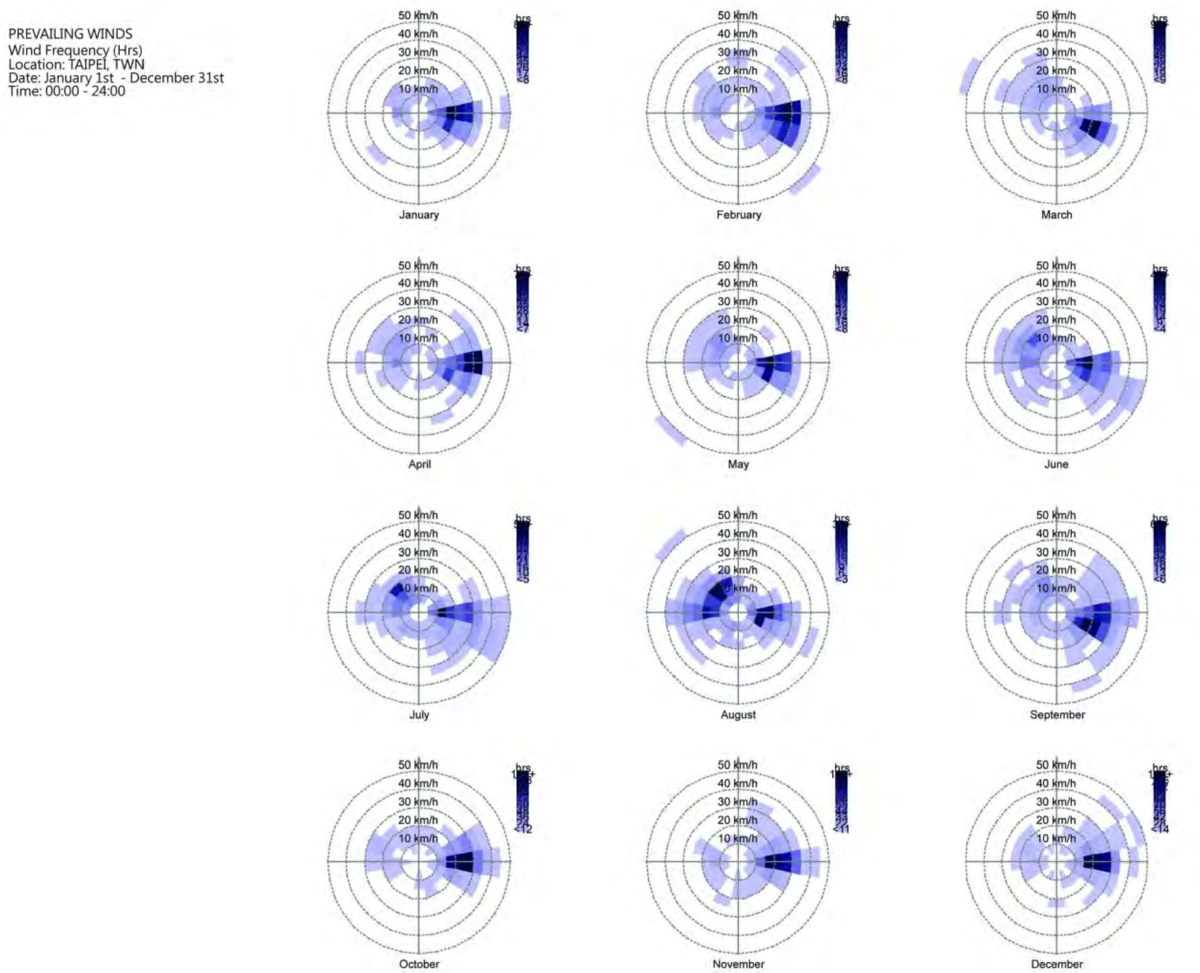
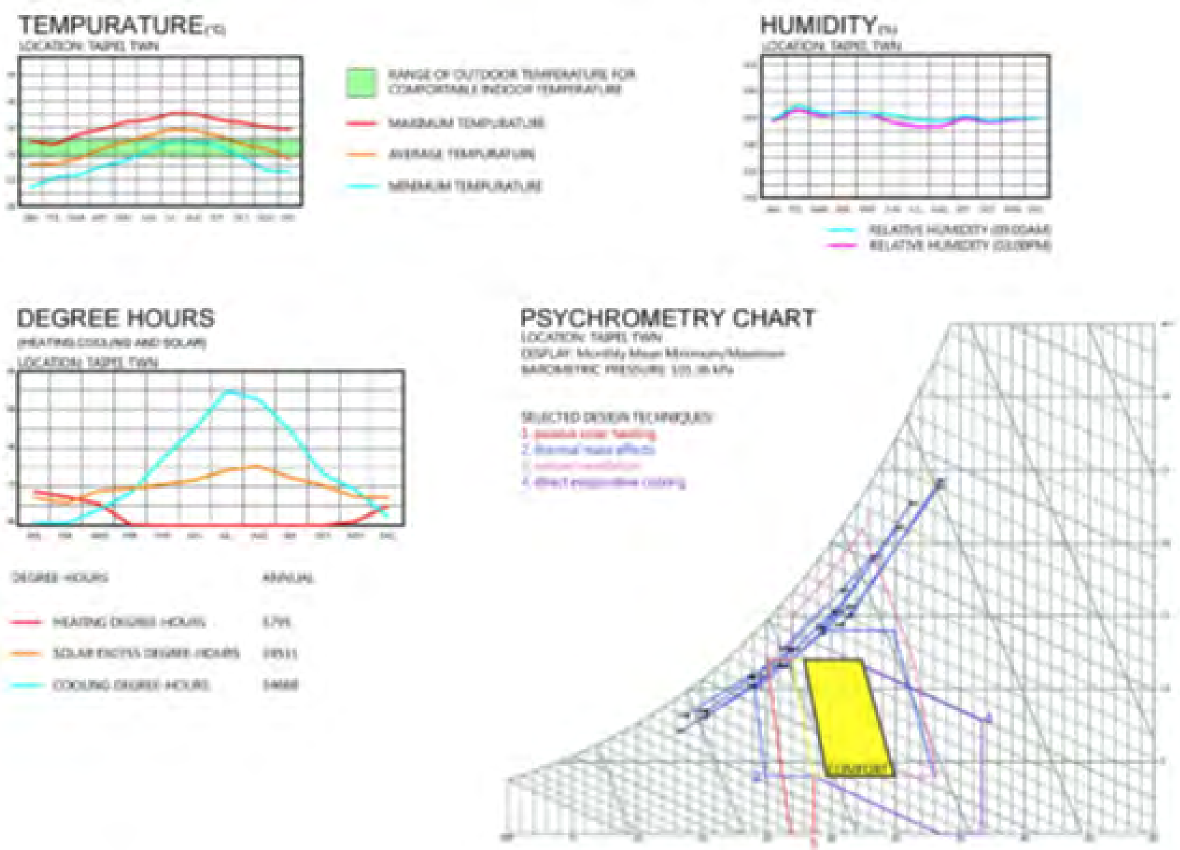


Figure 5.4.2.1.1c Monthly prevailing winds analysis of Taipei area

1.4 Team Energy Strategy

Various design strategies were implemented to maximize comfort while minimizing electricity use during summer and winter climate condition. The overall energy strategy is to first use passive methods followed by semi-passive methods, and finally mechanical systems when no alternative methods are available. The electricity required to operate the semi-passive and active systems will be generated from the photovoltaic cells installed on the roof of the Orchid House.



Cooling Strategies

- Shading
- Natural ventilation
- Solar chimney
- Earth and vegetation cooling
- Evaporative cooling
- Heat pump cooling with heat exchanger

Heating Strategies

- Direct solar gain
- Greenhouse effect
- Thermal wall
- Heat exchanger preheated by solar hot water
- Heat pump heating with heat exchanger

2.0 Influence of energy analysis in the project design (Project Design Optimization)

2.0.1 Solar Exposure

Solar exposure simulation was used as an aid during building envelope, shading and opening considerations. The sun path simulation allows for the analysis of solar angle and exposure during specific seasons or days.

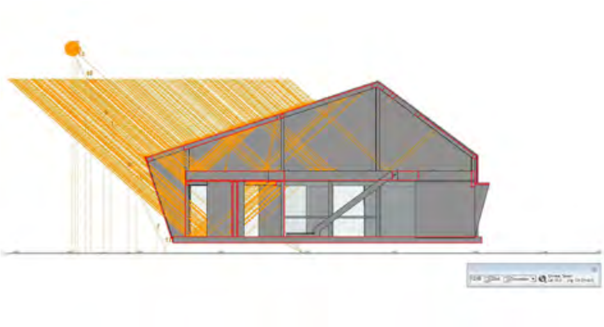


Figure 5.4.2.1.2a Solar exposure on building envelope during Winter Solstice

Figure 5.4.2.1.2b Solar exposure on building envelope during Summer Solstice

Figure 5.4.2.1.2c Solar exposure on building envelope during Spring Equinox

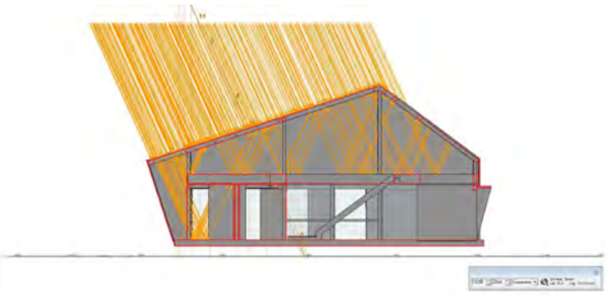


Figure 5.4.2.1.2d Solar exposure on building envelope during Autumn Equinox

2.0.2 Simulation of Indoor Environmental Comfort, Heat Balance and Applying Design Optimization

For preliminary analysis, we used Energyplus analysis software to simulate Orchid House indoor temperature and heat balance fluctuations under the conditions of Taipei climate. The heat balance algorithm inherent in Energyplus allows for the simulation of hourly indoor temperature, in addition it provides analysis of heat gain and heat loss from individual building components such as exterior walls, ceilings, floors, windows, doors, etc. This provides valuable information to determine which components require and will benefit the most from the application of energy saving strategies.

For example, the Terrace Area on the first floor of Orchid House is designed to be a Buffer Zone to the indoor mechanically ventilated space. During preliminary analysis, we discovered that during sunny days, solar radiation through the skylight and wall glazing of the enclosed Terrace Area generate large amounts of heat that subsequently gets transferred to the indoor measurable zone (mechanically ventilated space).

Figure 2.5 shows the temperature and heat balance fluctuation of the Terrace Area throughout a summer day (June 22) before ventilation strategy was implemented to mitigate the generated heat. On that day, outdoor temperatures reach as high as 33.5oC, while the Terrace Area has a peak temperature of

31.5oC. The heat balance chart shows that indoor heat gain can be attributed to solar radiation from the envelope windows. Beginning from 7am in the morning, solar radiation enters the Terrace Area from the east facing windows, followed by solar radiation entering directly through the skylight from noon until 5pm causing indoor temperature to rise steadily throughout the day. It is not until the sun path passes the point of solar incidence between the indoor temperatures begins to decline slowly.

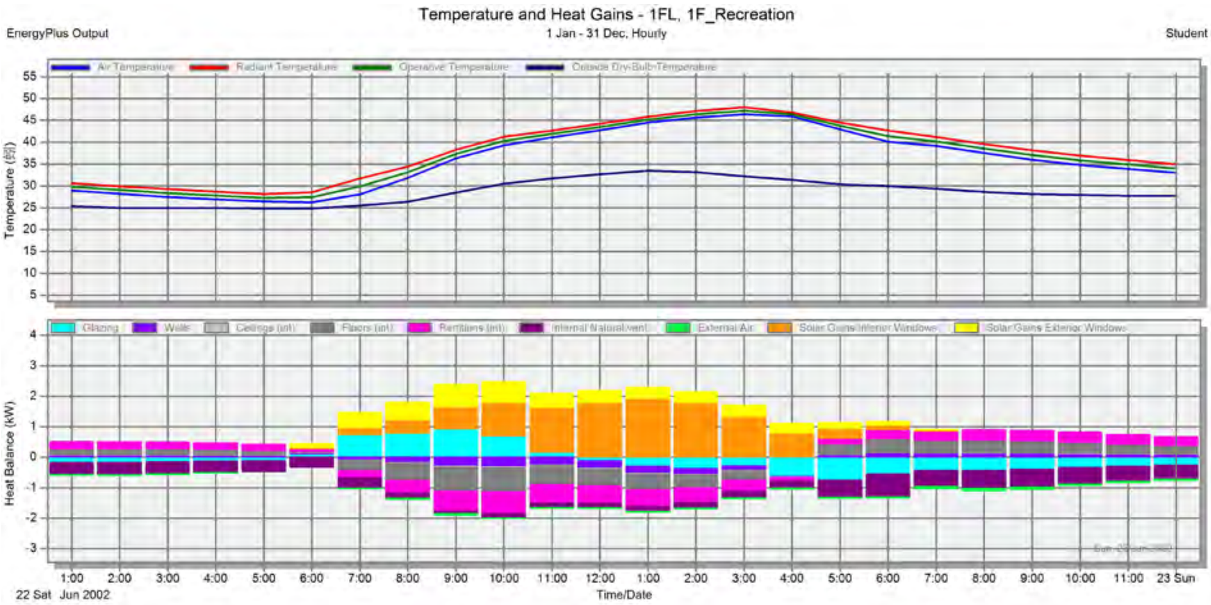


Figure 5.4.2.1.2e 1F Terrace Area temperature and heat gain analysis chart

In order to solve this overheated problem, the glazing material has to be changed to lower the Solar Heat Gain Coefficient (SHGC). The strategy of ventilating the Buffer Zone at night is also utilized. Figure 2.5 shows that solar radiation through windows and the conductivity heat through glazing reduce significantly after these two strategies applied. From the peak of 2.5kw reduce to 0.6kw. Sufficient heat loss at night, lower the peak temperature in the daytime.

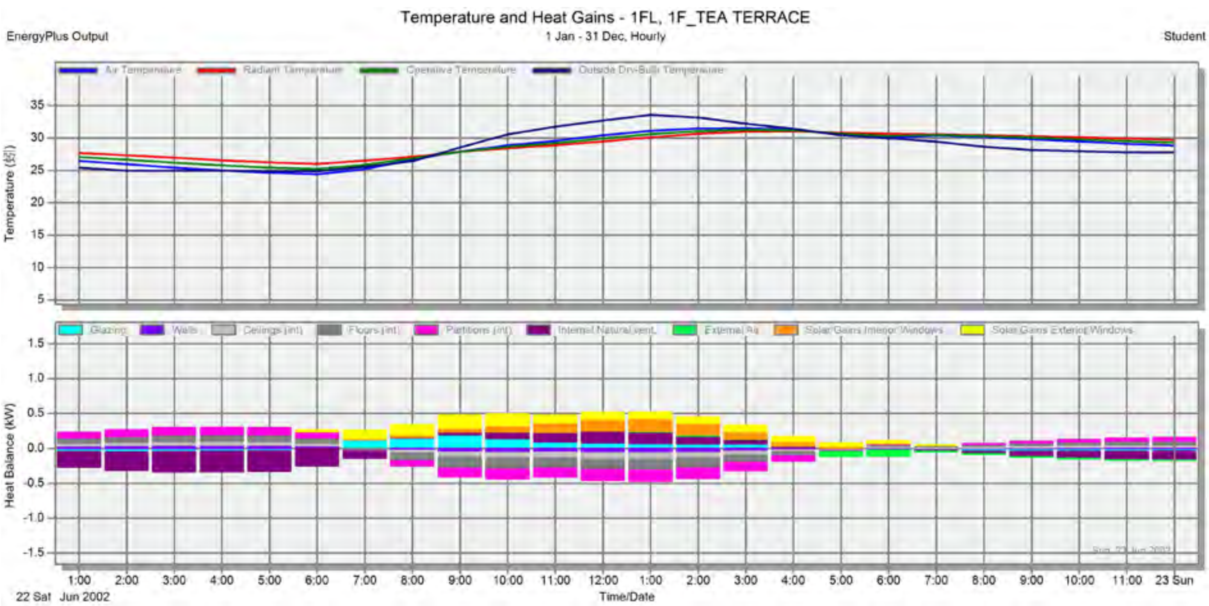


Figure 5.4.2.1.2f Building heat balance analysis before ventilation strategy

Because the temperature of the Buffer Zone effects the amount of heat transfer from the measurable area, the retaining heat in the Buffer Zone effects the measurable area's thermal condition. Figure 2.7 shows the measurable area's temperature in the whole year if the openings of the Buffer Zone and the measurable area are closed without any ventilation. There will be 2481.4 hours of time when the temperature is from 30 to 33C0. Figure 2.8 shows that if the openings are open at night, the hours of the temperature between 30 and 33C0 will reduce to 1337.8. The hours of the temperature between 32 and 33C0 reduce ever more. It will be reduced from 1593.3 hours to 186.1 hours.

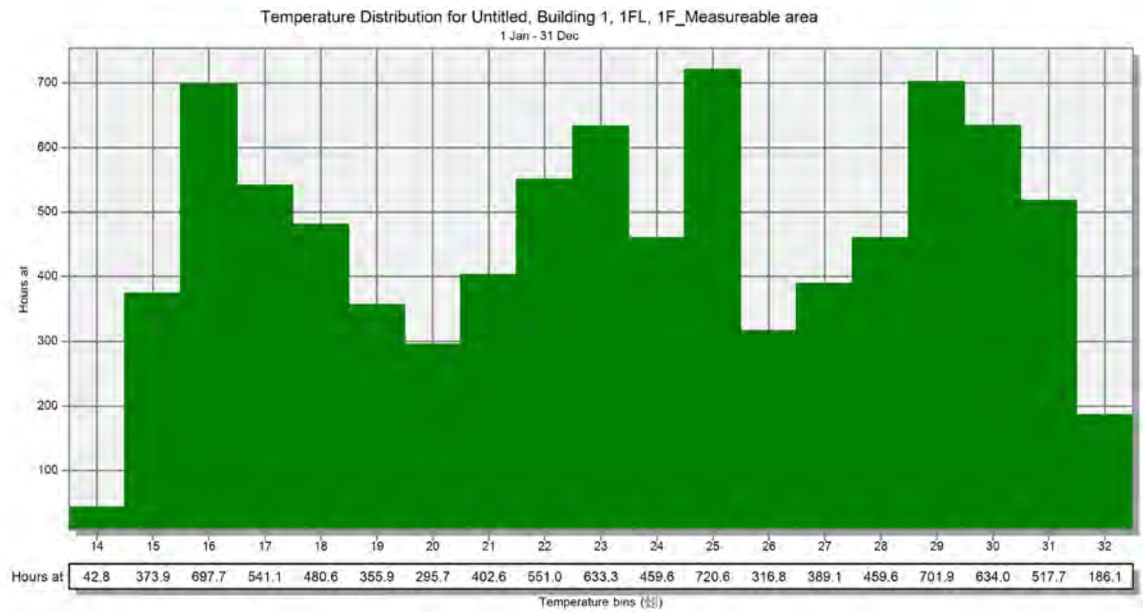


Figure 5.4.2.1.2g Measurable zone interior annual air tempature distribution before ventilation strategy

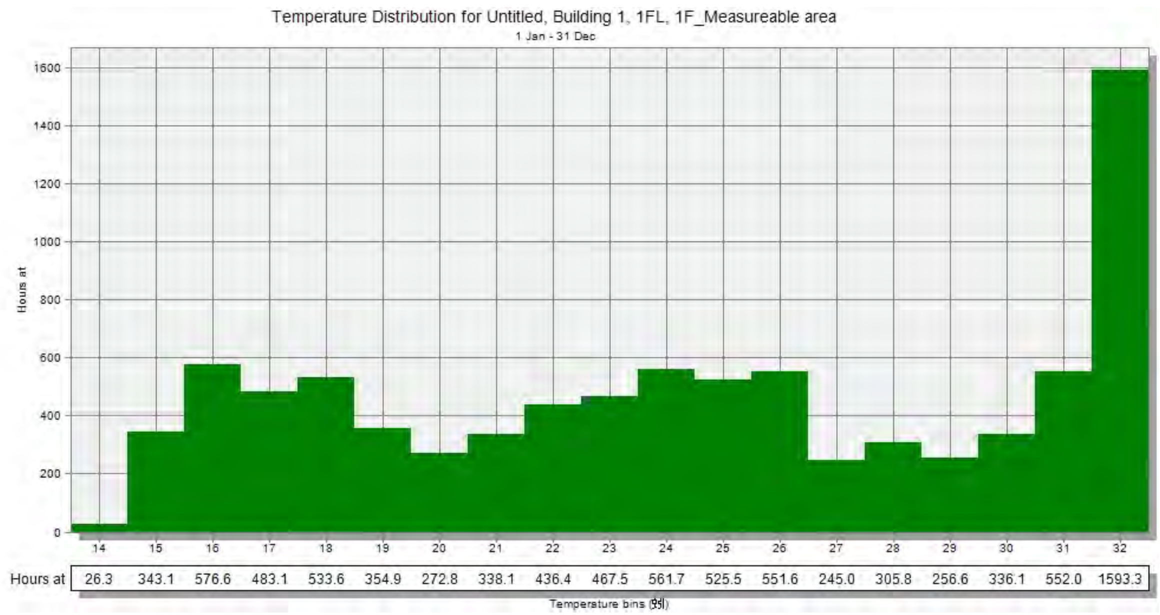


Figure 5.4.2.1.2h Measurable zone interior annual air tempature distribution after ventilation strategy

3.0 Influence of the energy analysis in the HVAC systems (conditioning systems optimization)

In the Deliverable 3, the analysis revealed that the useful solar energy collected by the solar thermal system, which is of 2.6 / m2 gross area of solar collectors, is only enough to provide heat for both the domestic hot water and space heating for 5 months and CO_2 heat pump is required to backup the solar thermal system for 7 months. Now, the gross area of solar collectors has increased from 2.61 m2 to 13.6 m2, the new analysis has shown the solar thermal energy can cover the load of both domestic hot water and space heating almost completely in nine months with high irradiation, backup heating is necessary in just three months. The new analysis is shown in Appendix B.

5.4.3 Comprehensive Energy Analysis and Discussion Report

Section II – Projected Performance of Final Housing Unit Design

1.0 Housing Unit and Systems Description
1.1 The Geometric Envelope

The geometry of the Orchid House is generated by its physical environmental condition. The weather analysis shows that shading and natural ventilation are the most important passive design strategies for Taiwan's climate. The NCTU/UNICODE team designs the house to maximize shading and natural ventilation with its geometric form.

The angle of the roof determines the solar yields on the PV panels. The latitude of Taipei is 240, so the theoretically optimal roof tilt angle is 24o. Because Taiwan's peak electrical load happens in summer for cooling purposes, the roof angle of the Orchid House is designed to be 6o less than 24o that makes it 180. This roof angle increases solar yields during overheated season.

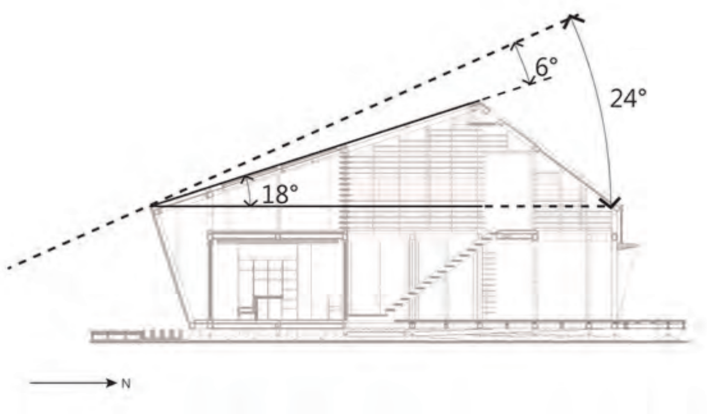


Figure 5.4.2.2.1a Roof Angle Diagram

The angle of the south façade directs the summer shading and winter direct solar gain. Based on the climate analysis of Taipei, the comfortable indoor temperatures 22°C ~ 29°C result from an outdoor balance point temperatures of 19°C ~ 26°C. People, appliances, and PV panels generate heat in the house, and this heat needs to be released to outdoor in order to maintain at a comfortable level. The balance point temperature is the outdoor temperature that causes balance between thermal gains and losses at a desired indoor temperature with natural heat transfer. Plotting the average temperatures of Taipei to the balance point temperature, The NCTU/UNICODE Team found the overheated period is from June 1st to September 21st, and the under-heated period is from December 1st to March 21st. The Orchid House reached the optimal south façade angle of 66o for both the ideal summer shading and winter solar radiation.

1.2 Energy Analysis Methodology

Energy Analysis is performed using Green BIM (Building Information Modeling) where the design model is created using BIM software and then transferred to supplementary simulation software to simulate environmental conditions and energy use.

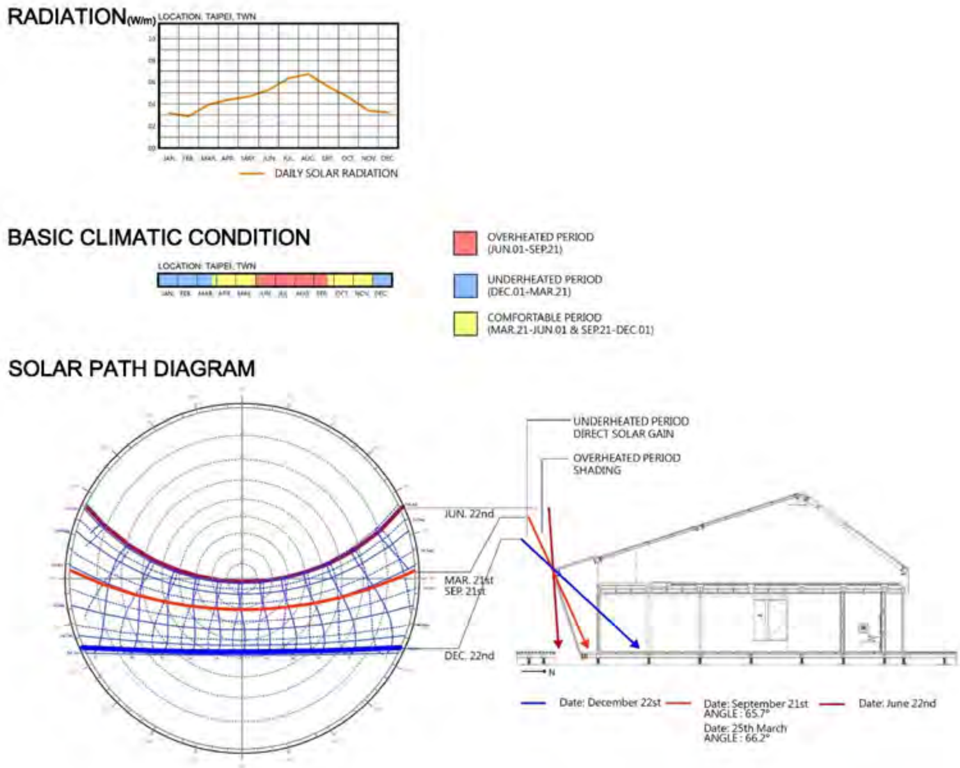


Figure 5.4.2.2.1b Solar Angle for south facade

The climate analysis shows that natural ventilation is the most efficient passive design strategy in Taiwan. The geometry of the Orchid House increases natural ventilation for summer cooling. The prevailing wind of Taipei comes from the southeast. The large openings on both south and north side of the house create positive wind load on the south façade and negative wind load on the north façade. This pressure difference may induce air flow into the house.

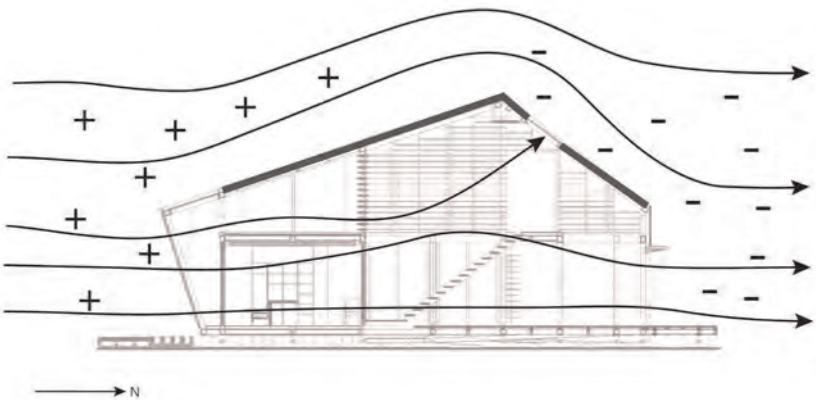


Figure 5.4.2.2.1c Natural Ventilation Generated by Air Pressure Difference

The geometry of the Orchid House also generates Bernoulli Effect to induce natural ventilation. Bernoulli Effect states the natural phenomenon that increases the velocity of air while decreasing its static pressure. The wind flow through the angled roof of the Orchid House has a longer travelling distance than the air flowing into the house. The longer travelling distance increase its velocity and decrease its static pressure. As a result, the low air pressure near the roof top opening induces air flow towards it.

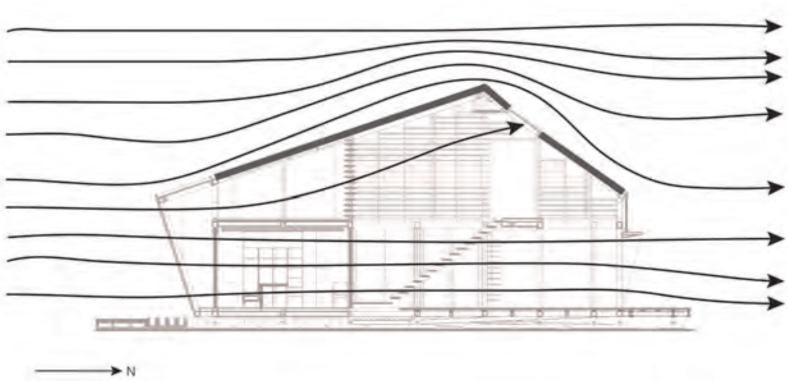


Figure 5.4.2.2.1d Natural Ventilation by Bernoulli Effect Diagram

1.2 Passive Design Strategies

The NCTU/UNICODE team designed several passive strategies to achieve thermal comfort in the Orchid House. The passive cooling strategies include shading, natural ventilation, solar chimney, heat sink, evaporation, and vegetation cooling. The passive heating strategies include direct solar gain, green house effect, thermal wall, and heat changer preheated by solar hot water.

I. The passive design strategies for cooling are:

1. Shading

The geometry of the Orchid House is based on the solar angle. And the solar angle was decided by the weather analysis. The overheated period is from June 1st to September 21st, and the under-heated period is from December 1st to March 21st in Taipei. For cooling purposes, we need to shade the south openings from sunlight that comes down over 66° until September 2ist. This shading device will cover the openings for the whole overheated season. The building geometry of the Orchid House offers a shading area on the south side to protect the solar radiation during the overheated season.

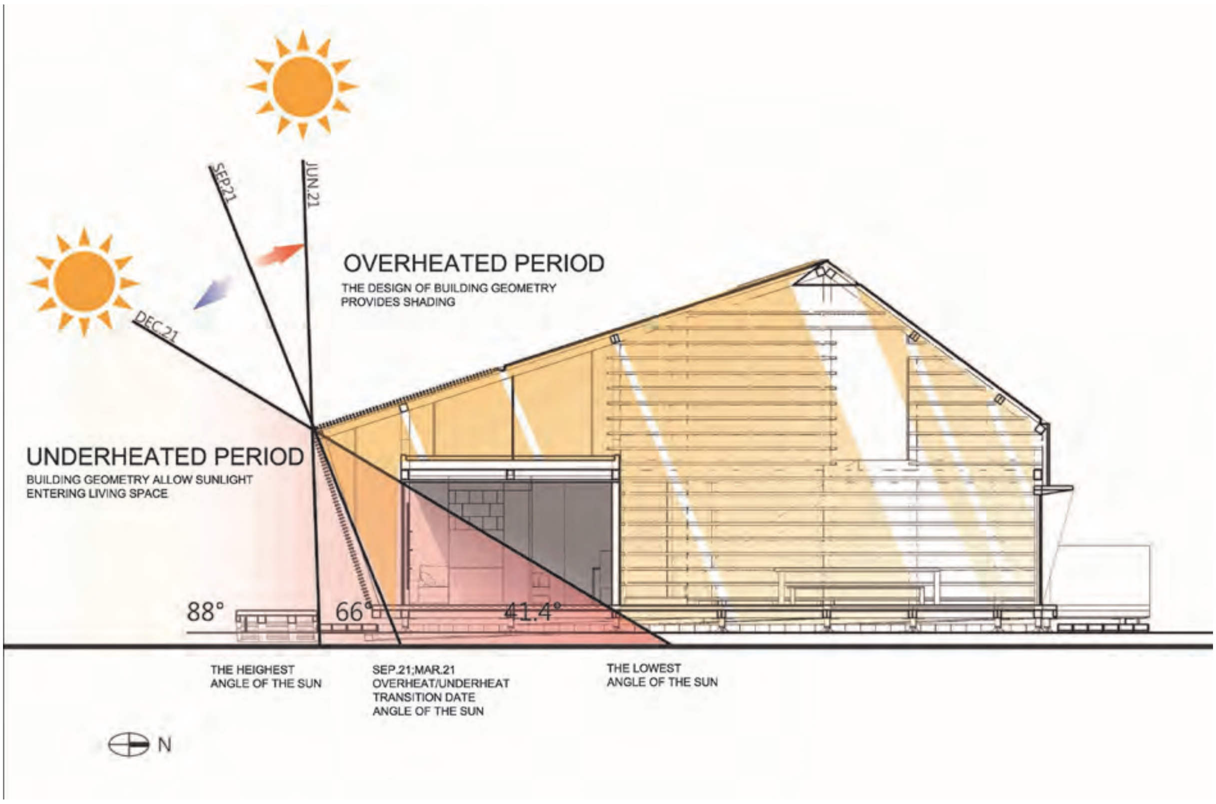


Figure 5.4.2.2.1e Solar Angle and Shading Diagram

2. Natural Ventilation

When the outdoor temperature is within the comfortable range and the wind is blowing, all windows and louvers of the Orchid House would open up to allow natural wind to blow in. Because of the prevailing southeast summer wind in Taiwan, the Orchid House has large openings on both south and north sides to create pressure difference which induces natural wind blowing through the entire house. The geometry of the Orchid House further increases the interior air movement with the Venturi Effect. The ridge of the house increases the outdoor air velocity near the ridge and creates a low pressure on the opening near it, which is known as the Bernoulli Effect. This decrease in pressure at the opening will cause an increase in the speed of the indoor air movement, which then will remove the indoor heat generated by Human, appliances, and PV panels. It also blows on human skin to increase comfort.

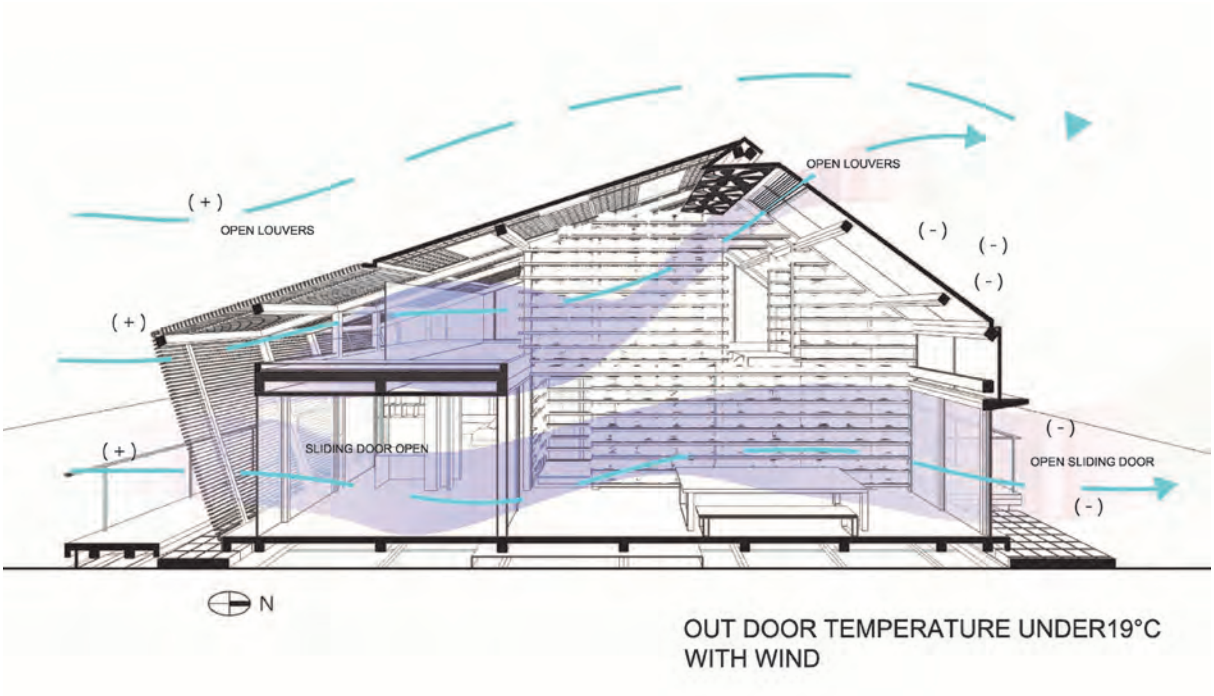
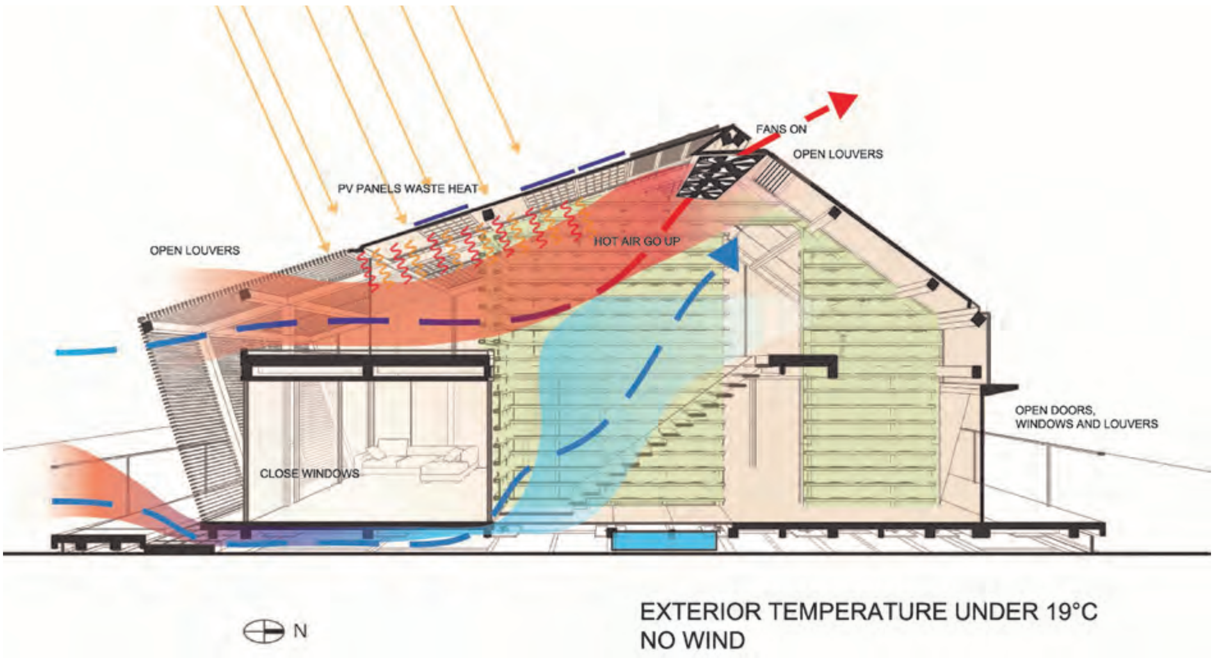


Figure 5.4.2.2.1f Natural Ventilation Diagram

3. Solar Chimney

When the outdoor temperature is comfortable but there is no wind, the waste heat generated on the underside of the PV panels creates stack effect. The waste heat creates the temperature difference between indoor and outdoor on the ridge opening. The temperature difference then generates the pressure difference which would not exist otherwise. The indoor warm air would rise and escape through the ridge opening. All exterior windows and louvers need to be opened to allow outdoor air to enter. This air movement will drive away the heat and humidity from inside the house. The surface temperature of the PV panels is measured around 50°C. The solar chimney resolves the waste heat problem, and at the same time, creates comfortable living condition.



4. Heat Sink and Vegetation Cooling

When the outdoor temperature is above the comfortable level, a series of fans near the ridge of the roof would be turned on automatically in the Orchid House. These running fans would create a negative pressure which draws the outdoor air to the space underneath the floor. The air then would flow through the floor opening in the green core. After the air flows into the green core, it penetrates the vegetation wall around the green core and enters the terrace area. The warm outdoor air is first cooled by the existing building concrete slab and rain water tank under the floor and then cooled by the evaporative effect of the plants.

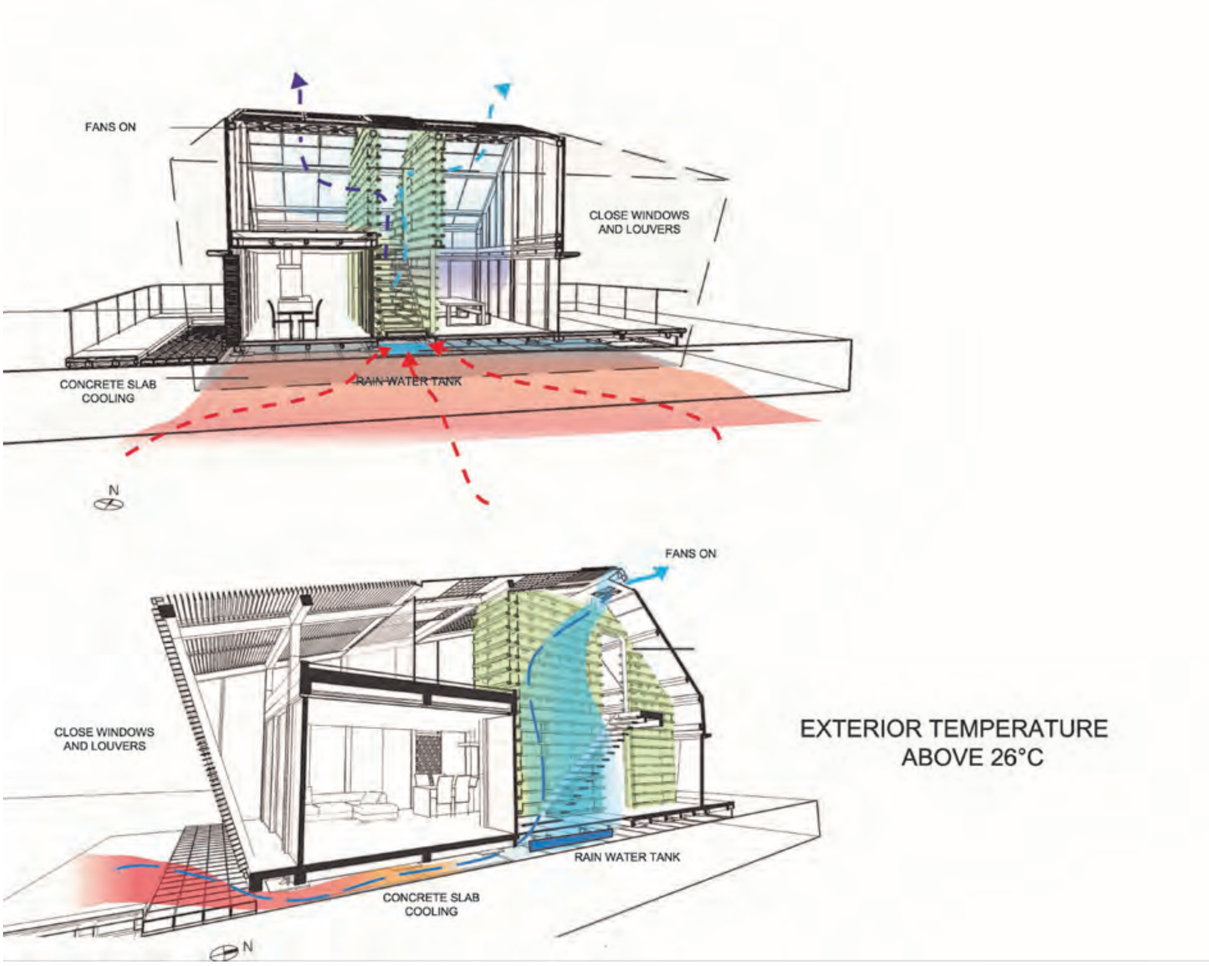


Figure 5.4.2.2.1h Heat Sink and Vegetation Cooling Diagram

In the competition site of Versailles, “Heat sink and Vegetation Cooling” will be modified as “Earth and Vegetation Cooling.” The Orchid House is sitting on the earth ground in the competition site instead of its urban site on the roof top. During the two competition weeks, the Orchid House will draw the outdoor air through underneath the house and use the earth as heat sink to lower the temperature of the outdoor air before it enters the house.

5. Evaporative Cooling

Inspired by the agricultural technology of orchid greenhouse, the NCTU/UNICODE team designed a water wall in the inlet side window of the Orchid House. The purpose of the water wall is to lower the outdoor air temperature before it enters the house. When the outdoor temperature is above the comfortable level, the water wall near the south end of the house would come on automatically. The outdoor air will then be drawn into the terrace space by the fans near the ridge of the roof. In order to adjust to the high humidity in Taipei's summer, the water in the water wall runs in metal pipes. Some metal plates are connected to the pipes to increase the heat transfer area.

In the prototype constructed in Versailles, the water in the wall will be exposed to the air. The wall is built up with many Rasching rings which are plastic rings with a lot of holes. Water is dropped on the top of the wall where the Rashing rings separate the water to small particles. When the warm outdoor air passes through the water particles, the sensible heat in the air turns to latent heat which evaporates water drops to vapor. The outdoor air temperature decreases through this evaporation while the humidity increases. The low temperature of the terrace reduces the heat gain to the living space while the humidity is physically stopped by the windows. This process will also remove the waste heat of the PV panels.

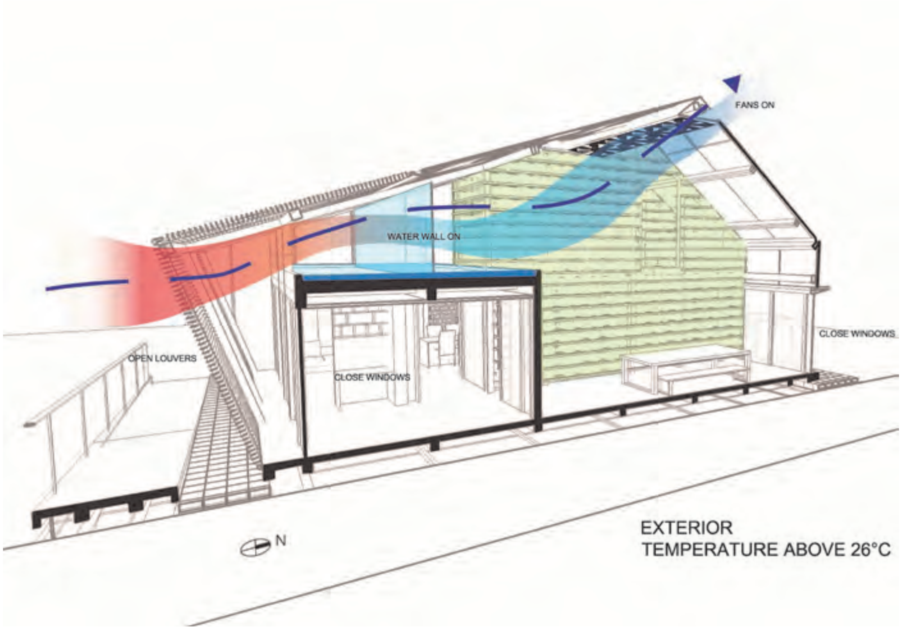


Figure 5.4.2.2.1i Evaporative Cooling Diagram

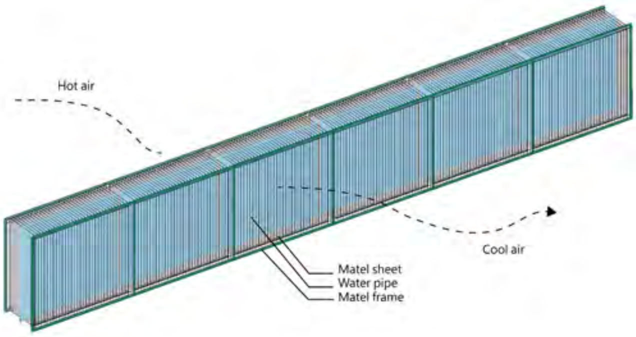


Figure 5.4.2.2.1j Water Wall Design in Taipei

Figure 5.4.2.2.1k Water Wall Design in Versailles

II. The passive design strategies for heating Include:

1. Direct solar gain

The climate analysis of Taipei indicates an under-heated period from December 1st to March 21st. In order to provide direct solar gain for the living spaces during the under-heated period, the building geometry was designed to allow direct solar radiation into the living spaces during the under-heated season.

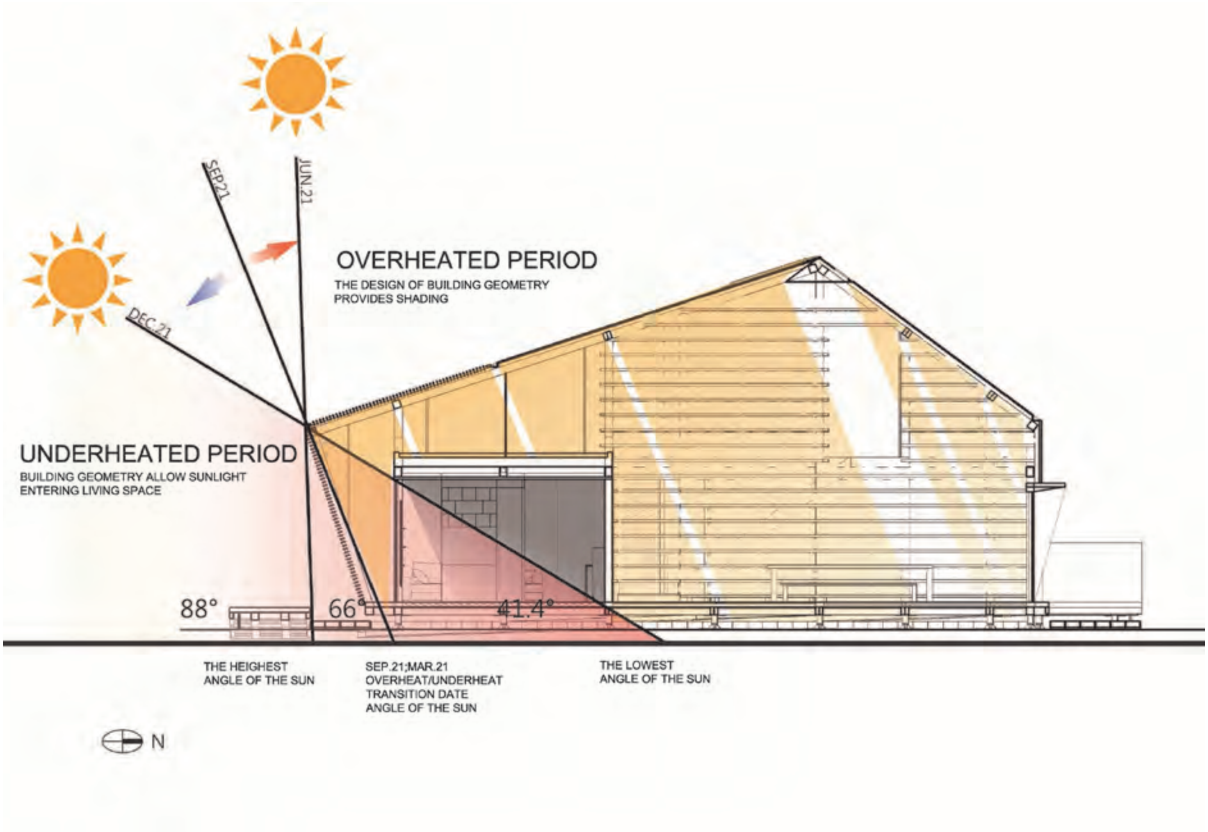


Figure 5.4.2.2.1l Solar Angle and Direct Solar Gain Diagram

2. Greenhouse effect

During the under-heated days, all exterior windows and louvers of the Orchid House will remain closed to keep out the cold wind. The exterior glazing of the greenhouse is made by a Polycarbonate sheet - Makrolon® that allows 77% of solar radiation to penetrate. After the short wave solar radiation is absorbed by the interior materials, the indoor temperature increases as the temperature of the interior materials increases and releases long wave infrared heat which cannot penetrate Makrolon®. The waste heat generated underneath the PV panels is also long wave infrared which remains indoors and further elevates the indoor temperature.

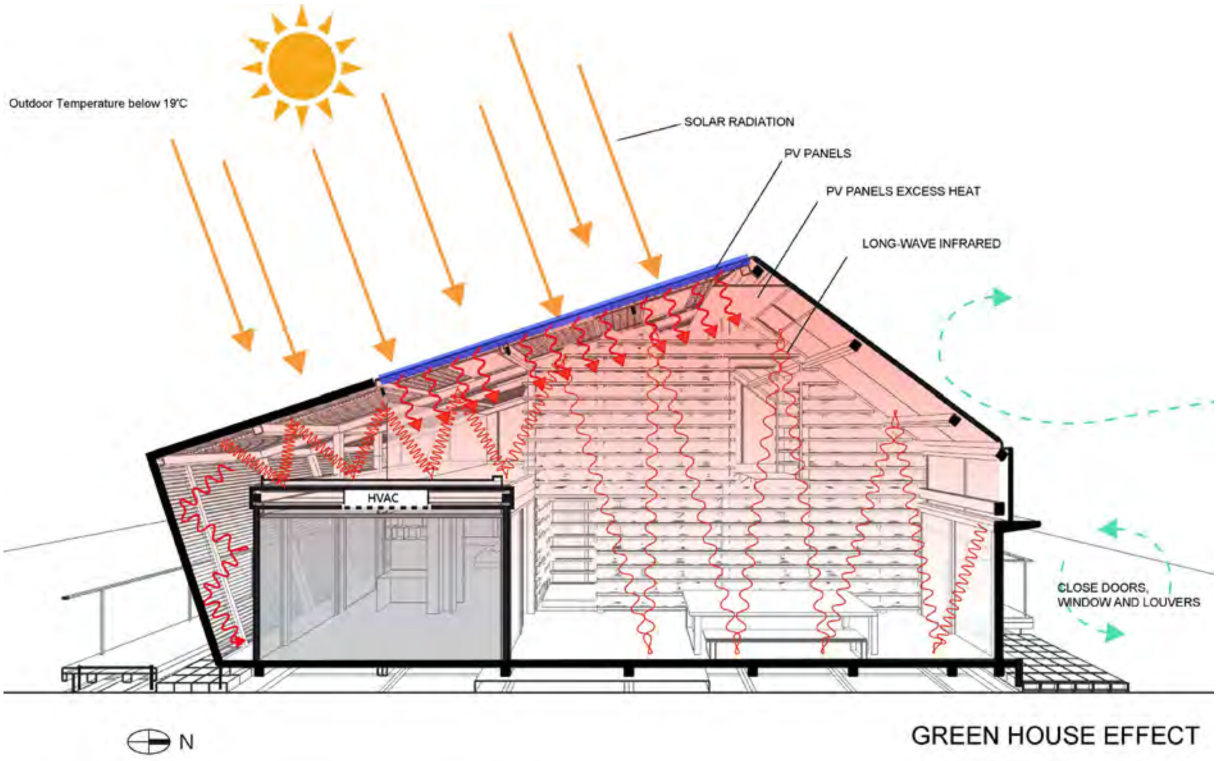


Figure 5.4.2.2.1.m Greenhouse Effect Diagram

3. Thermal wall

A 30cm water thermal wall is built on the west side of the house. The thermal wall is constructed with recycled Polyethylene Terephthalate Polymer bottles – the Polli-Bricks. Each bottle contains 6 litter of water. The bottles are piled up to 2 meter height-wise and 3 meter length-wise. The bottles are held together and fixated to a transparent acrylic sheet on their exterior side. The water in the thermal wall absorbs solar radiation during the day and releases heat to interior space at night. The air space between the bottles and the acrylic sheet remains heated during day time through the green house effect and it also prevents radiant heat loss at night. In Taipei, the acrylic sheet has openings on both the upper and lower ends. These openings allow air circulation in the summer heat and that will reduce overheating in summer. As a result, the wall will receive solar radiation during the day, and allow heat loss to the outdoor at night. A three day experiment showed the thermal wall could keep the indoor temperature constant even when the outdoor temperature fluctuates drastically.

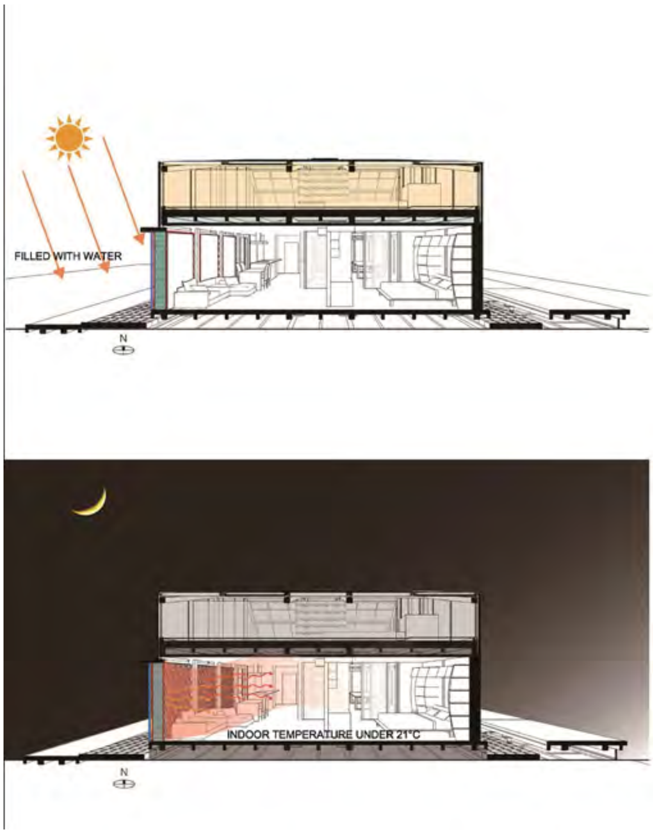


Figure 5.4.2.2.1n Thermal Wall Diagram in Under-heated Season

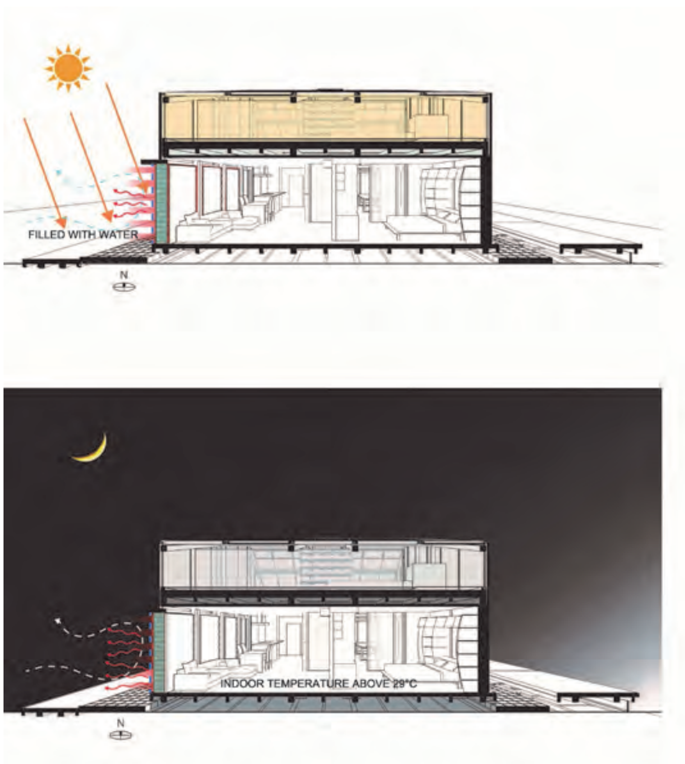


Figure 5.4.2.2.1o Thermal Wall Diagram in Over-heated Season

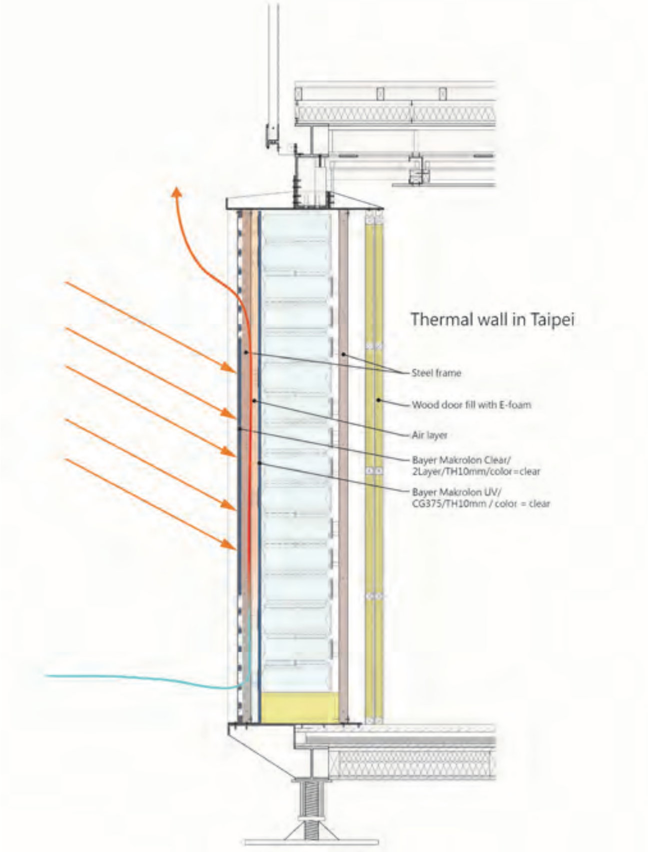


Figure 5.4.2.2.1p Thermal Wall Detail in Taipei

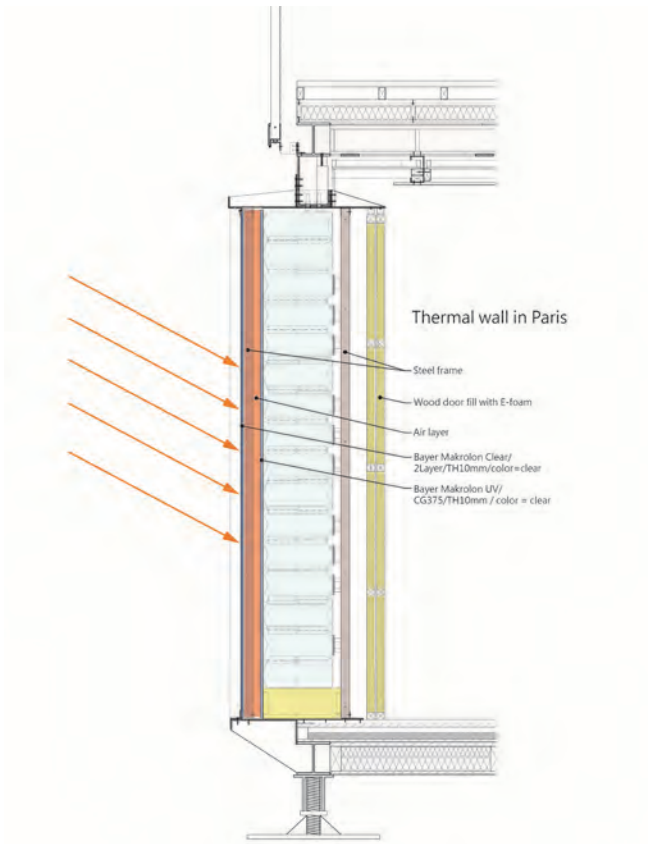
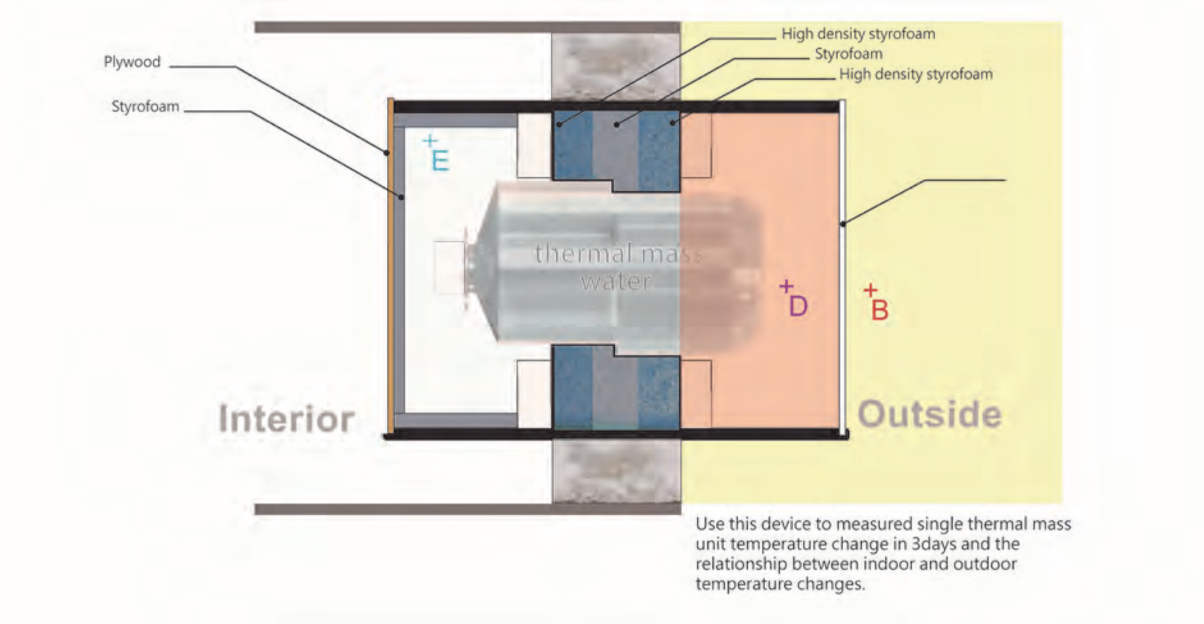


Figure 5.4.2.2.1q Thermal Wall Detail in Versailles



Polli-Bricks temperature records
2013/10/07-09

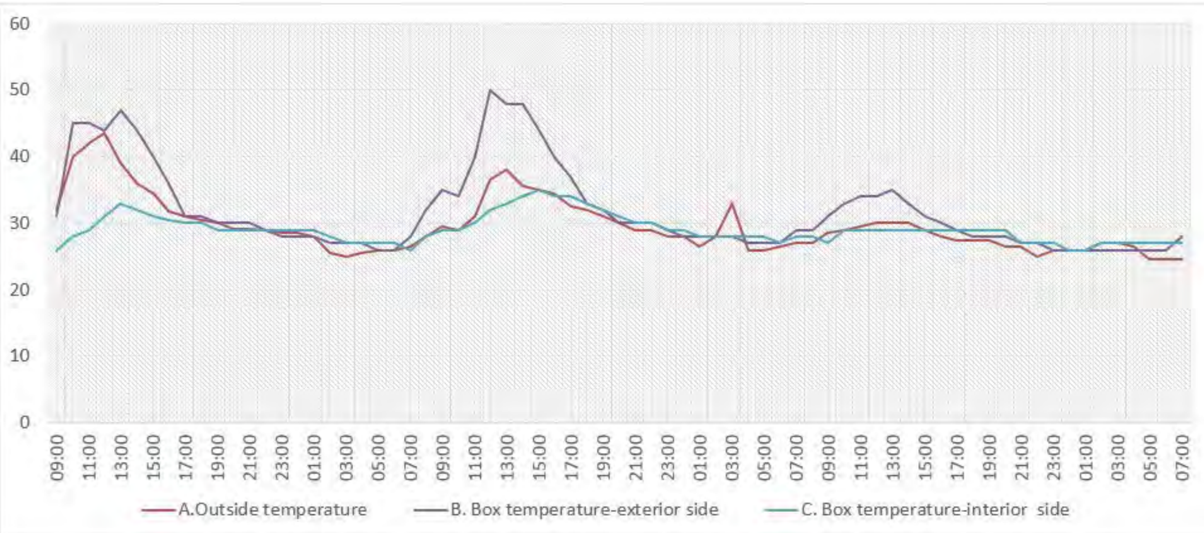


Figure 5.4.2.2.1r Thermal Wall Experiment Diagram

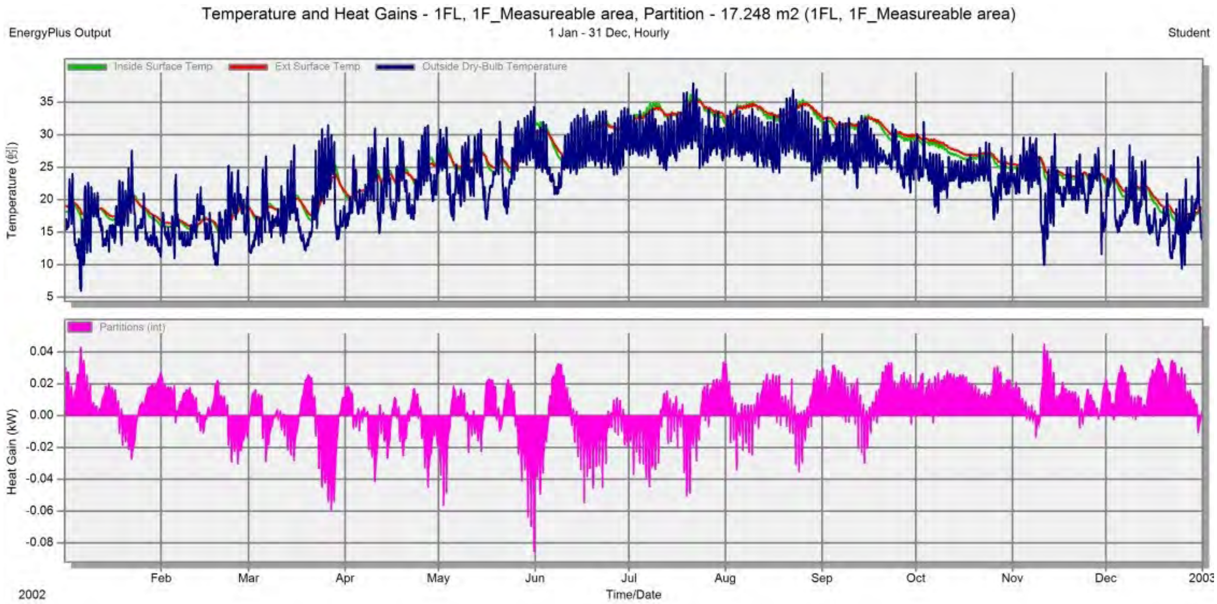
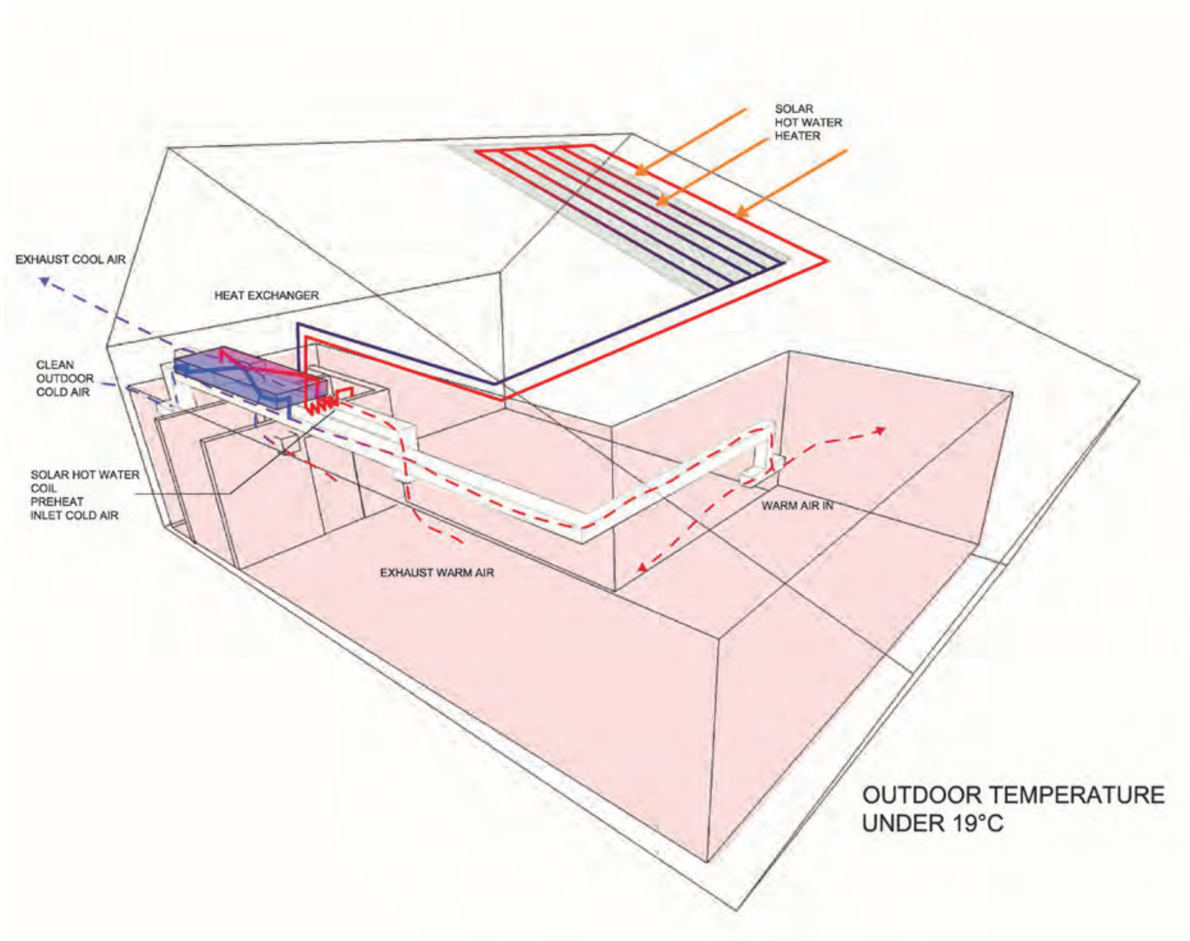


Figure 5.4.2.2.1r Thermal Wall Year Round Simulation in Taipei

4. Heat exchanger preheated by solar hot water

The solar hot water system on the roof provides domestic hot water and preheats inlet air in heat exchanger for winter heating. The hot water is drawn to the coil in the inlet duct of the heat exchanger which preheats the inlet air before it enters the living spaces. This will help us decrease the use of heat pumps.



2.0 House, Appliances and HVAC Simulations (Annual Simulation)

2.1 Simulation Tools Description

The building energy modeling tool used for this project is DesignBuilder, developed by DesignBuilder Software Ltd located in the United Kingdom. For accurate energy analysis, DesignBuilder uses the EnergyPlus dynamic thermal simulation engine developed under the U.S. Department of Energy. For Orchid House, DesignBuilder was used to model internal temperature fluctuations, HVAC loading, and heat balance (relationship between time and heat gain/loss). The simulation results generated by DesignBuilder aided the project team in developing passive design strategies, operational schedules, systems and materials selection, and evaluate building efficiency. The limitation with using DesignBuilder is a less accurate Computational Fluid Dynamics (CFD) simulation needed to model natural ventilation and air flow within the project building.

TRANSYS Simulation Program is adopted for the HVAC Simulation. Three portions of HVAC system have been done:

1. Heat pump energy consumption for both space cooling and heating.
2. Energy recovery ventilator to reclaim the thermal energy, sensible and latent heat, from the exhaust air.
3. Solar thermal system to provide a limited amount of energy for space heating.

The results of simulation including the input and output data, and the summary are shown in Appendix B.

2.2 Housing Unit Modeling: internal gains, occupancy behavior patterns, ventilation and comfort temperature

1. Modeling Methodology and Zoning

Before energy simulation can be performed, a model of the project building is created first. We used Autodesk Revit to build the design model of Orchid House, and then through format conversion (gbXML – Green Building XML Schema), the model was transferred to the DesignBuilder platform. The advantage of using separate software platforms is the ability to leverage the comparative strengths and apply it into the simulation process. Revit is a prevalent and powerful BIM tool that allows for the data entry of individual building components. For example, during the placement of a wall, parameters such as wall thickness, layer composition and physical properties can easily be inputted. When transferred to DesignBuilder this data is used by the energy analysis algorithm to derive the thermal properties of the wall. This is applied to every building component throughout the model, to create an accurate physical environment for energy simulation. In addition, Revit software has the feature to input individual Thermal Zones, allowing for the analysis of individual areas, and also allows easy creation of building openings, glazing, and shading devices. Figures 5.4.2.2.2b ~ 2d show the individual Thermal Zones and building openings in the DesignBuilder software.

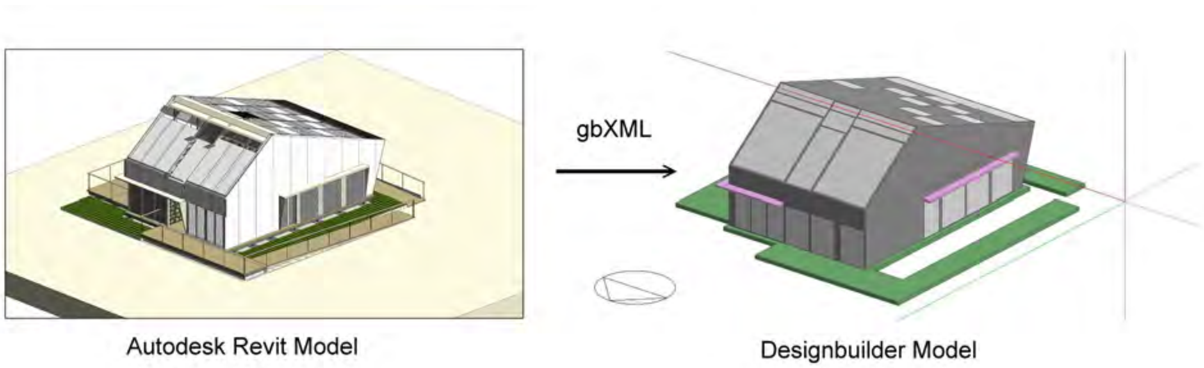


Figure 5.4.2.2.2a The transfer process between Revit and DesignBuilder by gbXML simplifies the model and removes irrelevant information which allows for more efficient energy simulation

Figure 5.4.2.2.2b A visualization of the DesignBuilder energy model

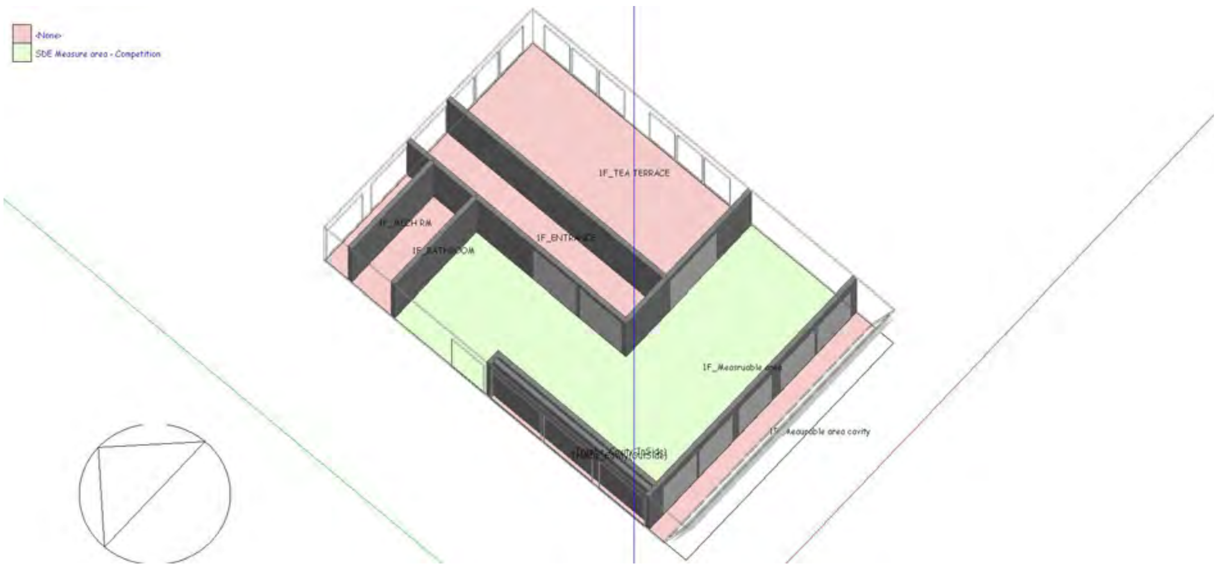


Figure 5.4.2.2.2c Ground Floor thermal zones and building openings in DesignBuilder

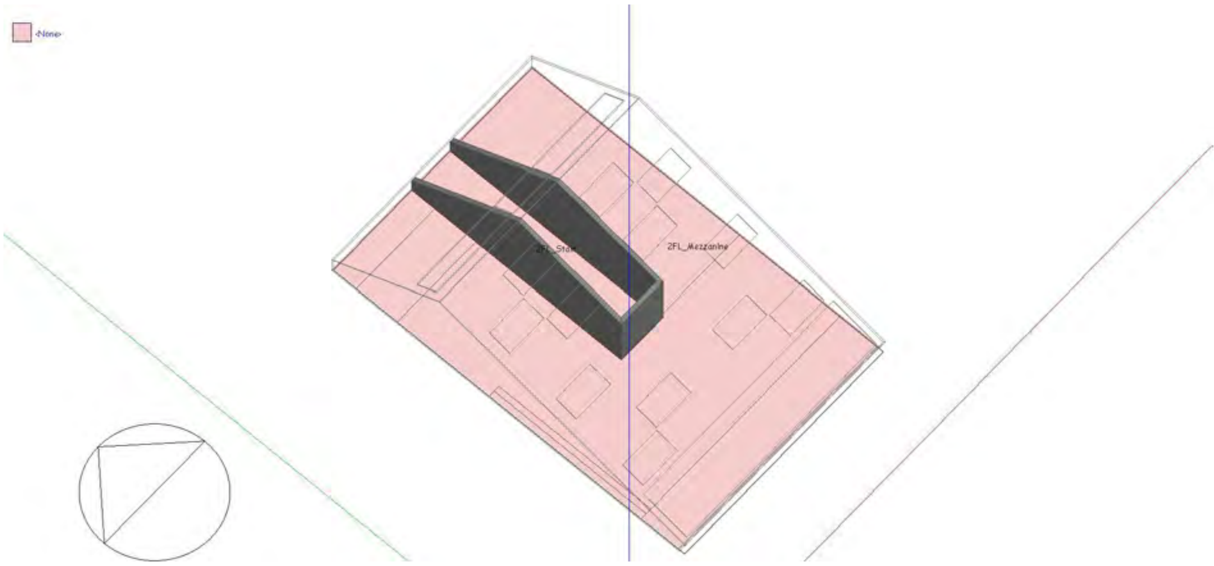


Figure 5.4.2.2.2d Second Floor thermal zones and building openings in DesignBuilder

2. Material Thermal Properties

Asides from the physical properties of materials that get transferred from Revit to DesignBuilder, additional thermal properties must be inputted for these materials to perform accurate energy analysis.

Thermal properties for building materials are obtained from:

- Test reports provided by materials manufacturers
- Green building reference guides such as the British Chartered Institution of Building Services Engineers Guide A or Taiwanese Green Building Standards.

The thermal properties for building materials used in Orchid House are as follows:

Ground Floor					
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	Density (Kg/m²)
Inner	Plywood	6.00	0.13	2500.00	560.00
	Plywood	12.00	0.13	2500.00	560.00
	VIP	30.00	0.01	687.00	177.00
	Glass Foam	130.00	0.07	840.00	117.00
Outer	Plywood	6.00	0.13	2500.00	560.00

Second Floor					
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	Density (Kg/m²)
Inner	Plywood	6.00	0.13	2500.00	560.00
	Plywood	12.00	0.13	2500.00	560.00
	VIP	30.00	0.01	687.00	177.00
	Glass Foam	130.00	0.07	840.00	117.00
	Plywood	24.00	0.13	2500.00	560.00
Outer	Plywood	6.00	0.13	2500.00	560.00

1F Wall(East+West)					
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	Density (Kg/m²)
Outer	Polycarbonate	40.00	0.04	1200.00	1200.00
	Air	60.00	0.02	1008.00	1.23
	Plywood	24.00	0.13	2500.00	560.00
	Glass Foam	65.00	0.07	840.00	117.00
	VIP	30.00	0.01	687.00	177.00
	Plywood	12.00	0.13	2500.00	560.00
Inner	Plywood	6.00	0.13	2500.00	560.00

Thermal Wall					
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	Density (Kg/m²)
Outer	Polycarbonate	10.00	0.03	1200.00	1200.00
	Air	40.00	0.02	1008.00	1.23
	PET	3.00	0.51	1000.00	1370.00
	Water	250.00	0.58	4190.00	990.00
	PET	3.00	0.51	1000.00	1370.00
	Polycarbonate	10.00	0.03	1200.00	1200.00
	Air	40.00	0.02	1008.00	1.23
Inner	Plywood	40.00	0.13	2500.00	560.00

2F Wall(East+West)					
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	Density (Kg/m²)
Outer	Polycarbonate	15.00	0.03	1200.00	1200.00
	Air	10.00	0.02	1008.00	1.23
Inner	Polycarbonate	15.00	0.03	1200.00	1200.00

PLYCARBONATE ROOF					
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	Density (Kg/m²)
Outer	Polycarbonate	3.00	0.0280	1200.00	1200.00
	Air	10.00	0.0240	1008.00	1.23
Inner	Polycarbonate	3.00	0.0280	1200.00	1200.00

Interior partition					
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	Density (Kg/m²)
Inner	Plywood	6.00	0.13	2500.00	560.00
	Plywood	12.00	0.13	2500.00	560.00
	VIP	30.00	0.01	687.00	177.00
	Glass Foam	130.00	0.07	840.00	117.00
	Plywood	12.00	0.13	2500.00	560.00
Outer	Plywood	6.00	0.13	2500.00	560.00

ROOF-PV Panel					
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	Density (Kg/m²)
	Soda lime glass	10.00	1.00	750.00	2500.00

Transparent panel(10mm)								
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	SHGC	VLT	Density (Kg/m²)	熱傳導率-U值 (W/m².K)
Outer	Polycarbonate	3.00	0.03	1200.00	0.43	0.42	1200.00	9.33
	Air	4.00	0.02	1008.00			1.23	6.00
Inner	Polycarbonate	3.00	0.03	1200.00			1200.00	9.33

Transparent panel(6mm)								
Layer	Insulation Type	Thickness (mm)	Thermal Conductivity (W/m².K)	Specific Heat (J/kg-k)	SHGC	VLT	Density (Kg/m²)	熱傳導率-U值 (W/m².K)
	Polycarbonate	6.00	0.03	1200.00	0.63	0.65	1200.00	4.67

3. Interior Gains

The energy model includes various inputs for heat gains such as appliances, lighting fixtures and occupancy. Affecting these inputs includes other constraints such as power consumption, operating schedule and thermal emissions. For appliances and lighting fixtures, the main parameters investigated for Orchid House are the energy rate and heat gain fraction. However, since there are few reference documents for appliance and lighting heat gain fraction, the following assumptions were used for the energy model:

Interior gains – Appliance

Space	Product Name	Energy rate(w)	Heat gain fraction		
			Fraction Radiant	Fraction Latent	Fraction Lost
Kitchen	Refrigerator	308	0.3	0	0.3
	Oven	3500	0.4	0.1	0.3
	Electrical stove	1800	0.1	0.3	0.1
Living Room	TV	29	0.3	0	0.3
Work station	Note book	180	0.3	0	0.3
Mezzanlne	Clothes dryer	1000	0.1	0.3	0.3
	Clothes washer	1400	0.1	0.3	0.3

- The Radiant fraction is the fraction of heat emitted by the device as long-wave radiation.
- The Latent fraction is the fraction of the rated power which is converted to latent energy and affects the moisture balance in the zone instead of the sensible heat balance.
- Fraction heat lost is the fraction of the sensible heat emitted which is lost or vented directly to outside without affecting the zone heat balance.
- Fraction Convective = 1.0 – (Fraction Latent + Fraction Radiant + Fraction Lost)

Interior gains –Lighting fixtures

Space	Product Name	Energy rate(w)	Heat gain fraction		
			Fraction Radiant	Fraction Latent	Fraction Lost
Kitchen	Tons T8 LED	93.6	0.4	0	0.3
Living Room	Tons T8 LED	62.4	0.4	0	0.3
Work station	Tons T8 LED	63.6	0.4	0	0.3
Tea Terrance &Mech. RM.	Tons ODL-005/1.2W	28.4	0.4	0	0.3
Mezzanine	Tons T8 LED	36.8	0.4	0	0.3

The occupancy of Orchid House is set as the common Taiwanese household of Husband and Wife duo couple with the following metabolic rates (thermal emissions):

Interior gains – Occupancy

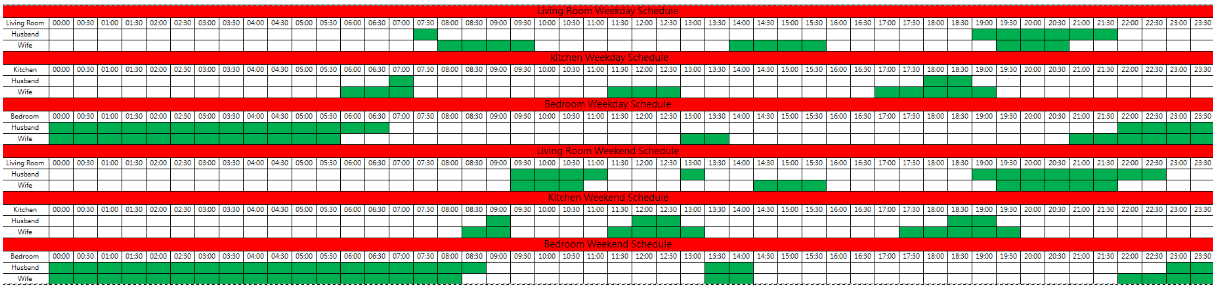
Space	Occupancy	Metabolic	
		Metabolic rate (w/person)	Factor
Measurable area	2	126	0.9

- Metabolic rate data according to ASHRAE Handbook of Fundamentals, Chapter 8,Table 5.

4. Occupancy Behavior Pattern

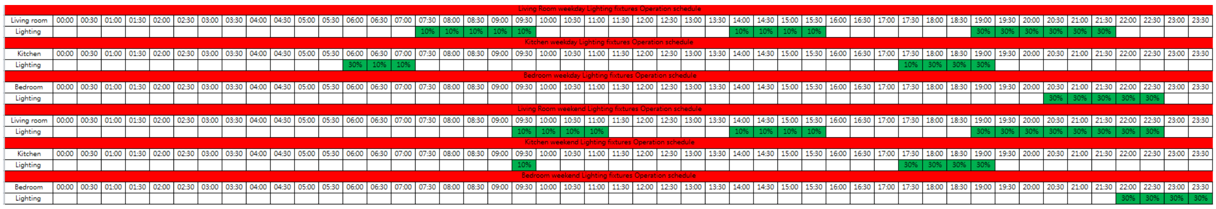
Occupancy rate and behavior will reflect the operation schedule and energy consumption of the appliances and various fixtures within the model house. Therefore, setting a believable mode of occupancy behavior becomes vital for achieving accurate energy simulation. Based on a Taiwanese research report “A study on the Energy Consumption Certificate of Residential Buildings”, the author created a statistical model for the average Taiwanese household occupancy rate and behavior. Referencing these results the following occupancy schedule was created and used for the energy model of Orchid House in Taiwan setting.

(1)Occupancy schedule



(2)Appliance Operation schedule

(3) Lighting fixtures Operation schedule



(4)HVAC System operation schedule

In the report, "A study on the Energy Consumption Certificate of Residential Buildings", the author documents that the average Taiwanese household does not use mechanical heating devices, and the adjustment of clothing is used instead to cope with the change in indoor temperatures during colder weather. Therefore no heating devices are inputted in the energy model for Orchid House when simulating Taiwanese conditions. In order to accommodate heating days and energy heat balance in the model, the control temperature is set at 20oC, set between the dates of January 1st to April 30th, and December 1st to December 31st.

The HVAC system operation schedule below is based on the average Taiwanese occupancy behavior, the parameters that influence HVAC use in the model include:

- When outdoor temperatures exceed 29oC, HVAC systems are switched on and set at a control temperature of 26.5oC
- The occupancy rate of the building

HVAC System operation schedule – Kitchen

Start date			End date		HVAC System Operation profile	
Month	day	~	Month	day	Weekday	Weekend
1	1	~	4	30	-	-
5	1	~	6	14	-	12:00-13:00
6	15	~	8	31	12:00-13:00 18:00-19:00	12:00-13:00 18:00-19:00
9	1	~	10	31	-	12:00-13:00
11	1	~	12	31	-	-

HVAC System operation schedule – Bed Room

Start date			End date		HVAC System Operation profile	
Month	day	~	Month	day	Weekday	Weekend
1	1	~	5	7	-	-
5	8	~	6	15	-	12:00-13:00
6	16	~	6	22	13:00-14:00	12:00-13:00 18:00-19:00
6	23	~	6	29	13:00-14:00 22:00-23:00	13:00-14:00 23:00-24:00
6	30	~	7	12	13:00-14:00 22:00-04:00	13:00-14:00 22:00-04:00
7	13	~	7	20	13:00-14:00 22:00-23:00	13:00-14:00 23:00-24:00
7	21	~	7	25	13:00-14:00 22:00-04:00	13:00-14:00 23:00-24:00
7	26	~	8	12	13:00-14:00 22:00-01:00	13:00-14:00 23:00-01:00
8	13	~	8	18	13:00-14:00 22:00-04:00	13:00-14:00 23:00-04:00
8	19	~	8	31	13:00-14:00 22:00-23:00	13:00-14:00 23:00-24:00
9	1	~	10	31	12:00-13:00 18:00-19:00	12:00-13:00 18:00-19:00
11	1	~	12	31	-	-

HVAC System operation schedule – Living Room

Start date			End date		HVAC System Operation profile	
Month	day	~	Month	day	Weekday	Weekend
1	1	~	5	7	-	-
5	8	~	6	15	-	12:00-13:00
6	16	~	6	22	13:00-14:00	12:00-13:00 18:00-19:00
6	23	~	6	29	13:00-14:00 22:00-23:00	12:00-13:00
6	30	~	7	12	13:00-14:00 22:00-04:00	-
7	13	~	7	20	13:00-14:00 22:00-23:00	
7	21	~	7	25	13:00-14:00 22:00-04:00	12:00-13:00
7	26	~	8	12	13:00-14:00 22:00-01:00	12:00-13:00 18:00-19:00
8	13	~	8	18	13:00-14:00 22:00-04:00	12:00-13:00
8	19	~	8	31	-	-
9	1	~	10	31	12:00-13:00 18:00-19:00	12:00-13:00 18:00-19:00
11	1	~	12	31	-	12:00-13:00

5. Ventilation

Taiwan experiences large day-night temperature fluctuations throughout the summer and mid-seasons of the year (autumn and spring). Due to this climate factor, Taiwan is suitable for night time cooling strategies. This can be achieved by passive ventilation of the core space through openings in the envelope and can achieve reduction in HVAC load.

The following natural ventilation schedules were used in the energy model for the natural ventilation strategy of Orchid House throughout the year.

Natural Ventilation Setting

Space	Ratio of Operable Area Open-Windows and Doors (%)	Start date			End date		HVAC System Operation profile	
		Month	day	~	Month	day	Weekday	Weekend
Tea Terrance &Mech. RM.	100%	5	1	~	10	31	23:00-04:00	23:00-04:00
Mezzanine	100%	5	1	~	10	31	23:00-04:00	23:00-04:00
Measurable Zone South Cavity Area	100%	5	1	~	10	31	23:00-04:00	23:00-04:00

The algorithm used by Energyplus to simulate natural ventilation is Airflow Network based on the AIRNET tool developed by the National Institute of Standards and Technology (NIST), it provides simulation for:

- Envelope leakage
- Operable windows and doors
- Leakage and openings between zones

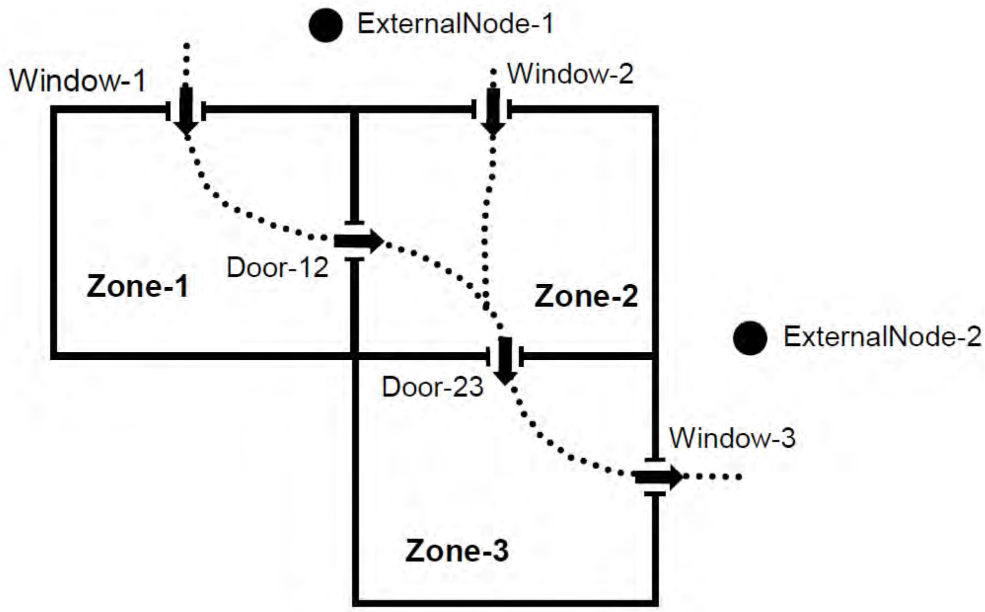


Figure 5.4.2.2.2e Example of Energyplus Airflow Network

Factors influencing Natural Ventilation include:

- Wind speed
- Buoyancy
- HVAC distribution system
- Zone exhaust fan
- Surface leakage
- Large vertical openings(windows and doors)
- Large horizontal openings
- Zone-to-zone airflow

Energyplus control types: Temperature

- All of the zone's openable windows and doors are opened if Tzone > Tout and Tzone > Tset and operation schedule allows venting.
- Tout is the outdoor air temperature,
- Tzone is the previous time step's zone air temperature,
- Tadjcacent zone is the previous time step's air temperature for the adjacent zone for interior surfaces,
- Tset is the zone natural ventilation set point temperature, in this case is 27°C

6. Indoor Thermal Comfort Setting

The indoor environmental comfort temperature range is set at 26.5°C in the summer, and 20°C in the winter.

2.3 Housing Unit Energy Loads

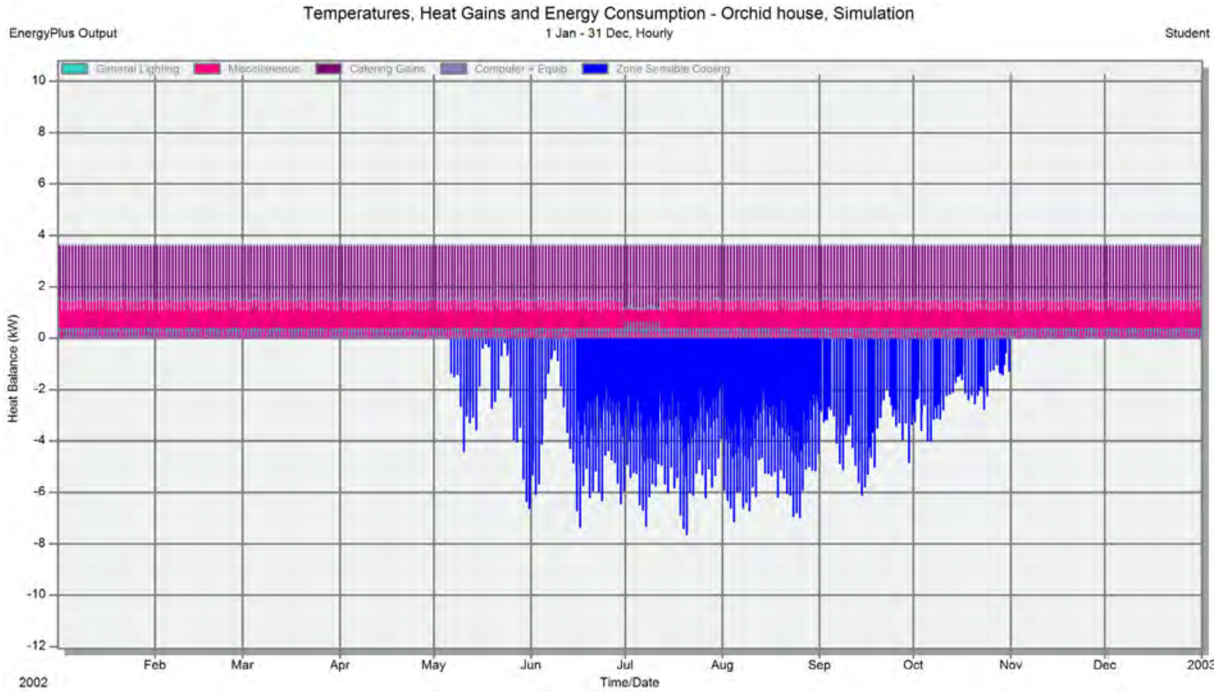
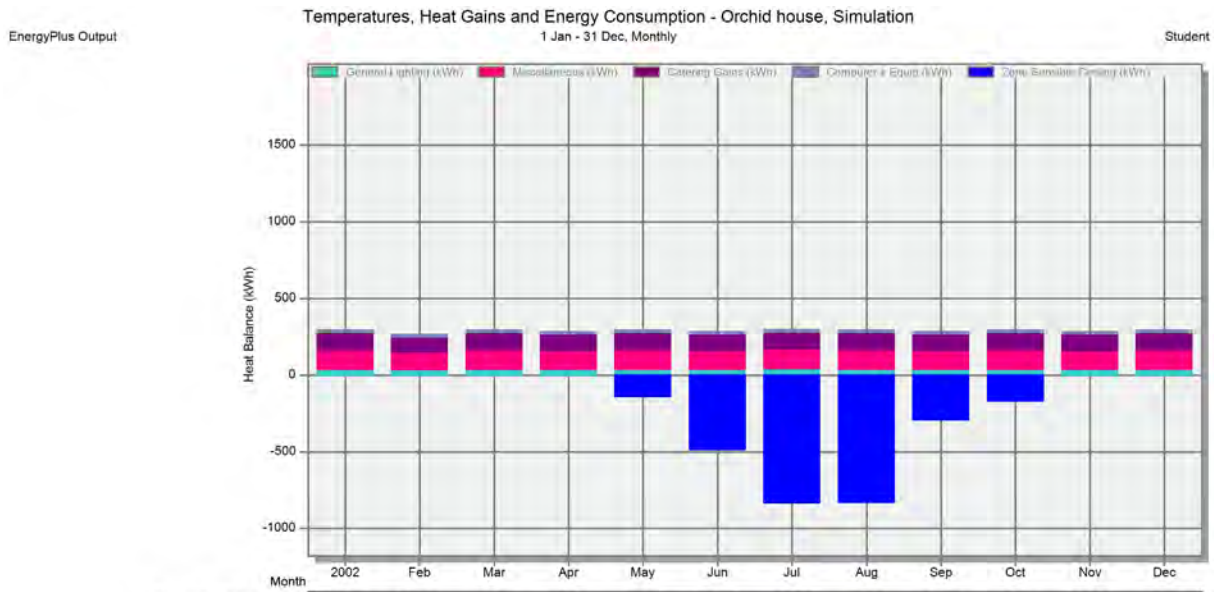


Figure 5.4.2.2.2f Housing Energy Loads Simulation Result - Hourly



Month	2002	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
General Lighting (kWh)	38.66	34.90	38.51	37.61	38.51	37.65	42.64	38.51	37.46	38.66	37.30	38.82
Miscellaneous (kWh)	127.78	115.42	127.78	123.66	127.78	123.66	127.78	127.78	123.66	127.78	123.66	127.78
Catering Gains (kWh)	110.05	99.40	110.05	106.50	110.05	106.50	110.05	110.05	106.50	110.05	106.50	110.05
Computer + Equip (kWh)	15.38	13.92	15.56	14.65	15.56	15.02	15.20	15.56	14.84	15.38	15.02	15.20
Zone Sensible Cooling (kWh)	0.00	0.00	0.00	0.00	-138.70	-486.75	-831.94	-830.54	-293.57	-167.53	0.00	0.00

Figure 5.4.2.2.2g Housing Energy Loads Simulation Result - Monthly

Housing Unit Energy Loads-Annual	
Unit	Energy Loads (kWh)
Appliances	2891.58
Lighting	328.02
Cooling Load	3893.53
Heating Load	179.11

3.0 Results and Discussions

3.1 Heat gains and losses by the building envelop

Figure 5.4.2.2.2h shows the simulation result of annual heat balance of the Orchid House. Most of the heat gains are solar heat gain from exterior and interior windows. As a result, it is sufficient to save energy by changing wall materials and glazing with lower Solar Heat Gain Coefficient.

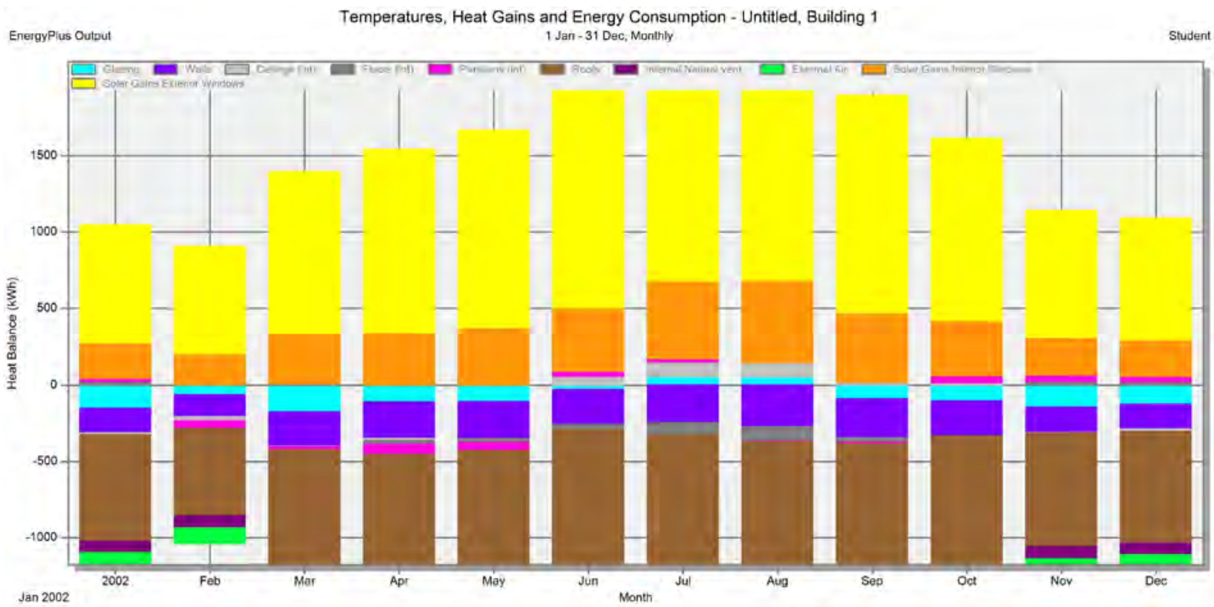


Figure 5.4.2.2.2h Monthly heat gains and losses by the building envelop

The type of Heat Gains occurs in the Orchid House:

- Glazing - the total heat flow to the zone from the glazing, frame and divider of exterior glazing.
- Solar Gains Exterior Windows - Short-wave solar radiation transmission through all external windows.
- Solar Gains Interior Windows - Total beam + diffuse solar radiation transmission through interior windows.
- Walls - Sum of heat gains to the zone from external wall inner surfaces.
- Roofs - Sum of heat gains to the zone from external roof inner surfaces.
- Ceilings - Sum of heat gains to the zone from ceiling inner surfaces.
- Floors - Sum of heat gains to the zone from internal floor inner surfaces.
- Partitions - Sum of heat gains to the zone from internal partition inner surfaces.

- Internal Natural Ventilation - heat gain from other zones due to air exchange through open internal windows, doors, vents, holes.

3.2 Predicted indoor temperatures in passive days

The results of the indoor temperature fluctuation for the Measureable Area and various Buffer Zones during each season (Figure 5.4.2.2.2h) show that without natural ventilation, the Measurable Area throughout the year experiences less temperature fluctuation than the adjacent Buffer Zones.

The spikes in temperature in the Measurable Area can be attributed to the use of household culinary appliances such as the stove or oven. Due the thermal insulation of the designed envelope is, heat emission from appliances in the interior of the building will accumulate and cause the indoor temperature to rise. Therefore, in the summer and mid-seasons, without the operation of mechanical cooling, the Measureable Area can reach temperatures higher than the surrounding Buffer Zones. In the winter, the thermal insulated envelope allows the interior to stay in the range of 25°C even when outdoor temperature is an average of 15°C. This shows that the Measurable Area is within thermal comfort conditions without the need of any mechanical heating.

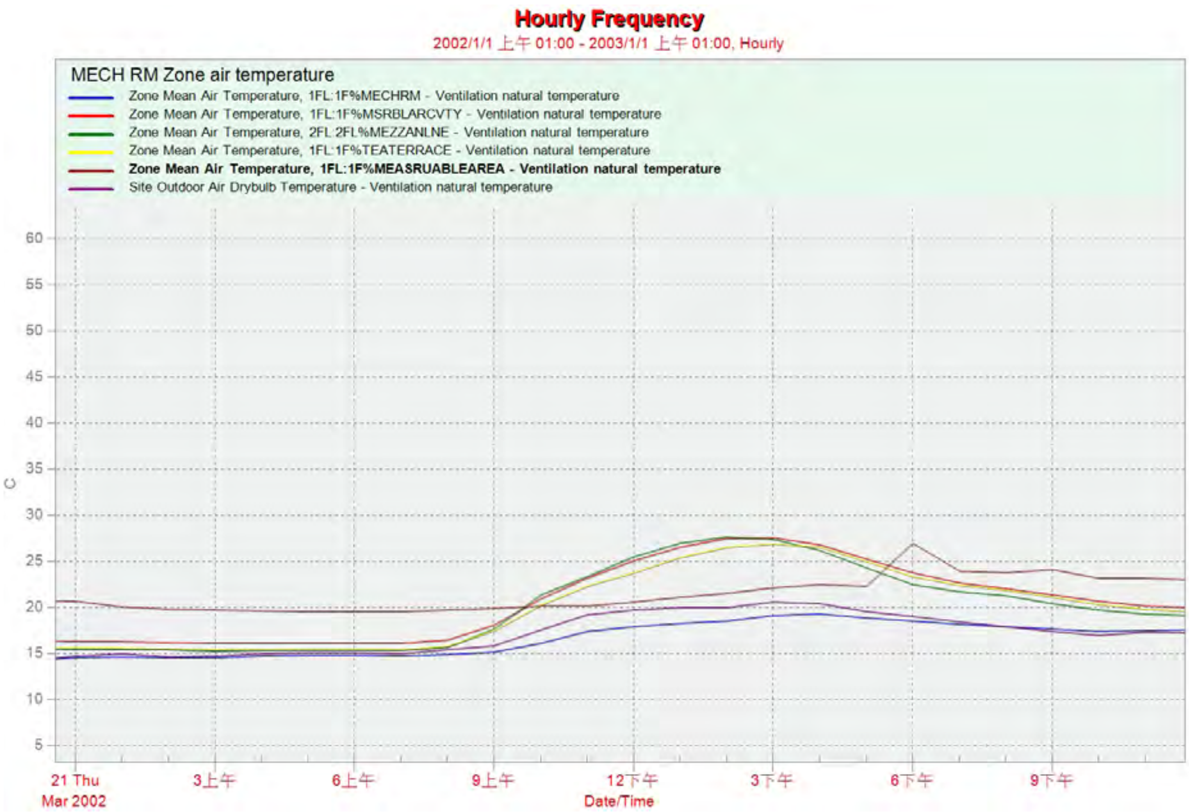


Figure 5.4.2.2.2i Summer Solstice Zone Air temperature comparison between several spaces

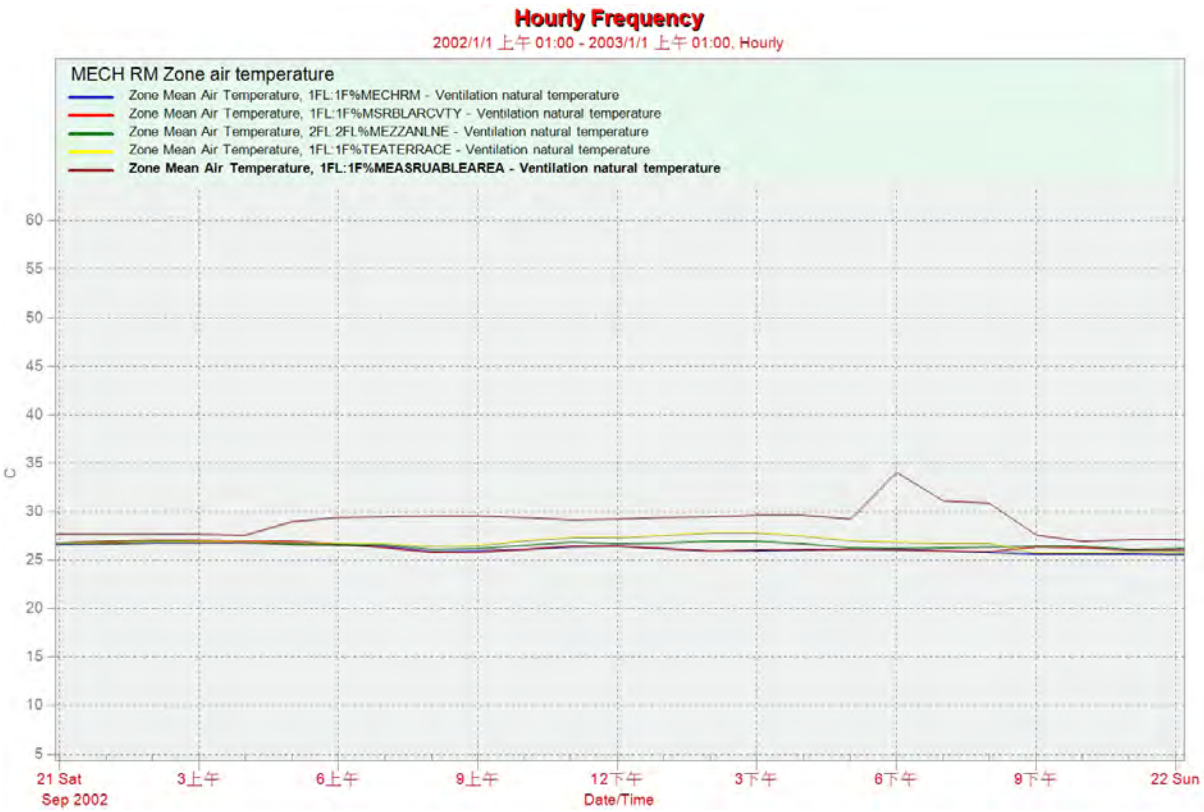


Figure 5.4.2.2.2j Autumn Equinox Zone Air temperature comparison between several spaces

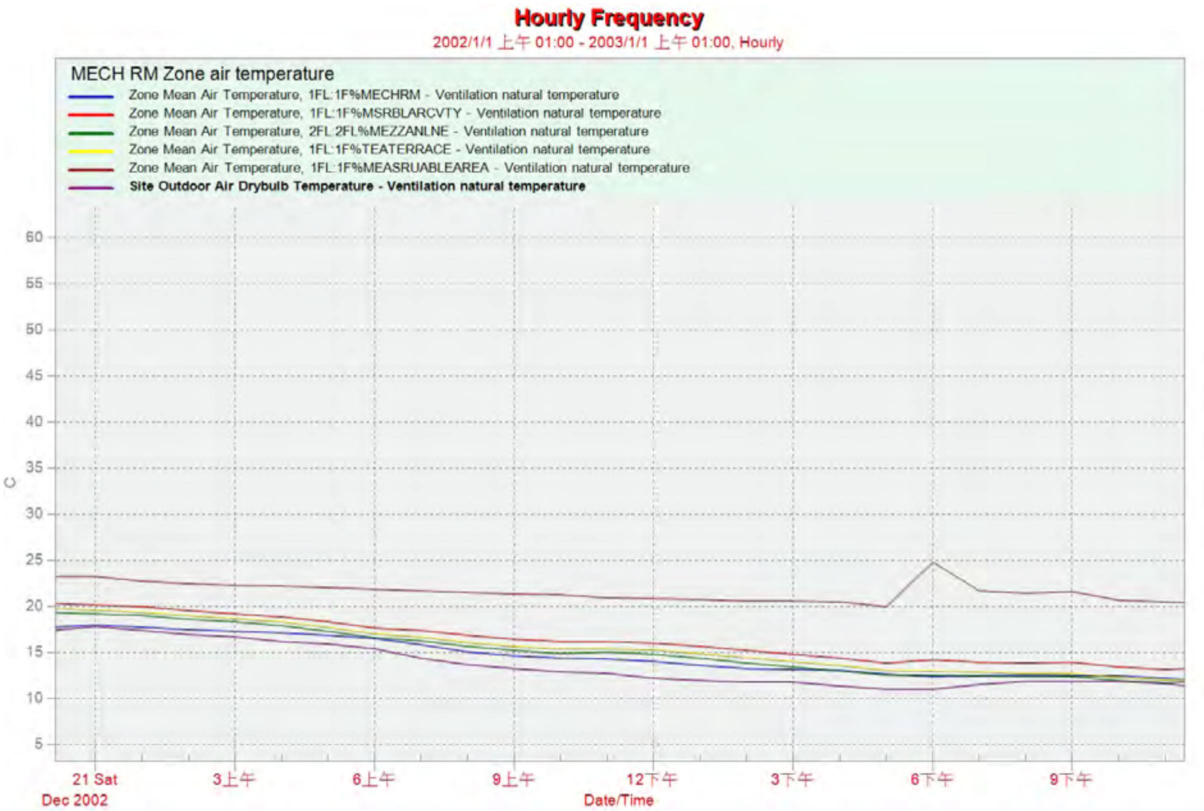


Figure 5.4.2.2.2k Winter Solstice Zone Air temperature comparison between several spaces

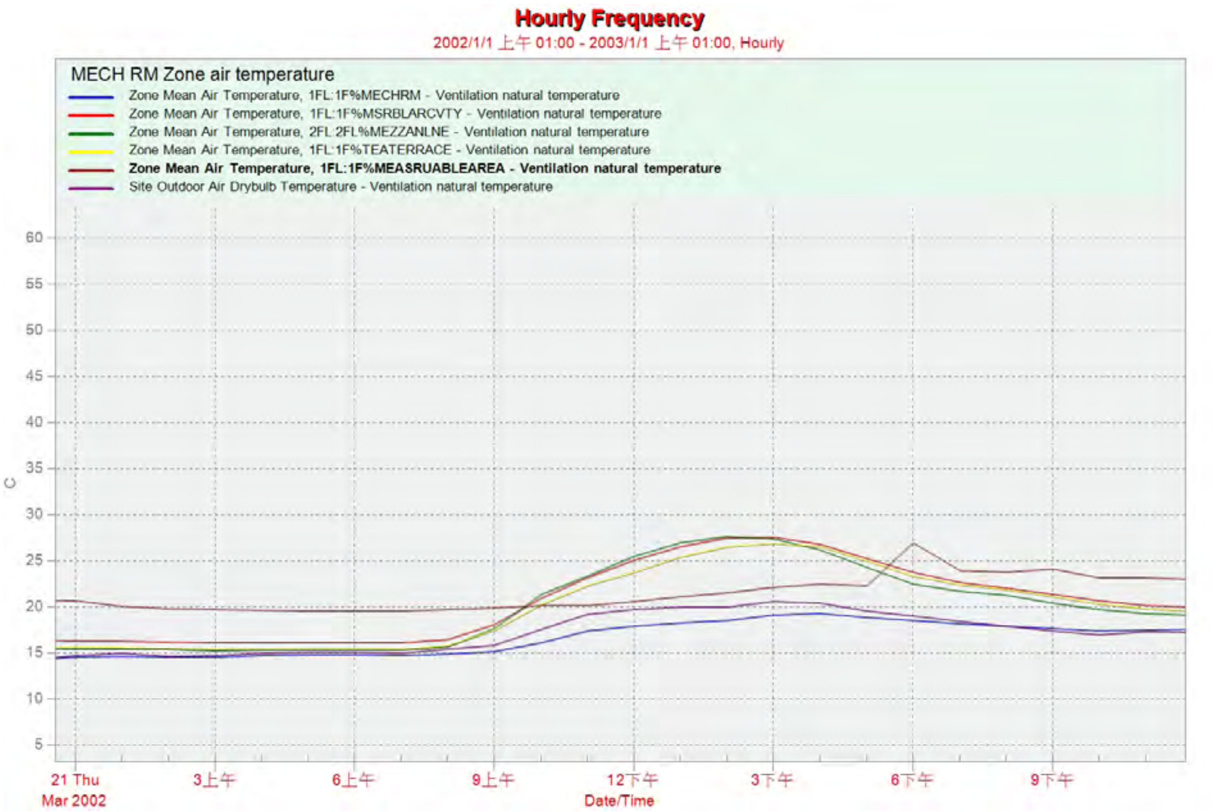


Figure 5.4.2.2.2l Spring Equinox Zone Air temperature comparison between several spaces

3.3 HVAC Selection Criteria

The HVAC system is selected to meet the following basic criteria:

- Appropriate size: the cooling and heating capacity is larger than the cooling and heating loads calculated based on the extreme yearly conditions.

Maximum Load, kW		Heat Pump Capacity, kW	
Cooling	Heating	Cooling Mode	Heating Mode
10.8(Taipei) 7.4(Versailles)		• Indoor unit: 4.7 + 4.7 = 9.4 • Outdoor unit: 11.2	
	0.8(Taipei) 7.7(Versailles)		• Indoor unit: 5 + 5 = 10 • Outdoor unit: 12.5

1. To achieve high energy – efficiency

The high energy-efficient elements of HVAC system is selected to achieve the goal of saving energy in the cooling and heating of the human.

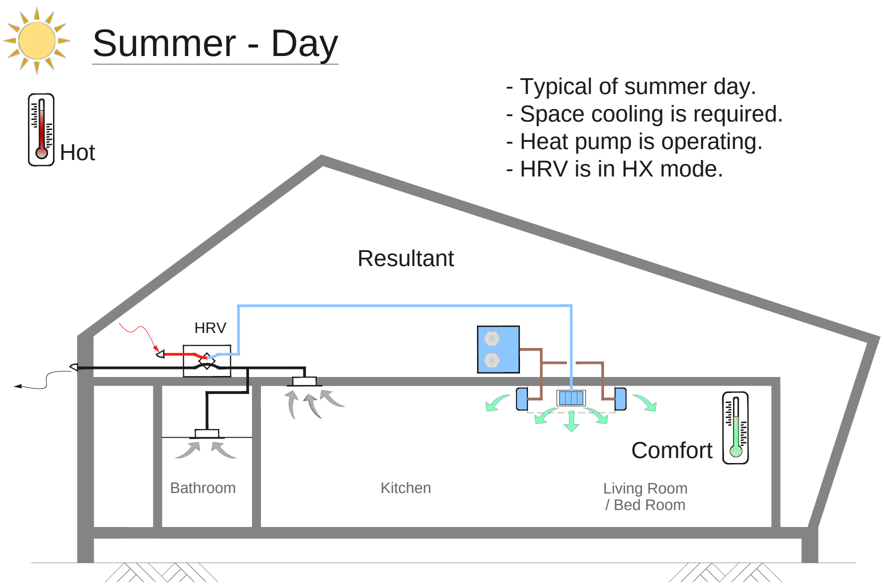
i. Heat pump selected with one of the highest efficiency in the industry: 6.7 IEER and 3.8 COP.
ii. Energy recovery ventilation with highly efficient energy recovery of 76% efficiency is selected and automatically switched between heat exchanger and bypass.

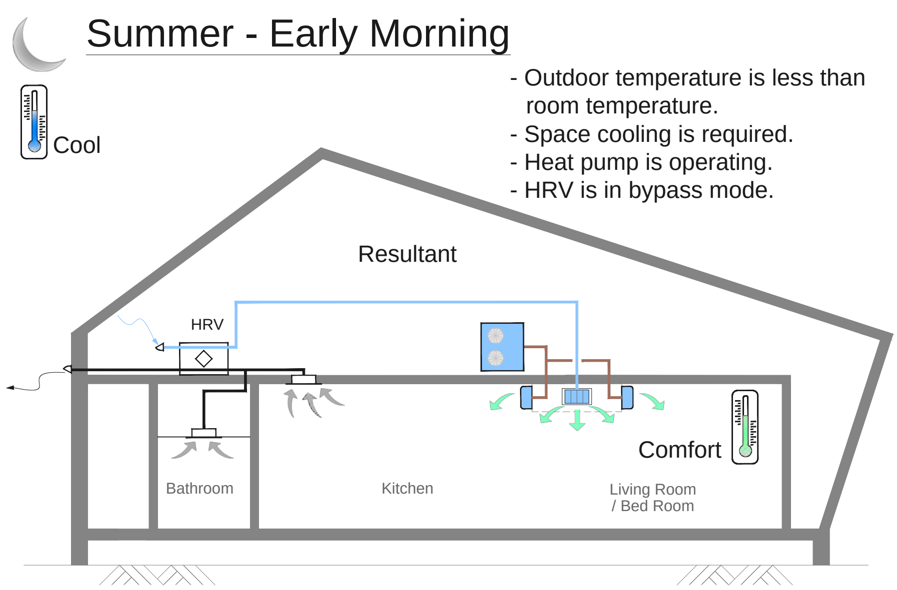
3. To keep the noise generated by the HVAC elements low to help the room stay within the limits for noise.

i. Final design of HVAC system
The HVAC System consists of cooling, heating and ventilation system.

ii. Cooling System

- The air-conditioning equipment for the space cooling is a heat pump system comprising one outdoor unit and two indoor units.
- The heat pump features the R-410A refrigerant for its zero ODP effect and for energy saving. Other major breakthrough technologies include the reluctance DC scroll compressor, area spiral fan DC fan motor and super area grille. All these features can help achieve the high overall energy efficiency – the COP is 3.8 based on the indoor temperature of 27°C DB / 19°C WB and outdoor temperature of 35°C DB.
- The heat pump with DC inverter achieves the excellent partial load performance.

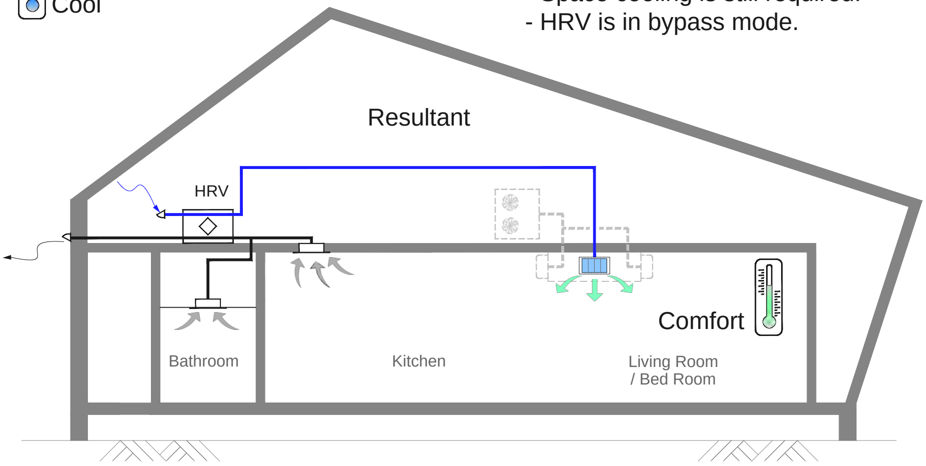




Spring - Night

Cool

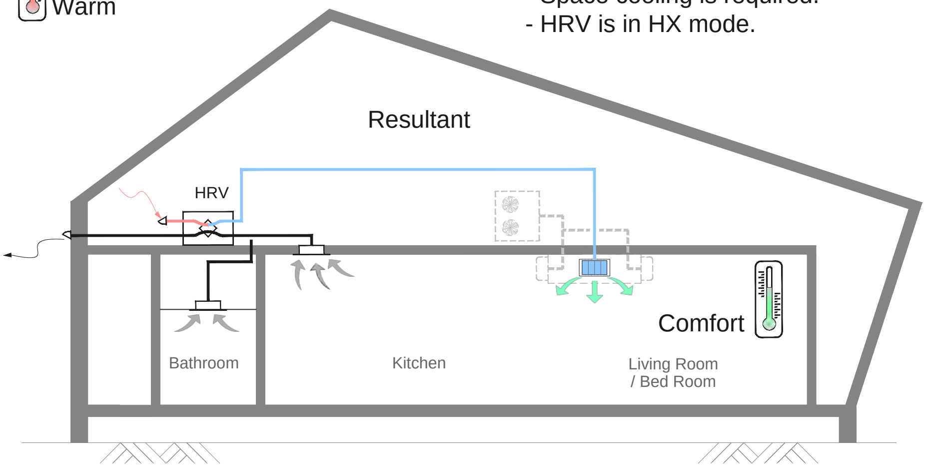
- Outdoor temperature is much less than room temperature.
- Space cooling is still required.
- HRV is in bypass mode.

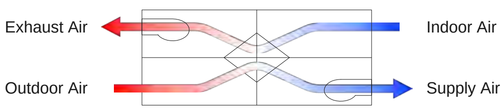


Spring - Day

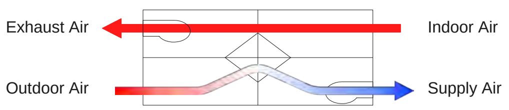
Warm

- Outdoor temperature is higher than room temperature.
- Space cooling is required.
- HRV is in HX mode.





HRV - Heat Exchange Mode



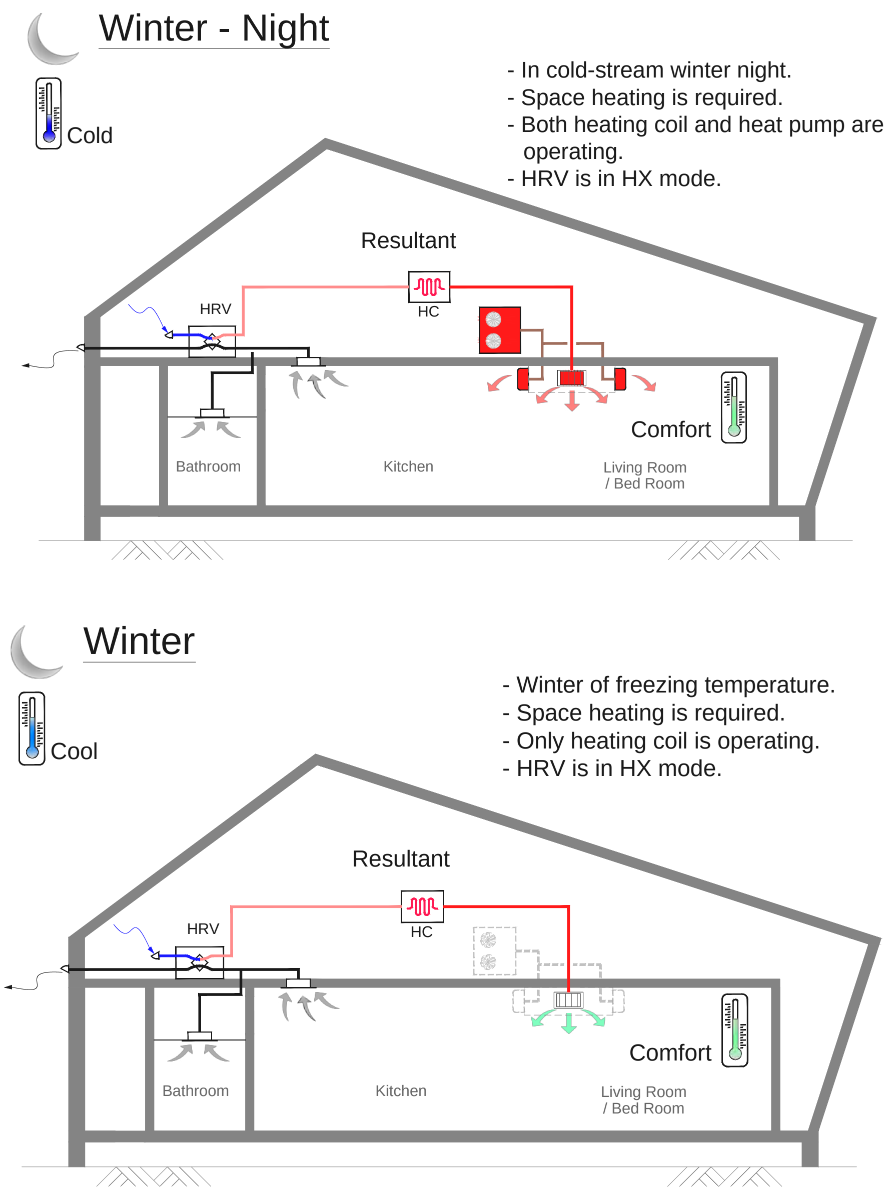
HRV - Bypass Mode

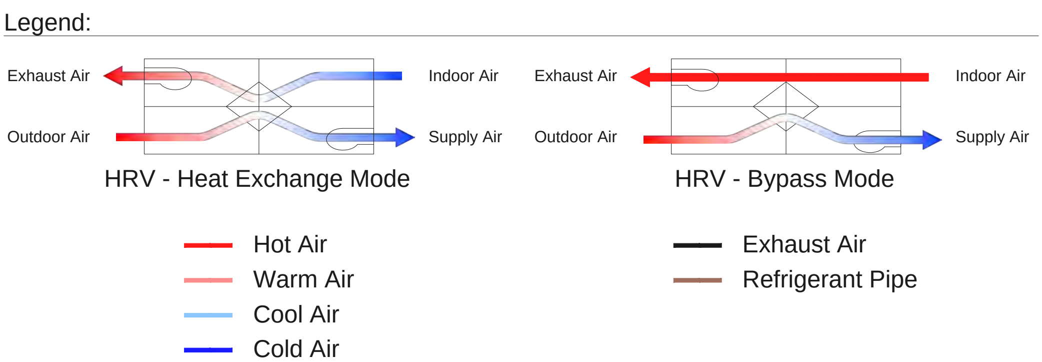
Hot Air
Warm Air
Cool Air
Cold Air

Exhaust Air
Refrigerant Pipe

ii. Heating System

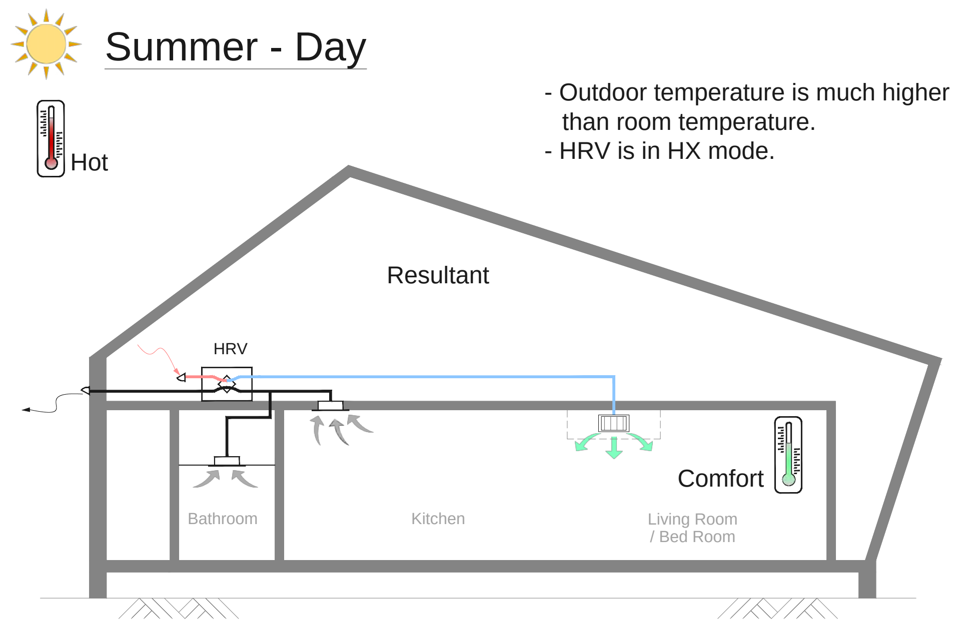
- Since the winter temperature is not severe in Taiwan, the required heat can be provided from the ventilation system – the heating coil on the fresh air supply duct. The heat source of the heating coil comes from the solar energy, i.e. the energy harnessed by the solar thermal collector.
- During a few especially cold winter days, the heat pump operates.

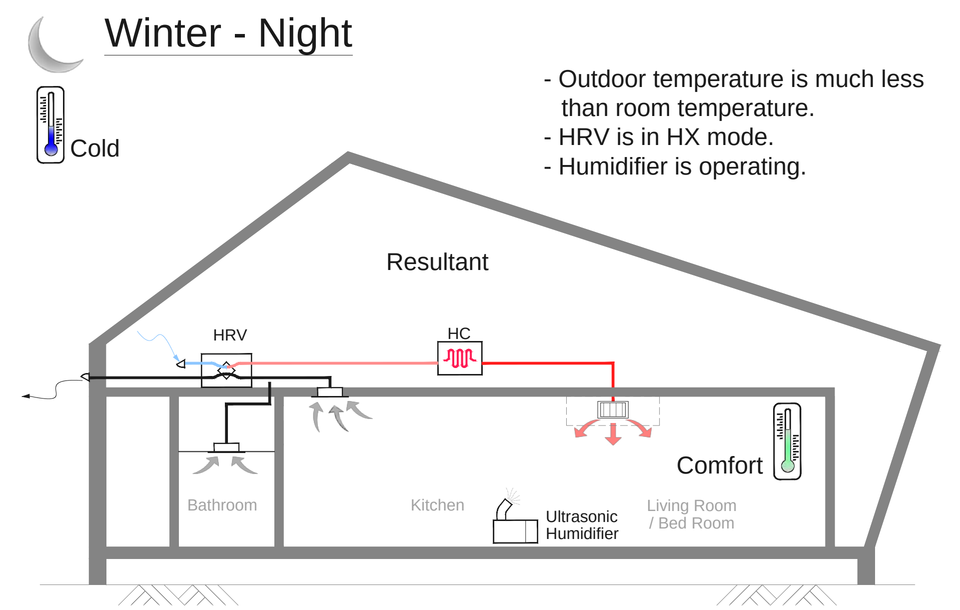




iii. Ventilation System

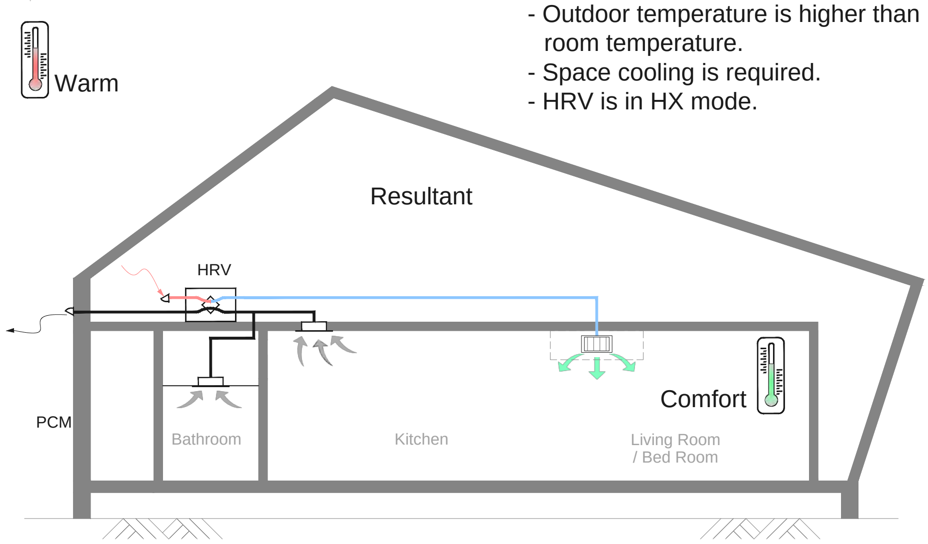
- Fresh air is supplied at all times of the day with intermittent stop while the room's CO_2 concentration is lower than the predetermined value – 800 ppm. Clean air obtained thanks to fine filter Class F7 in the fresh air inlet and Class G4 in the exhaust air.
- The HRV (Heat Reclaim Ventilation) is a highly efficient heat recovery system which recovers the thermal energy of exhaust air and reuses it for heating or cooling of supply air. The enthalpy exchange efficiency can achieve 66% in cooling operation and 72% in heating operation.
- The heat recovery mode and bypass mode are to be selected considering the indoor and outdoor temperature to achieve the high energy saving and good thermal comfort.





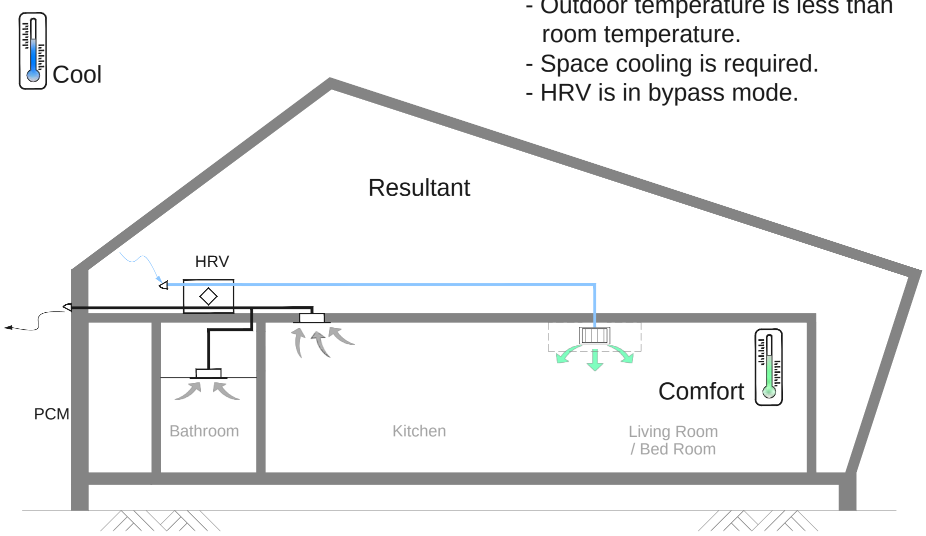
Spring - Day

- Outdoor temperature is higher than room temperature.
- Space cooling is required.
- HRV is in HX mode.

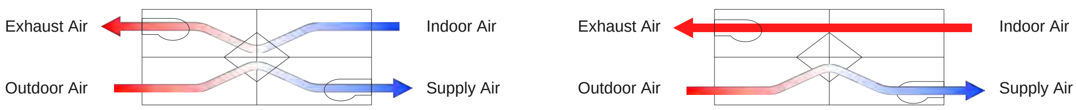


Spring - Night

- Outdoor temperature is less than room temperature.
- Space cooling is required.
- HRV is in bypass mode.



Legend:



HRV - Heat Exchange Mode HRV - Bypass Mode

iv. The fresh air intake is sucking in the air from the space underneath the floor, where the ambient air is precooled by the earth masses.

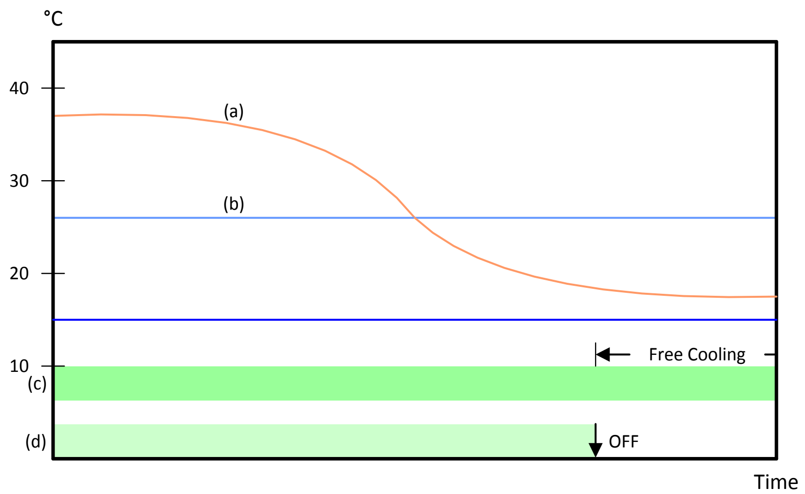
v. Other High Efficiency and Performance Strategies

- Control system integrates the heat pump and HRV:

1. Automatic Ventilation Mode Changeover

Operation	Sensor of Ventilation	Mode of Operation
Cooling	Indoor Temp. > Outdoor Temp.	Bypass
	Indoor Temp. < Outdoor Temp.	Heat Recovery
Heating	Indoor Temp. > Outdoor Temp.	Heat Recovery
	Indoor Temp. < Outdoor Temp.	Bypass

2. Free Cooling



(a) Outside Temperature
(b) Room Temperature
(c) Operation State of HRV
(d) Operation State of Heat Pump

3. The automatic ON/OFF of HRV and heat pump is operated according to the pre-set conditions or through the BAS after confirming the status of the occupants' presence.
4. With the standard interface for BACnet and LonWorks, it is integrated with the House's BAS System.

- The Optimal Operations
  The optimal operations by combining above equipment and systems to achieve the maximum energy saving are shown in the following drawings.

3.4 Predicted Heating and cooling loads and HVAC energy demand

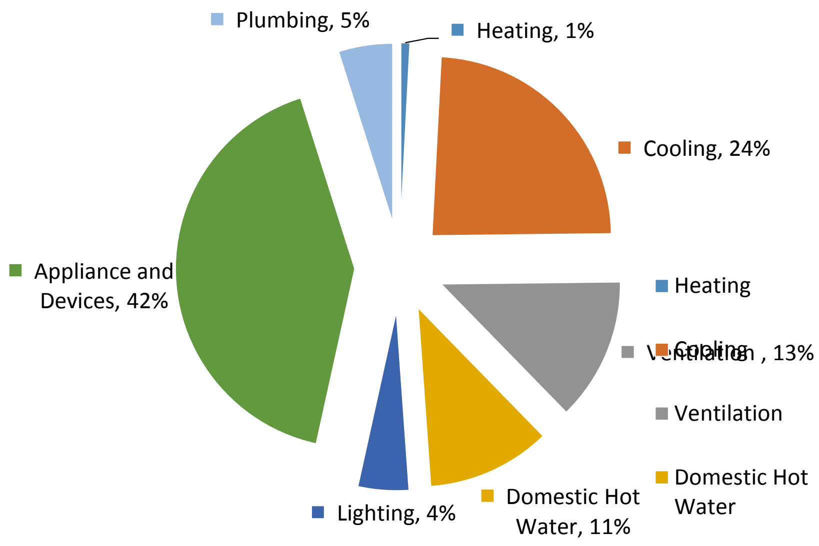
From the Energyplus simulation, the whole year cooling load is 3893.53kWh, and heating load is 179.11kwh. Transys program turns the heating and cooling loads into HVAC consumption. The yearly HVAC energy demand is 1718kWh (Cooling energy) +58.5 kWh (Heating energy) =1776.5kWh/year.

3.5 Housing unit performance

The annual nergy Demand of the Orchid House in Taipei:

Energy Use Characterization	Demand Energy (kWh/year)	% of Total Energy consumption
Heating	58.5	0.82%
Cooling	1718	24.00%
Ventilation	922	12.88%
Domestic Hot Water	799	11.16%
Lighting	328.02	4.58%
Appliance and Devices	2981.58	41.66%
Plumbing	350	4.89%
Total	7151.1	-
Energy electrical consumption per conditioned (kWh/year per m2)	42.14	

The Annual Energy Demand of the Orchid House in Taipei



4.0 Conclusion

The simulation results provide the NCTU/UNICODE Team information to predict the performance of the Orchid House in both its local site and the competition site. The simulation of Taipei is a year round simulation which helps the team to understand the house's thermal condition in different seasons. The simulation predicts overheated summer due to the large glazing area, and the solution is to change the glass glazing to Polycarbonate sheet which has a lower SHGC of 77%. The simulation also predicts that the high thermal resistance value of wall insulation material prevents heat loss in summer. When the active cooling device is not operating, this insulation keeps the interior heat gain by people, appliance, and lightings indoors. This creates thermal problems to the Measurable Area. The solution is to remove the most expensive insulation material, VIP, from the Orchid House in Taipei. That resolves the overheated problem, and also reduces the overall cost of the house.
The simulation of the contest weeks also predicts the thermal performance of the house in Versailles.

It focuses the two competition weeks. The simulation includes the two passive days when no active devices are operating. The simulation result shows overheated night. Another simulation adds night ventilation to the house and results in a significant temperature drop at night. The team decided to open windows at night during the competition weeks to obtain a better thermal condition.
The simulation also predicts the shortage of thermal hot water system. With the original design, the solar hot water can only provide hot water for domestic use. In order to provide sufficient solar hot water for space heating, the team adds the area of solar collectors.

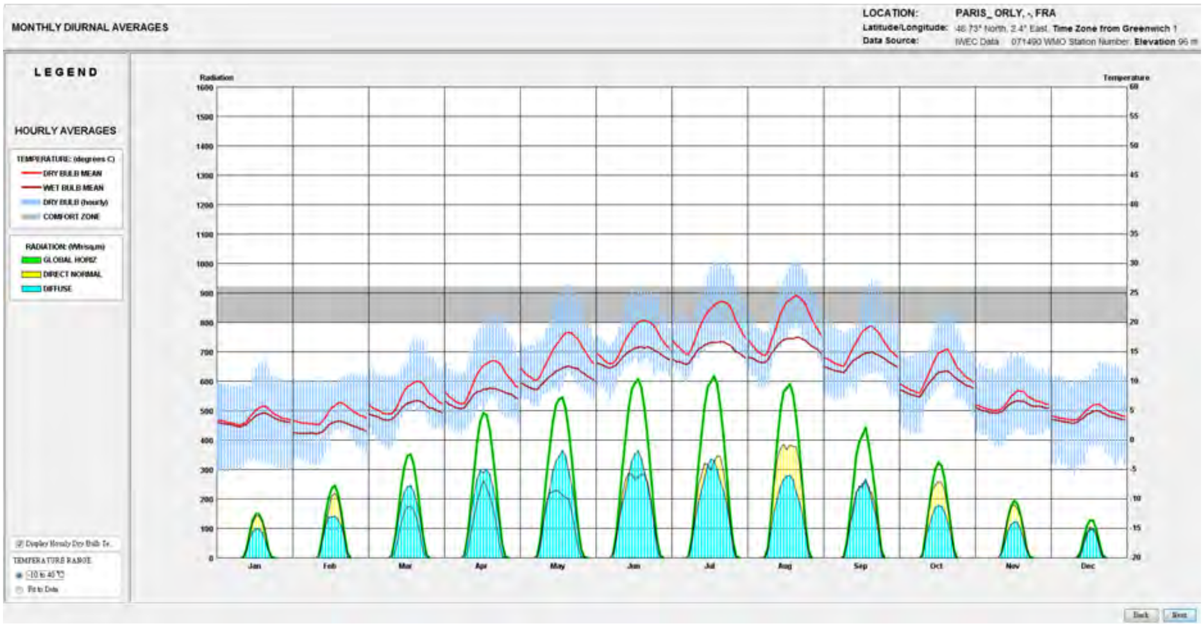
5.4.2 Comprehensive Energy Analysis and Discussion Report

Section III - Adaptations made by the Team in the house for the prototype in Versailles

1.0 Adaptations made by the Team in the house for the prototype in Versailles

1.1 Weather Analysis

The town of Versailles, situated 16 kilometers to the south-west of Paris, sits on an elevated plateau. The four seasons in Versailles are distinctive with comfortable humidity. Winter weather can be wet and windy, and January is predictably the coldest month, when the likelihood of snowy weather is at its highest.
The climate can feel colder if the winds are strong, although daytime temperatures do tend to stay around 6°C / 43°F. However, a dramatic rise in temperature can be expected from March onwards, as summer quickly approaches.
The summer climate in Versailles is often sunny and warm, May to September are historically the driest months. However, even though July and August do see highs of more than 25°C / 77°F, some days can be a little overcast with occasional rainy weather.



The average daily temperature from June to August is 18~20°C. In sunny days, the outdoor temperature may go up to 30°C due to solar radiation. The daily temperature difference may go up to 10°C.
The weather of Versailles is very different from that of Taipei in summer. During the competition weeks, the weather of Versailles needs to be considered as a factor of modification. The design of the prototype needs to consider both insulation and heat loss at daytime, and insulation and heat gain at night time.

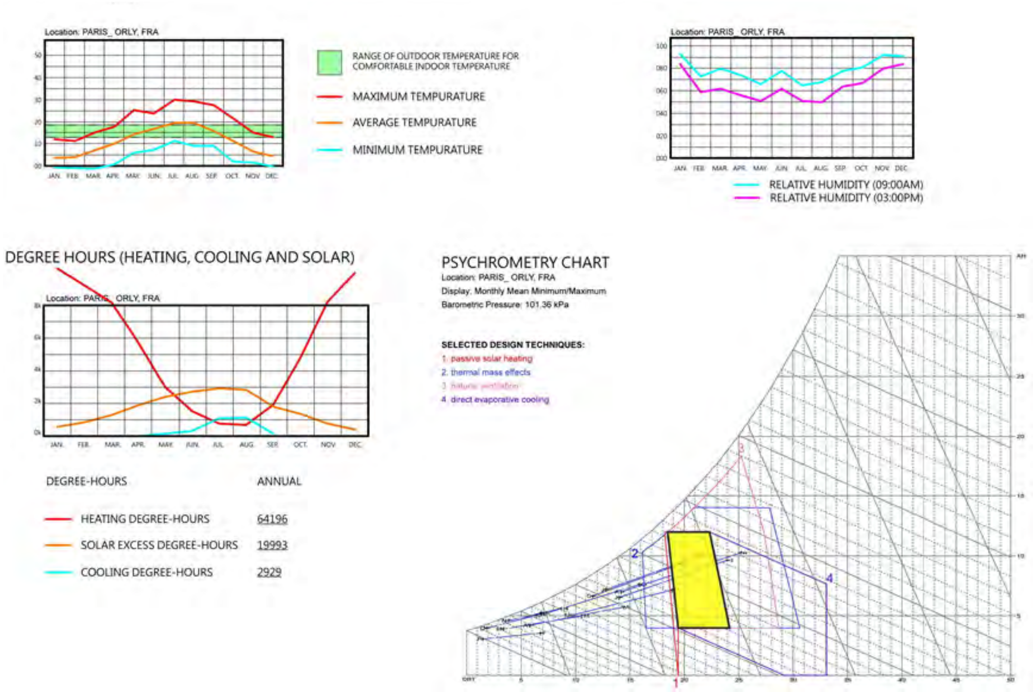


Figure 5.4.2.3.1b Various climate data including Temperature, Humidity, Degree Hours and Psychrometry Chart

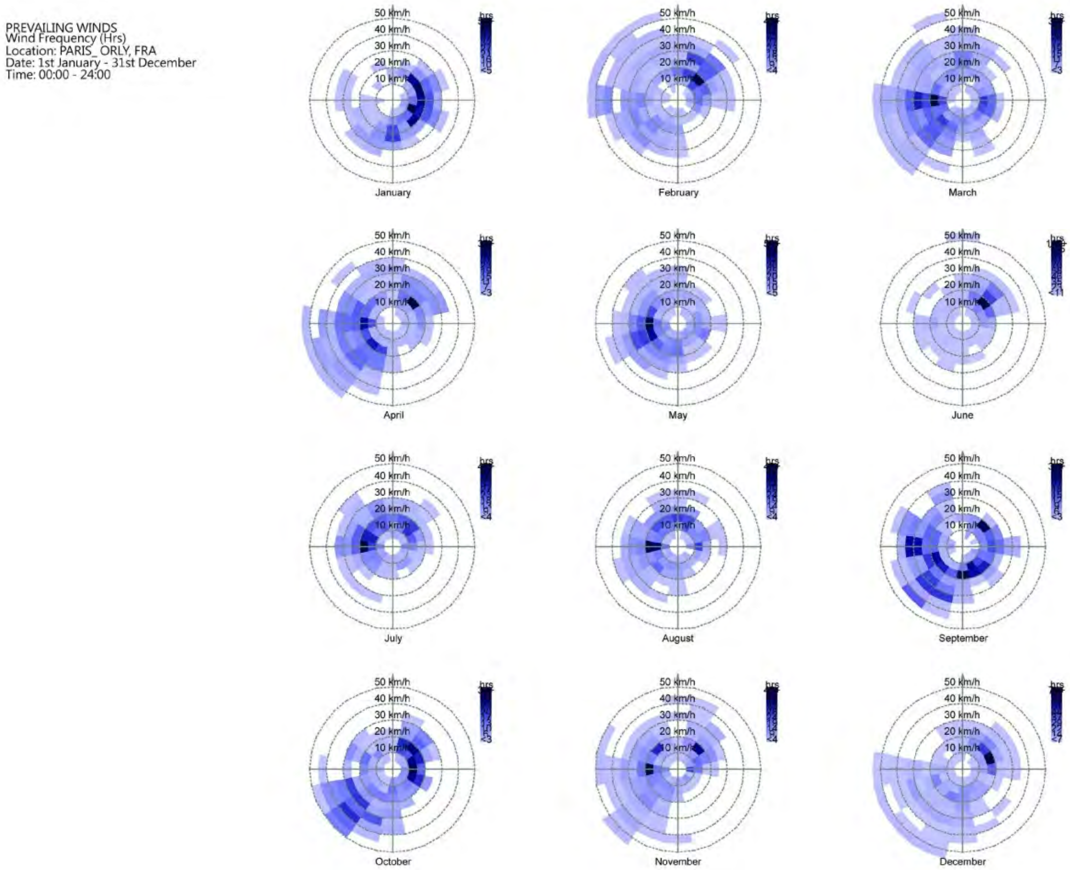


Figure 5.4.2.3.1c Monthly prevailing winds analysis of Paris area

1.2 Adaptations made by the Team in Orchid house

Our adaptation design Strategy included:

- High isolation performance envelop.
- Thermal wall and green house for daily heat storage and diffuse to interior space at night.
- Free cooling system.
- Daily natural ventilation.

2.0 House, Appliances and HVAC Simulations (two competition weeks in Versailles)

2.1 House Passive interior air temperature Simulation

The NCTU/UNICODE Team try to use simulation program to understand the indoor thermal condition during the competition weeks. The following graphics shows the indoor temperature in the measurable area under the condition of interior heat gain from appliances without ventilation.

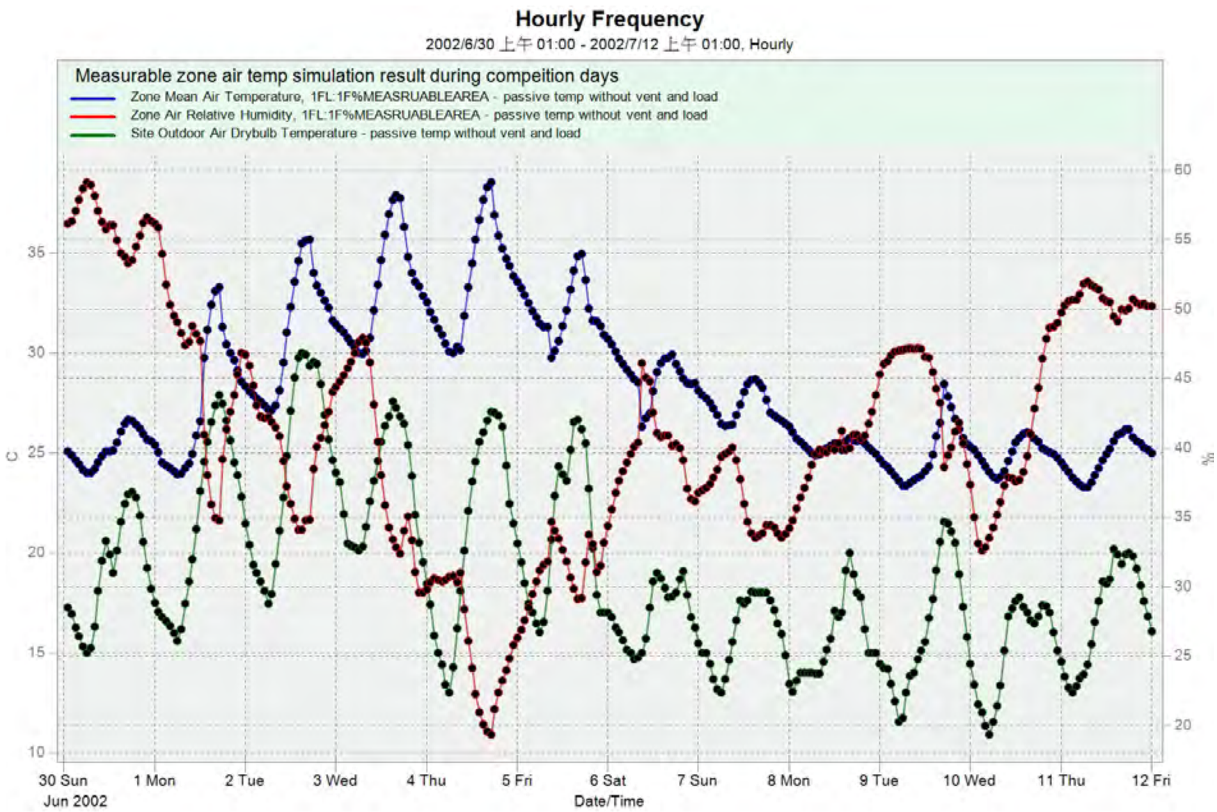


Figure 5.4.2.3.2aMeasurable area air temperature, humidity simulation result

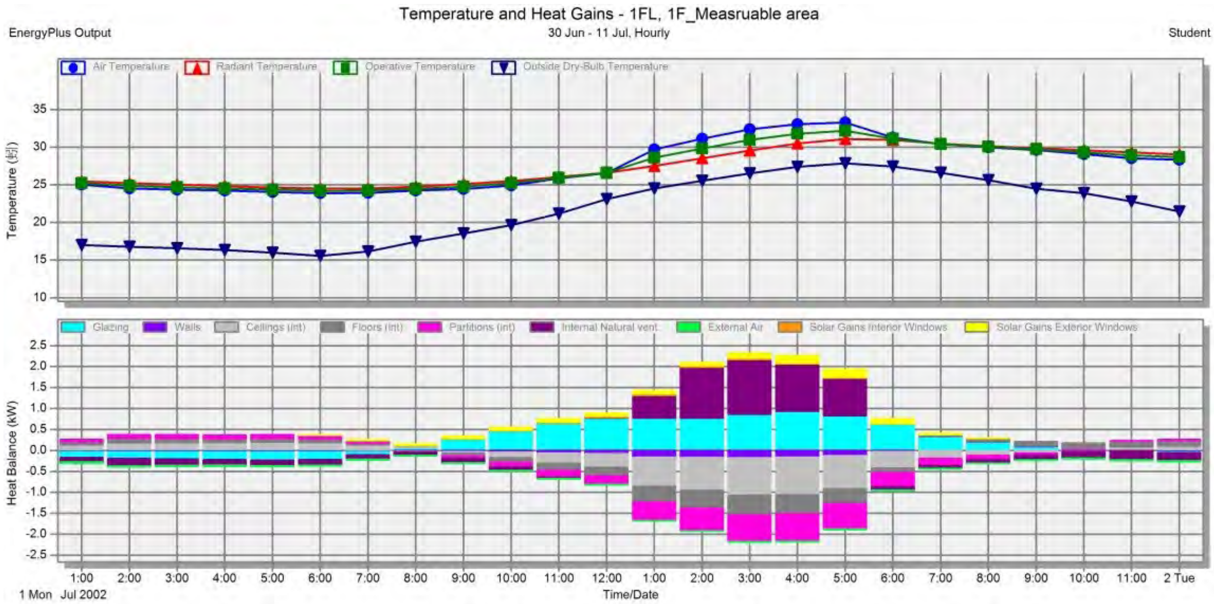


Figure 5.4.2.3.2b Measurable area heat balance simulation in Jul 2

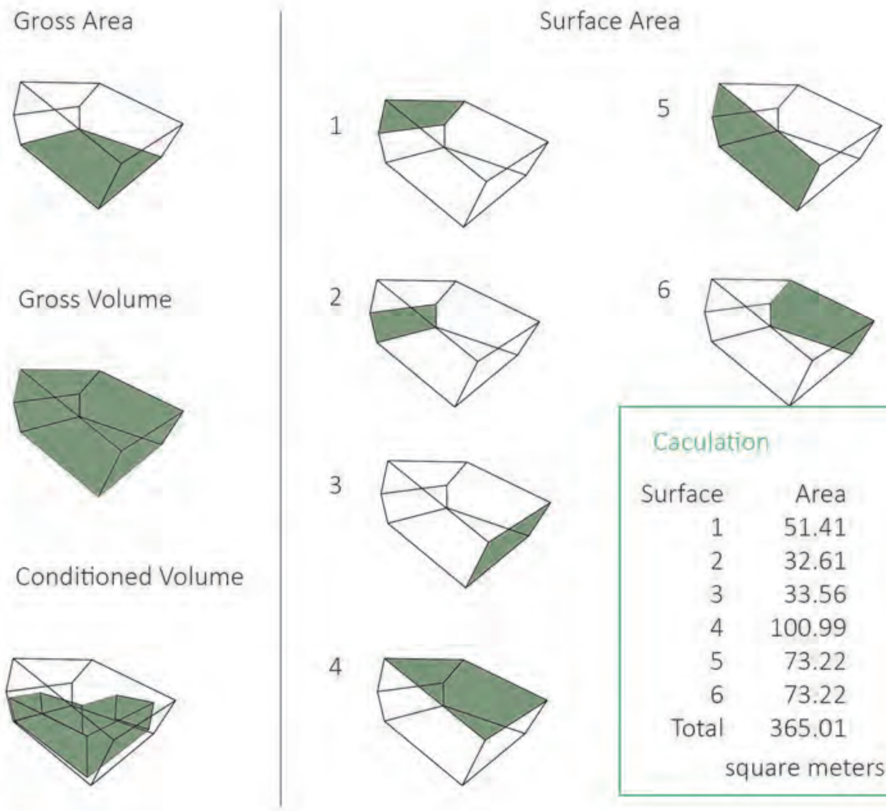
During the sunny days with strong solar radiation, the temperature of the Buffer Zone increases by the solar radiation heat gain through large glazing areas. Because the temperature of the Buffer Zone changes the heat transfer rate from the Measurable Area, the temperature of the Measurable Area is effected.

2.2 Appliances and HVAC simulation

The Orchid House Energy model was calculated by the operation time and frequency according to the competition schedule.

The General Evaulation Period- 12 Days (Base on FRA_Paris.Orly.071490_IWEC TMY3 Climate)														
Item	**End Use Breakdown**	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11	TTL
Total Electricity Consumption (kwh)		23.21	29.63	28.27	29.38	16.63	12.32	11.82	17.94	20.28	21.41	23.79	15.48	250.16
Appliances	Refrigerator/Freezing	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	7.5
	Clothes Washer	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	10.0
	Clothes Dryer	0.39	0.39	0.39	0.39	0.39	0.00	0.00	0.39	0.39	0.39	0.39	0.39	3.9
	Cooking	0.90	1.80	0.90	1.80	0.00	0.00	0.00	0.90	0.90	0.90	1.80	0.00	9.9
	Oven	1.75	3.50	1.75	3.50	0.00	0.00	0.00	1.75	1.75	1.75	3.50	0.00	19.3
	Hood	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	2.0
	Dishwashing	1.06	1.06	1.06	1.06	1.06	0.00	0.00	1.06	1.06	1.06	1.06	1.06	10.6
Devices	TV	0.17	0.17	0.17	0.17	0.17	0.00	0.00	0.17	0.17	0.17	0.17	0.17	1.7
	DVD/Projector	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	2.4
	Notebook	1.08	1.08	1.08	1.08	1.08	0.00	0.00	1.08	1.08	1.08	1.08	1.08	10.8
	ipad	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.4
Lighting	Kitchen	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	2.2
	Living Room	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	1.5
	Workstation/Bedroom	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1.5
	Bathroom	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.6
	Tea Terrance &Mech. RM.	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.7
	Mezzanine	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.9
HVAC	Cooling /Heating/Ventilation	13.91	17.68	18.97	17.43	9.98	9.36	8.86	8.64	10.98	12.11	11.84	8.83	148.6
Plumbing	Domestic Water Pump	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	9.7
	Gray Water Pump	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.5
	Water Wall Pump	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	5.6

1. Project Dimension

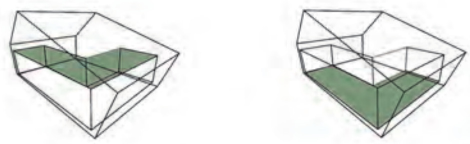


Caculation

Surface	Area
1	51.41
2	32.61
3	33.56
4	100.99
5	73.22
6	73.22
Total	365.01

square meters

Net Floor Area



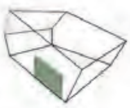
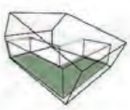
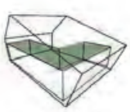
Caculation

Net Floor Area	
2F	71.30
1F	71.30
Total	142.60

square meters

Project Dimensions	
Gross area	116.66 square meters
Gross Volume	683.48 cubic meters
Surface area	365.01 square meters
Net floor area	71.30 square meters
Conditioned Volume	206.06 cubic meters

2. House Envelope
Taipei

	Insulation Type	Thickness (mm)	Thermal Conductivity (W / m*K)	Thermal Transmittance (W/m2k)	Thermal Resistance (m2K)/W	AREA (m2)
Wall AR-341	Exterior Air Film				0.05	
	Polycarbonate	40	0.044	1.1	0.9091	
	Air	75	0.024	0.32	3.125	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	12	0.13	10.83333333	0.0923	
	E Foam	72	0.0379	0.526388889	1.8997	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	3	0.13	43.33333333	0.0231	
	Interior Air Film				0.15	
TOTAL:		238		0.153230057	6.52613	
Wall (Interior)	Interior Air Film				0.15	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	12	0.13	10.83333333	0.0923	
	E Foam	102	0.0379	0.371568627	2.6913	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	3	0.13	43.33333333	0.0231	
	Interior Air Film				0.15	
TOTAL:		153		0.295543159	3.3836	
Thermal Wall AR-342	Exterior Air Film				0.05	
	PET	3	0.51	170	0.0058824	
	Water	250	0.58	2.32	0.4310345	
	PET	3	0.51	170	0.0058824	
	Air	30	0.024	0.8	1.25	
	Plywood	3	0.13	43.33333333	0.0230769	
	E-foam	35	0.0379	1.082857143	0.9234828	
	Plywood	3	0.13	43.33333333	0.0230769	
	Interior Air Film				0.15	
TOTAL:		327		0.349352803	2.8624359	
Floor (1F Deck) Deck M-Area Panel	Interior Air Film				0.15	
	Plywood	16	0.13	8.125	0.1230769	
AR-321	Plywood	18	0.13	7.222222222	0.1384615	
	E Foam	24	0.0379	1.579166667	0.6332454	
	Plywood	12	0.13	10.83333333	0.0923077	
	Plywood	18	0.13	7.222222222	0.1384615	
	E Foam	45	0.0379	0.842222222	1.1873351	
	Glass Foam	65	0.0711	1.093846154	0.9142053	
	Plywood	12	0.13	10.83333333	0.0923077	
	Exterior Air Film				0.15	
TOTAL:		210		0.276288796	3.6194012	
Roof (2F Deck) Deck M-Area Panel	Interior Air Film				0.15	
	Plywood	25	0.13	5.2	0.19231	
AR-322	Air	54	0.024	0.444444444	2.25	
	Waterproof Plasti	2	0.03	15	0.06667	
	Plywood	18	0.13	7.222222222	0.13846	
	E Foam	11	0.0379	3.445454545	0.29024	
	Glass Foam	65	0.0711	1.093846154	0.91421	
	Plywood	12	0.13	10.83333333	0.09231	
	Plywood	18	0.13	7.222222222	0.13846	
	E Foam	100	0.0379	0.379	2.63852	
	Plywood	12	0.13	10.83333333	0.09231	
	E Foam	28	0.0379	1.353571429	0.73879	
	Plywood	9	0.13	14.44444444	0.06923	
	Air	63	0.024	0.380952381	2.625	
	Plywood	12	0.13	10.83333333	0.09231	
	Interior Air Film				0.15	
TOTAL:		429		0.093995539	10.6388	

Appendix B Analysis of Electrical System Performance

A. Orchid House in Taipei

A1. Analysis of Solar Thermal System Performance

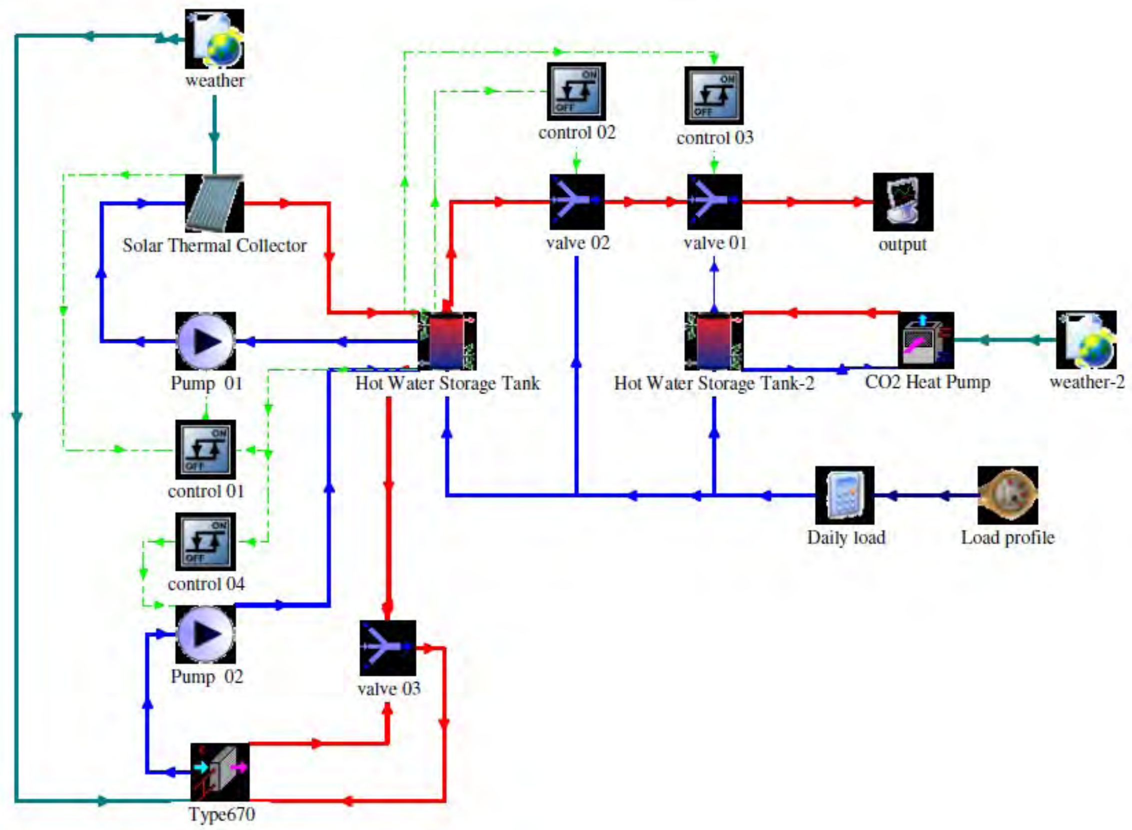


Fig A.1.1 TRNSYS model

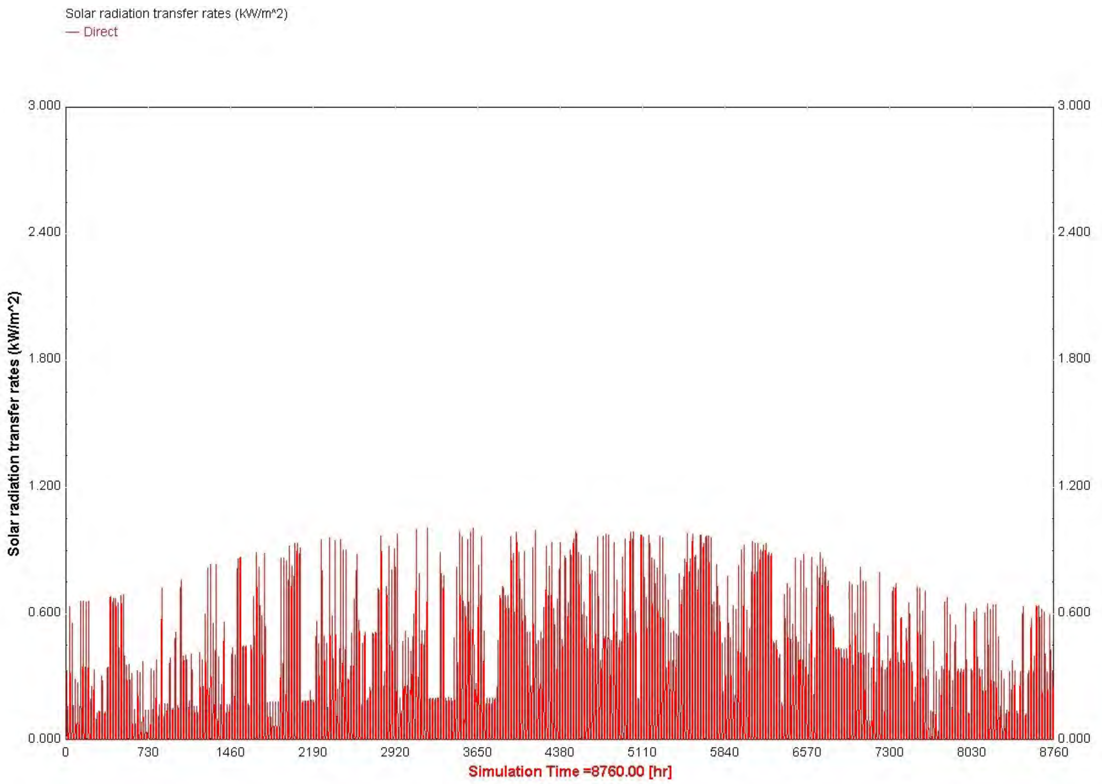


Fig A.1.2 Direct radiation hour of year

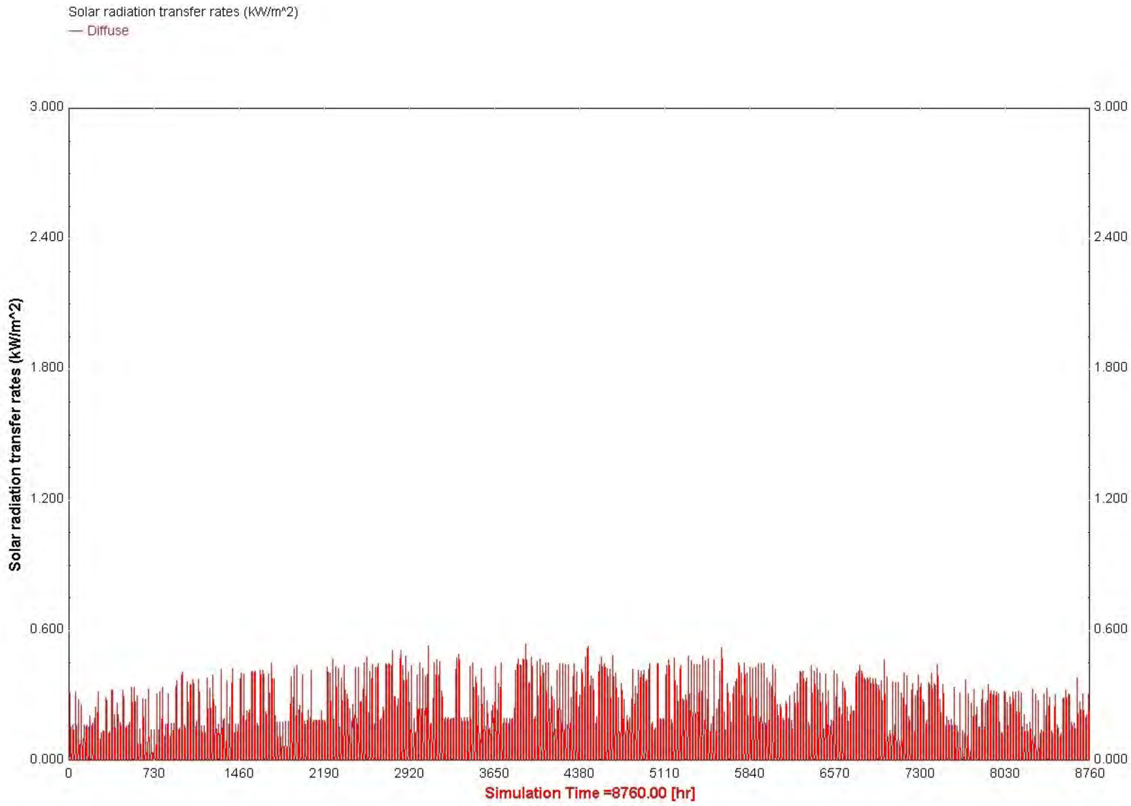


Fig A.1.3 Diffusion radiation hour of year

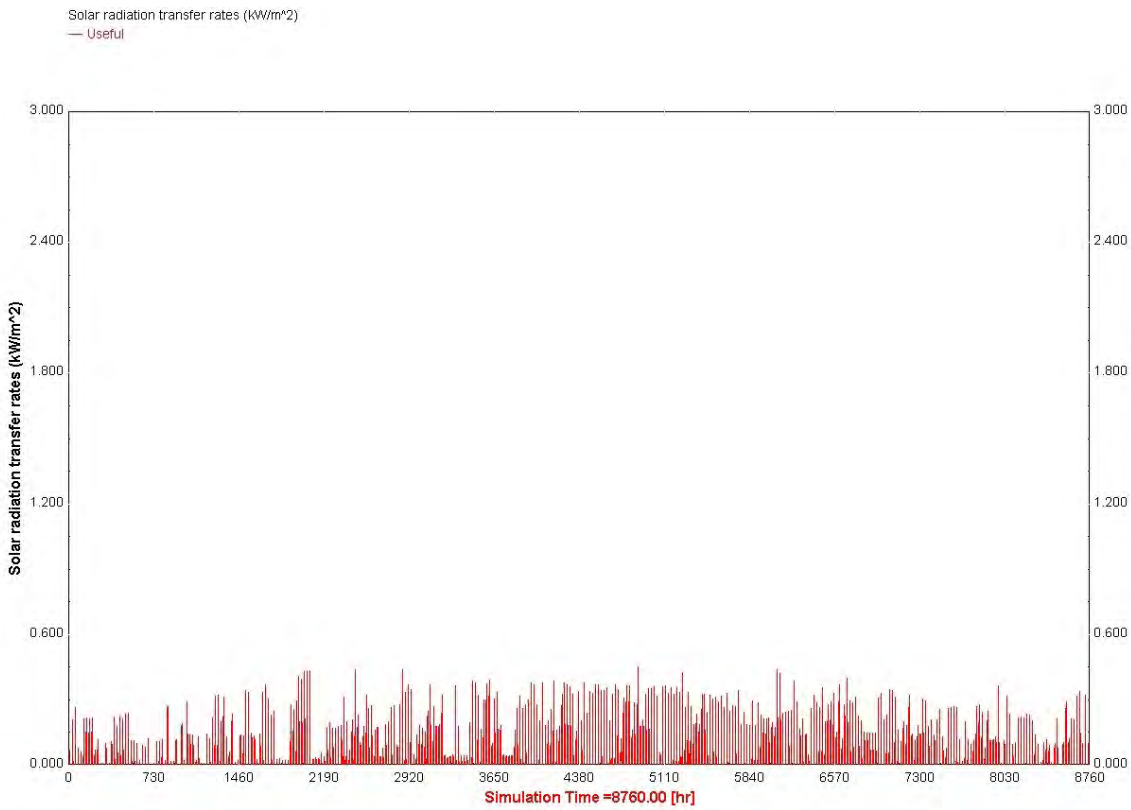


Fig A.1.4 Useful radiation hour of year energy collected from solar collectors

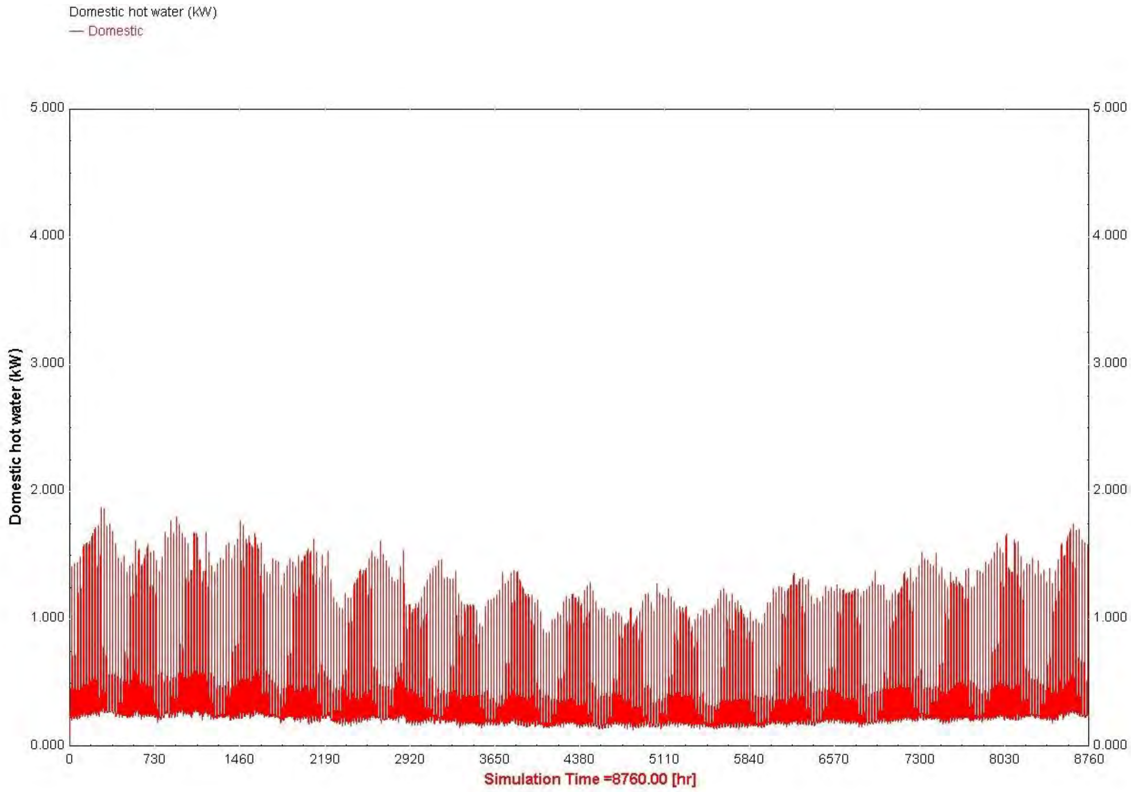


Fig A.1.5 Heating load – domestic hot water

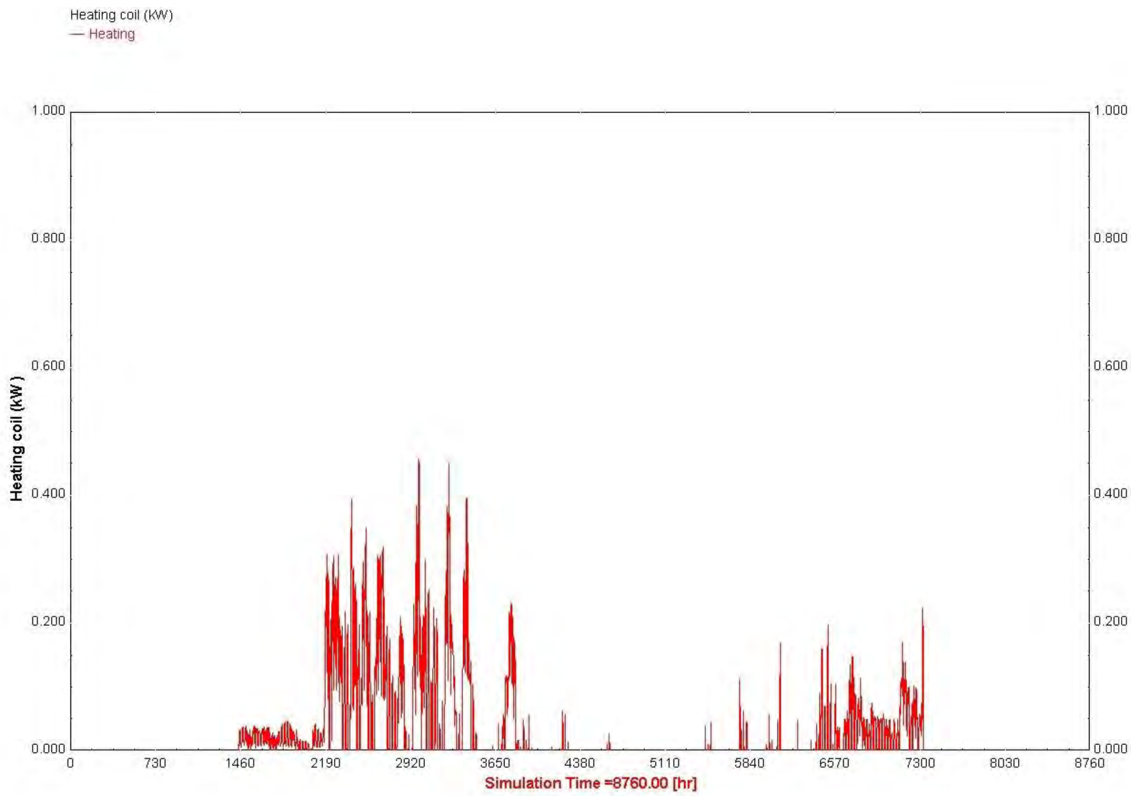


Fig A.1.6Solar thermal energy available for space heating –solar energy collected deducts the energy consumed by heating the domestic water, hour of year

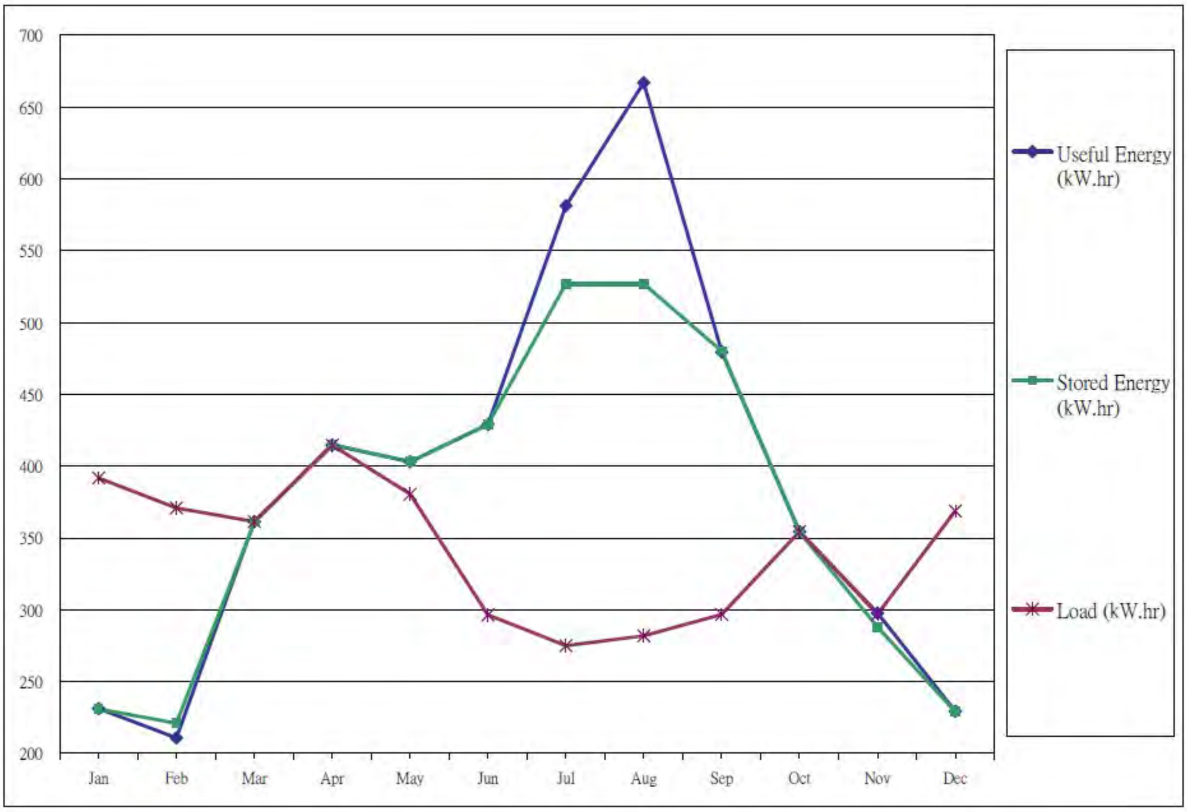


Fig A.1.7 Useful Energy, stored energy and heating load (domestic water plus space heating) profile, hour of year

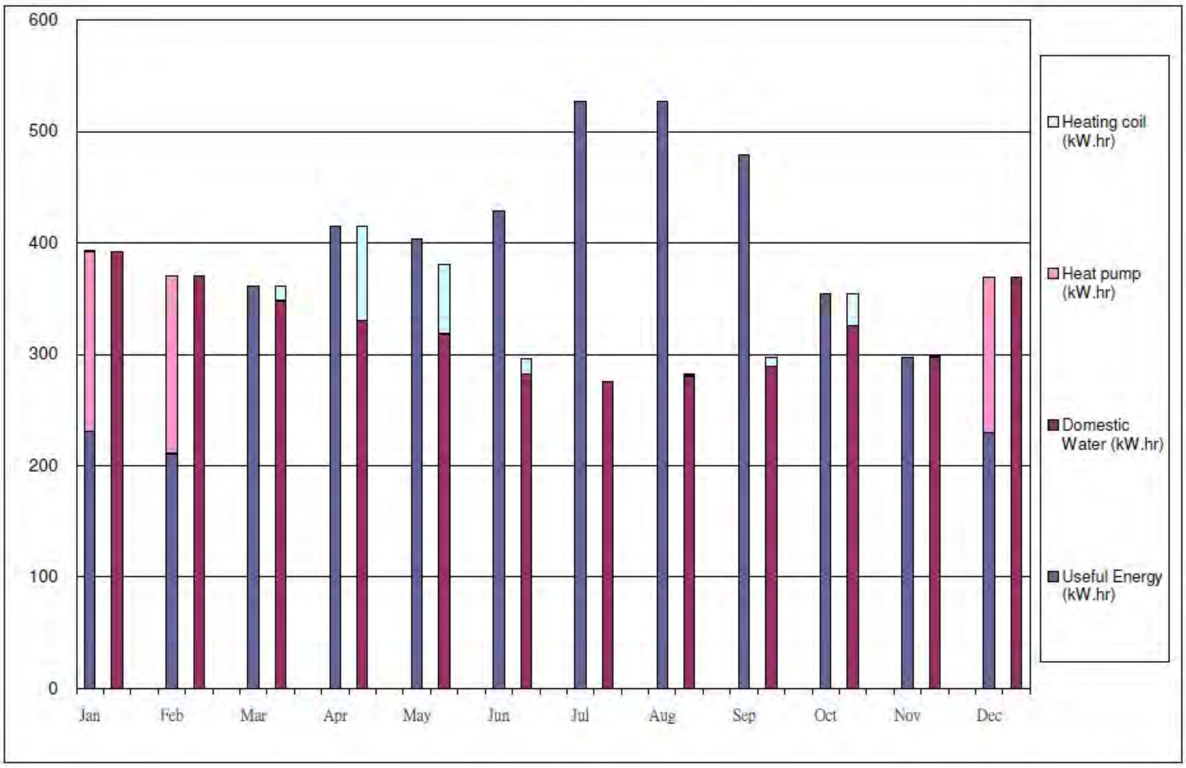


Fig A.1.8 Result of solar thermal system's performance –
solar energy collected, heat pump generation and energy consumed, hour of year

A1. Analysis of HRV'S Performance

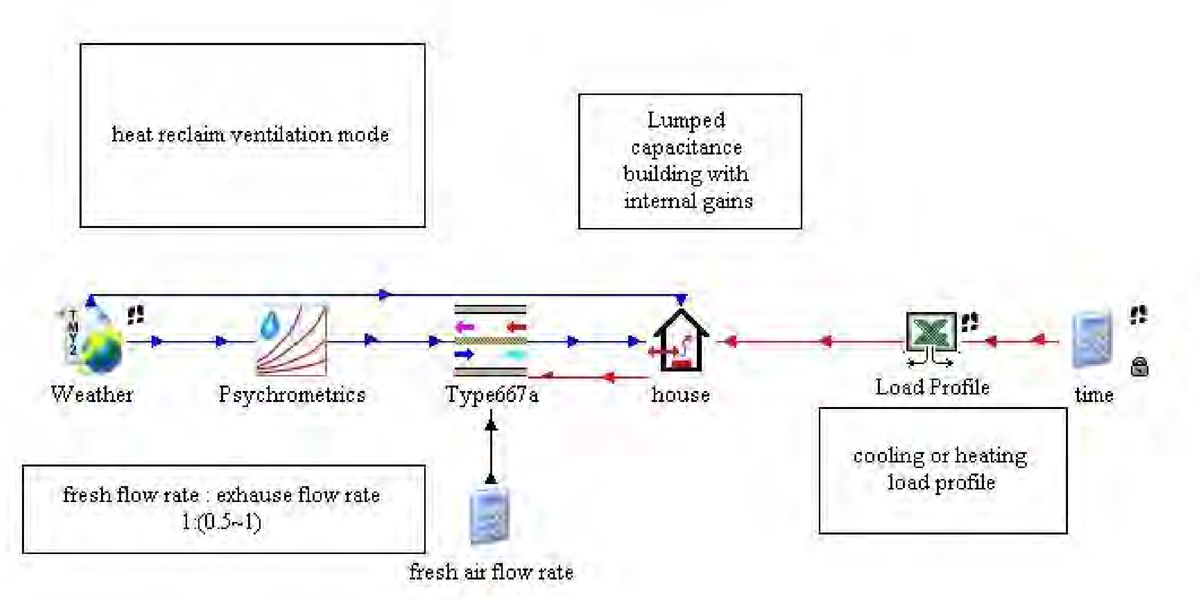


Fig A.2.1 TRNSYS mode

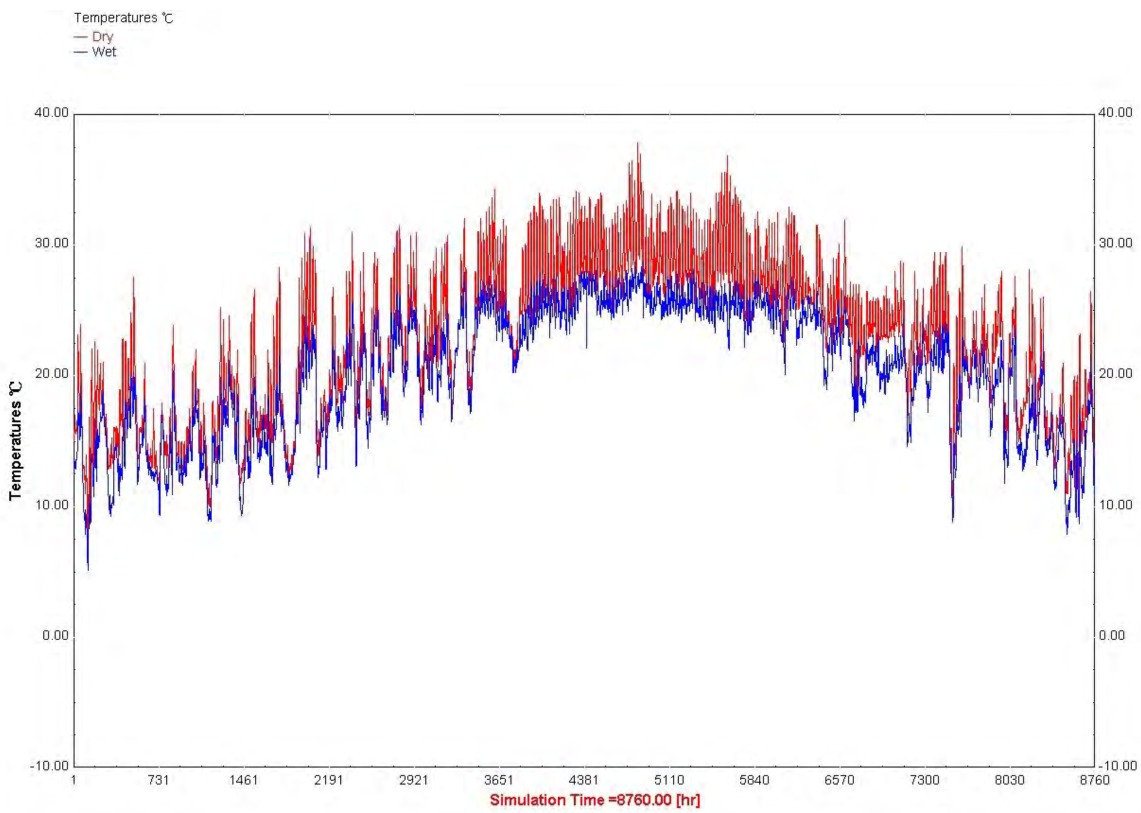


Fig A.2.2 Dry bulb and wet bulb temperature, hour of year – outdoor conditions

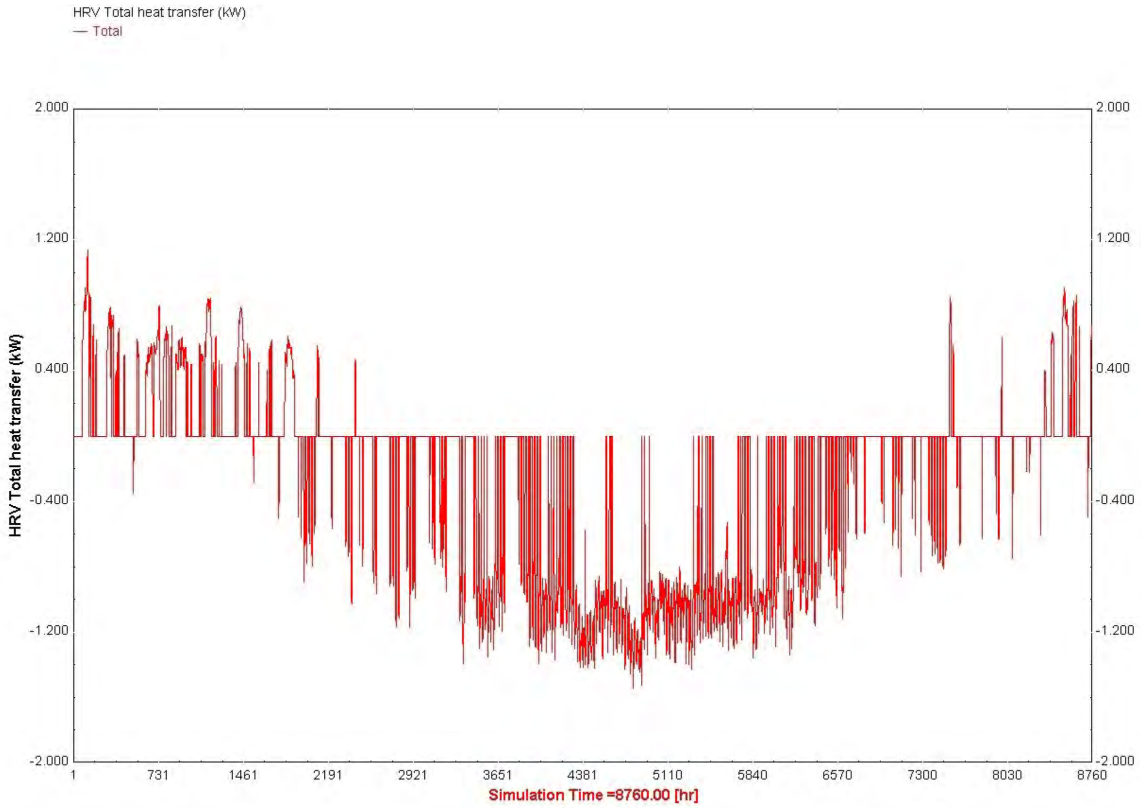


Fig A.2.3 Energy recovered by HRV, hour of year
Positive value represents heating energy recovered; negative value represents cooling energy recovered

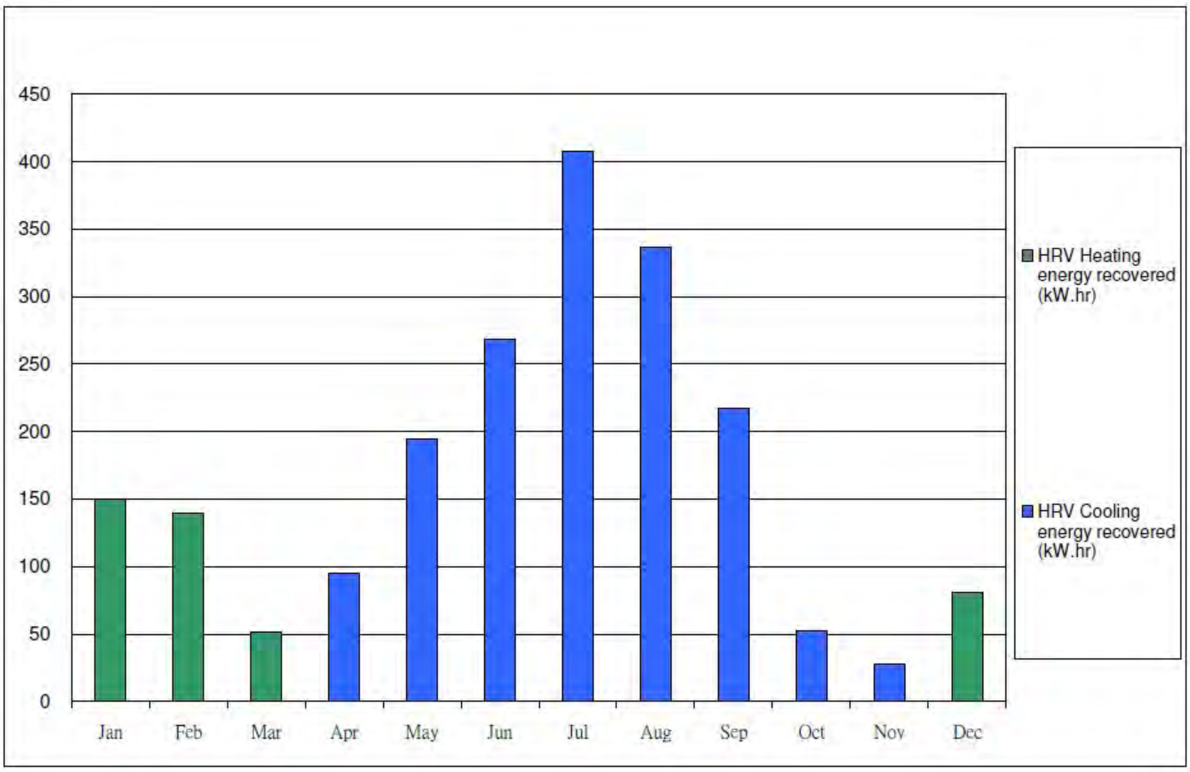


Fig A.2.4 Summary of HRV performance, hour of year

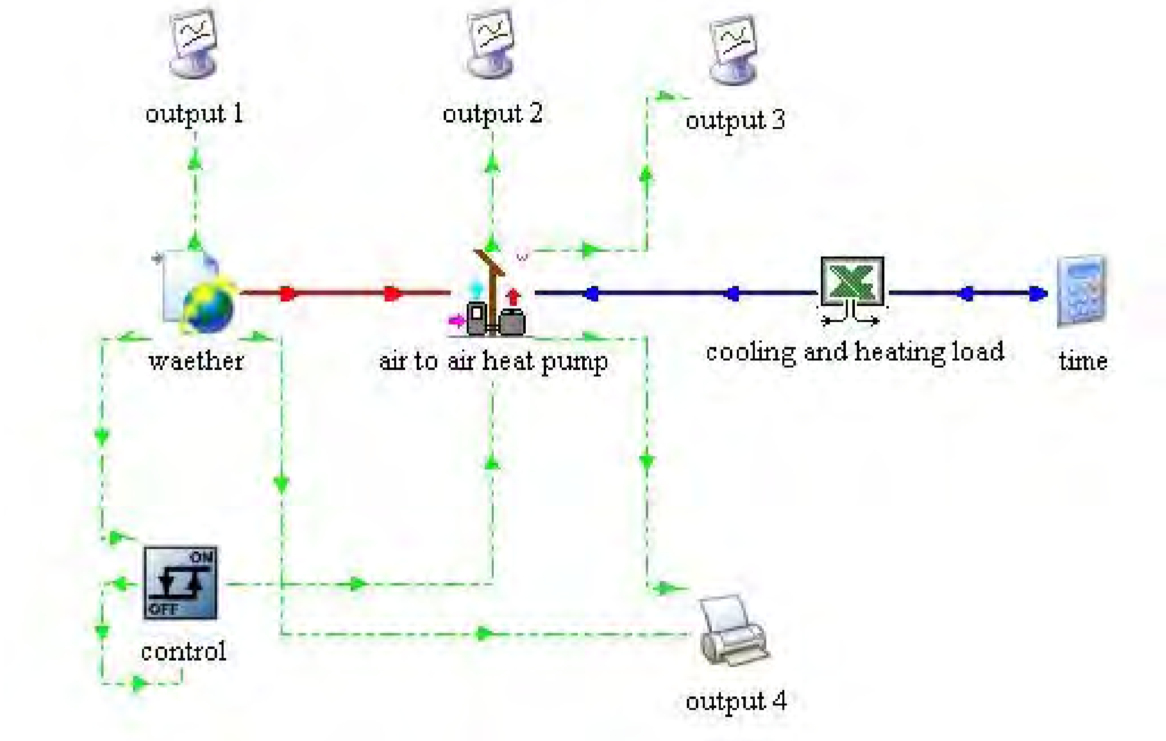


Fig A.3.1 TRNSYS model

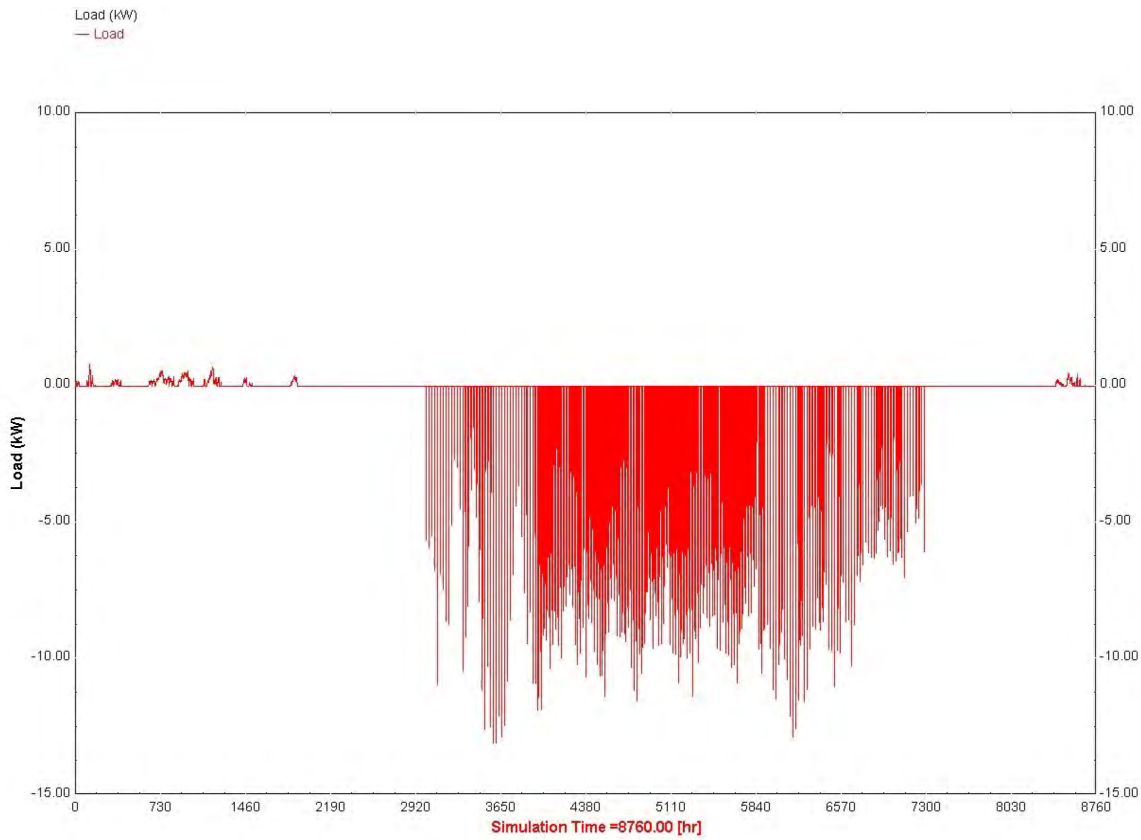


Fig A.3.2 Cooling loads and heating loads, hour of year
Positive value represents heating loads and negative value represents cooling loads.

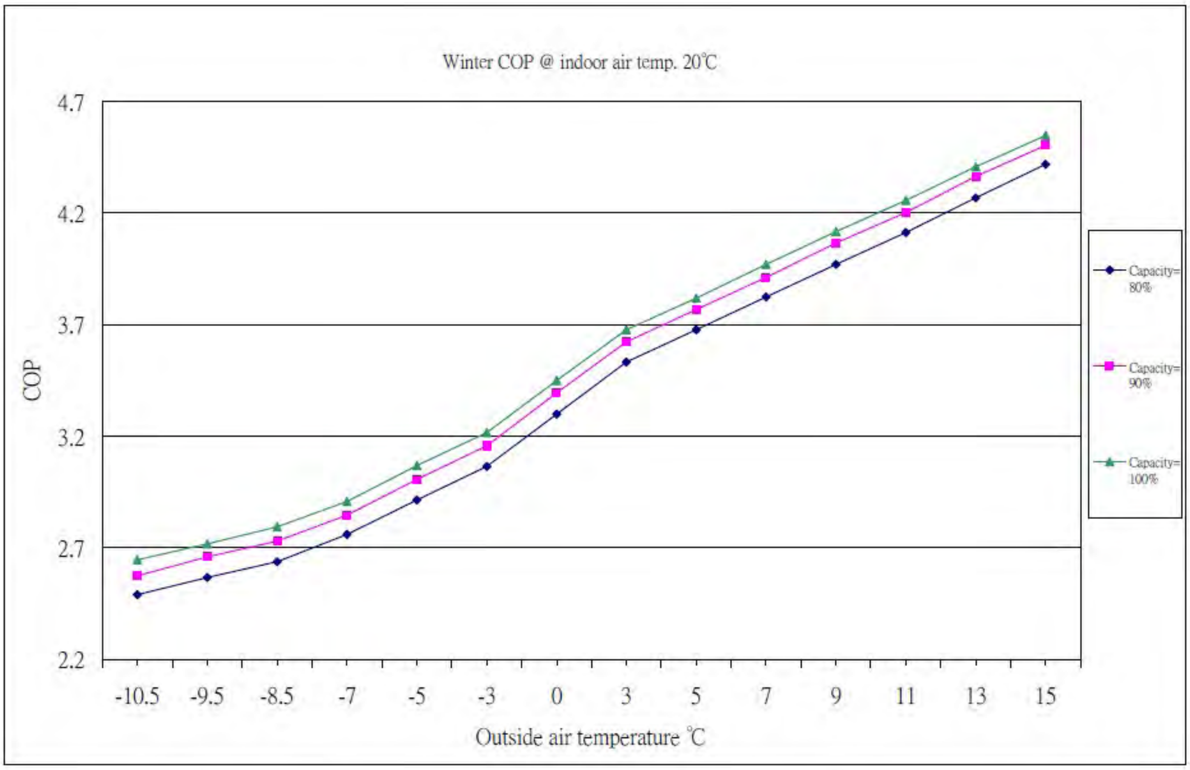


Fig A.3.3COP of VRV in the heating mode

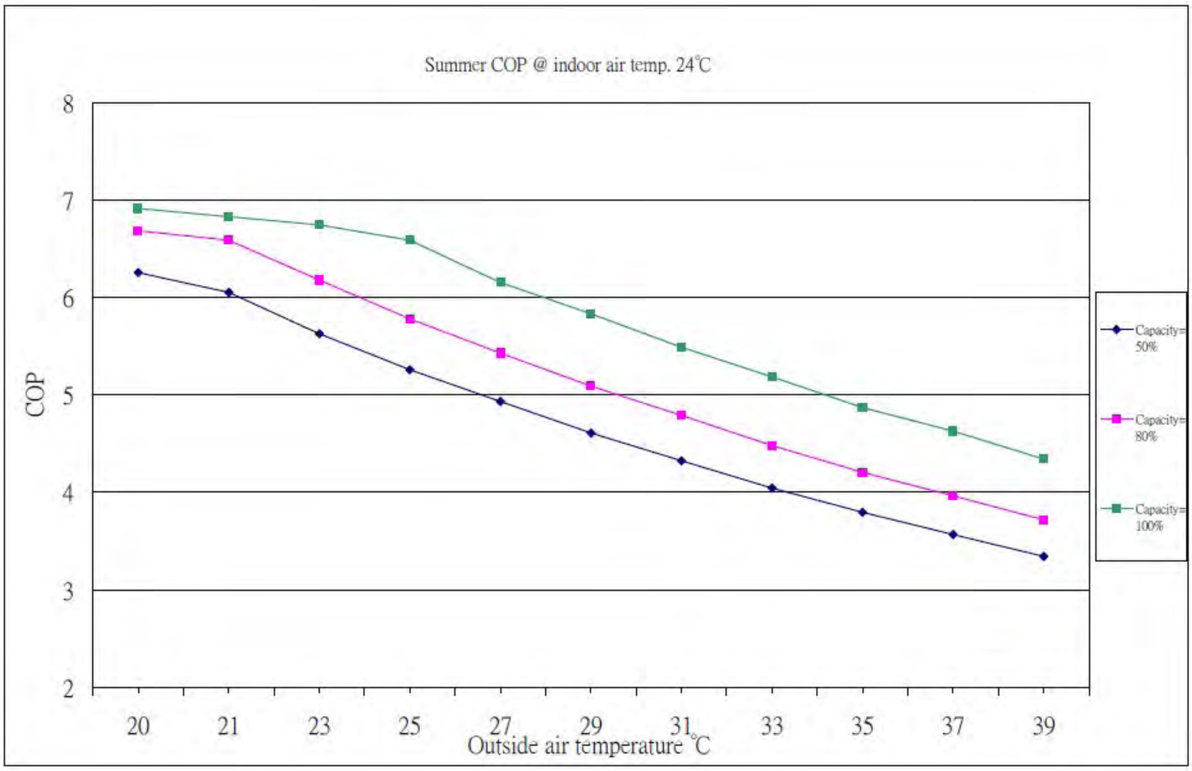


Fig A.3.4COP of VRV in the cooling mode

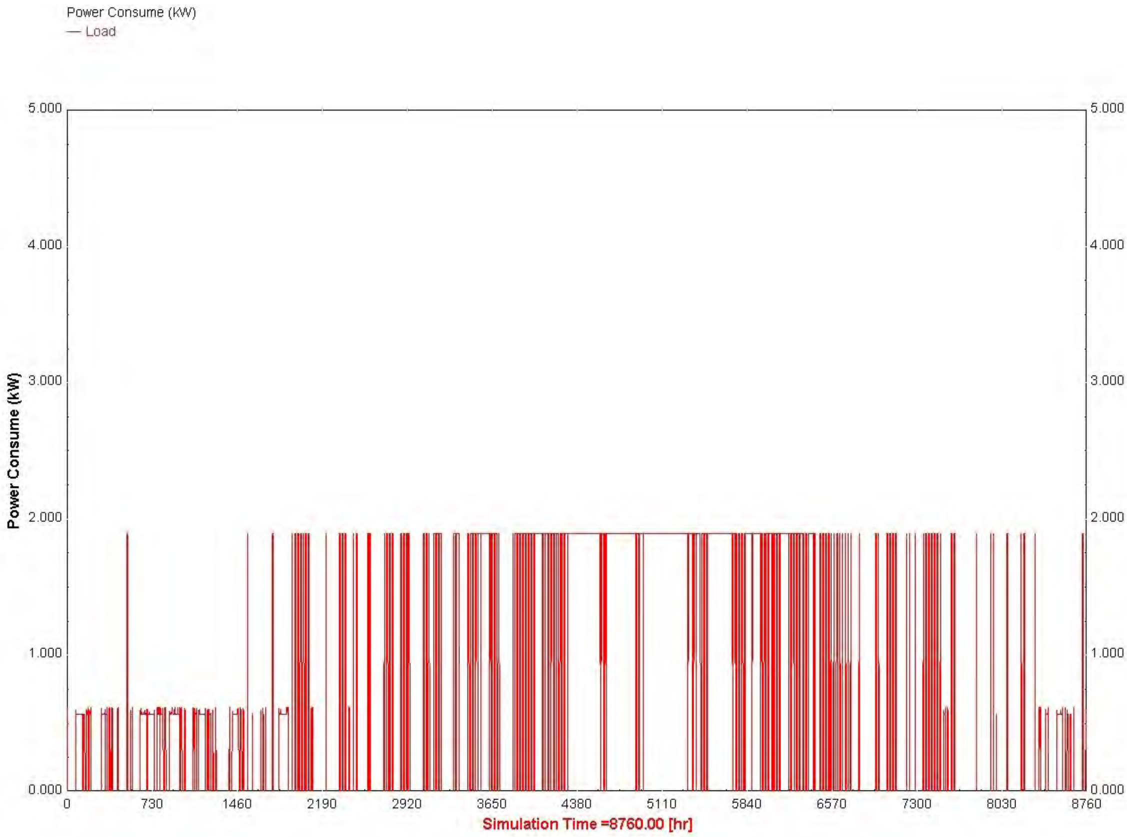


Fig A.3.5 Electrical energy consumption by VRV, hour of year

A.4 CO2 Heatpump's Electrical Energy Consumption Analysis

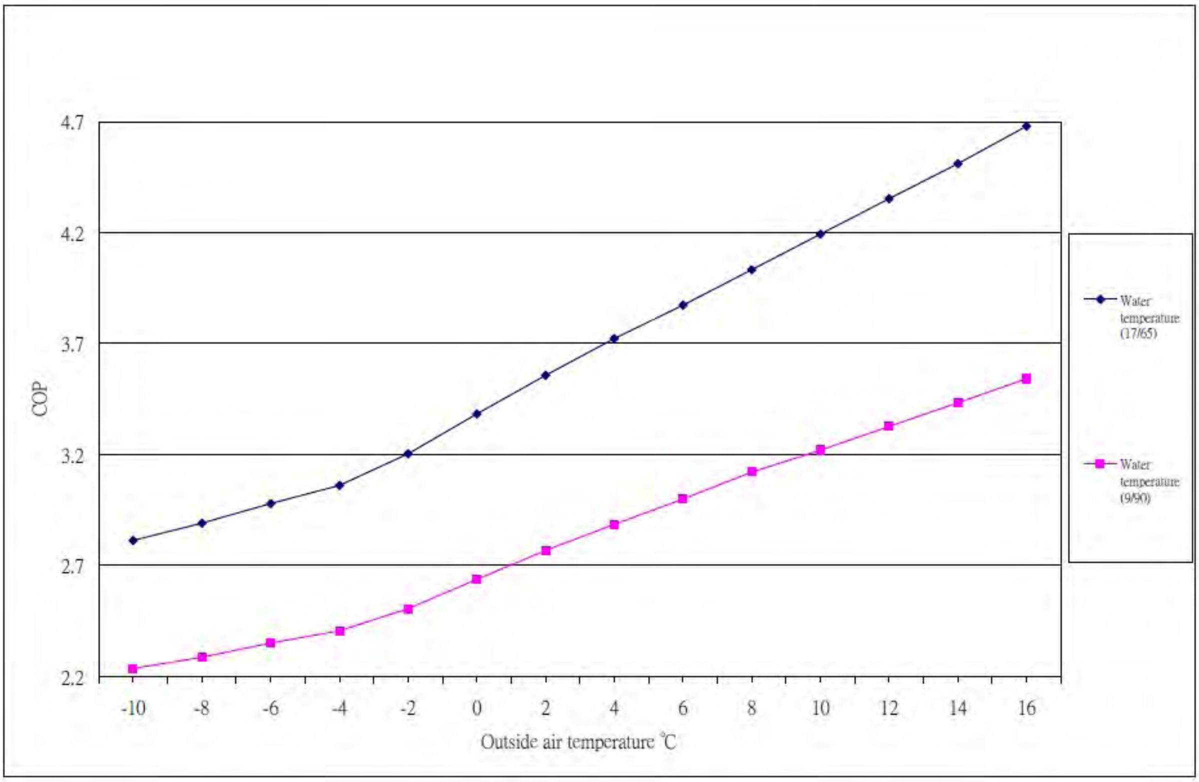


Fig A.4.1 COP of CO2 heat pump

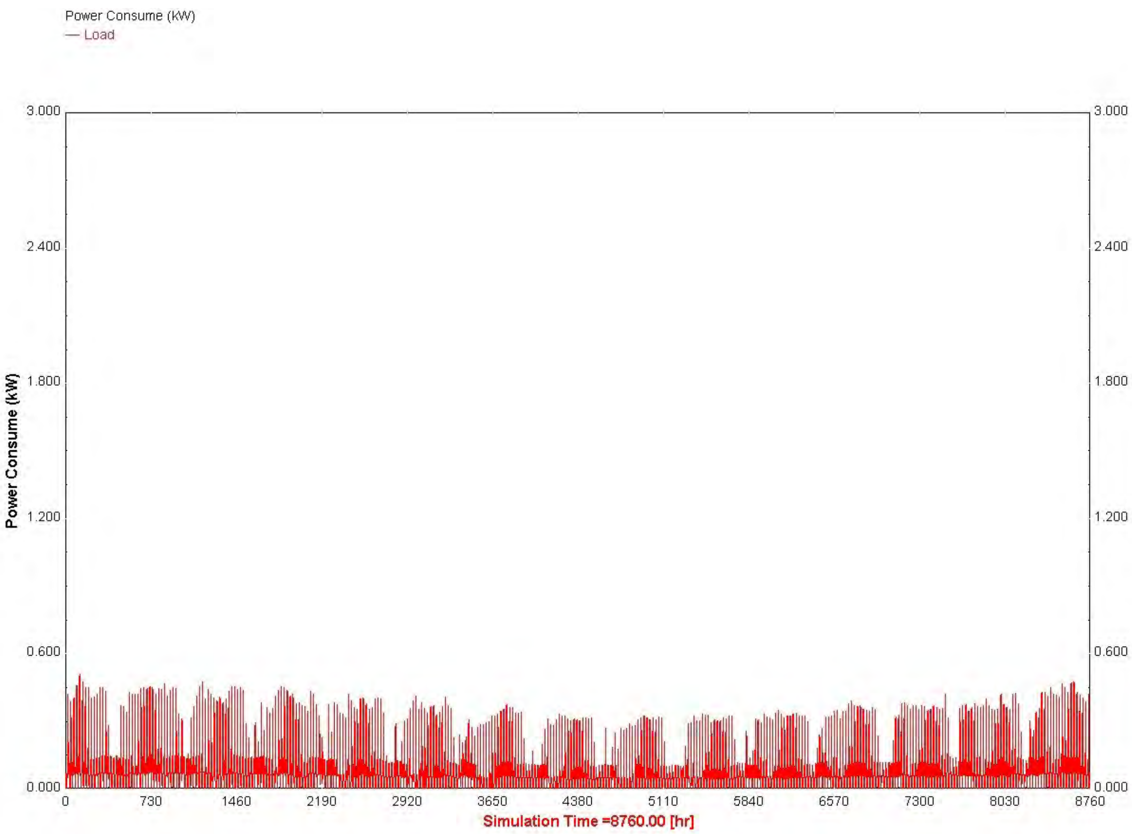


Fig A.4.2 Electrical energy consumption by CO2 heat pump, hour of year

B. Orchid House in Versailles

B1. Analysis of Solar Thermal System Performance

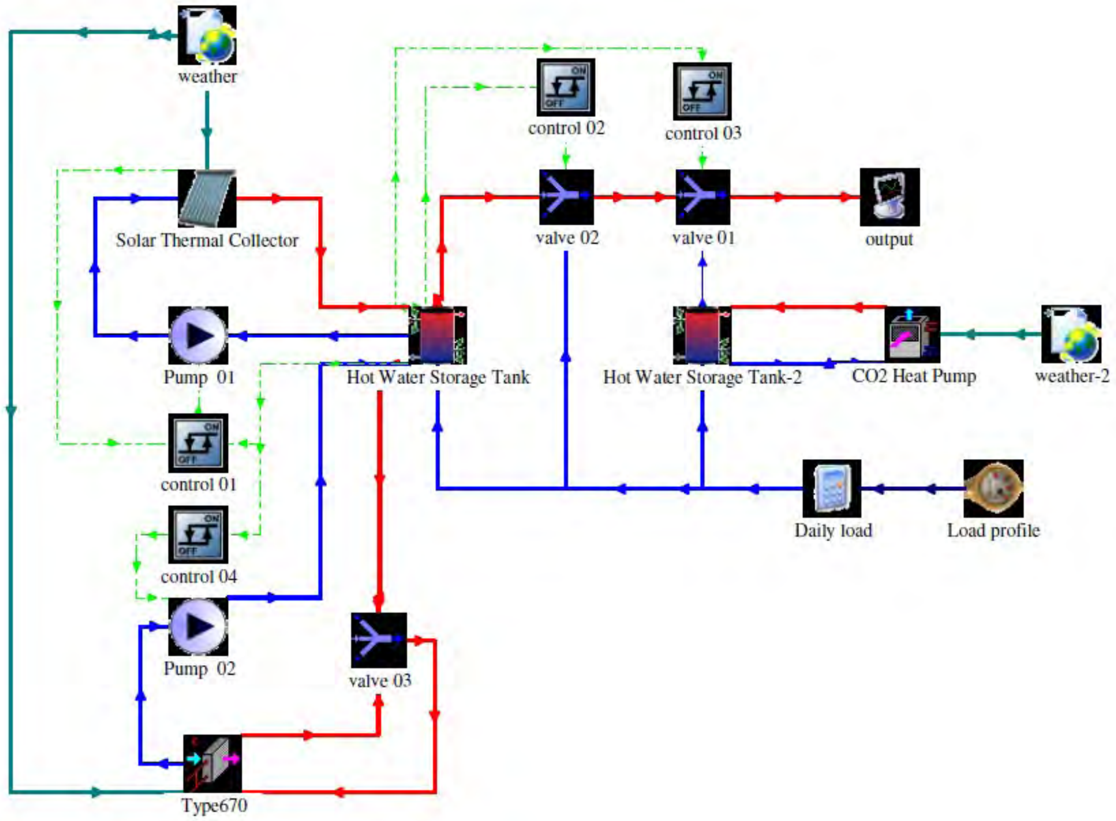


Fig B.1.1 TRNSYS model

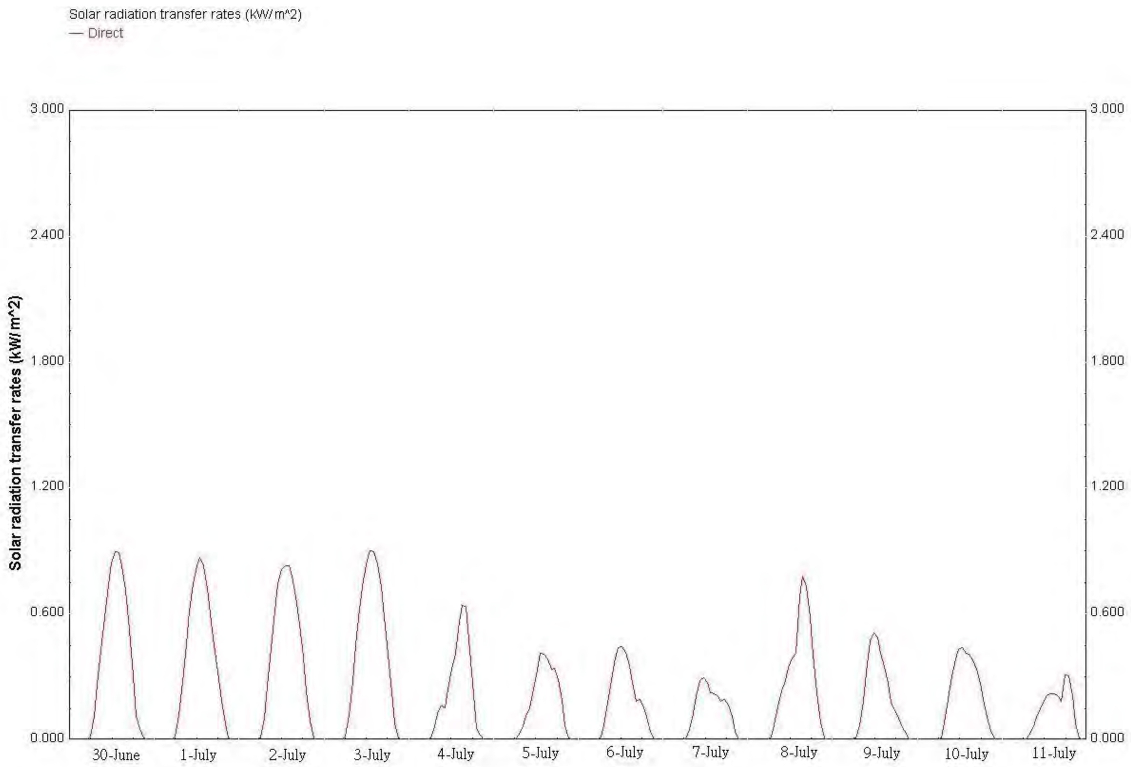


Fig B.1.2 Direct radiation 30-June to 11-July

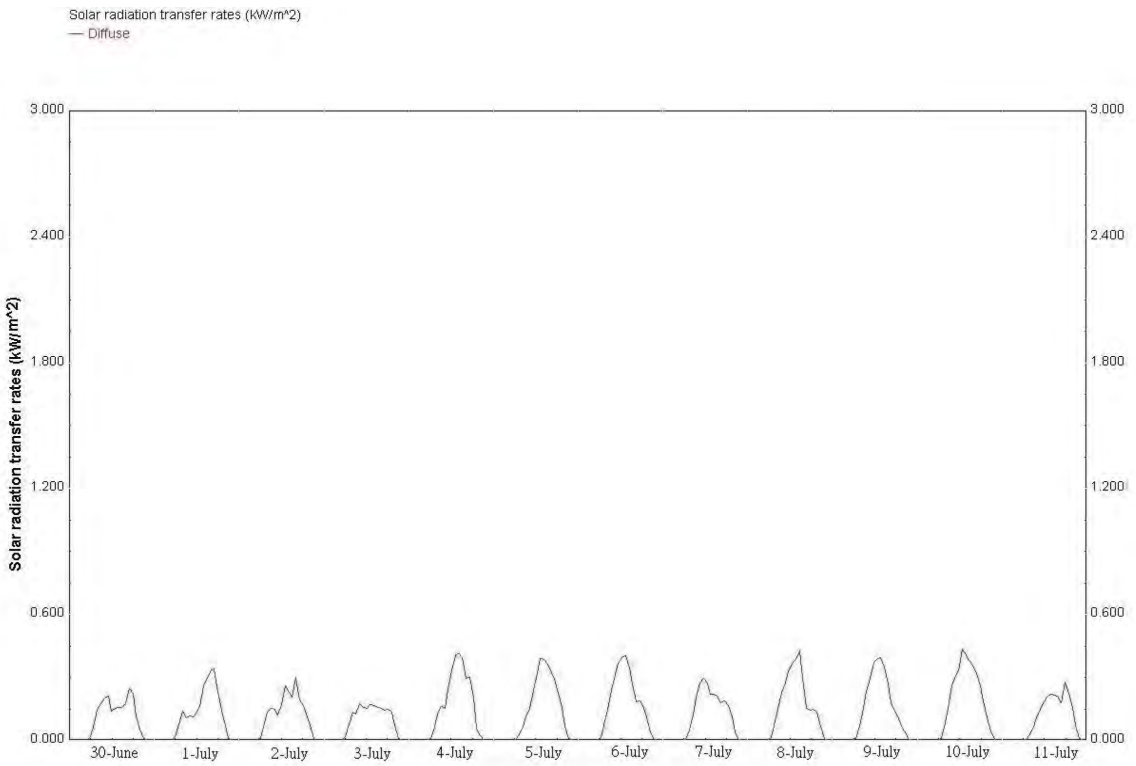


Fig B.1.3 Diffusion radiation 30-June to 11-July

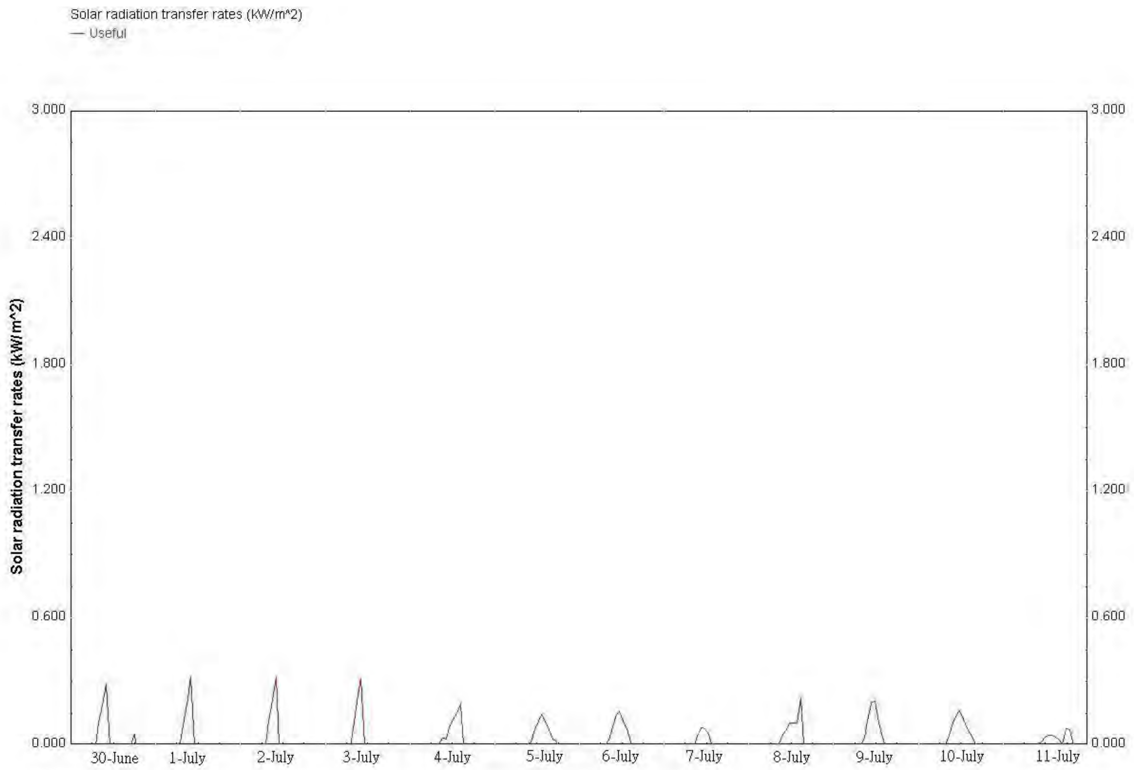


Fig B.1.4 Useful radiation 30-June to 11 July
Energy collected from solar collectors

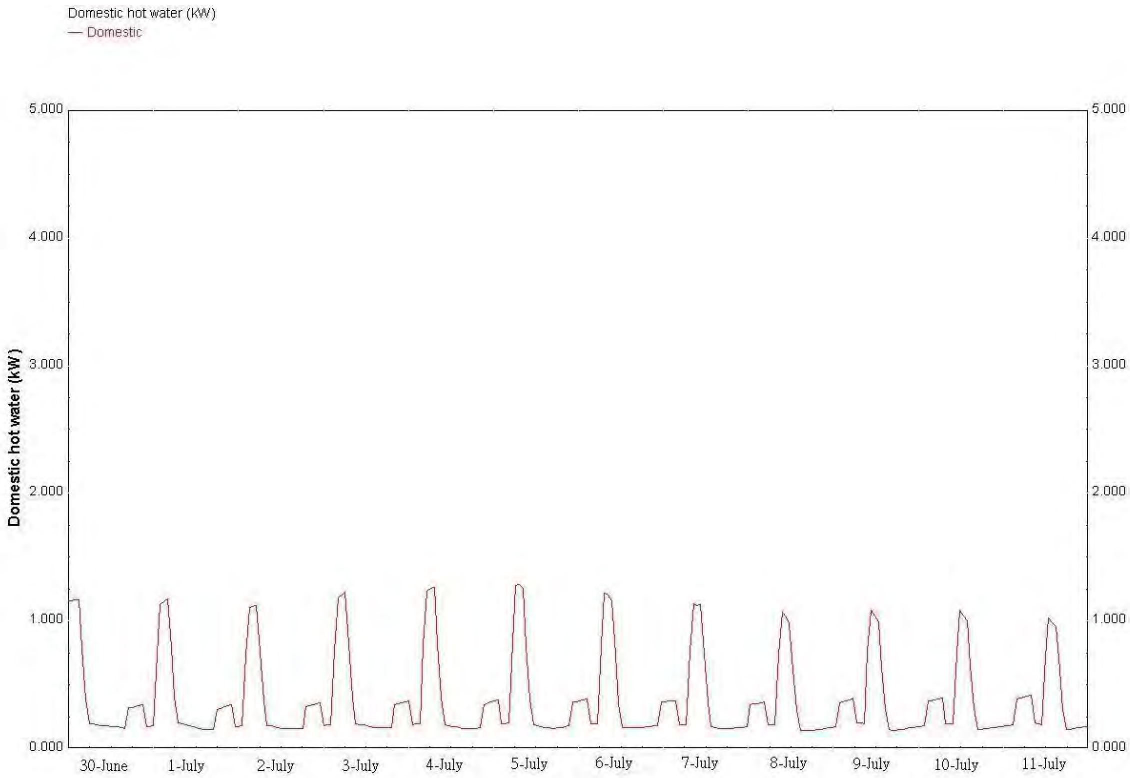


Fig B.1.5 Heating load – domestic hot water

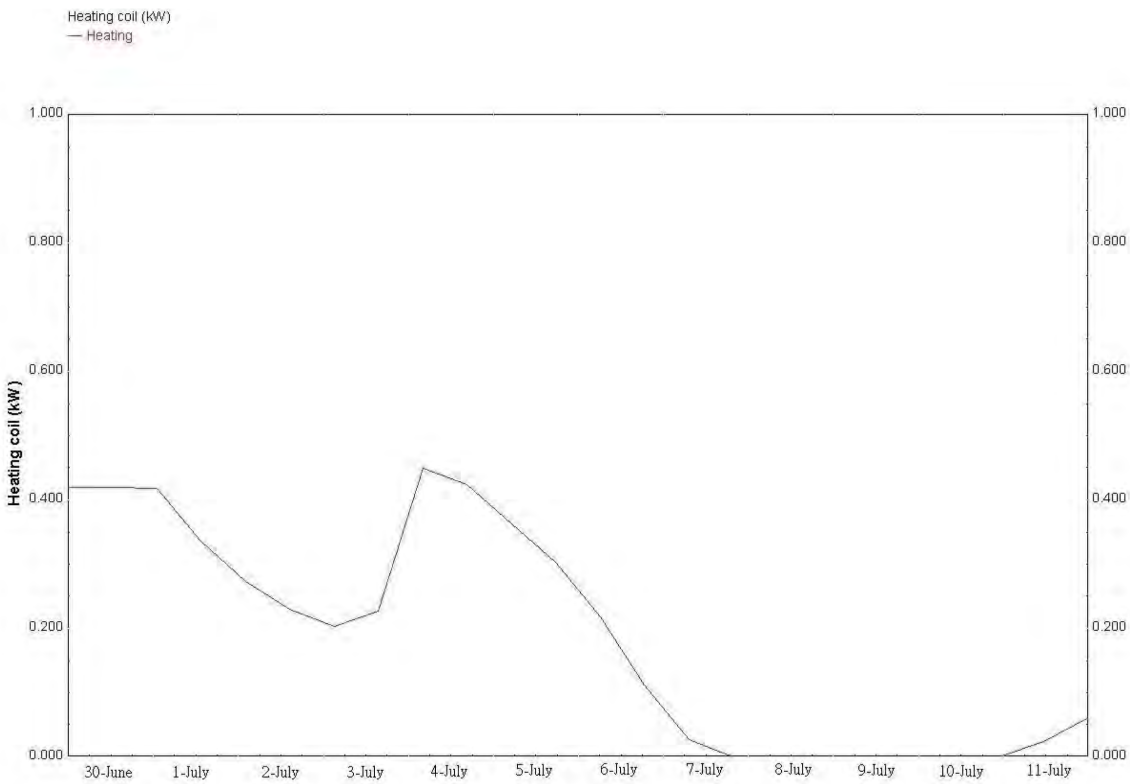


Fig B.1.6 Solar thermal energy available for space heating – solar energy collected deducts the energy consumed by heating the domestic water, 30-June to 11-July.

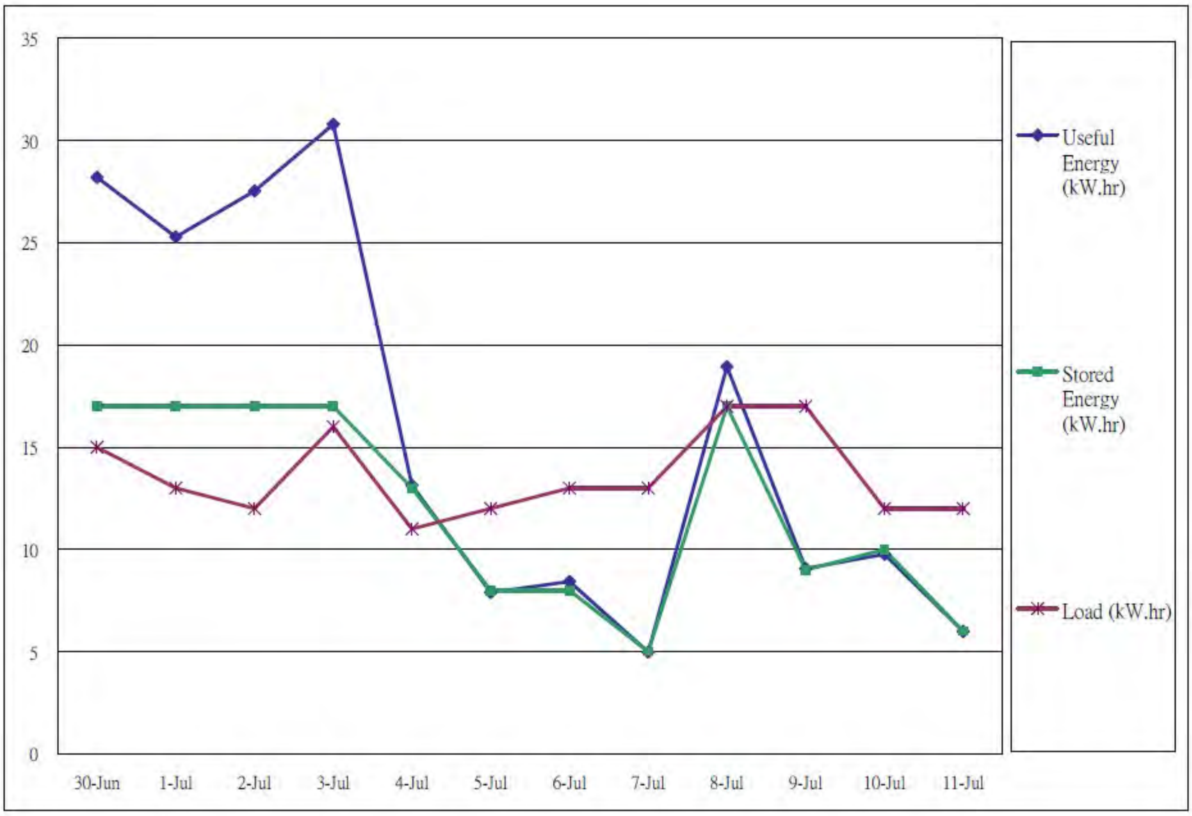


Fig B.1.7 Useful energy, stored energy and heating load (domestic water plus space heating) profile, 30-June to 11-July.

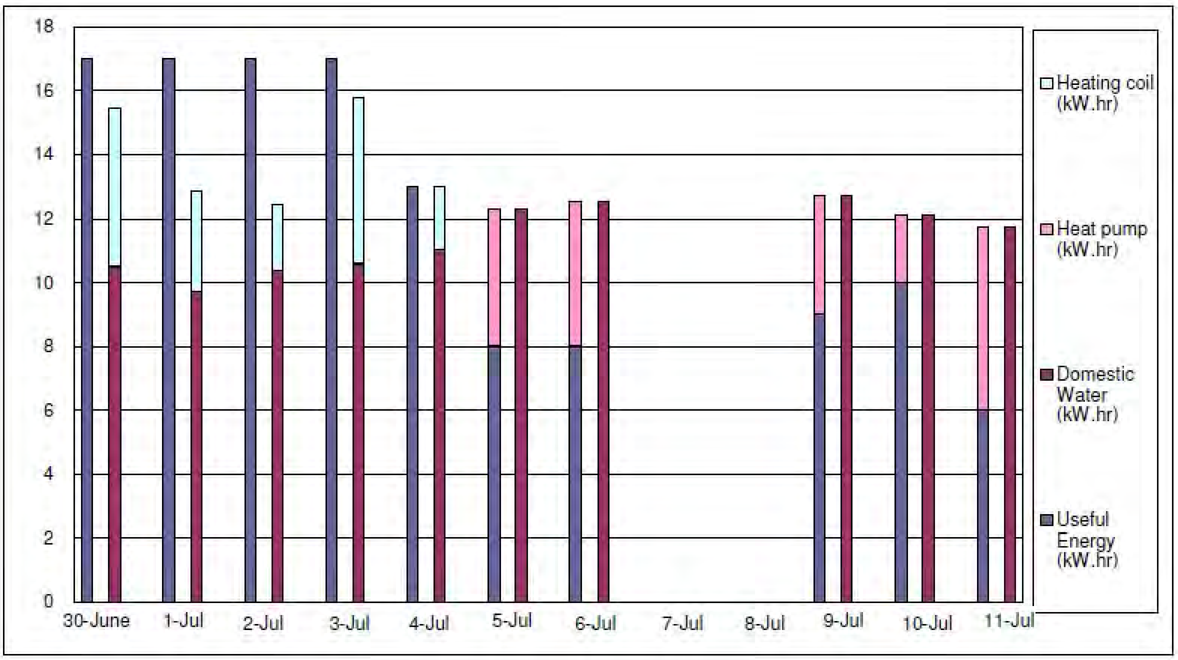


Fig B.1.8 Result of solar thermal system's performance – solar energy collected, heat pump generation and energy consumed, 30-June to 11-July.

B2. Analysis of HRV'S Performance

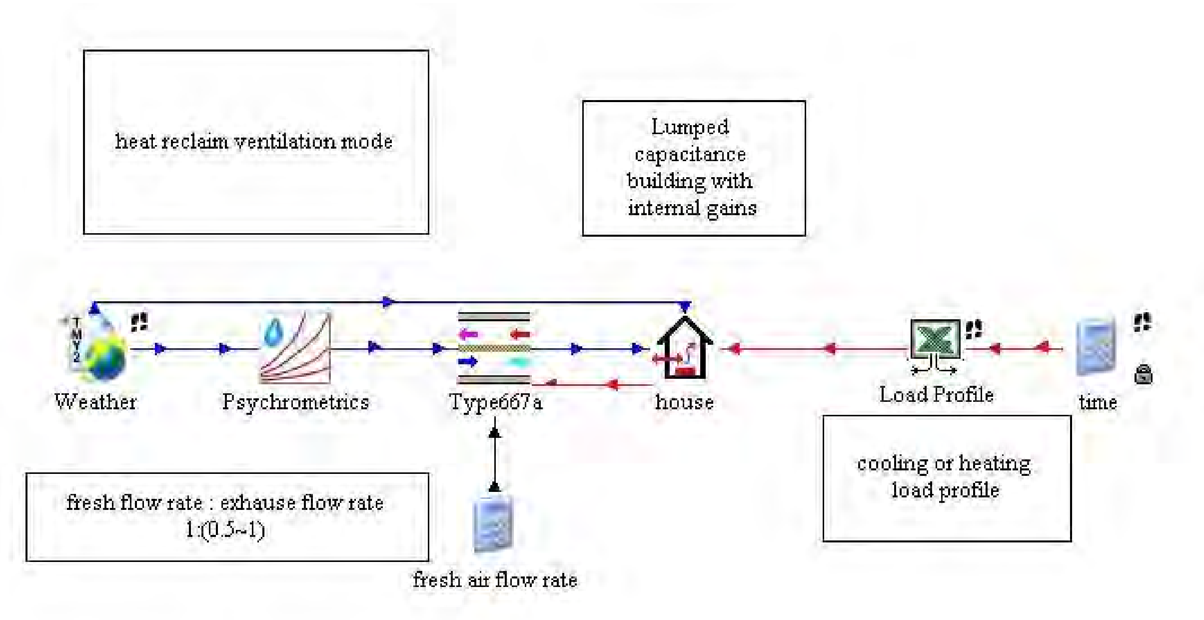


Fig B.2.1 TRNSYS model

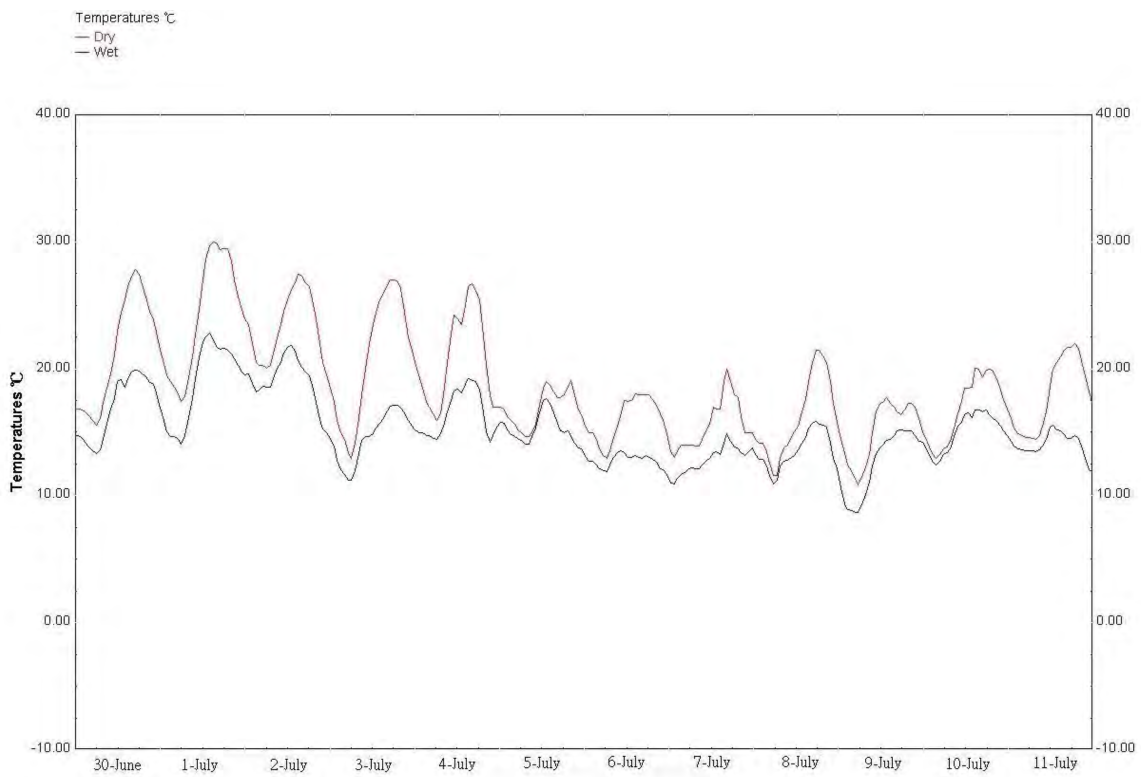


Fig B.2.2 Dry bulb and wet bulb temperature, 30-June to 11-July – outdoor conditions

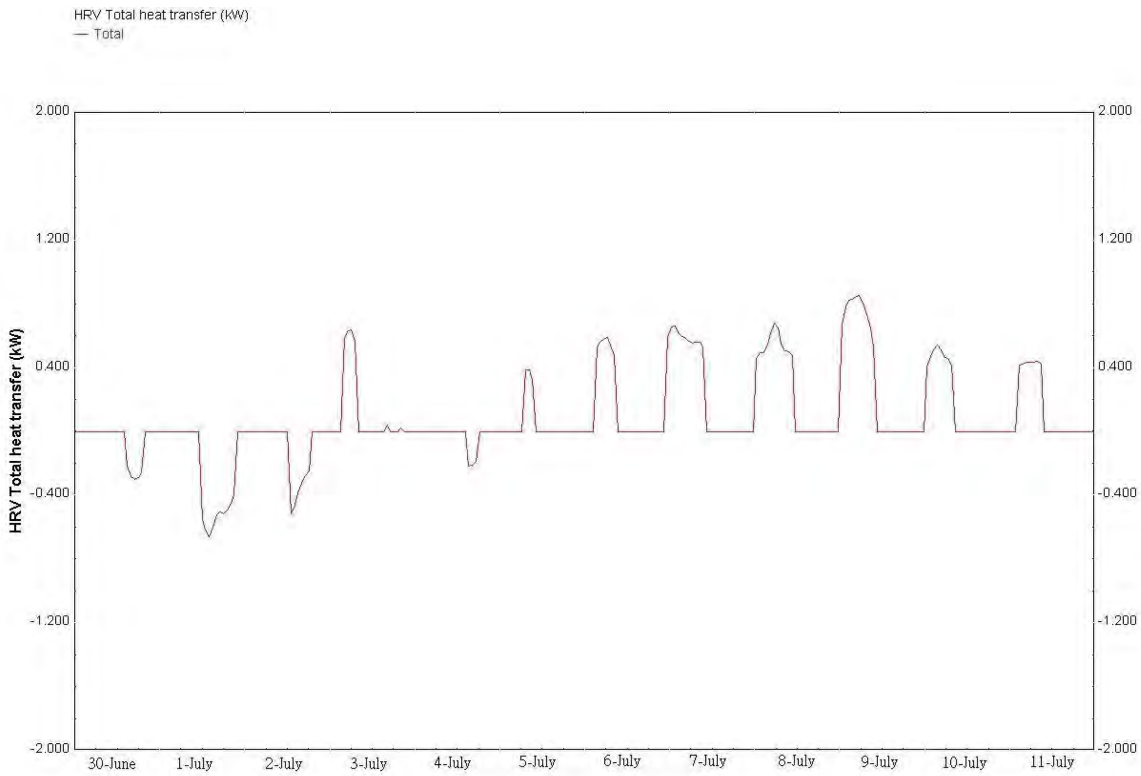


Fig B.2.3 Energy recovered by HRV, 30-June to 11-July
positive value represents heating energy recovered; negative value represents cooling energy recovered

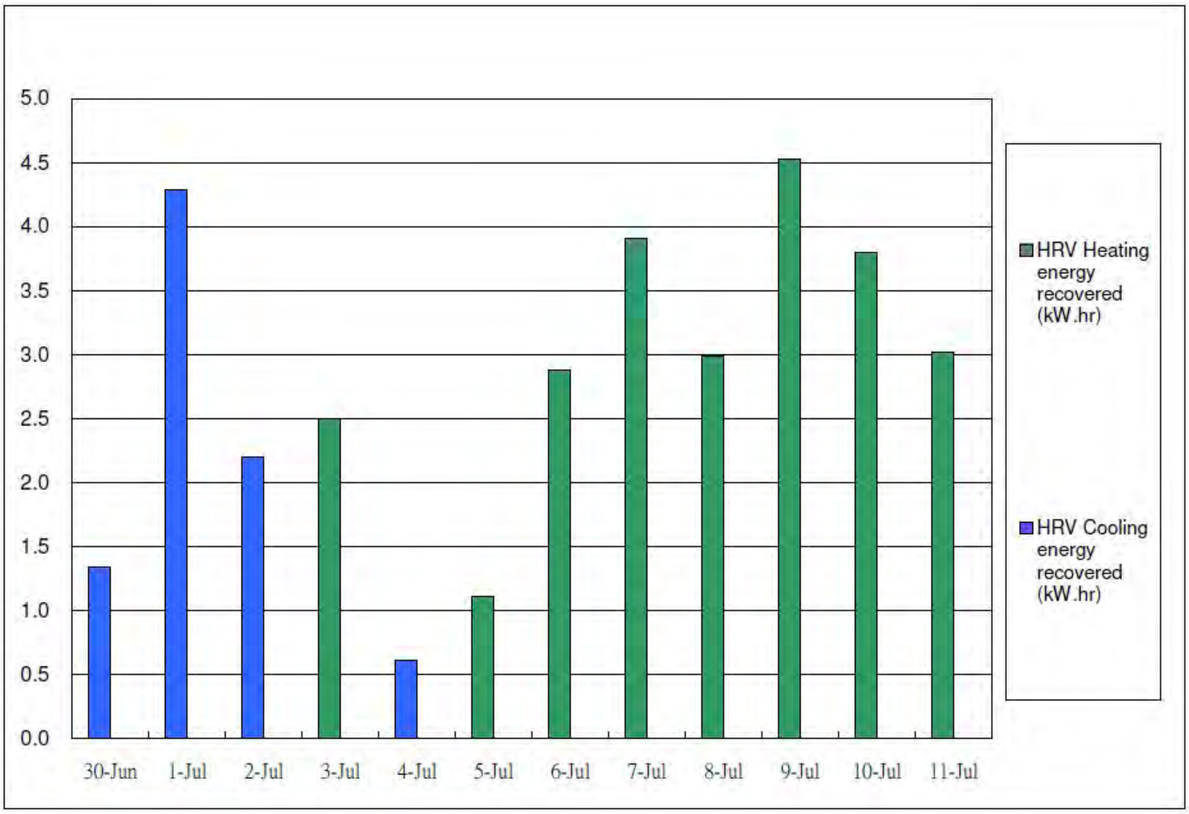


Fig B.2.4 Summary of HRV performance, 30-June to 11-July

B3. VRV Electrical Energy Consumption Analysis

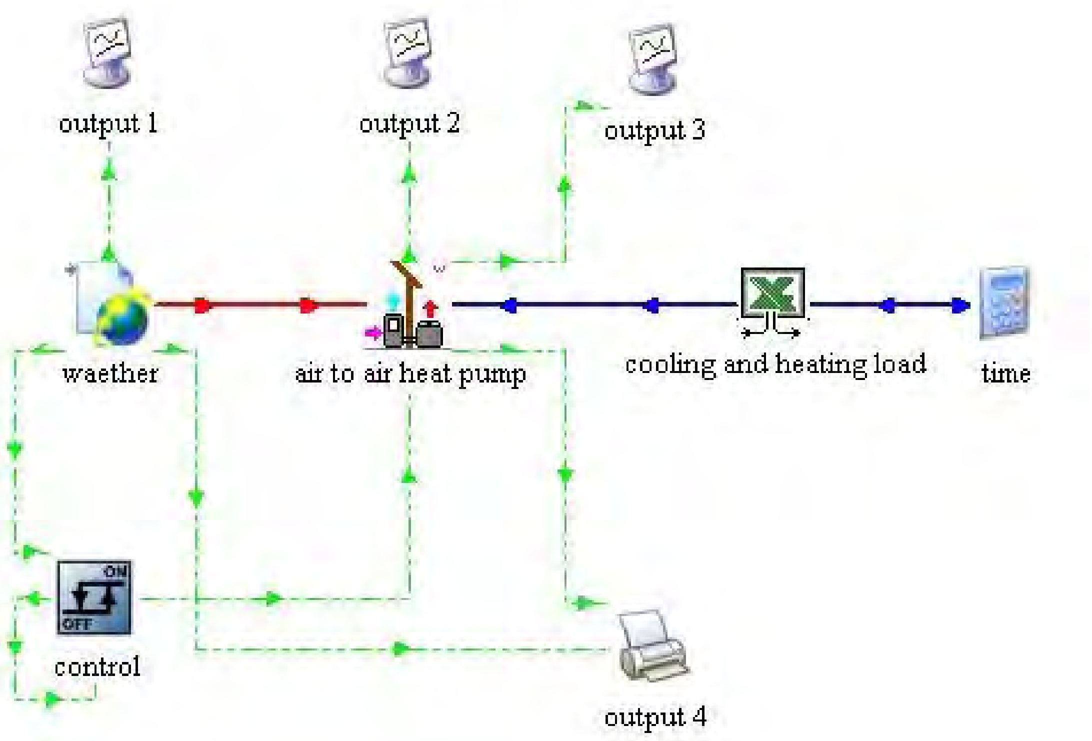


Fig B.3.1 TRNSYS model

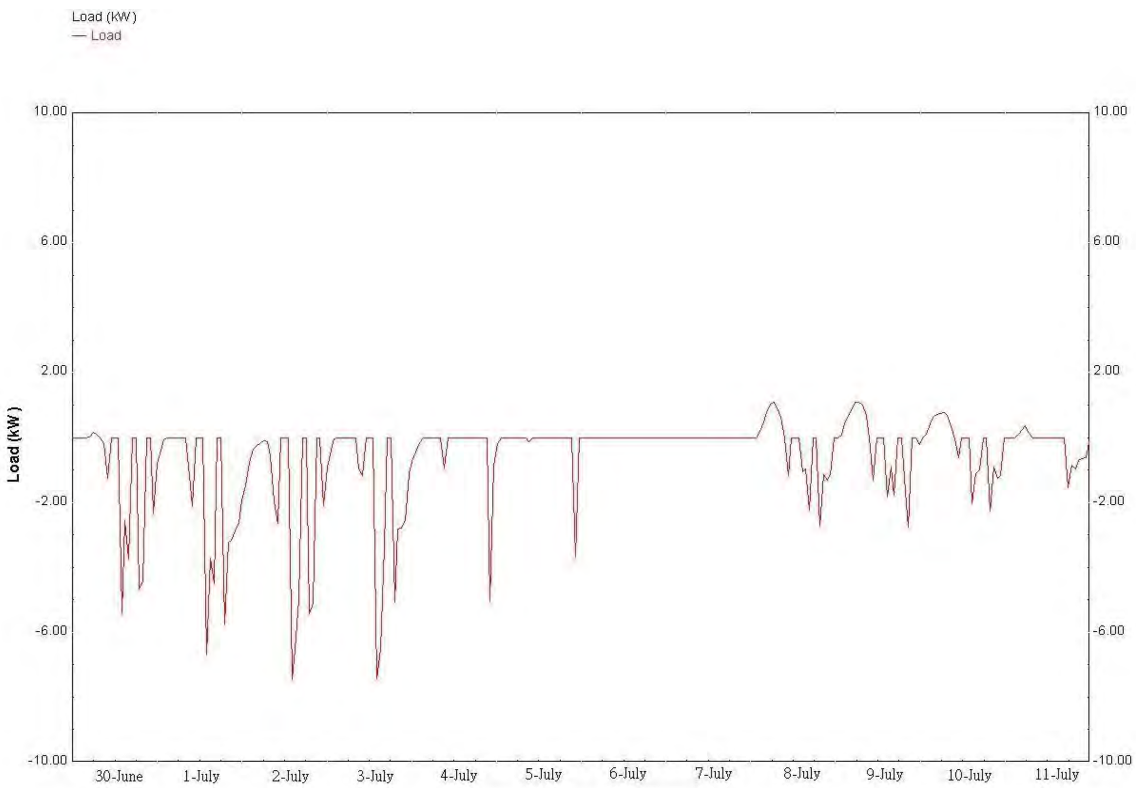


Fig B.3.2 Cooling loads and heating loads, 30-June to 11-July
Positive value represents heating loads and negative value represents cooling loads.

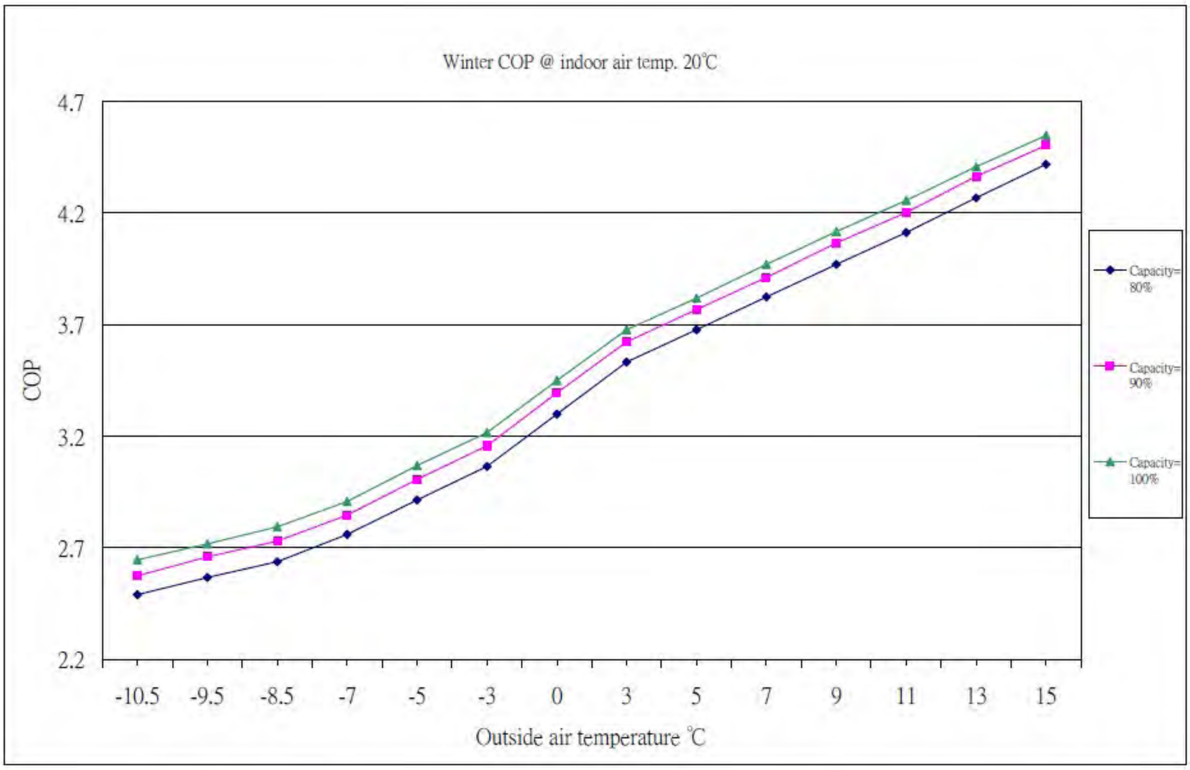


Fig B.3.3 COP of VRV in the heating mode

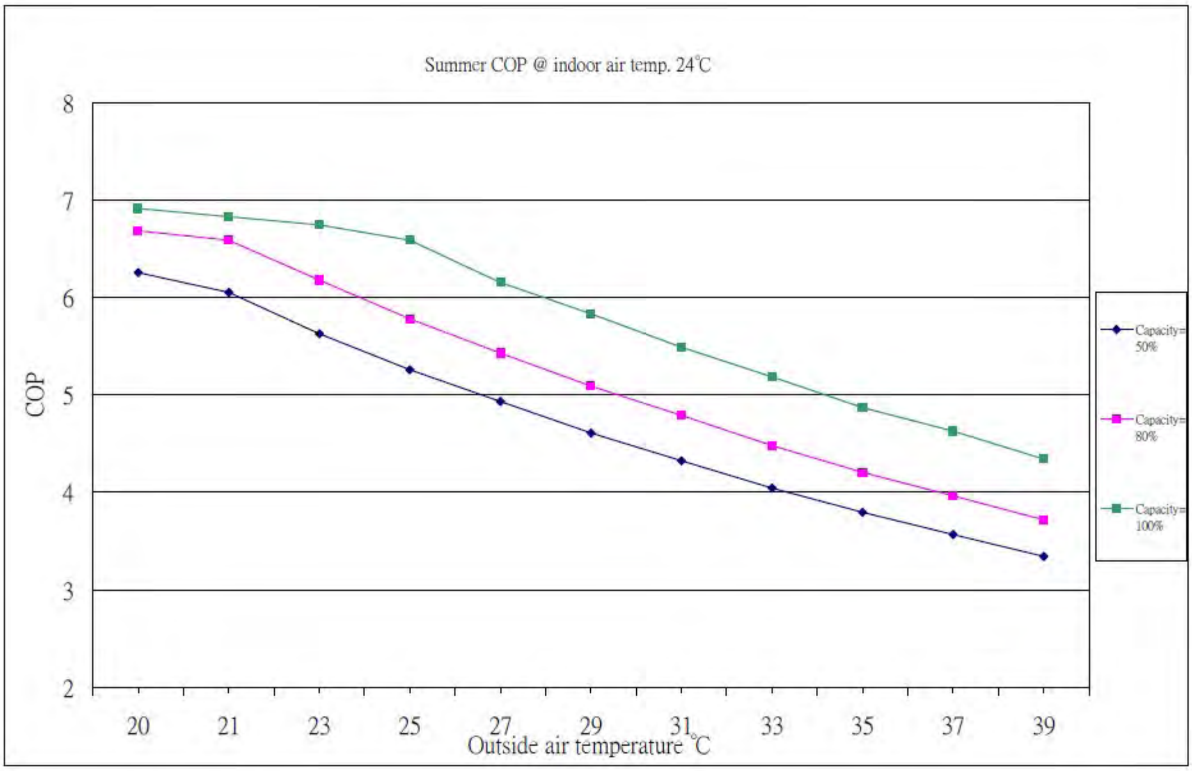


Fig B.3.4 COP of VRV in the cooling mode

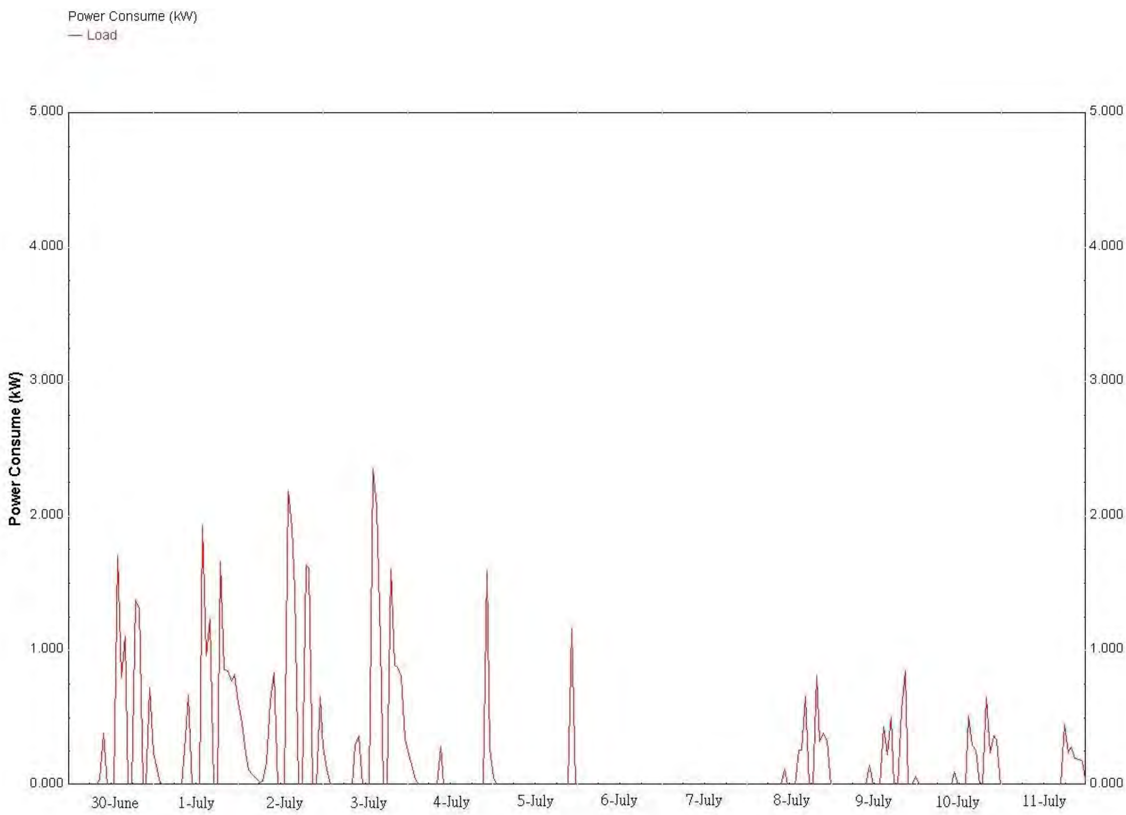


Fig B.3.5 Electrical energy consumption by VRV, 30-June and 11-July

B3. CO2 Heatpump's Electrical Energy Consumption Analysis

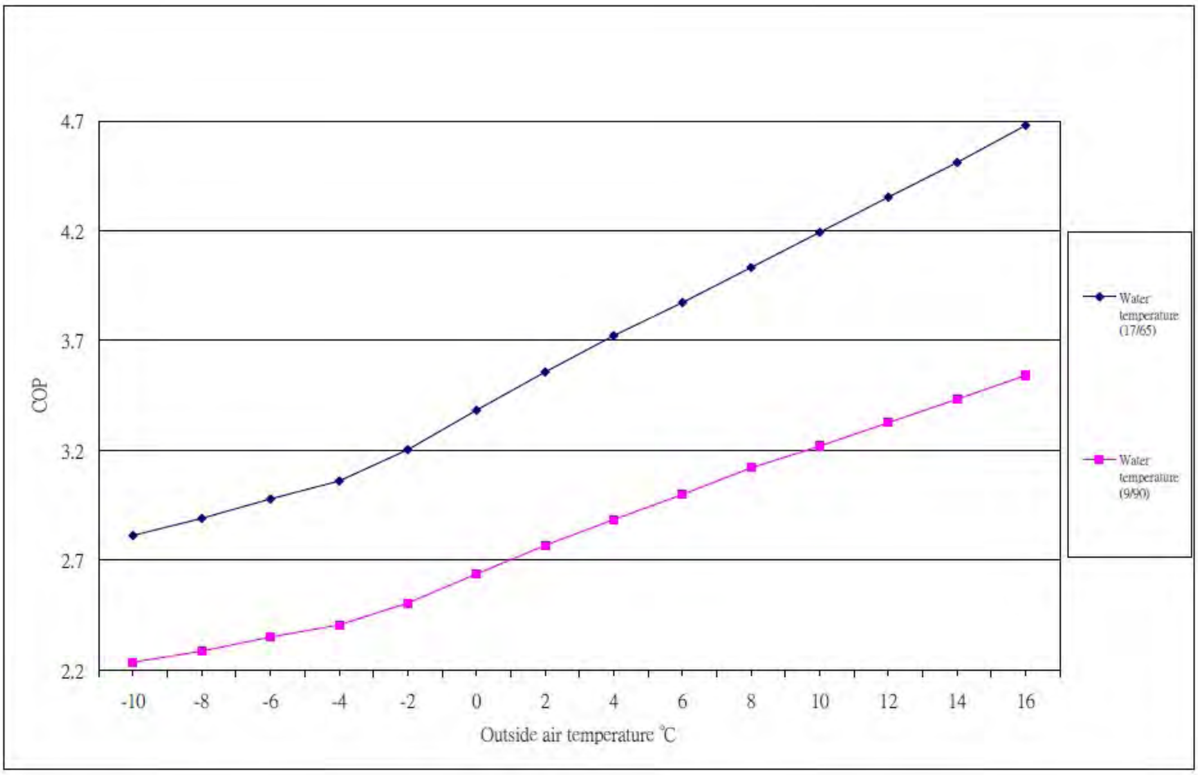


Fig B.4.1 COP of CO2 heat pump

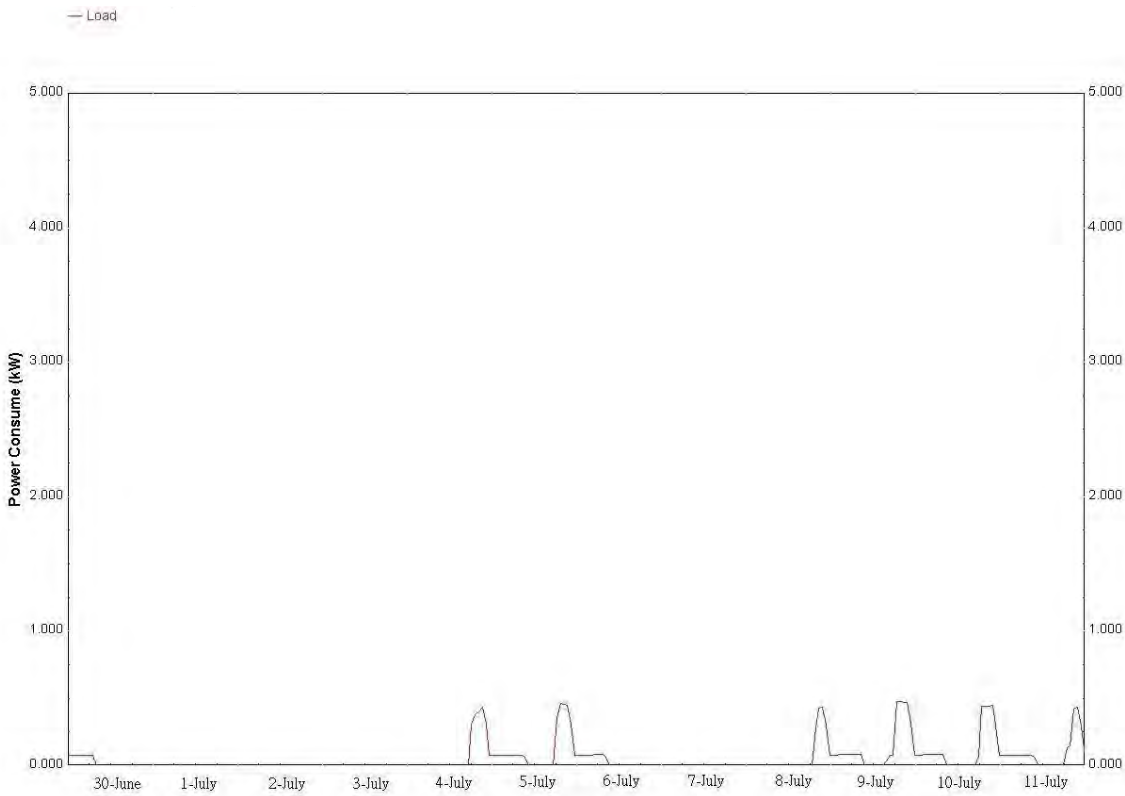


Fig B.4.2 Electrical consumption by CO2 heat pump, 30-June to 11-July

Appendix C Appliances Report

Product Name	Manufacturer	Model Name	Specifications	Size (D/W/H) mm	Energy label	Power(Consumption)
Refrigeration / Freezing	MIELE	KFN37452 i DE	R: 170 L F: 57 L	560/550/1772	A++	308W(0.627kwh/24hr)
Oven	MIELE	H2161 B CLST	56 L	593/560/555	A	3500 W
Dishwasher	MIELE	G6995 SCViK2O	Normal：55℃ Intensive：75℃	598/570/845	A+++	2110W/10A
Cooking	MIELE	Domino CS 1112E	2 heating plates 1200W/600-1800W	272/500	A	1800 W
Cloths Washer	MIELE	W 664	46L	456/600/900	A++	1400W(0.77kwh)
Dryer	BOSCH	WTW84381FF	112L	640/700/880		1000W(212kwh)
TV	JVC	LT-28HA52U	LED/ 28 inch	444/642/210	A	29W
Notebook	ASUS	Transformer AiO P1801	18.4 inch	46.6/16.2/37.6		180 W
Extractor hood	Best	Gloss	630 m3/h	455/435/830		260 W

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Grid-Connected System: Simulation parameters

Project :	**2014 SDE PARIS**			
Geographical Site	**Taipei**		**Country**	**China**
Situation	Latitude	24.5oN	Longitude	121.4oE
Time defined as	Legal Time	Time zone UT+8	Altitude	10 m
	Albedo	0.20		
Meteo data :	Taipei, Synthetic Hourly data			
Simulation variant :	**140217_交大台北_5kWp**			
	Simulation date	17/02/14 10h13		

Simulation parameters				
Collector Plane Orientation	Tilt	18 deg	Azimuth	0 deg
Horizon	Free Horizon			
Near Shadings	No Shadings			
PV Array Characteristics				
PV module Si-poly	Model	**D6P250B3A**		
	Manufacturer	DelSolar		
Number of PV modules	In series	10 modules	In parallel	2 strings
Total number of PV modules	Nb. modules	20	Unit Nom. Power	250 Wp
Array global power	Nominal (STC)	**5.00 kWp**	At operating cond.	4439 Wp (50oC)
Array operating characteristics (50oC)	U mpp	276 V	I mpp	16 A
Total area	Module area	**32.7 m2**	Cell area	29.2 m2
Inverter	Model	**Solar inverter SOLIVIA 5.0 TR**		
	Manufacturer	Delta Energy		
Characteristics	Operating Voltage	150-480 V	Unit Nom. Power	5.50 kW AC
PV Array loss factors				
Thermal Loss factor	Uc (const)	20.0 W/m2K	Uv (wind)	0.0 W/m2K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m2, Tamb=20oC, Wind=1 m/s.)			NOCT	56 oC
Wiring Ohmic Loss	Global array res.	293 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	0.2 %
Module Mismatch Losses			Loss Fraction	2.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05
User's needs :	Unlimited load (grid)			

Grid-Connected System: Main results

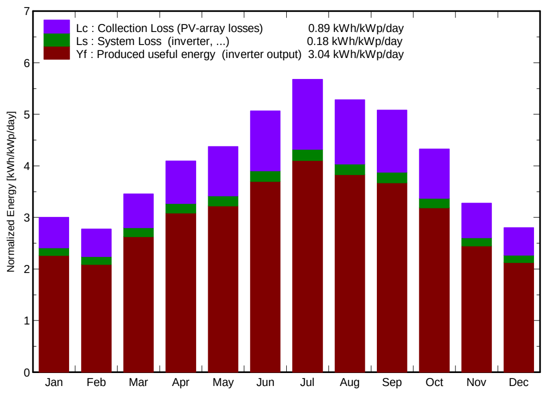
Project : **2014 SDE PARIS**

Simulation variant : **140217_交大台北_5kWp**

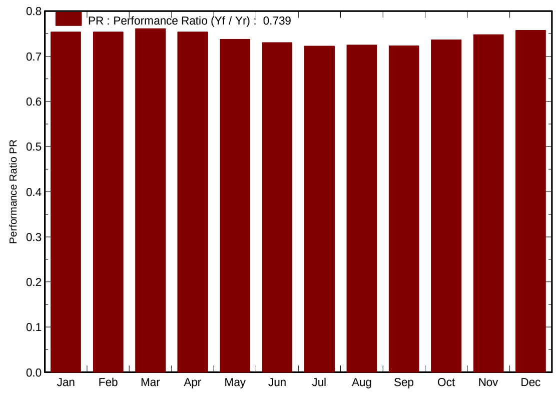
Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	18 deg	azimuth	0 deg
PV modules	Model	D6P250B3A	Pnom	250 Wp
PV Array	Nb. of modules	20	Pnom total	**5.00 kWp**
Inverter	Model	Solar inverter SOLIVIA 5.0 TR	Pnom	5.50 kW ac
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**5540 kWh/year**	Specific prod.	1108 kWh/kWp/year
	Performance Ratio PR	73.9 %		

Normalized productions (per installed kWp): Nominal power 5.00 kWp



Performance Ratio PR



140217_交大台北_5kWp

Balances and main results

	GlobHor kWh/m2	**T Amb** oC	**GlobInc** kWh/m2	**GlobEff** kWh/m2	**EArray** kWh	**E_Grid** kWh	**EffArrR** %	**EffSysR** %
January	80.0	18.20	93.0	89.9	374.1	350.8	12.31	11.54
February	71.0	18.60	77.7	75.1	313.8	292.8	12.37	11.54
March	103.0	20.20	107.1	103.7	434.3	407.4	12.41	11.64
April	123.0	23.00	122.8	118.8	491.0	463.0	12.24	11.54
May	141.0	25.60	135.6	131.0	529.7	499.9	11.96	11.28
June	162.0	27.30	151.9	146.8	585.9	554.9	11.80	11.18
July	186.0	29.00	176.1	170.6	669.5	636.0	11.64	11.06
August	166.0	28.70	163.8	158.7	625.7	593.4	11.69	11.09
September	146.0	27.80	152.5	147.9	581.9	551.2	11.68	11.06
October	121.0	26.00	134.2	130.0	522.3	493.9	11.92	11.27
November	85.0	22.80	98.3	95.0	390.9	367.4	12.18	11.45
December	74.0	20.00	86.9	84.1	351.5	329.3	12.38	11.59
Year	1458.0	23.96	1499.9	1451.6	5870.8	5540.1	11.98	11.31

Legends:				
	GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
	T Amb	Ambient Temperature	E_Grid	Energy injected into grid
	GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
	GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

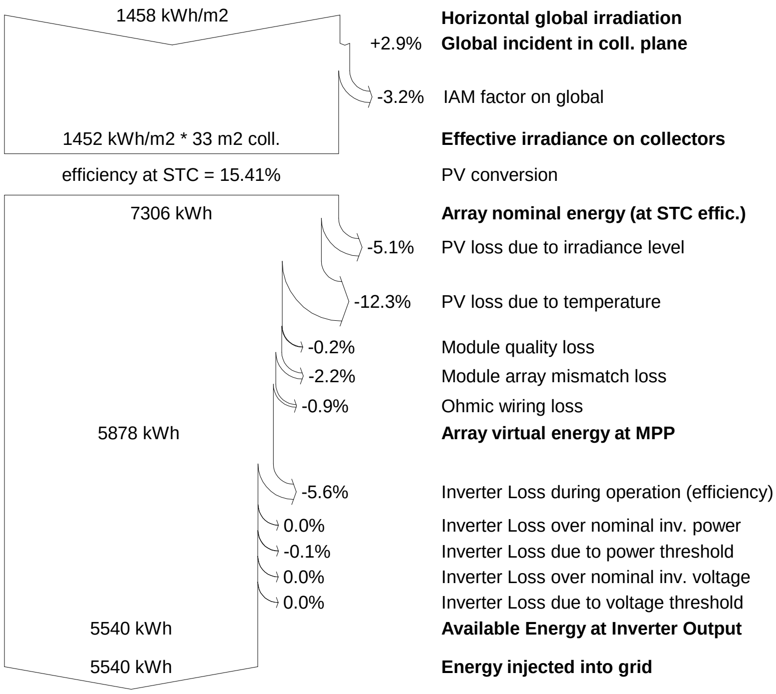
Grid-Connected System: Loss diagram

Project : **2014 SDE PARIS**

Simulation variant : **140217_交大台北_5kWp**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	18 deg	azimuth	0 deg
PV modules	Model	D6P250B3A	Pnom	250 Wp
PV Array	Nb. of modules	20	Pnom total	**5.00 kWp**
Inverter	Model	Solar inverter SOLIVIA 5.0 TR	Pnom	5.50 kW ac
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



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Grid-Connected System: Simulation parameters

Project :	**2014 SDE PARIS**			
Geographical Site	**Paris**		**Country**	**France**
Situation	Latitude	49.1oN	Longitude	2.1oE
Time defined as	Legal Time	Time zone UT+1	Altitude	26 m
	Albedo	0.20		
Meteo data :	Paris, Synthetic Hourly data			
Simulation variant :	**140217_交大巴黎_5kWp**			
	Simulation date	17/02/14 10h21		

Simulation parameters				
Collector Plane Orientation	Tilt	18 deg	Azimuth	0 deg
Horizon	Free Horizon			
Near Shadings	No Shadings			
PV Array Characteristics				
PV module Si-poly	Model	**D6P250B3A**		
	Manufacturer	DelSolar		
Number of PV modules	In series	10 modules	In parallel	2 strings
Total number of PV modules	Nb. modules	20	Unit Nom. Power	250 Wp
Array global power	Nominal (STC)	**5.00 kWp**	At operating cond.	4439 Wp (50oC)
Array operating characteristics (50oC)	U mpp	276 V	I mpp	16 A
Total area	Module area	**32.7 m2**	Cell area	29.2 m2
Inverter	Model	**Solar inverter SOLIVIA 5.0 TR**		
	Manufacturer	Delta Energy		
Characteristics	Operating Voltage	150-480 V	Unit Nom. Power	5.50 kW AC
PV Array loss factors				
Thermal Loss factor	Uc (const)	20.0 W/m2K	Uv (wind)	0.0 W/m2K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m2, Tamb=20oC, Wind=1 m/s.)			NOCT	56 oC
Wiring Ohmic Loss	Global array res.	293 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	0.2 %
Module Mismatch Losses			Loss Fraction	2.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05
User's needs :	Unlimited load (grid)			

Grid-Connected System: Main results

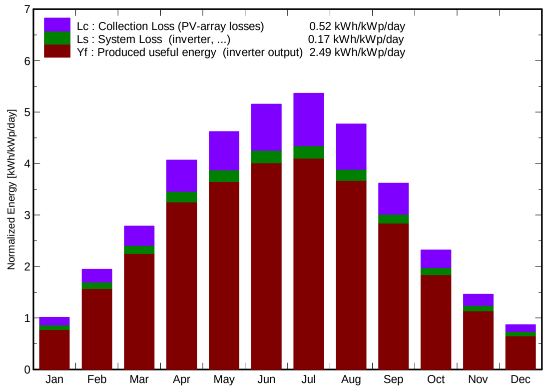
Project : **2014 SDE PARIS**

Simulation variant : **140217_交大巴黎_5kWp**

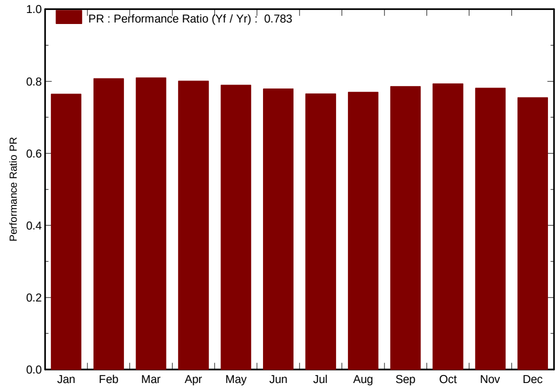
Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	18 deg	azimuth	0 deg
PV modules	Model	D6P250B3A	Pnom	250 Wp
PV Array	Nb. of modules	20	Pnom total	**5.00 kWp**
Inverter	Model	Solar inverter SOLIVIA 5.0 TR	Pnom	5.50 kW ac
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**4536 kWh/year**	Specific prod.	907 kWh/kWp/year
	Performance Ratio PR	78.3 %		

Normalized productions (per installed kWp): Nominal power 5.00 kWp



Performance Ratio PR



140217_交大巴黎_5kWp

Balances and main results

	GlobHor	**T Amb**	**GlobInc**	**GlobEff**	**EArray**	**E_Grid**	**EffArrR**	**EffSysR**
	kWh/m2	oC	kWh/m2	kWh/m2	kWh	kWh	%	%
January	24.0	4.60	31.5	30.0	134.2	120.3	13.05	11.70
February	43.0	4.70	54.6	52.3	237.9	220.3	13.35	12.36
March	76.0	7.00	86.3	83.0	373.9	349.3	13.26	12.39
April	114.0	9.80	122.1	117.7	519.3	488.7	13.02	12.25
May	140.0	13.50	143.3	138.3	600.9	565.5	12.84	12.08
June	153.0	16.30	154.6	149.4	638.6	602.0	12.64	11.92
July	163.0	18.90	166.4	160.7	673.7	636.5	12.39	11.71
August	139.0	19.00	147.9	142.9	602.7	569.3	12.47	11.78
September	96.0	16.00	108.5	104.7	452.9	426.3	12.77	12.02
October	59.0	11.80	72.0	69.1	306.9	285.4	13.05	12.13
November	32.0	7.30	43.8	41.7	187.1	170.9	13.08	11.95
December	20.0	5.10	27.0	25.6	114.3	101.7	12.98	11.55
Year	1059.0	11.21	1157.9	1115.5	4842.3	4536.2	12.80	11.99

Legends:

GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
T Amb	Ambient Temperature	E_Grid	Energy injected into grid
GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

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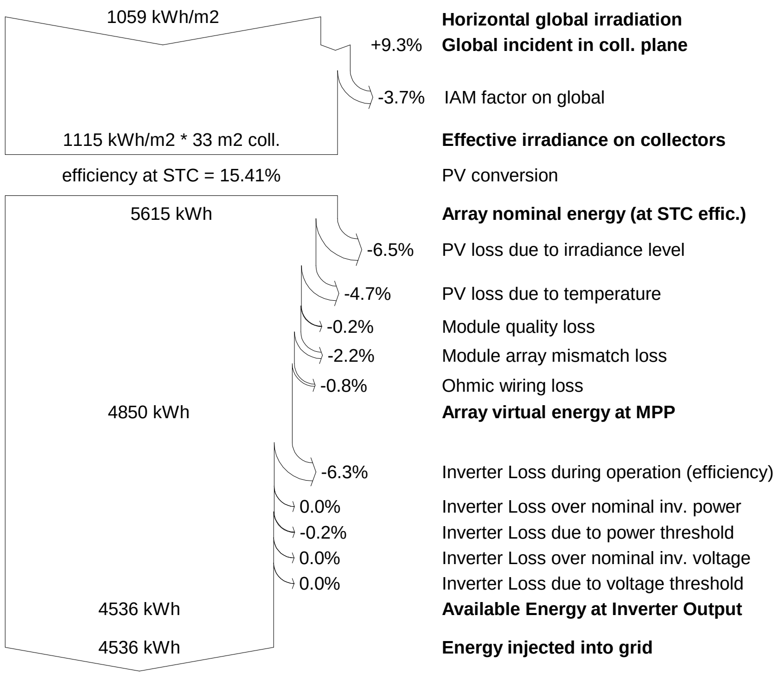
Grid-Connected System: Loss diagram

Project : **2014 SDE PARIS**

Simulation variant : **140217_交大巴黎_5kWp**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	18 deg	azimuth	0 deg
PV modules	Model	D6P250B3A	Pnom	250 Wp
PV Array	Nb. of modules	20	Pnom total	**5.00 kWp**
Inverter	Model	Solar inverter SOLIVIA 5.0 TR	Pnom	5.50 kW ac
User's needs	Unlimited load (grid)			

Loss diagram over the whole year



5.5 Innovation Report

Objective

The Orchid House will be installed on 20 – 30 years old residential buildings' rooftop for intending to solve several serious urban issues, which Taipei needs to face next coming decades, such as energy shortage, natural disasters and heat island effect. In order to adapt on different condition and environment of each sites, the Orchid House mutates its general construction system. The prototype at Versailles, France is one of many solutions on Taipei rooftop condition adjusted to the French local conditions.

Even though Taiwan is recognized as one of the largest Photovoltaic cell manufacturing countries in the world, the actual installation of PV system within its country hardly seen. Most of the residential building rooftops are covered with illegal metal sheet enclosures without any regulations. The innovations in Orchid House are dedicated to improve these local Taipei conditions and compared with the typical systems used in most of the rooftop solutions in Taiwan.

The Orchid House's energy consumption is 20kWh/m2 based on computer simulation, which is 40% less than typical Taiwanese residential building due to its passive design strategies. The Orchid House also consume 50% less portable water compare with typical Taiwanese residential building by recycling gray water and harvesting rainwater. Since Taipei city sewage system has limited capacity and flood problem, the Orchid House rainwater harvesting system improves city infrastructure.

5.5.1 Innovation in Architecture

Innovation	Description	Reference
Sustainable rooftop extension in Taipei City	20 – 30 years old 4-5 story residential buildings in Taipei need urgent reformation. Orchid House will be place on their rooftop to revitalize those buildings and promote sustainable urban regeneration	5.2.1
Double envelope with moderated buffer zone	Basic principle of moderated buffer zone is inspired by Taiwanese orchid green house for controlling perfect temperature and humidity. The Orchid House evolves the traditional technique into new bioclimatic system. The moderated buffer zone will protect interior space from harsh direct sun yet bring enough daylight into space.	5.2.2
House keeper system	House keeper system does not only provide comfort living quality in the house, but also connect the residents of Orchid House to Taipei city data network. The Orchid House computing system can download the data from Taipei city and display on tablet computer or smart phone through the specially developed APP for the system.	5.2.2
Green core	The green core is the heart of Orchid House for not only esthetic point reason, but also interior space comfort condition control. The vertical garden can host around 700 green plants with gray water irrigation system.	5.2.2
Smart Skin	Smart skin reacts with surrounding environmental condition without any electricity consumption by utilizing memory alloy spring.	5.2.2
Over 5% daylight factor well lit interior space	The Orchid House bring in natural light as much as possible without over heating the interior space with direct sun light. Based on the Ecotect analysis, the interior space daylight factor is average 5.19%, which is considered well lit for typical interior space.	5.2.3

5.5.2 Innovation in Engineering and Construction

Innovation	Description	Reference
Foundation system for existing Taipei rooftop	Eliminates unnecessary construction for placing the Orchid House on existing building in Taipei	5.3.1.4
High efficiency wall system	The thermal conductivity of the Orchid House is 0.15 W/m2K, which is about 18 times more efficient than typical brick wall in Taiwanese residential construction	5.3.2.2
Liquid thermal mass	The liquid thermal mass for Orchid House is unique application of stackable POLLI-Brick, which made with 100% post-consumer carbon neutral air insulated curtain wall system.	5.3.2.8
High R-Value thermal insulations: Glass foam, EFoam and Vacuum Insulated Panel	The Orchid House system investigates various possibility with thermal insulation materials. The insulation will be installed prefabricated wood boxes and placed on wall, floor and ceiling. The criteria of material selection focus on its efficiency and environmental concern.	5.3.2.10
DHW Production	The thermostatic 3-way mixing valves regulate the hot water temperature	5.3.3.3b
Gray water reuse	Collects waste water from shower, band sink, HVAC condensation and cloth washing machine for conserving portable water use.	5.3.3.3c
Rain water harvesting	Reduce the burden of Taipei City sewage system and utilize it for irrigation, water closet and washing machine.	5.3.3.3e

5.5.3 Innovation in Energy Efficiency

Innovation	Description	Reference
Double Skin on South Façade with automated louvers	The south façade of Orchid House is 66 degree to avoid direct sun gain into interior space. There are buffer zone between the automated louver and house interior envelop for controlling natural ventilation and greenhouse effect.	5.4.2.1
Evaporative cooling	Inspired by the agricultural technology of orchid greenhouse, the water wall is to lower the outdoor air temperature before it enters the house envelope.	5.4.2.2
Heat exchanger	The solar hot water system on the roof provides domestic hot water and preheats inlet air for reducing the use of heat pump.	5.4.2.2
Heat Reclaim Ventilation	HRV recovers the thermal energy of exhaust air and reuses it for heating or cooling of supply air. The enthalpy exchange efficiency can achieve 66% in cooling operation and 72% in heating operation	5.4.3.3
Relative Humidity Control	Relative humidity (RH) control is still rare for general households in Taiwan, but the living comfort can be improved by keeping the room's relative humidity within a range between 40% and 55%.	5.1.2

5.5.4 Innovation in Communication and Social Awareness

Before the competition

Innovation	Description	Reference
Disseminating Orchid House & SDE to high school students and teachers in Taiwan	NCTU professors and students gave lectures at several high schools in Taipei and Hsinchu for promoting Solar Decathlon Europe and the Orchid House project, and also interviews the candidates for the winter camp hosted by NCTU UNICODE and Delta Foundation.	Communication action
Winter Camp, disseminating sustainable city development idea to young generation	As one part of the focal point for the NCTU UNICODE's communication action, winter camp for high school students were hosted on February 7th to 9th 2014. The group of high school students develop different rooftop schemes to improve Taipei city	Communication action
Solar Ambassador Program	After interview all the students and instructors during the winter camp, the best high student from the group is selected as the Solar Ambassador to join Solar Decathlon Europe 2014 with NCTU UNICODE. The ambassador will share his experience during the SDE with his schoolmates to expand dissemination of sustainable development idea.	Communication action
Exhibition of Orchid House concept and model at Delta Foundation	NCTU UNICODE collaborated with Delta Foundation to host the exhibition about Orchid House at their headquarter building in Taipei to share the vision with general public.	Communication action
Weekly countdown on Facebook page	Every week NCTU UNICODE shares the activities log with our Facebook followers since beginning of the Orchid House Project. The number of log is now over 40 posts and keep going until the end of the Orchid House journey.	Communication action

During the competition

Innovation	Description	Reference
Cultural event to promote Taiwanese inhabitant at La cite du Soleil®	NCTU UNICODE is going to collaborate with the one of our sponsors Delta Electric to host cultural event at La cite du Soleil® to promote Taiwanese culture. Currently planning to project “Aerial Image of Taiwan” with high resolution projector.	Communication action
Different house tours by the audience	NCTU UNICODE will prepare different tour routes for different type of audience during the public visit for better understanding of our vision of the Orchid House. General public will be guided with the member of UNICODE for the basic concept, while VIP and Professional will be guided to understand innovative system of the house.	Communication action
Live broadcast on web	There will be live stream camera installed in the house during the Solar Decathlon Europe to share the excitement with the people who cannot attend the event at La cite du Soleil®.	Communication action

After the competition

Innovation	Description	Reference
Orchid House installation at Huashan 1914	After the journey to La cite du Soleil® in France, the Orchid House will be installed at Huashan 1914 to celebrate their 100th year anniversary. Huashan 1914 is one of the most popular cultural spots for the young people in Taipei and the Orchid House will promote sustainable life style to general public with their live experience.	Communication action
Orchid House portfolio publication	NCTU UNICODE is collecting all the research from the development of the Orchid House project to publish the project portfolio book to share our idea and experience to wider range of audience in Taiwan. The book launch event will be hosted at the Orchid House in Huashan 1914 after the house is back from France.	Communication action
Documentary movie of Orchid House experience	NCTU UNICODE is documenting every phase of the Orchid House project to edit a film to share the general public our experience through the journey. The film will be broadcasted at the Orchid House for general public to enjoy at Huashan 1914 site.	Communication action

5.5.5 Innovation in Urban Design, Transportation and Affordability

Innovation	Description	Reference
Solve urgent issues in Taipei old residential buildings	Orchid House proposal aims to solve all these urgent issues at once with not only what's being carefully designed in the house but also the outdoor spaces shaped and enclosed by the new structure.	5.1.1
Phased development for sustainable urban strategy	The Orchid House's vision toward Urban Design including the following three, Phase 1: Inserting the Dots & Fill in the Vacancies, Phase 2: Connecting the Dots & Bridging the Gaps, and Phase 3: Spreading the Dots & Multiplex the Effects.	5.1.1
Provide young professionals decent rental space combining with the government's policy	Our proposed roof addition through Orchid House, will not only coincide with the governmental policy in place, we also aim to optimize it by connecting to other resources both from the city and central government and leverage the unique conditions that the five representative sites can offer.	5.1.2

5.5.6 Innovation in Sustainability

Innovation	Description	Reference
Reduce Taipei city CO2 emission rate	Conserving energy use, generating renewable energy and reducing construction waste contribute to reduce carbon footprint of Taipei City	5.6.1
Provide young professional opportunity to live in Taipei downtown	Reduce the commuting time and distance by providing rentable space on rooftop to eliminate unnecessary carbon footprint.	5.6.2
Maximize bioclimatic strategies to conserve energy	Strategies solar shading, natural ventilation, and insulation for suitable passive strategies in Taiwanese climate.	5.6.3
Reduce construction solid waste and CO2 emission	Prefabrication steel construction can eliminate solid waste and CO2 emission compared with typical RC construction in Taiwan	5.6.4
Utilize energy recovery ventilator to reduce energy consumption	Energy recovery ventilator recovers about 80% of exhausted energy and reduce energy consumption by 3430 kWh per year	5.6.6
Install Taiwan produced PV Cell in Taiwanese residential buildings	Even though Taiwan is second largest PV cell manufacturing countries, the installation ratio of PV system is very low. The Orchid House will promote PV system made in Taiwan to install Taiwanese residential buildings	5.6.6.1
Harvest rainwater to reduce burden of city sewage system	Taipei sewage system capacity is in short for handling heavy annual perception and typhoon. The Orchid House rainwater harvesting system reduce the burden of sewage system.	5.6.7

5.6 Sustainability Report

5.6.1 Objective

Taipei, Taiwan's national capital city, is built up with versatile development history. Especially past decades, Taipei is recognized as one of the most important cities in South Eastern Asia due to its economic and industrial value. However, the main focus of Taipei past development was its economic and military arrangement, thus Taipei's unorganized infrastructure has started creating urban issues such as traffic jam and environment pollution. NCTU UNICODE will propose bottom up city development with the Orchid House Project placed on Taipei rooftops and promote Taipei's urban regeneration for the sustainable future.

The Orchid House project is not only to propose a solution for housing demands, but also to elaborate Taipei's future demands for energy, protection from natural disasters and improvement of city environmental quality. First of all, the energy demands in Taipei has been increasing drastically and it is covered over 78% by imported fossil fuels such as oil and coal and 18% by Nuclear power based on APEC Energy Demand and Supply Outlook summary. (*Figure 5.6.1.1: Energy source graph*) However, on 5 Jun 2008, the Ministry of Economic Affairs released the Framework of Taiwan's Sustainable Energy Policy to state that Taipei is facing insufficient natural resources and limited environmental carrying capacity. The Orchid House project will convert Taipei residential building rooftop surface to be able to generate energy through PV and consume by the tenant building or its neighbors. This new energy addition to existing infrastructure will reduce the burden of power grid and contribute to reduce the energy intensity and city's CO_2 emissions.

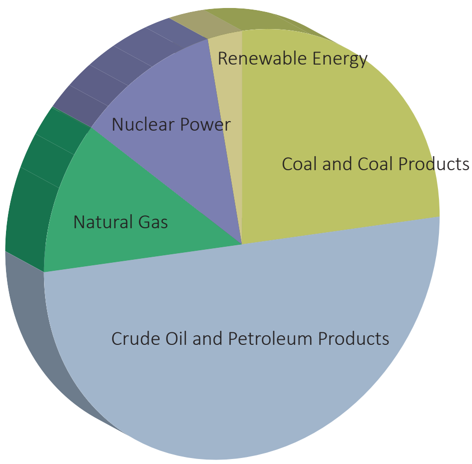


Figure 5.6.1.1: Energy source graph

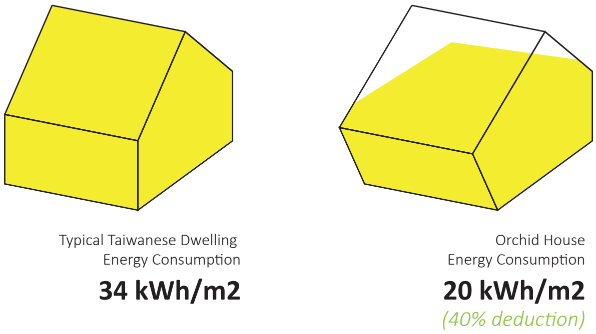


Figure 5.6.1.2: Energy Consumption Comparison

Regarding to the new renewable energy policy, NCTU UNICODE believes that the Orchid House project should not only contribute by generating the electricity, but also by reducing the energy consumption for air-conditioning. (*Figure 5.6.1.2: Energy consumption Comparison*) Thus, the house is designed with passive strategies such as high insulated wall, promoting natural ventilation, and also avoiding heat gain from direct sunlight. Most of Taiwanese residential buildings are built with reinforced concrete construction with brick infill. The concrete roof and floor absorb heat during the day and emit during the night. Also the brick infill, which is one of the lowest insulated wall, transmit heat and lose condition temperature.

These are the reasons that the Orchid House project is not only to plug-in new extension on the roof-top, but also renovate existing residential building with new façade treatment with proper sun shading design. The renovation plan also incorporates addition of elevators to the existing buildings since the most of 4 to 5 stories raw houses are not equipped with automated vertical circulation. (*Figure 5.6.1.3: Exploded Axon*) The Orchid House extension will contribute to the existing housings not only for energy solution, but also creating new proper infrastructures for plumbing and circulations.

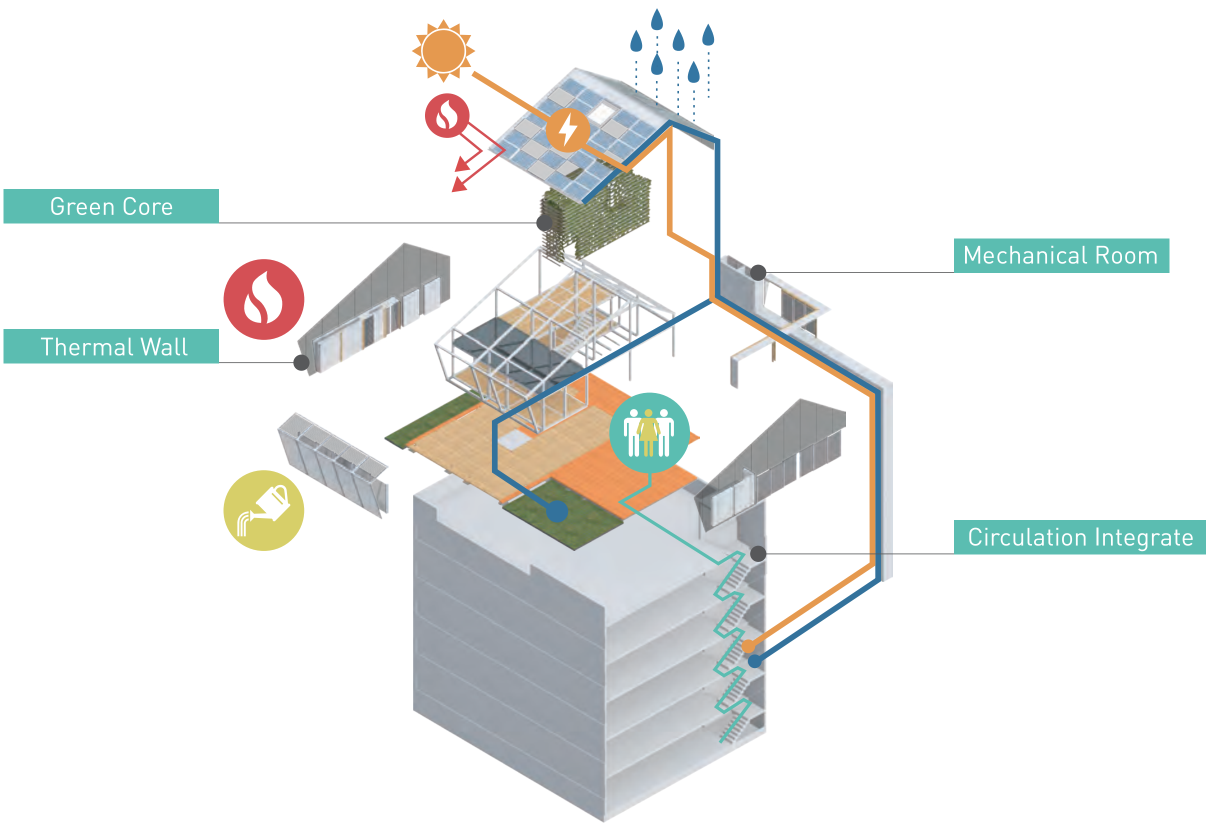
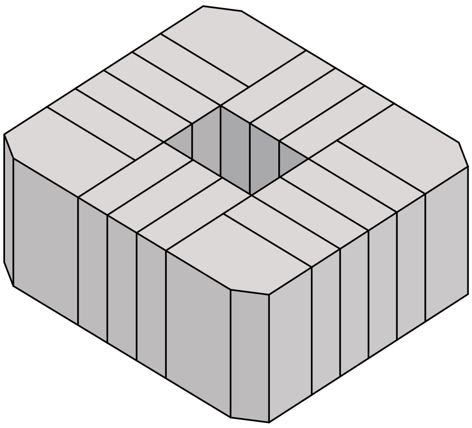
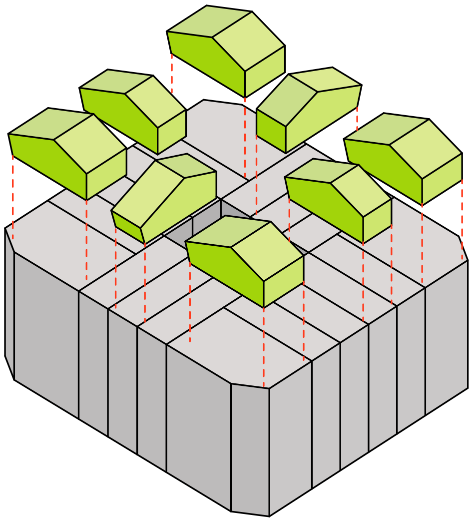


Figure 5.6.1.3: Exploded Axon

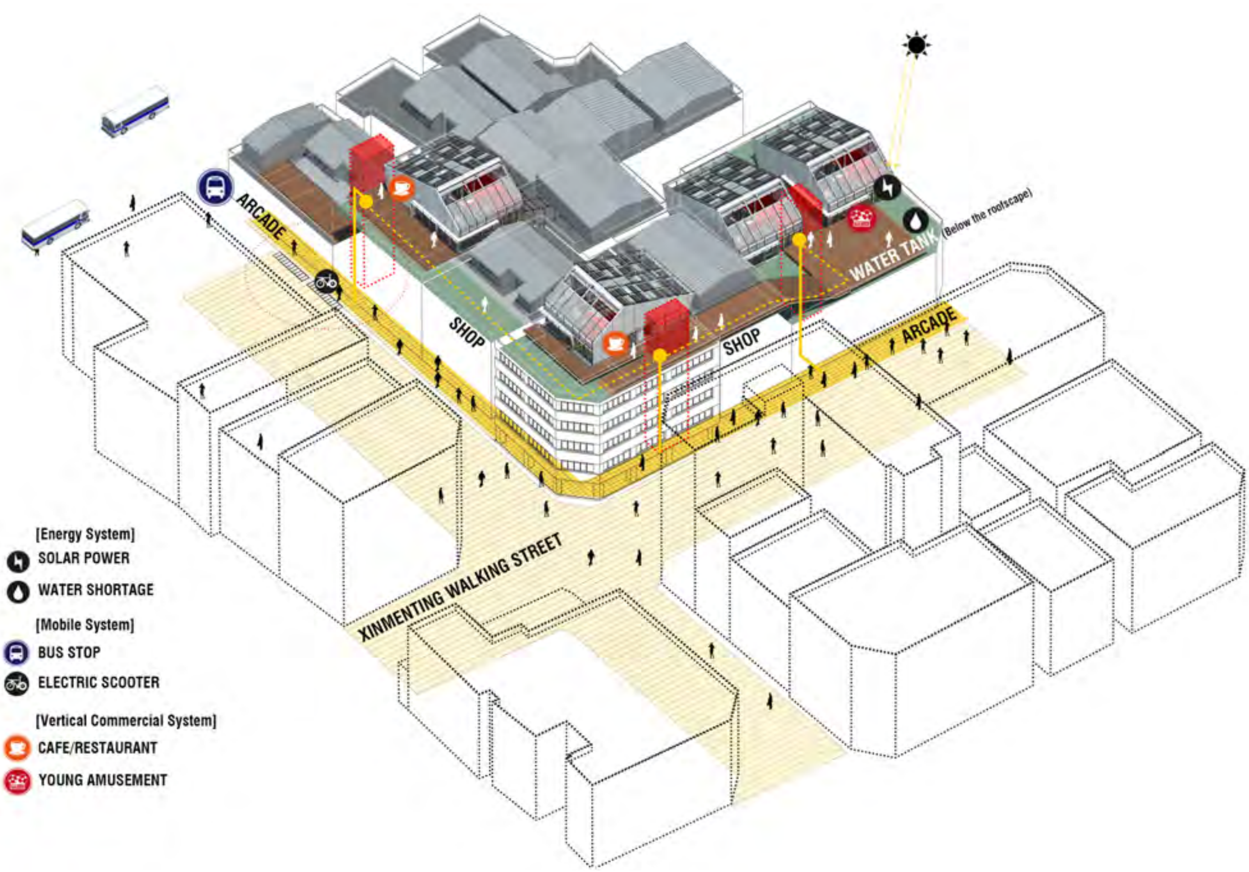
During the past decades of Taipei city urban planning, the most of developments were done by demolishing existing and create new massive high-rise building. However, this top down urban planning just pushes urban issues to the rest of neighbor and not solving them. The bottom up city planning is to focus on smaller components of city, such as residential buildings, and to promote urban regeneration not only to renovate the buildings, but also to activate the neighborhood by inserting the Orchid House.



Original City Block



Orchid Craster



5.6.2 Urban Design, Transportation and Affordability

Based on the research by Environmental Protection Administration (EPA), Taiwan is ranked 17th the world and ninth in Asia in terms of its carbon footprint. Each person in Taiwan, on average, produce 10.89 tons of carbon emissions a year, which is more than its Japan and South Korea, and daily per capita carbon footprint of 19.6 kg, almost four times the UN recommendation in 2011. Therefore, the Orchid House will increment lowering carbon footprint in urban design strategies by introducing PV and green roof for reducing heat island effect and increasing energy efficiency by reducing air-conditioning load.

Even though the highest carbon footprint sector is industrial, Taiwanese transport sector contributes its carbon emission by 14% of all. (*Figure 5.6.2.1: Carbon Emission Graph*) Among this transport sector, the road vehicles including motorcycles, passenger cars and trucks account for approximately 94% of all transport-related carbon dioxide emissions. Vehicle ownership in Taipei shows extremely high growth rate from 1980 to 2000 by 430% for cars and 173% for motorcycles due to the relatively poor level of service of the bus system. These high number of vehicle bring environmental pollution as well as traffic congestion. The average speed of private cars in Taipei city is about 20 kilometers per hour in peak periods while that of buses is about 10 kilometer per hour. Taipei city needs new transportation system, which contribute less carbon emission and street congestion. NCTU UNICODE propose green e-motor cycle parking system along with the Orchid House ground level for removing street parking and creating more renting e-motor cycle spots in the city.

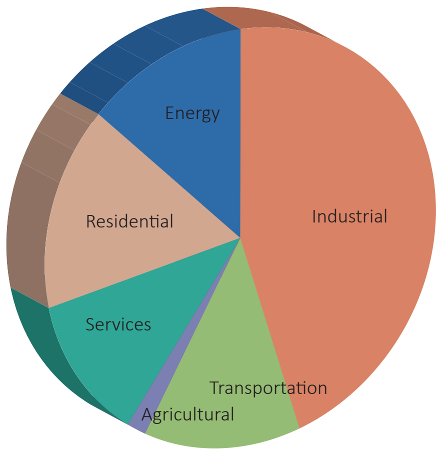
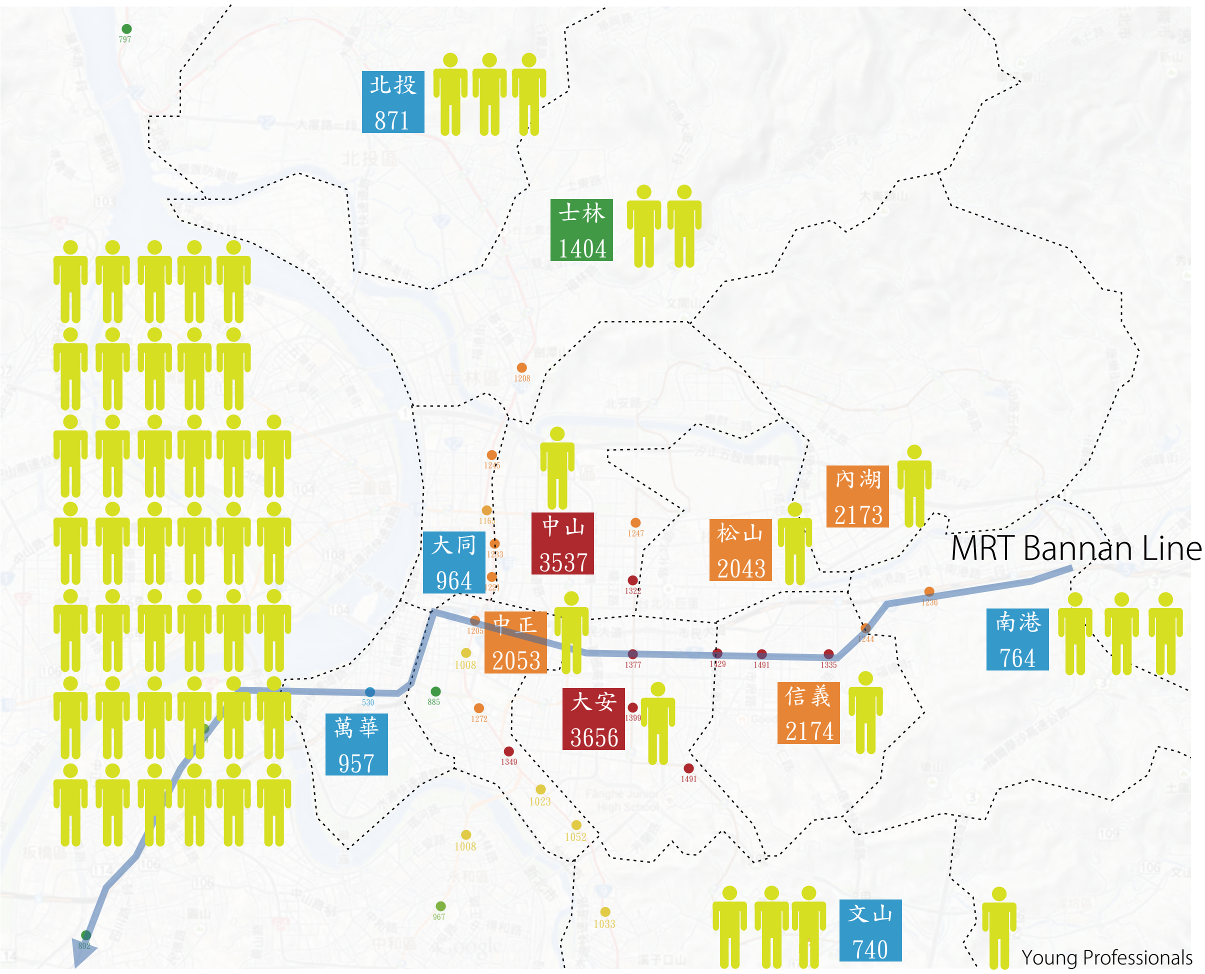


Figure 5.6.2.1: CO2 Emission graph

In order to promote sustainable city development, the housing affordability for young professionals is essential for the metropolitan city like Taipei, however, currently the housing price is way beyond of what general income resident to afford acquiring property in downtown Taipei. The average monthly salary of people who have a bachelor degree in Taiwan is NT $36,871 (€890.05) according to the 2013 survey conducted by Taiwanese online recruitment company, and standard size apartment (89.3 m²) with 22 years old building is NT $13 million (€ 317,857). Also Taipei is considered one of the highest rent price in Asian cities. Based on ECA International survey, Taipei is the 11th highest in Asia, and 46th in the world. Therefore, the young professionals who are within three years after their graduation from collage hardly make their lives in Taipei city. NCTU UNICODE will act as Non-Governmental organization to create Orchid House Urban Regeneration project to provide young professionals inspiring quality urban lifestyle with decent rental in downtown Taipei rooftop to stimulate sustainable city development.



Currently most of young professionals live far from the central area of Taipei due to the high rent price and their low income. Even though Taipei Metro system is well developed and covered most of the places, most of young professionals rather choose motor cycles for their commuting method. During the morning rush hour, the great number of motor cycle occupies street and create traffic chaos, which resulted in delaying the public bus schedule. The morning motorcycle commuters are also contribute significant amount of air pollution in Taipei. Motor cycle emits carbon monoxide, nitrogen oxide, non-methane hydrocarbon, and particulate matters. The Orchid House addition to existing city fabric will directly mitigate Taipei city air pollution by reducing the commuting distance for young professionals.

Young professionals commute to work in Taipei

Commuting time	**Average 0.45hr**
Commuting Method	
Motorcycle	**31.5%**
Car	25.5%
Bus	16.1%
Walking	8.8%
Bicycle	15.1%
Carbon footprint	**106.28 g/km**

Young professionals live in Orchid House

Commuting time	**Average 0.5hr**
Commuting Method	
Walking	**40.5%**
Bicycle	35.5%
Bus	10.5%
Motorcycle	0.5%
Car	0.5%
Carbon footprint	**6.15g/km**

95% Carbon footprint reduction in commuting

5.6.3 Bioclimatic Strategies

Currently Taiwanese building comfort condition managing methods are heavily relying on active strategies. Recently during the summer, Taiwan with limited energy resources, there are often crisis for energy shortage due to the high electricity energy consumption of buildings. The consumption raises to around 30% of total electric supply through the year, which is 40% to 50% during the summer time and around 20% during the winter. However, most of residential buildings are built with low insulated material such as reinforced concrete and bricks, the heat gain through the intensive sun radiation absorbs the cooled air from air-conditioning immediately. (*Figure5.6.3.0.1: Bioclimatic Strategies graph*)

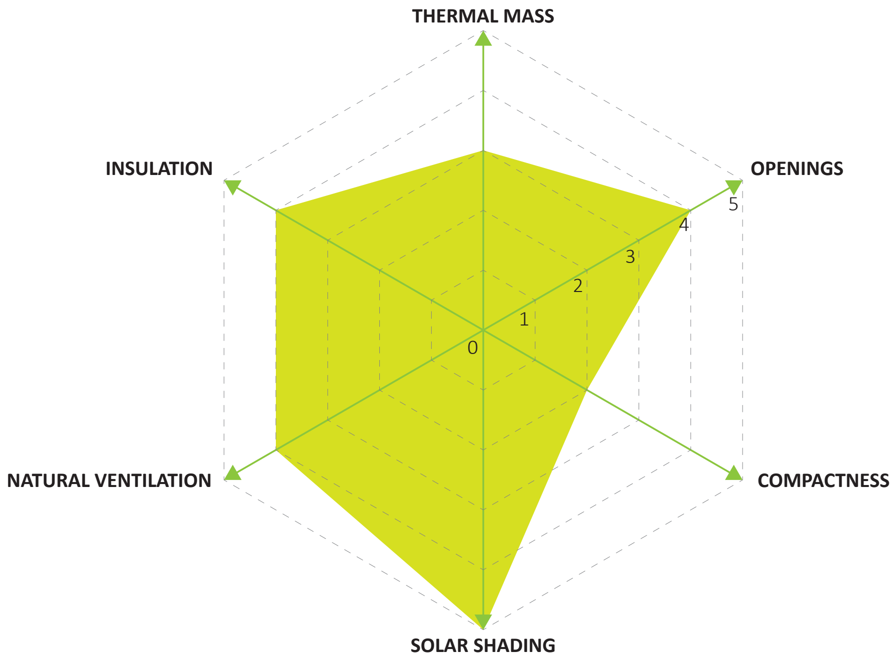


Figure 5.6.3.1 Bioclimatig Strategies Graph

Exterior Envelope

The Orchid House's exterior envelope consists with Makrolon® polycarbonate 40mm Low-E coated Inter-locking sheet from Bayer Material Science on general façade, automatic transparent glass louvers on south side, as well as high efficiency photovoltaic panel on the south facing roof.

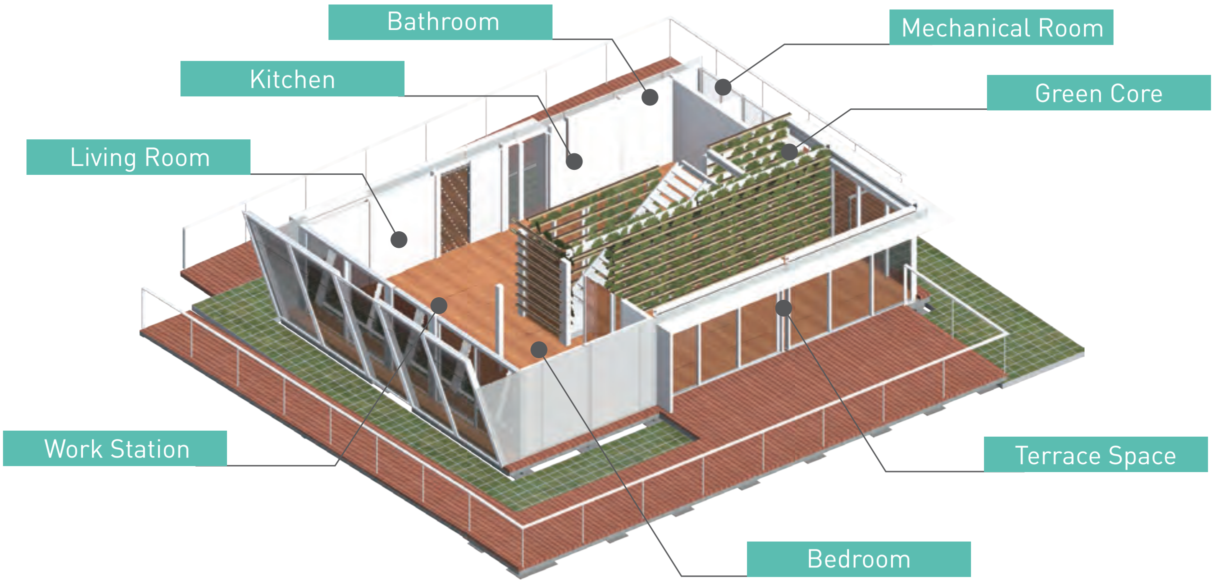
Even though the Makrolon® polycarbonate 40mm is 55% transparent and its U-value is 1.1 W/m²*K, the installation process and supporting materials are far less than conventional glass curtain wall system. The Orchid House will already eliminate large amount of material usage and human resource by incorporating this system. Also Makrolon® polycarbonate is also 100 % recyclable, making it inherently sustainable.

The south side automatic glass louvers contribute the main passive design strategies of the Orchid House. During the hot summer time the louvers will be open to promote natural ventilation, meanwhile during the winter time, it will be closed and promote greenhouse effect in between living volume and envelope to protect from cold weather as well as heat the indoor space.

L-shape living volume

The L-shape living volume build with layers of highly insulated material. The innovative glass foam will be installed in wall, floor and ceiling. The glass foam is made with 100% recycled glass and infinitely recyclable. Since it is rated as one hour fire protection, it is mainly used for the fire separation.

For the extreme weather condition, the Vacuum Insulation Panel (VIP) may be installed for the better performance of climate resistance. However, the usage of VIP will be exam carefully with the cost performance versus energy consumption.



Glazing

The Orchid House will incorporates Bayer Makrolon® polycarbonate 10mm with YKK AP air-tight window frame system for the most the openings for the Solar Decathlon Europe 2014 prototype due to the transportation and construction safety. Bayer Makrolon® polycarbonate 10mm U-value is 2.8 W/m²*K and the weight is only 1.7 kg/m². It is durable and easy to handle with non-skilled workers.

Daylight

The lighting strategy of Orchid house is to eliminate excessive lighting and utilize as much natural as possible.

The southern facade has louver that cuts the hot direct sun light in summer, and lets in natural light in winter. The geometry of south side house is adjusted to reduce heat gain during the summer, yet bring more direct sun light to the interior space during the winter time. The key is to extend the roof on the south side outward to create a perfect condition for lighting control.

The exterior parameter of Orchid House is mostly covered with planters to promote reflected light to come in through the openings. This externally reflected component will contribute to the interior day light.

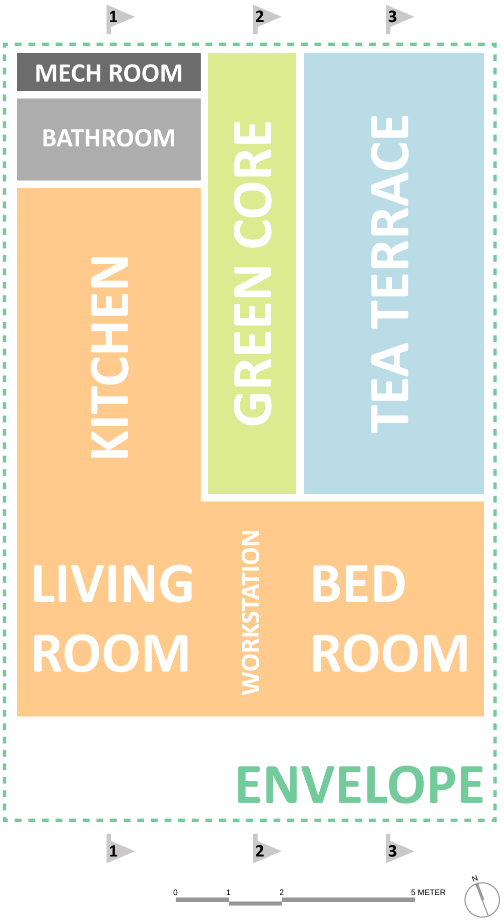
Lastly, the green core and POLLI-BRICK™ will bring diffused daylight to the interior space. The 30cm deep POLLI-BRICK™ thermal mass will filter harsh west afternoon sun light to soften diffused light and the living room will bright until the sunset. The clear Bayer Makrolon® polycarbonate 10mm will be placed at rooftop of central green care to drawn direct sun light to the center of the house. The wooden planters for the vertical garden will act as louvers to diffuse the light into the room.

View to thermal mass and Green core

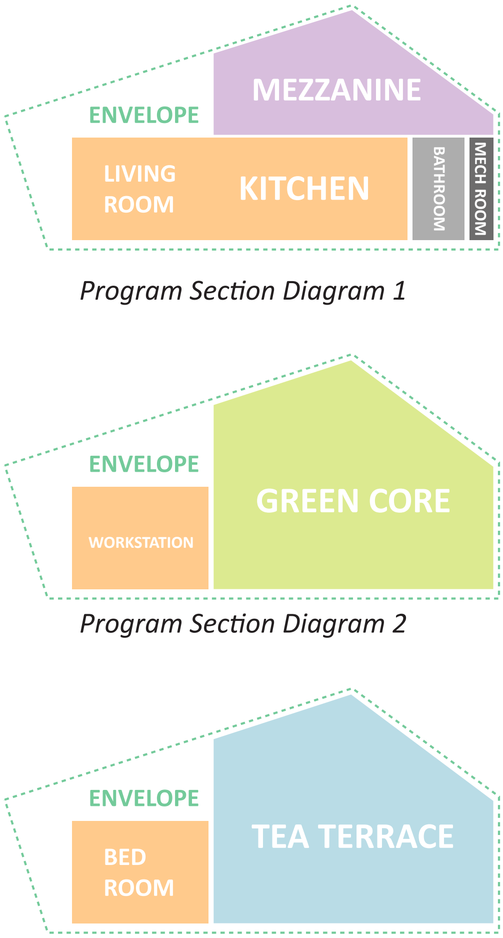
Space Planning

The Orchid House spacing planning criteria is including:

1. The vertical circulation space is place at the center of the house to promote natural lighting and fresh air ventilation.
2. The mechanical room and bathroom are located on north side to reduce heat loss of living space.
3. The kitchen, living room and bedroom forms an open plan which distributing radiant heat from west side thermal mass.
4. The double high tea terrace on east side is to bring morning sunlight to the house.
5. The mezzanine level space is for ventilating the heat generated by photovoltaic panel on the roof.



Program Plan Diagram



Program Section Diagram 1

Program Section Diagram 2

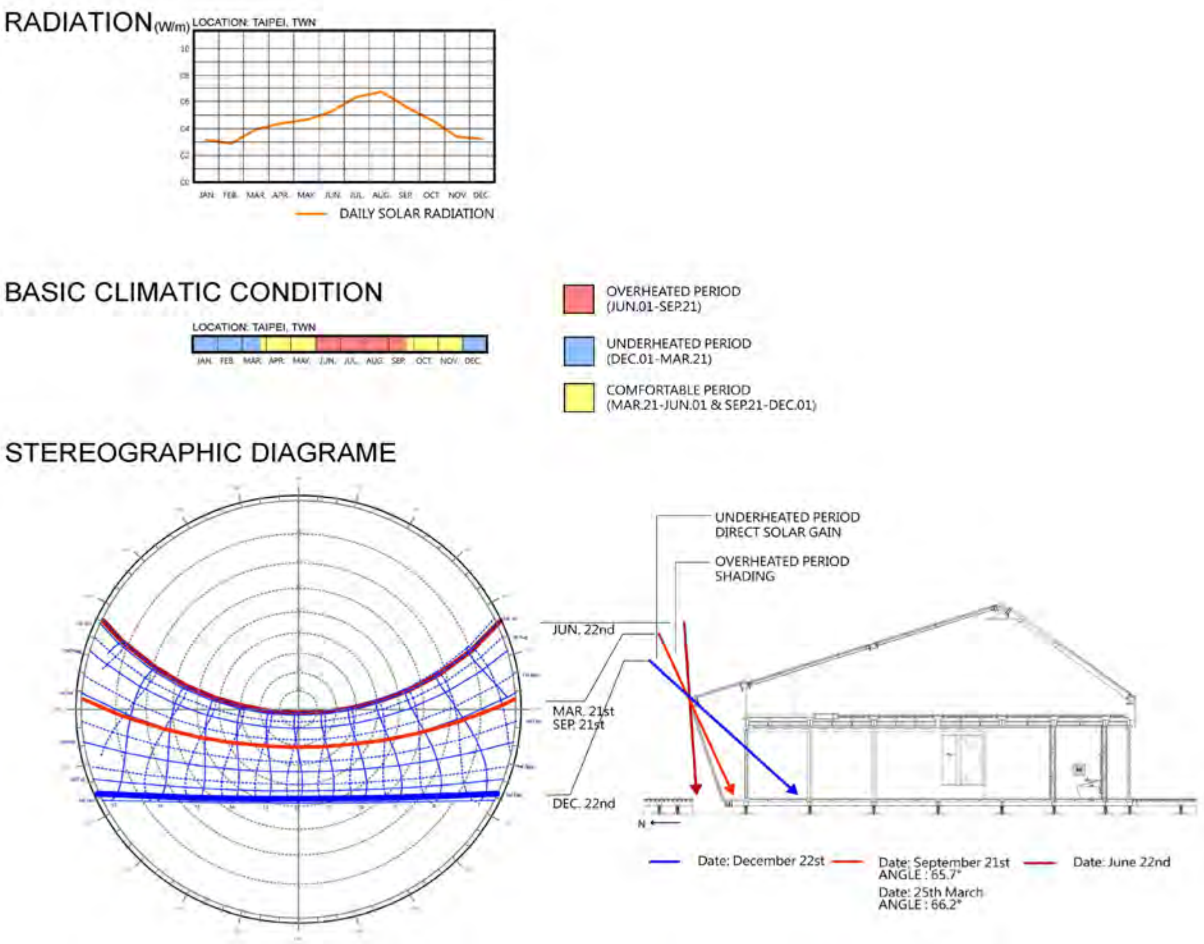
Program Section Diagram 3

Passive heating strategies

The passive Heating strategies include:

1.Direct solar gain:

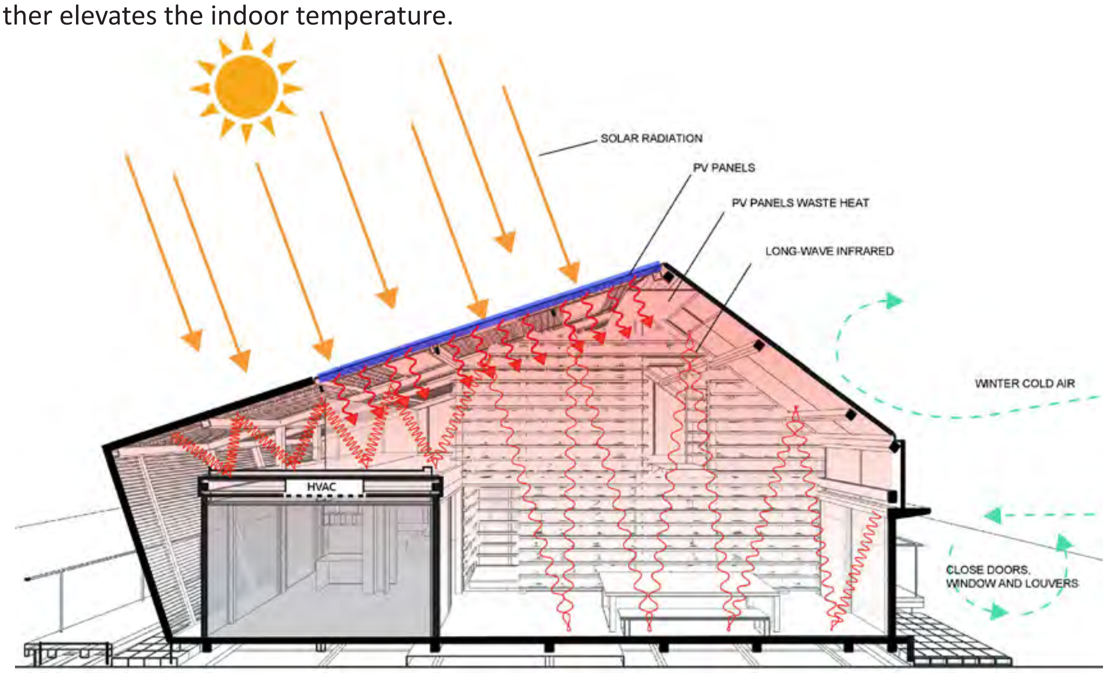
In order to keep the indoor temperature comfortable between 22°C and 29°C, the outdoor balance point temperature needs to be at 19°C to 26°C. The average temperature of Taipei is below 19°C from December 1st to March 21st which is defined as the under-heated period. To provide direct solar gain for the living space, the building geometry was designed with the purpose to allow solar radiation to enter the living space during the whole under-heated period.



Solar Angle and Direct Solar Gain Diagram

2.Greenhouse effect:

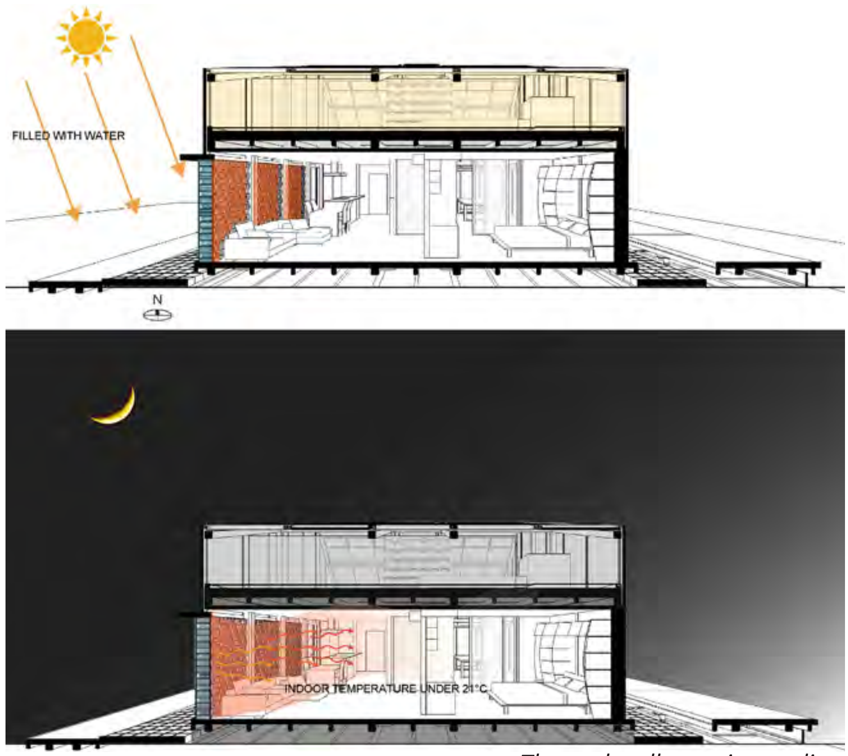
When the outdoor temperature is below 19°C, all exterior windows and louvers of the building will be closed. The greenhouse effect generated from the solar radiation will increase the indoor temperature. The waste heat generated underneath the PV panels also remains indoors and further elevates the indoor temperature.



Greenhouse Effect Diagram

3.Thermal wall:

The 30cm thick thermal wall on the west side of the house is built with water-filled 6-litter-bottles. The bottles are made of recycled Polyethylene Terephthalate Polymer. This thermal wall utilizes the high heat capacity of water to store solar energy for heating. The wall is 2.2 meters in height and 6 meters in width that accounts for 40% of the floor area.



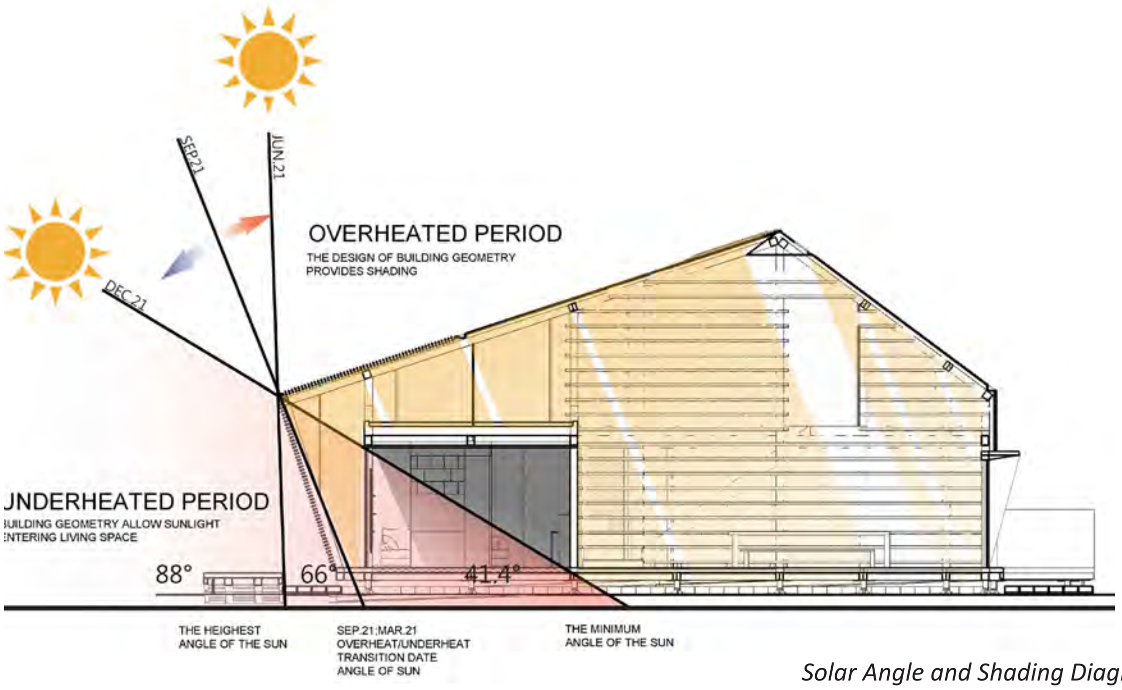
Thermal wall experiment diagram

Passive cooling strategies

The passive cooling strategies include:

1.Shading:

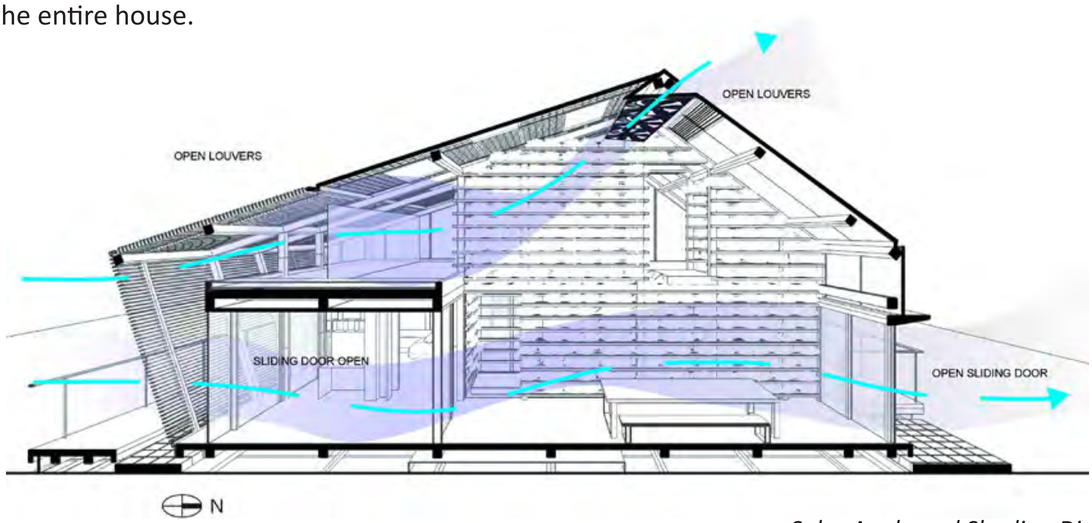
The average temperature in Taipei is above 26°C from June 1st to September 21st which may be defined as overheated period. It is essential to avoid solar radiation in the living space during these days. As a result, we need to shade the south openings from sun beams that come in at 66° until September 2ist. It will completely shade the south openings for the whole overheated season. The building geometry of the Orchid House offers a shading area on the south side to protect the solar radiation during the overheated period in Taipei.



Solar Angle and Shading Diagram

2.Natural Ventilation:

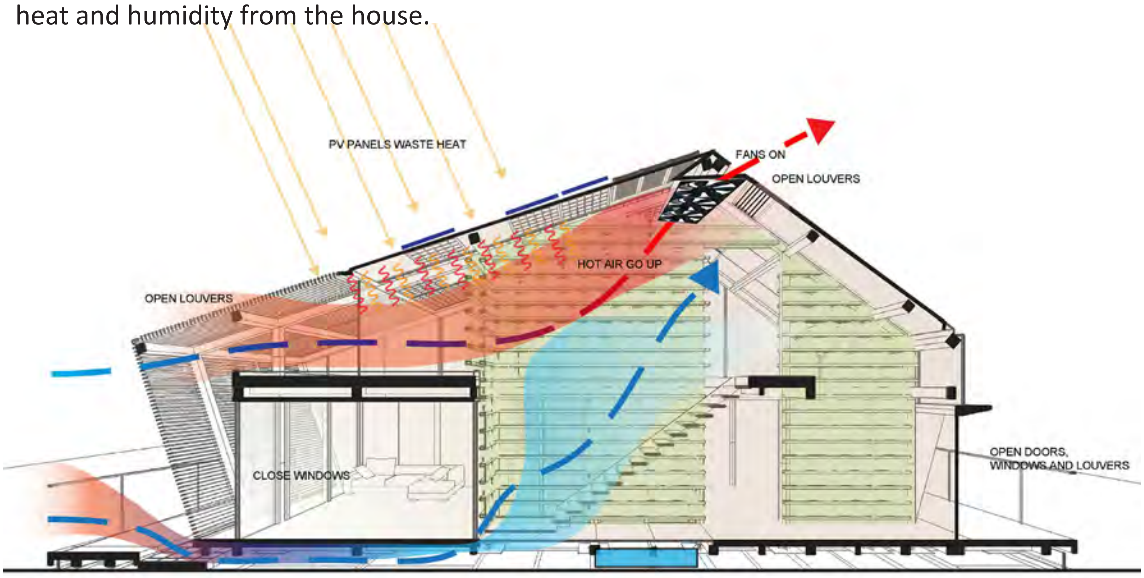
When the outdoor temperature is between 19°C and 26°C, and the wind is blowing, all windows and louvers of the Orchid House would open up to allow natural wind to blow in. The wind will carry off the waste heat generated by PV panels as well as the heat and humidity generated by human and appliances. Due to the prevailing summer southwest wind in Taiwan, the Orchid House has large openings on both the south and north sides to capture all natural wind blowing through the entire house.



Solar Angle and Shading Diagram

3.Solar Chimney:

When the outdoor temperature is between 19°C and 26°C but there is no wind, the waste heat generated by the PV panels under the roof will create stack effect, which means the indoor warm air would rise and escape through the opening near the ridge of the roof. This air movement will bring the outdoor air into the house through the windows and louvers which will drive away the heat and humidity from the house.



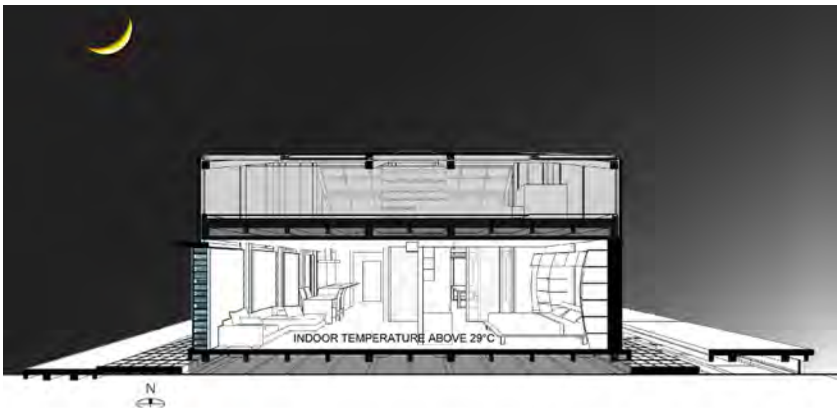
Solar Chimney Diagram

Thermal Energy Strategies

Thermal energy storage strategies are important passive design strategies for the Orchid House. The Unicode team's thermal energy strategies include:

1.Thermal wall:

For heating purpose, the thermal wall on the west side of the house stores solar radiation in the water and releases it into the indoor space at night when the temperature is below comfortable level. This energy storage process serves the best in autumn when the daily temperature takes a big dive at night in Taipei. It also performs well in sunny winter days when the daytime is warm and nighttime is cold. During the warm nights, a sliding wall panels with high thermal resistance may be closed to prevent heat radiates into the living space. During the extreme hot summer in Taiwan, when the solar radiation should be preferably kept out, the water in the thermal wall may be removed which will turn the thermal wall from thermal storage device to thermal resistance device. The thermal resistance value of the empty Polli-Bricks wall to 12m2*°C/w. See section 1.5.3 for more detail about Thermal wall.



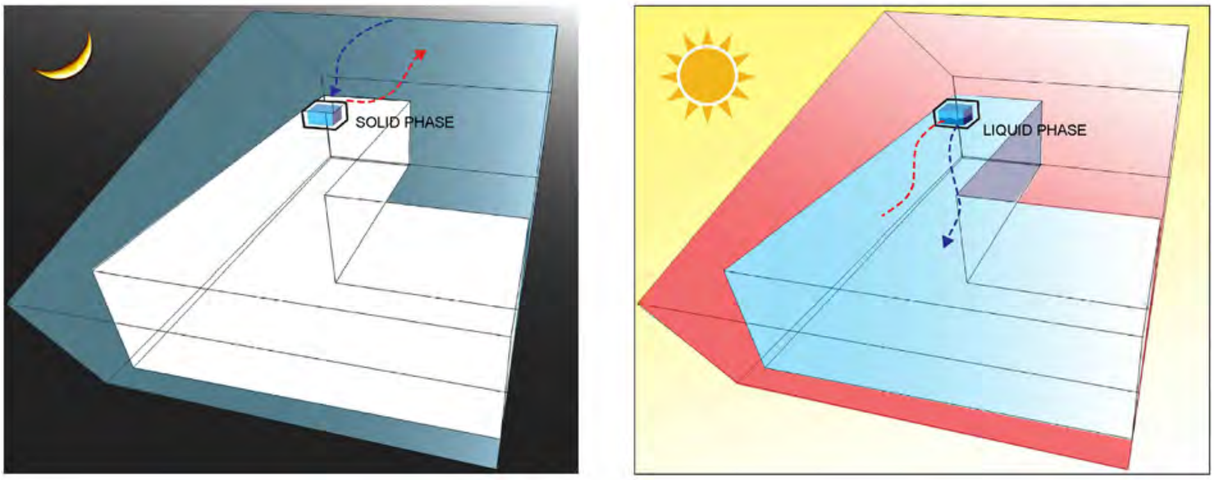
Thermal wall at overheated night

2.Earth and rain water tank heat-sink:

The Orchid House has a raised footing that sits on top of existing roof surface. There is a space between raised floor and underneath building structure to create a cool shaded space. Rain water tank also sits in this space. When the outdoor warm air (26+°C) flows into this space, the heat will be absorbed by the building structure and the rain water in the tank. That will cool down the air before it enters the terrace space. See section 1.6.4 for more detail about earth cooling.

3.Phase change material:

The Orchid House uses Phase Change Material (PHM) as a passive method to lower the daytime temperature on overheated days. The PHM releases heat at night and changes its phase to solid. On the next day, the outdoor warm air flows through it and release heat to PHM before it enters the living space. The heat transfer process melts the PCM to liquid phase in the daytime.



Phase Change Material Diagram

Ventilation

Because of the long, hot, and humid summers in Taiwan, ventilation becomes the most important passive design strategy for the Orchid House. Ventilation brings cool outdoor air into the space to lower the indoor temperature. The outdoor air may also be cooled by heat sink such as the earth and water tank or by evaporation before entering indoor spaces. Air flow on human skin can also lift some heat from our body. It also increases evaporation in our skin to increase comfort in overheated condition.

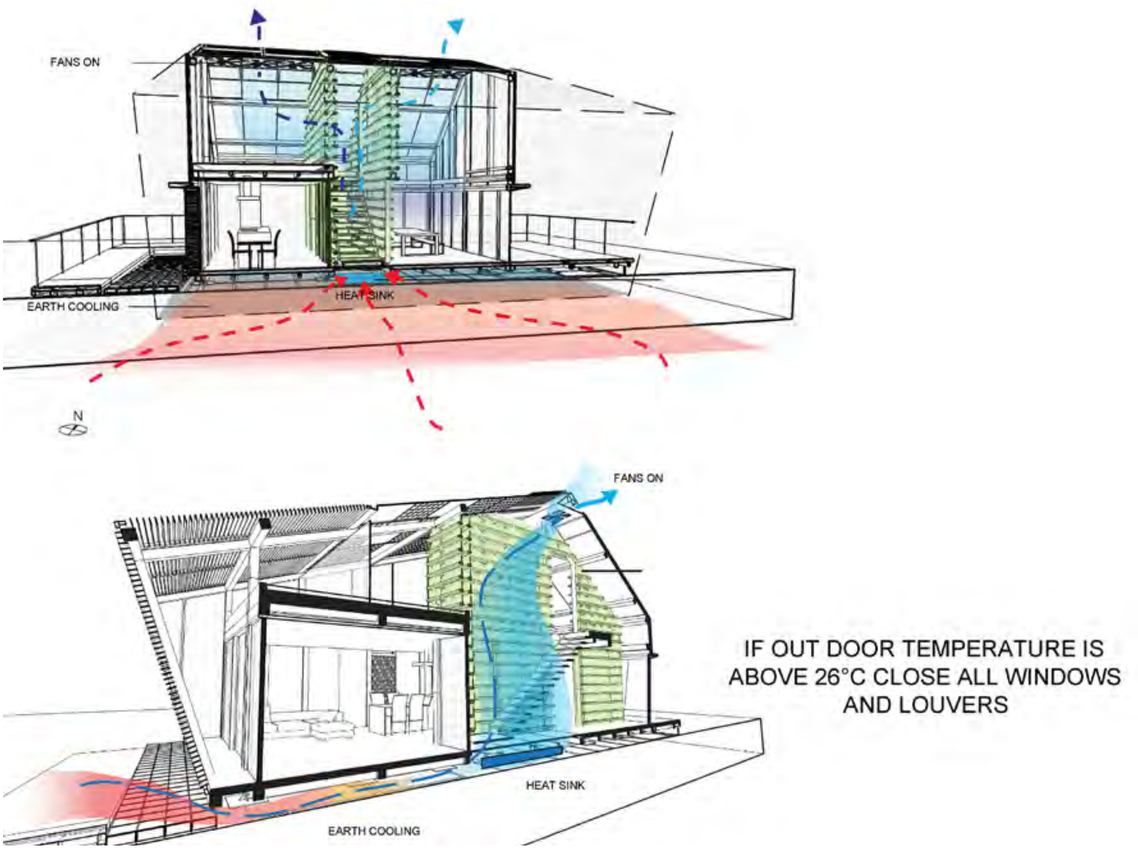
Our ventilation strategies include:
1.Natural ventilation: See section 1.6.2
2.Forced ventilation for earth and vegetation cooling: See section 2.9.1
3.Forced ventilation for evaporative cooling: See section 2.9.2

Hybrid or Semi-passive systems

The semi-passive systems include:

1.Forced ventilation with earth and vegetation cooling:

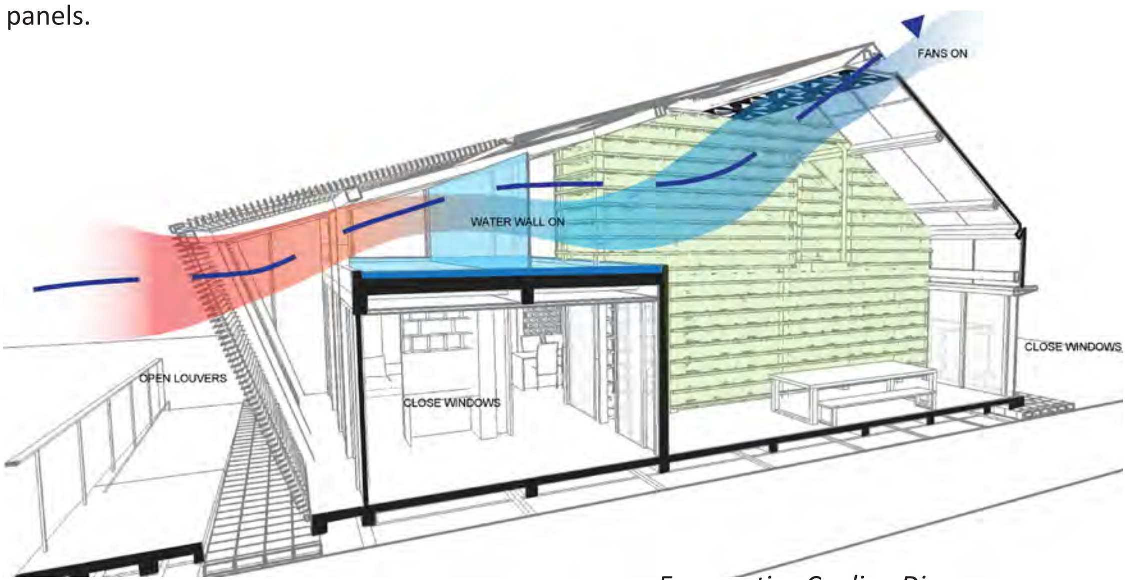
When the outdoor temperature is above 26°C, a series of fans near the ridge of the roof would be turned on. These running fans would create a negative pressure which draws the outdoor air to the underneath space of the floor. The air then would flow through the floor opening in the green core. After the air flows into the green core, it penetrates the vegetation wall around the green core and enters the terrace area. The warm outdoor air is first cooled by the underneath building structure and rain water tank under the floor and then cooled by the evaporative effect of the plants.



Earth and Vegetation Cooling Diagram

2.Forced ventilation with evaporative cooling:

When the outdoor temperature is above 26°C, a water wall would come on automatically. The outdoor air will then be drawn into the terrace space by the fans near the ridge of the roof. The outdoor air temperature is lowered by the evaporative effect. This process reduces the heat gain of the indoor space from the terrace. This process will also remove the waste heat from the PV panels.

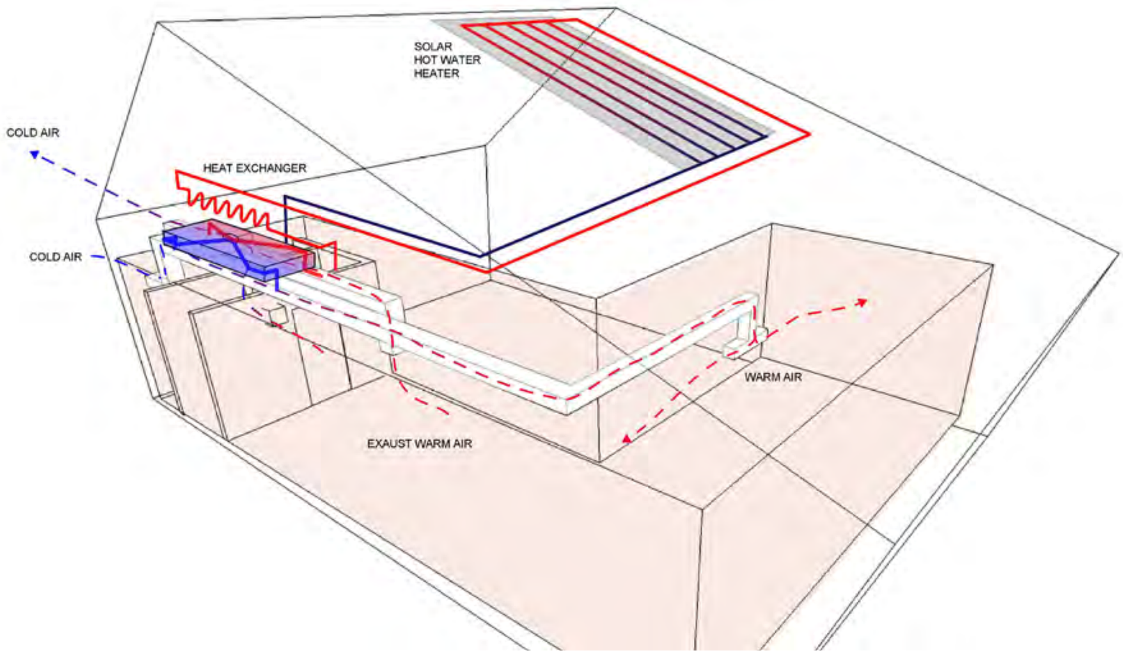


Evaporative Cooling Diagram

3. Phase change material: See section 2.7.3

4.Heat exchanger preheated by solar hot water:

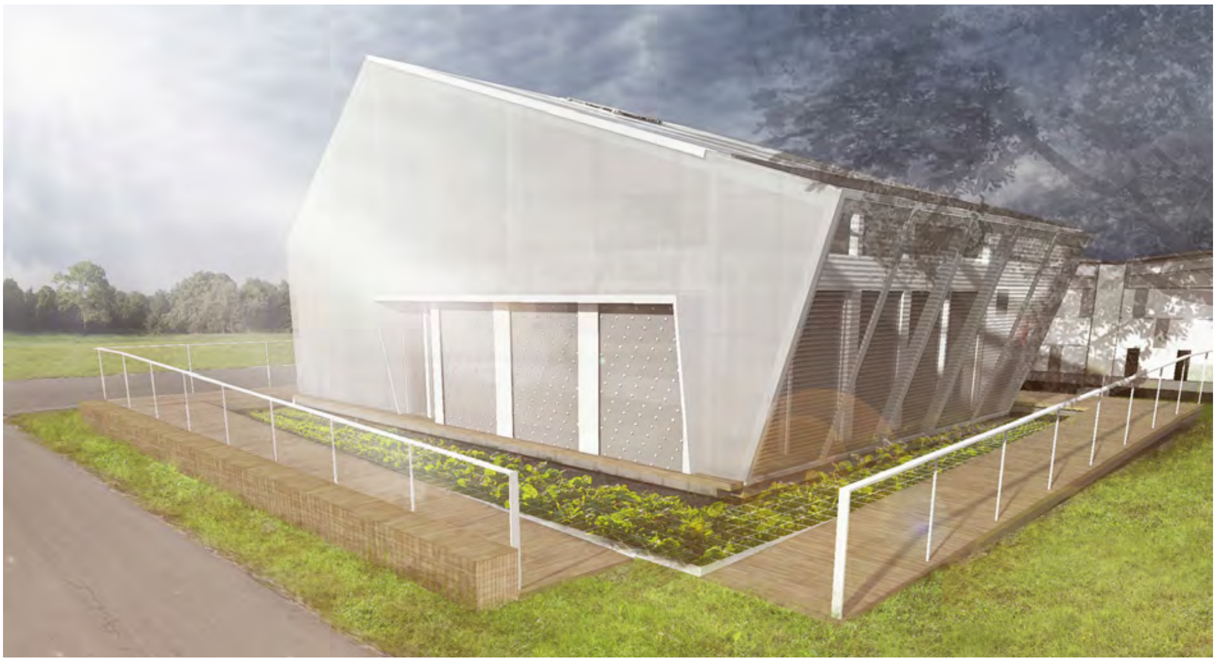
The solar hot water system on the roof provides domestic hot water as well as hot air for winter heating. The hot water is drawn to the inlet duct of the heat exchanger, so the inlet air is preheated before it enters the living space. This enables us to largely reduce the operation of heat pump for heating purpose .



Solar hot water preheat air handling system

Exterior Design

The concept of the Orchid House is to build a buffer space, the terrace, outside the living space. We use all passive and semi-passive strategies to control the temperature of the buffer space. No matter how extreme the outdoor climate may be, the microclimate of the buffer space is moderate which reduces the use of mechanical system in the living space. Some outdoor plants can also reduce air temperature around the house. It also lowers the air temperature through evaporation before the warm air enters the house.



East side view at Solar Decathlon Europe

5.6.4 Construction system

Taiwanese typical residential construction method is reinforced concrete columns and slabs with brick infill for 4-5 story building. (*Figure 5.6.4.0.1: Brick infill photo*) Many of Taipei residential buildings are widely opening store front at street level, however, it sometimes results in weak story on the first floor. Also, the concrete sub-contractor's insufficient engineering skill casts columns with lack of ductile and causes building collapsing after strong earthquake. According to the National Center for Research on Earthquake Engineering, earthquake over magnitude 6.3 around Taipei basin could trigger 4,000 building failures. The prime problem is that around 700,000 residential buildings in Taipei metropolitan area are over 30 years old and built with not adequate seismic proof design.

Figure 5.6.4.1 Brick Infill RC strcture

Taiwan is an Island with high population density, therefore the landfill waste is one of the biggest challenges to protect its own healthy environmental condition. According to the data from EPA in Taiwan, the construction waste is the second largest output among all enterprise waste after industrial waste. (*Figure 5.6.4.0.2: Waste chart*) Demolishing all the over 30-year old building in the metropolitan area such as Taipei, Taichung, and Kaohsiung for urban renewal will increase the construction waste amount drastically and garbage treatment system will be overcapacity. Waste treatment is also one of the biggest concern Taipei city renewal is currently facing.

By analyzing the existing site/rooftop condition, NCTU UNICODE propose the prefabricated steel structure for the Orchid House rooftop extension as well as the structural reinforcement for the below existing RC structure. All the steel structure will be manufactured in factories near Taipei area to reduce post construction waste and also all the post production waste to be recycled within the factory. Also with the Orchid House Urban Regeneration plan, the amount of landfill will be minimized comparing with typical demolishing urban renewal construction projects.

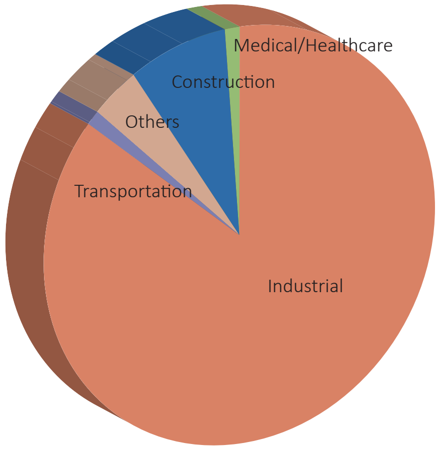
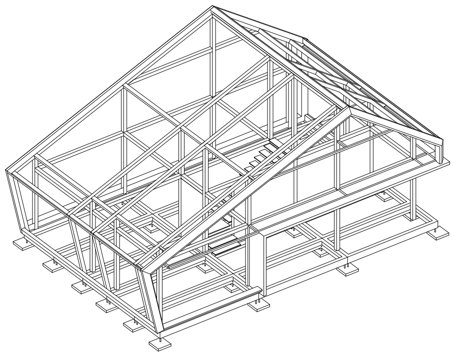
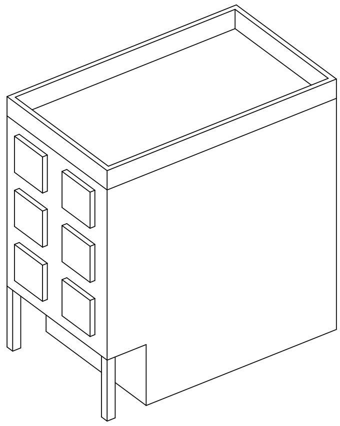


Figure 5.6.4.3: Waste Chart





	Orchid House Construction (Steel Prefabrication)	Typical Taiwanese RC Construction
Solid Waste	5% of Construction Material	Up to 20% of Construction Material
CO2 Emission	-20% in 20 years	5% to 13% per Cubic Meter
Construction Time	1 month	1 year
Production Energy	30 Gj per ton	1.4 Gj per ton

5.6.5 Materials

The Orchid House consists with main steel structural frame and series of box infill to incorporate different type of insulation material. The insulation material will be selected by the local environmental condition as well as the financial condition of the house unit. Both steel structure and box infill will be prefabricated in factory near Taipei city for reducing carbon footprint during the transportation.

Most of building material for the basic structure for the Orchid House is easily recyclable materials: Steel, Aluminum window frames, and simple glass. The Orchid House also integrates new material with sustainability concern such as Bayer Makrolon polycarbonate, MegaMaster eFoam insulation, and SPG’s 100% recycled glass foam insulation.

Materials selection

The Orchid House Prototype at Versailles, France material selection is including:

Façade

Polli-Bricks: Recycled, Recyclable, and Reusable
Polycarbonate Makrolon® polycarbonate: Recyclable and Reusable
Glass-louver: Recyclable

Structure

Steel: Recyclable and Reusable
Structural Plywood: Recyclable, Reusable, and Renewable

Floor

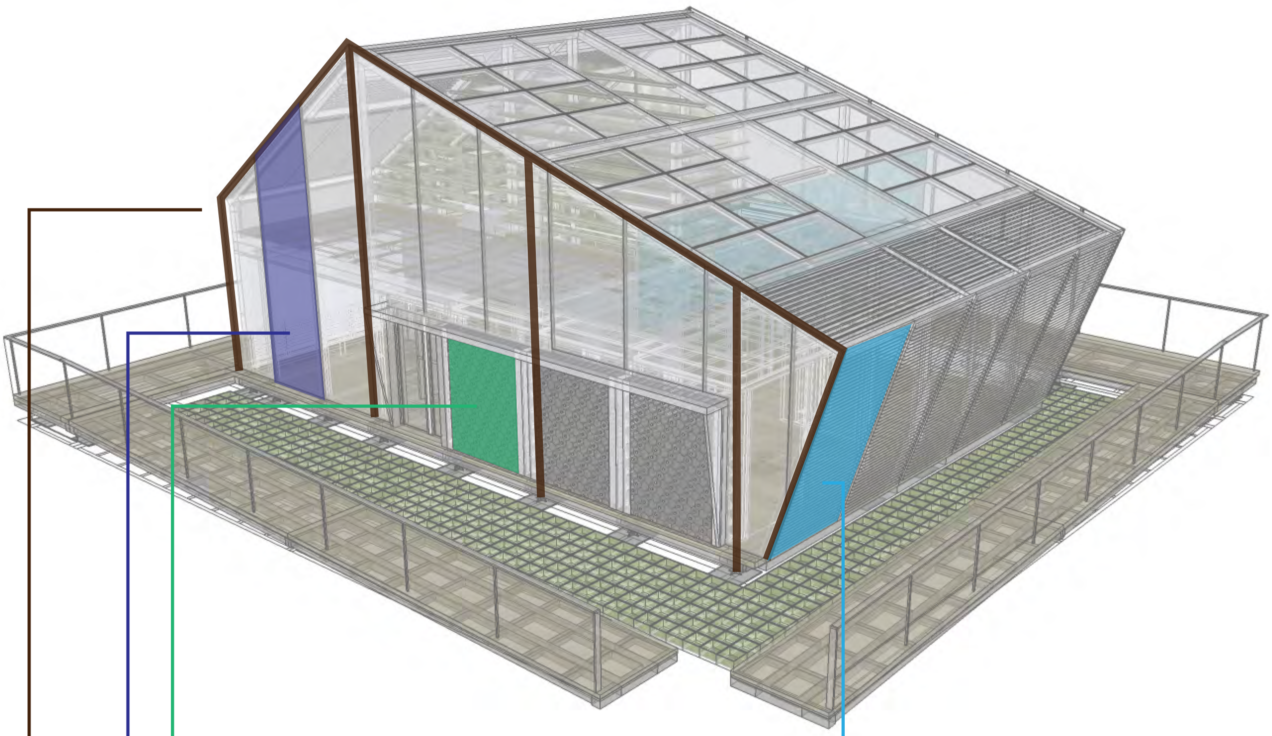
UA Floor: Recyclable and Renewable
Wood Plastic Composite: Recycled, Recyclable and Reusable

Insulation

Glass foam: Recycled, Recyclable, and Reusable
e-Foam: Recycled, Recyclable, and Reusable

Interior

Wood Furniture: Recyclable and Renewable



FACADE

POLLI-Bricks™ RECYCLED RECYCLABLE REUSABLE RENEWABLE

POLYCARBONATE RECYCLED RECYCLABLE REUSABLE RENEWABLE

GLASS-LOUVER RECYCLED RECYCLABLE REUSABLE RENEWABLE

STRUCTURE

STEEL RECYCLED RECYCLABLE REUSABLE RENEWABLE

STRUCTURAL PLYWOOD RECYCLED RECYCLABLE REUSABLE RENEWABLE

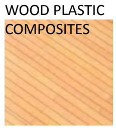
FLOOR

UA FLOOR :R1621 RECYCLED RECYCLABLE REUSABLE RENEWABLE

WOOD PLASTIC COMPOSITES RECYCLED RECYCLABLE REUSABLE RENEWABLE

UA FLOOR :R1621

WOOD PLASTIC COMPOSITES



INSULATION

GLASS FOAM FOAM RECYCLED RECYCLABLE REUSABLE RENEWABLE

EFOAM RECYCLED RECYCLABLE REUSABLE RENEWABLE

GLASS FOAM

EFOAM

INTERIOR

PLY WOOD RECYCLED RECYCLABLE REUSABLE RENEWABLE

Sustainable Material Matrix

Incorporated Energy

This calculation will be included in the next deliverables.

Incorporated CO2

The estimated building construction cost data shown below is based on 'per gross internal floor area' costs of services, sub-structure and frame construction. The cost of constructions and glazing is based on the 'per surface area' cost data from the constructions and glazing database. Surface finish costs are also calculated from actual building surface areas and entered surface finish per area costing data.
The results are indicative only and it is the user's responsibility to check that input data is checked and the basis for the calculations is understood.

Materials Embodied Carbon and Inventory	Area (m2)	Embodied Carbon (kgCO2)	Equivalent CO2 (kgCO2)	Mass (kg)
PV PANEL	66.9	8531.6	9033.5	10037.2
SDE Polycarbonates_LOWE(Bayer)	180.5	18772.5	24091.4	3128.8
SDE Thermass Water	21.0	0.0	0.0	6236.0
Polyethylene terephthalate(PET)	42.0	0.0	0.0	6040.7
SDE Polycarbonates(Bayer)	55.1	14209.8	18235.9	2368.3
SDE Vacuum Insulation Panel(VIP)	376.5	0.0	0.0	1999.1
SDE Wall Air	138.1	0.0	0.0	4.7
SDE Plywood	770.5	7462.6	7739.0	9213.0
SDE Glass-Foam	376.5	0.0	0.0	4314.4
Project Painted Oak	3.5	0.0	0.0	85.6
Plywood (Heavyweight)	61.9	351.1	364.1	433.5
Plasterboard	61.9	856.5	901.6	2254.0
Gypsum Plastering	55.6	274.8	289.2	723.1
MW Glass Wool (rolls)	61.9	150.0	164.7	98.0
XPS Extruded Polystyrene - CO2 Blowing	55.6	445.8	1482.7	154.8
Concrete Block (Medium)	55.6	623.0	623.0	7787.4
Cast Concrete (Lightweight)	61.9	594.5	594.5	7430.9
Brickwork Outer Leaf	55.6	2080.3	2174.9	9456.1
Sub Total		54352.4	65694.5	71765.5

Constructions Embodied Carbon and Inventory	**Area (m2)**	**Embodied Carbon (kgCO2)**	**Equivalent CO2 (kgCO2)**
SDE Bayer 6mm Panel	0.9	40.7	52.2
SDE Bayer 16mm Panel	3.8	164.9	211.6
SDE Bayer 6 mm trans Panel	6.8	291.7	374.3
SDE internal floor	13.1	249.1	258.3
Roof_PV PANEL	66.9	8531.6	9033.5
Project Wooden door	3.5	0.0	0.0
SDE Ground Floor	6.0	113.9	118.1
SDE Bayer 40 mm Panel	86.0	18566.9	23827.6
SDE West Wall(Water Thermal Mass)	21.0	0.0	0.0
SDE South Cavity Wood Frame	17.5	397.1	411.8
SDE Interior Floor	60.6	1568.0	1626.0
Project semi-exposed ceiling	61.9	1952.1	2024.9
Project semi-exposed wall	55.6	3423.9	4569.9
SDE Partition	190.8	3116.2	3231.7
SDE West Wall(Insulation)	48.3	14838.8	18816.4
SDE Ground Floors	57.6	1097.7	1138.3
Sub Total	700.4	54352.44	65694.47

Glazing Embodied Carbon and Inventory	**Area (m2)**	**Embodied Carbon (kgCO2)**	**Equivalent CO2 (kgCO2)**
Bayer 10mm Solid Panel (NRoof)	6.3	134.3	142.2
SDE Bayer Makrolon LowE_16mm(Roof)	14.9	284.5	301.2
Bayer 10mm LowE Panel (Door)	26.1	555.3	588.0
Bayer LowE Panel IQ-Relax IQ(Door)	6.8	144.0	152.5
Bayer LowE 6mm Panel IQ-Relax IQ(Roof)	2.9	37.3	39.5
Project roof glazing	32.1	613.1	649.2
Local shading		0.0	0.0
Window shading		0.0	0.0
Sub Total	89.1	1768.5	1872.6
Building Total	**789.5**	**56121.0**	**67567.0**

Maintenance Plan

Maintenance Plan for Active Systems
A plan is set up for the operation, performance evaluation and maintenance of the Orchid House to ensure the ongoing accountability and optimization of House energy, water consumption and IAQ performance in the future.

・Continuous metering for performance measurement and verification is implemented according to the documents issued by The International Performance Measurement and Verification Protocol (IPMVP). The following items are included:

- -Heat pump efficiency
- -Heat reclaim ventilator efficiency
- -Solar thermal collector efficiency
- -Water consumption
- -Energy balance
- -Electrical energy balance
- -Control system
- -Indoor air quality
- -Ventilation air Volumes

・Allocate an appropriate fund for ongoing monitoring of environmental performance, product pur chasing, maintenance, and improvement.
・Use environmentally safe cleaning materials.
・Facility the reduction of wastewater generated by House occupants.
・Educate the House occupants for the operation and maintenance.
・Every six months, evaluate existing systems to determine if they have remained undisturbed.
・Every six months, access House energy use to ensure it is at predicted levels.

5.6.6 Active System and Equipment

Active systems for the Orchid House have been selected based on their efficiency and performance. The systems include active solar system as DHW heating and active HVAC system. These two active systems will be simultaneously operated by the sensors imbedded in the Orchid House to achieve as comfortable indoor condition as possible with minimum energy cost.

Active systems and Equipment

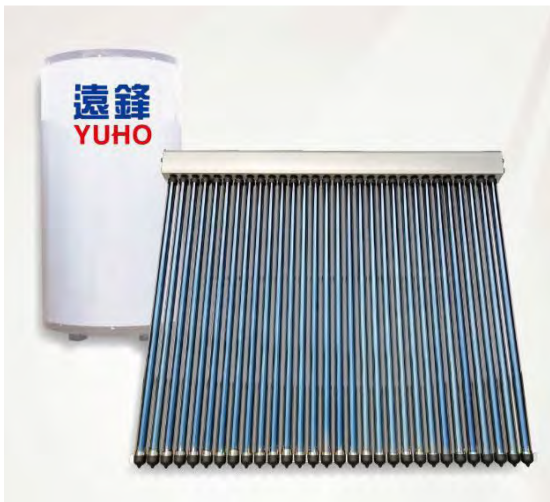
Orchid House

Active Solar System		Active HVAC System	
Indoor Heating	DHW Heating	Heat pump	Energy recovery ventilator
Provide Heat to Heat Pump	Solar Energy Collection Storage Use	Air Source 6.7 IEER and 3.8 COP.	Recover about 80% of Exhausted energy Maintain good IAQ

Solar Thermal System generates heat 6200 kwh/year

Energy Recovery Ventilartor reduce energy consumption 3430 kwh/year

First of all, in order to down size the heat pump and solar thermal system, the Orchid House needs to minimize its heat gain. By conserving the active system size, it is automatically reduce energy consumption and reduce the energy cost. The bioclimatic strategies of the Orchid House has been proven by the software simulations, such as F-Chart Software and helps farther engineering the house active system.
The solar collector for the Orchid house has been specified by its higher thermal performance and installed south facing mounted with 18 degrees to achieve 73% efficiency. The collected heated water will be stored with highly insulation water tank, which can contain two days amount of hot water for the best economic performance. The water tank will be located the mezzanine level of the house to avoid direct heat gain from exposed sun. The solar thermal system will be operated with automatic control system to optimize energy collection and storage.



Active solar thermal system is also designed to supply the space heating. The backup is provided by an air-to-water heat pump with its storage tank. The heat pump using carbon dioxide as refrigerant is more ecological and energy-efficient than other refrigerants. The COP of this air-to-water heat pump is as high as 4.6. The active solar thermal system have been configured to have two separate hot water storage tanks the solar thermal storage tank stores the higher temperature water of 90°C - the higher temperature water means the more solar energy stored – and the backup hot water tank will only supply 60°C hot water. The water in solar thermal store tank has the priority over the backup hot water to be used.

In order to maximize the efficiency of heat pump, the high efficiency heat reclaim ventilator is interlocked for optimal combined operation. The heat reclaim ventilator can recover nearly 80% of exhausted energy to reduce the ventilation energy while maintaining a good IAQ. The Orchid House active system is also automatically controlled to optimize the overall operation and achieve the maximum energy saving.

In order to visualize the effectiveness of the Orchid House active solar thermal system and active HVAC system, the simulation shows the result of how those two systems contribute to the energy reduction. The solar thermal system will generate 6200 kWh of heat annually. The simulation is shown in Appendix A , on page 1-4 . The heat reclaim ventilator of HVAC system will reduce the house's energy consumption of 3430 kWh annually. The simulation is shown in Appendix – A on page 5-6. The heat pump for space cooling and heating have the operating efficiency of 6.7 IEER and 3.4 COP respectively, which is among the best performance in the market.

Appliances

The appliances for the Orchid House prototype at Versailles, France is specially selected with EU complied since the electricity voltage difference between Taiwan 110V, 60 Hz and France 230V, 50Hz. The selection has made based on the appliance's energy efficiency class label.


Clothes Washer

Manufacturer : MIELE
Model : W664
Performance :
Energy Efficiency Class Certification
A++ EU Energy Label

Dryer

Manufacturer : BOSCH
Model : WTW8
Performance :
Energy Efficiency Class Certification
A++ EU Energy Label


Dishwasher

Manufacturer : MIELE
Model : G6995 SCViK20
Performance :
Energy Efficiency Class Certification
A+++ EU Energy Label


Oven

Manufacturer : MIELE
Model : H2161BCLST
Performance :
Energy Efficiency Class Certification
A EU Energy Label

Cooking

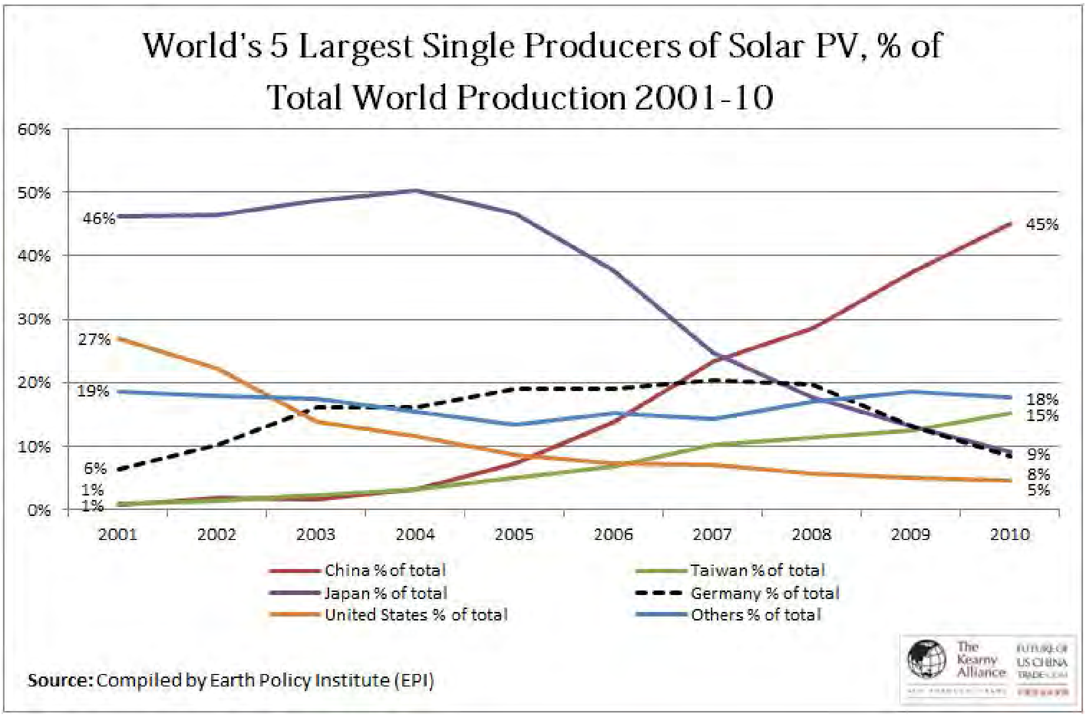
Manufacturer : MIELE
Model : Domino CS 1112E
Performance : 1200W

TV

Manufacturer : JVC
Model : LT-28HA52U
Performance :
Energy Efficiency Class Certification
A EU Energy Label

5.6.7 Solar Systems

Based on Earth Policy Institute (EPI) survey, Taiwan is the second largest solar PV producing counties among the world in 2010 (Figure: World 5 largest single producers). However, Taiwan's photovoltaic peak power capacity is about 206 MWp in 2012, which is much less than other countries such as Germany as 32,411 MWp, China as 8,043 MWp and Japan 6,704 MWp. NCTU UNICODE is aware this situation and likes to raise the social awareness in this solar energy issues and governmental policy with the Orchid House project.



NCTU UNICODE collaborates with Delta Electrics, which is the parent company of DelSolar as the largest solar cell producing company on a capacity basis, for Orchid House project to promote installing solar power system on residential buildings. Currently almost none of Taiwanese residential buildings install PV system on their rooftop, although Taiwan is received more than twice the sun exposure of Germany. For the Orchid House PV system, DelSolar D6P Multi-Crystalline module is chosen for its high efficiency and cost performance. It is light weight and easier to install.

Energy Recovery Time

Simulated yearly PV output energy is 5,540 kWh/year, simulation report is shown below.

PVSYST V5.71		17/02/14	Page 2/3

Grid-Connected System: Main results

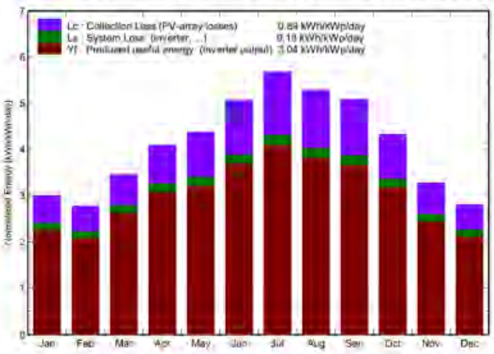
Project : **2014 SDE PARIS**

Simulation variant : **140217_交大台北_5kWp**

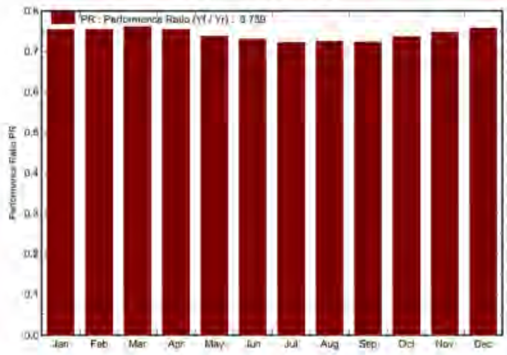
Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	18 deg	azimuth	0 deg
PV modules	Model	D6P250B3A	Pnom	250 Wp
PV Array	Nb. of modules	20	Pnom total	**5.00 kWp**
Inverter	Model	Solar inverter SOLIVIA 5.0 TR	Pnom	5.50 kW ac
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**5540 kWh/year**	Specific prod.	1108 kWh/kWp/year
	Performance Ratio PR	73.9 %		

Normalized productions (per installed kWp): Nominal power 5.00 kWp



Performance Ratio PR



140217_交大台北_5kWp

Balances and main results

	GlobHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	EffArrR	EffSysR
	kWh/m2	oC	kWh/m2	kWh/m2	kWh	kWh	%	%
January	80.0	18.20	93.0	89.9	374.1	350.8	12.31	11.54
February	71.0	18.60	77.7	75.1	313.8	292.8	12.37	11.54
March	103.0	20.20	107.1	103.7	434.3	407.4	12.41	11.64
April	123.0	23.00	122.8	118.8	491.0	463.0	12.24	11.54
May	141.0	25.60	135.6	131.0	529.7	499.9	11.96	11.28
June	162.0	27.30	151.9	146.8	585.9	554.9	11.80	11.18
July	186.0	29.00	176.1	170.6	669.5	636.0	11.64	11.06
August	166.0	28.70	163.8	158.7	625.7	593.4	11.69	11.09
September	146.0	27.80	152.5	147.9	581.9	551.2	11.68	11.06
October	121.0	26.00	134.2	130.0	522.3	493.9	11.92	11.27
November	85.0	22.80	98.3	95.0	390.9	367.4	12.18	11.45
December	74.0	20.00	86.9	84.1	351.5	329.3	12.38	11.59
Year	1458.0	23.96	1499.9	1451.6	5870.8	5540.1	11.98	11.31

Legends:				
	GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
	T Amb	Ambient Temperature	E_Grid	Energy injected into grid
	GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
	GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

The simulation is made with PVSYST simulation software based on Taipei's irradiance and temperature data.

Electrical energy input of manufacturing PV system is 2,525 kWh/kWp (according to report of IEA-PVPS-T10-01:2006). So, for this 5 kWp designed PV system, the energy consumed for building this PV system is:

Total energy input while manufacturing PV system: 2,525 kWh/kWp×5 kWp=12,625 kWh

So the energy pay-back time of this system is:

Energy Pay-Back Time (EPBT): 12,625 kWh÷5,540 kWh/year=2.279 year

CO2 emissions

CO2 emission saving associated to the PV panels' production

The CO2 per kWh emission is 0.636 kg in Taiwan. According to report of IEA-PVPS-T10-01:2006, electrical energy for PV module manufacturing is in total of 2,296 kWh/kWp, so for this 5 kWp system in Taiwan, Total CO2 emission for PV module manufacturing is:

0.636 kg/kWh×2,296 kWh/kWp×5 kWp=7,301.28 kg

Generally, PV system service life time is around 20 to 25 years, so in this PV system's life, the total CO2 reduced is:

0.636 kg/kWh×5,540 kWh/year×20 year=70,468.80 kg

So from the two calculations of above, the 20 years of net CO2 emission reduction of the 5 kWp system in Taiwan is 63,167.52 Kg

CO2 emission saving associated to a year of system functioning

As shown in above, simulated yearly PV system output power is 5,540 kWh, converted to CO2 emission saving of a year PV system functioning is:

0.636 kg/kWh×5,540 kWh/year×1 year=3,523.44 kg

Accessbility

All work in commissioning and maintenance of a system should be performed by a qualified technician.

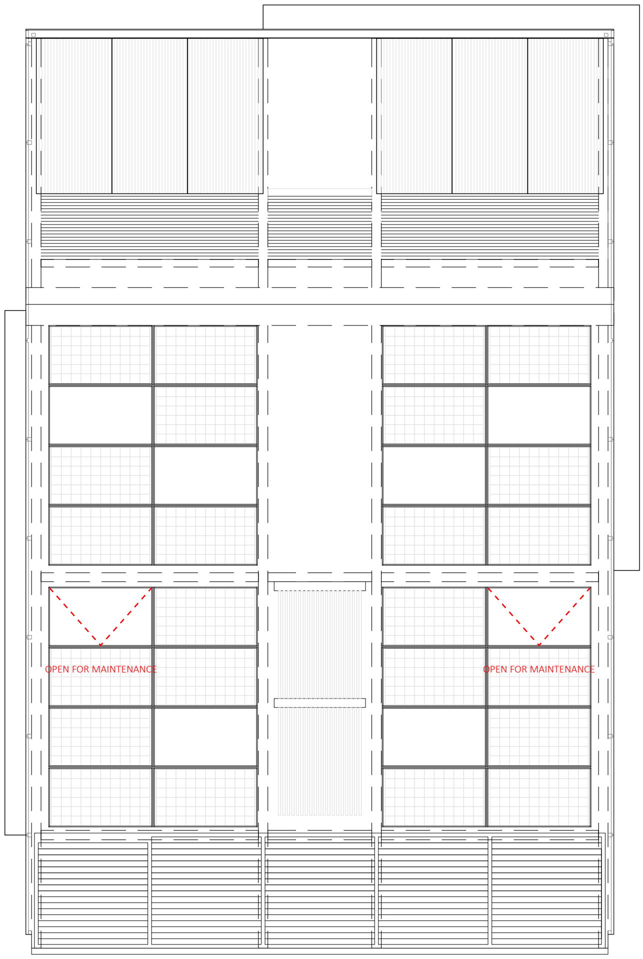
For general routine system maintenance, module glass should be cleaned periodically, or when it's dirty. Use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used to remove sticky dirt.

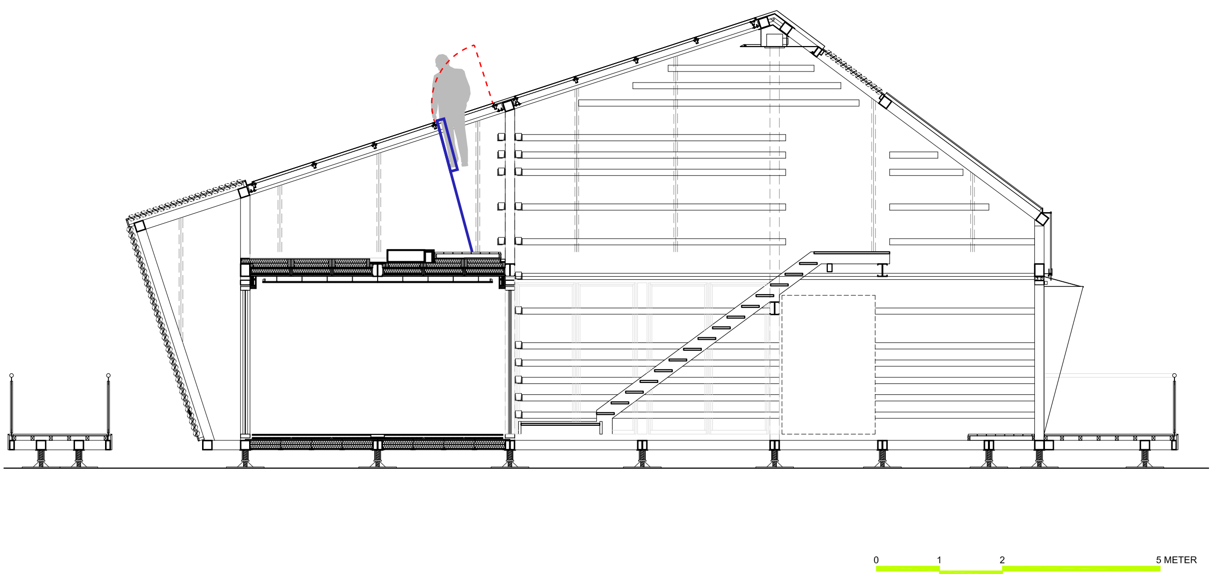
Check the electrical and mechanical connections periodically to verify they are clean, secure and undamaged. All electrical devices should be checked periodically by technician. Grounding also needs to be checked regularly.

Detail system maintenance can be found in PM#4, 5.3.8 of rule 36.8 for detail maintenance plan.

Maintenance Plan

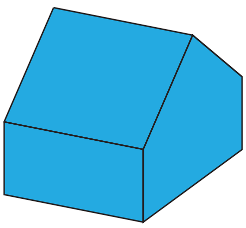
In order for the roof PV system to function maximum efficiency, there are couple of maintenance awing window pre-installed in the Orchid House roof system. For instant cleaning, the hydro-pressure cleaning device will be used for removing dusts from the surface from the opening of roof. On the other hand, for the deep cleaning, cleaning person will climb up to the roof with safety rope hooked to the house structure.





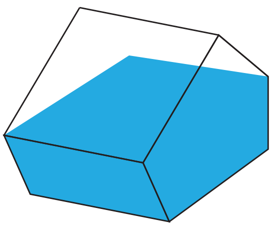
5.6.8 Water

Taiwan lies across the Tropic of Cancer, and the East Asian Monsoon directly influences its climate. The average annual rainfall is more than 2,500mm and some Eastern regions receive close to 5,000mm rainfall. Between July and October, there are several typhoons fit the island and due to the Taipei city's geographic condition as basin, the rain water runoff is one of the major reasons why some part of city get severe floods. (Figure: Taipei flood) The Orchid House project address these water runoff issues in Taipei rooftop not only for recycling the rain water, but also for reducing the basic portable water consumption for the house use.



Typical Taiwanese Dwelling
Water Consumption

500 L/day



Orchid House
Water Consumption

250 L/day
(50% deduction)

The Orchid house will consume water about 250L per day, in comparison with typical house hold in Taiwan uses 500L per day according to the report by Taiwan Water Corporation. In order to reduce 50% of portable water usage, the Orchid House selects appliances and plumbing fixtures based on its efficiency and utilizes gray water and rain water. By recycling the rainwater and conserving 50% of portable water, the Orchid House contributes to improve Taipei city water condition.

Fixture list

Water closet

Manufacturer: HCG
Model: C3016
Water consumption: 1.5 / 3 L
Label:

Lavatory faucet

Manufacturer: HCG
Model: LF3167PT(AW)
Water consumption: 6.7 lpm
Label:

Shower

Manufacturer: HCG
Model: ST8801TA
Water consumption: -
Label: -

Washing machine

Manufacturer: MIELE
Model: W664
Water consumption: 46 L
Label: A++

Dish washer

Manufacturer: MIELE
Model: G6995 SCVik20
Water consumption: 6.5 L
Label: A+++

Water System

Treatment of waste water
The black water discharged from Kitchen Sink, dish washer and water closet will connected to the city drainage system through the building's main – the design and construction shall comply with the local codes.

Greywater system
The graywater – drain from shower, hand sink and wash machine – is considered to be reused for water closet, irrigation, cleaning and washing machine after treated by graywater treatment system.

The recycling reuse of wastewater is applied to graywater. The measure of water revise is to collect the wastewater from washing machine, shower and hand sink, and then be treated with the process of pre-filtration, first active sludge treatment, second sedimentation, biological treatment and UV disinfection to remove grit, hair, lint, sand, soap, scum, silt, reduce the pollutants BOD, COD, SS, turbidity and disinfect. The quality of effluent will achieve BOD < 3 mg/L, SS < 2 mg/L, E. Coli < 1, Orgs / 100 ml, turbidity: 0.47 NTU, PH: 7.9, conductivity: 497 µs/cm which is suitable for the use of irrigation, water closets, building cleaning, car washing and even washing machines. In this project, the graywater reuse is estimated 254. Liters per day, which is primarily used by the House, and its surplus is planned to be stored in another storage tank for the use of other households in the building. One of the suppliers for graywater treatment system is Aqua2use use Taiwan.

The black water discharged from kitchen sink, dish washer and water closet will connected to the city drainage system through the building's main – the design and construction shall comply with the local codes.

Managing rainwater
A rainwater harvesting system consisting roof catchment surface, gutter and downspouts for collection, leaf screen and first-flush divert and storage tank will be in place for rainwater use. The leaf screen and first-flush divert are used to remove dust and debris from the initial catchment runoff. First flush diverters are designed to divert a portion of the initial rainfall to eliminate contaminants that were on the catchment surface when the rainfall started.

The contribution of rainwater harvesting in Taiwan is projected below:
$S = R \times A \times C$
Supply = Rainfall × Area × Run-off coefficient (RC)
S = Mean annual rainwater supply (m3)
R = Mean annual rainfall (m)
A = Area (m2)
C = Run-off coefficient
Therefore:
$S = 2.405 \times 118.7 \times 0.9 = 256.92615$ m3

The rainwater is harvested and stored in a storage tank to be used by all the residents in the building, therefore the greatest utilization of rainwater will be realized. Note: In Taiwan, the rain often comes in the form of sudden downpour.

5.6.9 Solid Waste

Taipei city spends large effort for recycling the city garbage. After the Environmental Protection Administration (EPA) established a program in 1998, a financial resource called the Recycling Fund applied to establish recycling companies and waste collectors. Between 1998 and 2008, the recycling rate increased from 6 percent to 32 percent. The Orchid House project's waste management assessment principal follows those basis of Taipei city waste management system.

Taiwan's majority of solid waste is generated from industrial filed, which occupies over 90% of waste. However construction waste is the second largest in Taiwan and need to improve for reducing landfill waste. The Orchid House structure is composed with the prefabricated steel frame, which can minimize the construction solid waste to 5% of construction material. By considering the typical Taiwanese residential buildings are built with reinforced concrete with brick infill generate up to 20% waste of its construction material, the Orchid House project can eliminate large amount of construction waste.

Construction phase assessment

The Orchid House construction phase waste management must follow the hierarchy of desirability by activities. (Figure 5.6.8.2.1: Waste Management Hierarchy) It states that waste avoidance is the most preferable option, followed by minimization of quantities and hazards of waste generated. Next, it indicates that reuse, recovery and recycling should be preferred over treatment of waste and disposal should be considered as a last option.

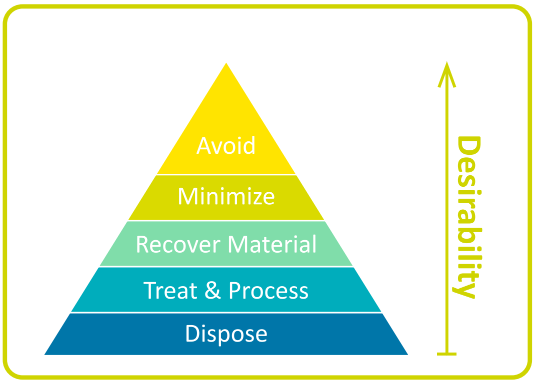


Figure 5.6.8.2.1 Waste Mangement Hierarchy

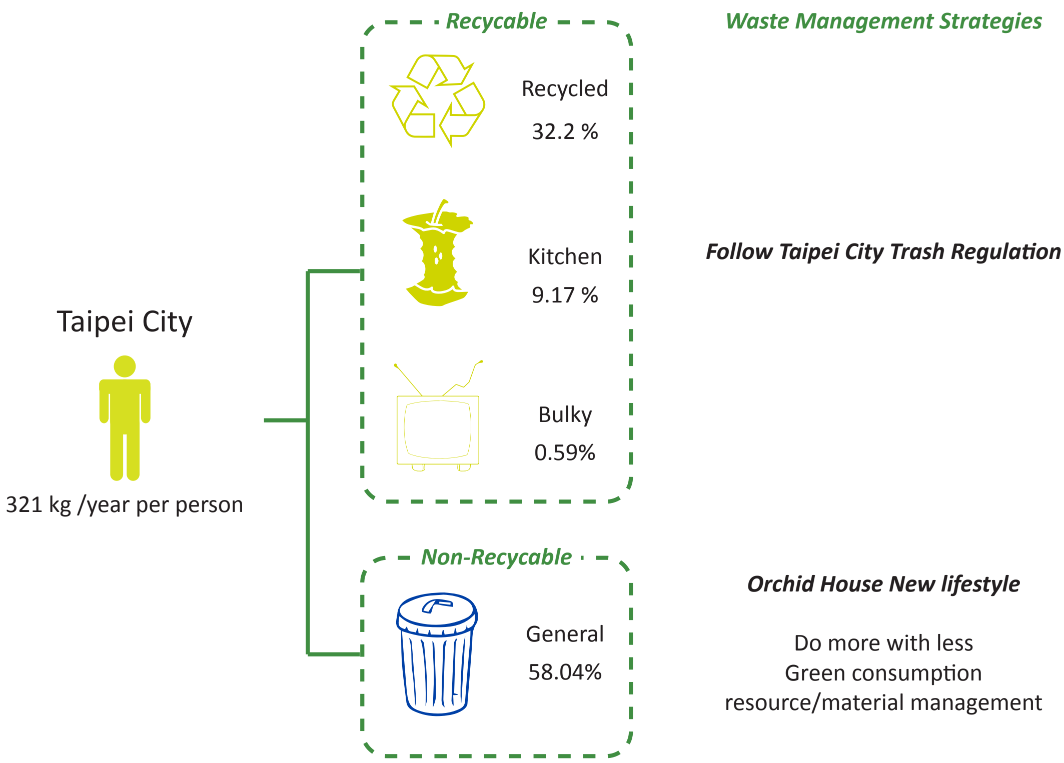
During the construction phase of the Orchid House, the solid waste management assessment are summarized below:

- To assess the construction activities involved for the proposed works and determine the type, nature and where possible estimate the volume of waste to be generated
- To identify any potential environmental impacts from the generation of waste associated with the work
- To categories waste materials where practical, for example, suitability for re-use/recycling, disposal to public filling areas, disposal to landfill and any pre-treatment requirement prior to disposal
- To recommend appropriate waste management options (including waste minimization on-site, reuse or recycling opportunities and off-site disposal option
- To identify site management/mitigation measures that should be implemented to minimize any potential impacts from the generation, handling, storage and disposal measures/routings of waste, in accordance with the current legislative and administrative requirement

Project use and maintenance

People in Taipei produce average 321 Kg domestic waste a year, 32.2 % recyclable, 9.17 Kitchen waste, 0.59% bulky waste and 58.04% general waste. In Taipei city recycling system, not only recyclable waste, but also Kitchen waste and bulky waste can also be reused, which adds up to 41.96 % recycling. This percentage is relatively high comparing with other metropolitan cities. However, the 58.04 percent of general waste still needs challenge to minimize.

The Orchid House domestic waste management is basically educating the tenant with strict garbage separation into recycled, kitchen west, bulky waste and general waste following the Taipei City trash separation rule. However in order to minimize the amount of general trash, the Orchid House must act as new educational hub for re-thinking a new way of life. Since the Orchid House is presenting special opportunities to young professionals, the tenants of house will demonstrate their new lifestyle in the house as “Do more with less”, “Green consumption”, and “resource/material management” to reduce daily basis of waste management.



5.6.8.4 End of life assessment

The Orchid House’s end of life assessment is divided into four stages, deconstruction/demolition, transport, waste processing and disposal. During the end of life stage of building, the most carbon critical elements are substructure, superstructure and internal finishes. The Orchid House superstructure is made with steel frame, which can recycle without losing its structural capacity. Also the façade material Bayer Makrolon is 100% recyclable, which contributes much less demolition waste from the construction. Lastly, the Orchid House interior finish is mostly build with wood materials, which can process to processed products.

5.6.10 Life Cycle Analysis

Methods: Using the LCA calculation software Simapro provided by the SDE committee and choosing the closest resembling construction materials from the materials database (Ecoinvent 2.0).

Data Input: Taken from project data files CM.xls, Simulation Input Data.xls and WCC.xls

Results: Impact assessment was performed using prescribed methods Recipe Midpoint(H), Cumulative Energy Demand and IPCC 2007 GWP 100a, to determine related environmental impact. Based on the amount of data available for this submission, LCA results are presented for the two product stages: Materials and Building (Including Materials, Transport of Materials, Use Phase and Transport of Users while Excluding Construction).

Impact Assessment: Materials

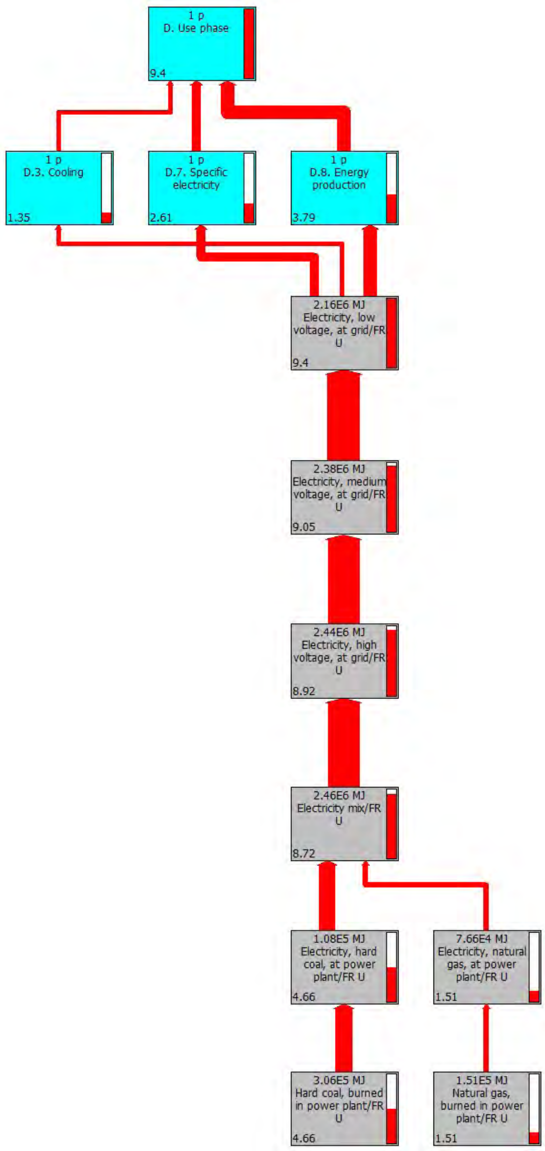


Diagram 1. Network Structure of construction materials contributing to Climate Change (kg CO2 eq)

Table 1. Materials Environmental Impact

Impact category	Unit	Total	1. Roads, networks, utilities	2. Foundations and subsoils	3. Superstructure - masonry
Climate change	kg CO2 eq	23919.942	214.58853	29.188418	6992.4238
Ozone depletion	kg CFC-11 eq	0.002764059	0.000220632	1.21E-06	0.000706491
Terrestrial acidification	kg SO2 eq	109.56058	2.3532882	0.095840917	16.588662
Freshwater eutrophication	kg P eq	0.83526853	0.002221726	0.003773183	0.032320323
Marine eutrophication	kg N eq	6.8062239	0.034157878	0.002622512	0.68348245
Human toxicity	kg 1,4-DB eq	14003.903	27.823215	12.676513	235.23127
Photochemical oxidant formation	kg NMVOC	127.53908	1.5987452	0.099182815	17.711831
Particulate matter formation	kg PM10 eq	49.769086	0.65036939	0.092477974	6.6511402
Terrestrial ecotoxicity	kg 1,4-DB eq	93.220695	0.13036746	0.003629595	0.34669383
Freshwater ecotoxicity	kg 1,4-DB eq	91.718339	0.8850578	0.25814319	8.0060765
Marine ecotoxicity	kg 1,4-DB eq	99.779806	1.0738193	0.27785721	9.5381951
Ionising radiation	kg U235 eq	10712.153	31.676867	4.7646122	4211.0281
Agricultural land occupation	m2a	283450.34	0.746768	0.72227098	642.55215
Urban land occupation	m2a	2979.3821	2.3318151	0.25381636	55.112488
Natural land transformation	m2	28.812262	0.87595805	0.004151398	1.9401376
Water depletion	m3	217.17674	2.0602236	0.34716626	54.241106
Metal depletion	kg Fe eq	6752.814	6.2046244	18.366857	5375.5576
Fossil depletion	kg oil eq	8990.5819	581.08492	9.1540325	2136.2258

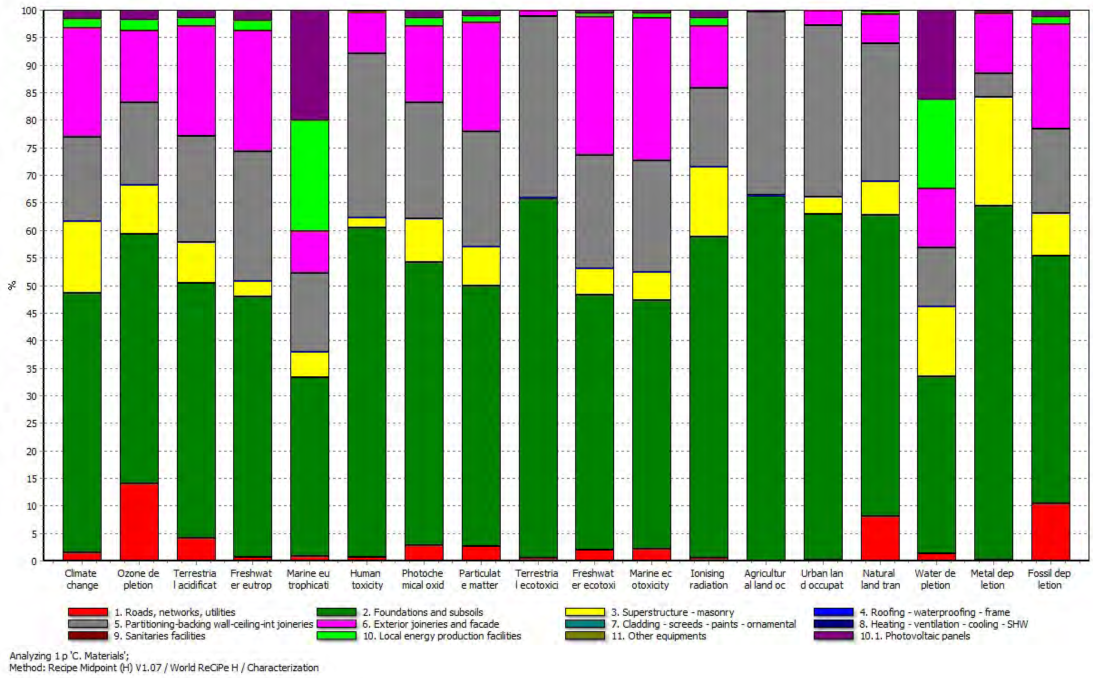


Chart 1. Materials Impact Assessment proportion from individual building components

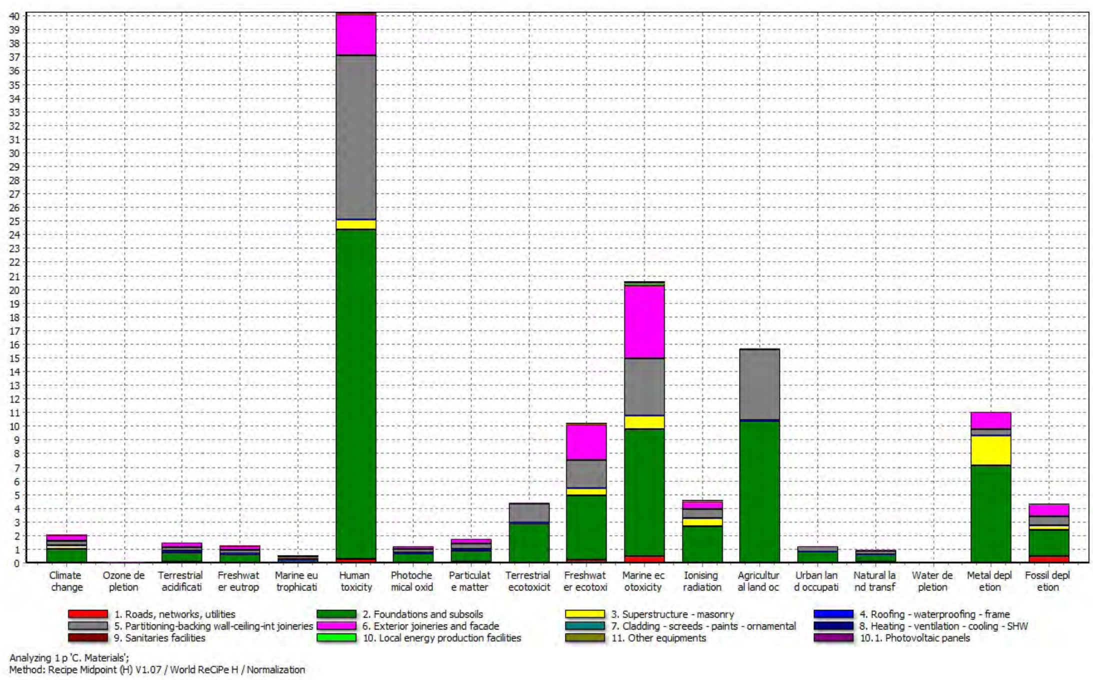


Chart 2. Materials Impact Assessment proportion from individual building components (Normalized)

Results Analysis: The first draft of LCA calculation is essentially an experimental trial in running Simapro to evaluate current data output. As expected, as only parameters for wall partitions, superstructure and photovoltaic, the results are reflected as such. However, based on the current calculations, we have a glimpse of the environmental impact from these materials.

Impact Assessment: Building

For the impact assessment of the entire building, the following product stages were included Materials, Transport of Materials, Use Phase and Transport of Users. For the Use Phase, cooling and heating data are derived from the energy simulation model of the project using DesignBuilder modeled for the climate of Taipei, Taiwan. Water consumption data is derived from calculated model in WCC.xls. The Transport of Users is defined by 2 occupants traveling 30km each day by tram (15km one way); this is an approximation of average days commute of Taipei City.

Table 2. Project Building Environmental Impact

Impact category	Unit	Total	A. Construction	B. Transport of materials	C. Materials	D. Use phase	E. Transports of users
Climate change	kg CO2 eq	47238.367	0	143.67167	23919.942	22783.638	391.11597
Ozone depletion	kg CFC-11 eq	0.003986074	0	2.20E-05	0.002764059	0.001158569	4.15E-05
Terrestrial acidification	kg SO2 eq	241.38052	0	0.78066194	109.56058	129.60784	1.4314384
Freshwater eutrophication	kg P eq	0.97870718	0	0.000919228	0.83526853	0.13530149	0.007217931
Marine eutrophication	kg N eq	10.192295	0	0.028192538	6.8062239	3.2901056	0.067773071
Human toxicity	kg 1,4-DB eq	18682.712	0	6.6994106	14003.903	4626.4047	45.704467
Photochemical oxidant formation	kg NMVOC	207.33977	0	0.88462942	127.53908	74.80624	4.1098152
Particulate matter formation	kg PM10 eq	94.617794	0	0.29429397	49.769086	43.5981	0.95631418
Terrestrial ecotoxicity	kg 1,4-DB eq	99.907158	0	0.018170705	93.220695	6.6295319	0.038760601
Freshwater ecotoxicity	kg 1,4-DB eq	126.57069	0	0.18000027	91.718338	33.548716	1.1236333
Marine ecotoxicity	kg 1,4-DB eq	180.07229	0	0.26758074	99.779806	78.634608	1.3902927
Ionising radiation	kg U235 eq	271701.29	0	14.950686	10712.153	259866.08	1108.1027
Agricultural land occupation	m2a	284098.39	0	0.56721309	283450.34	642.45803	5.0298464

Urban land occupation	m2a	3246.2336	0	1.7498661	2979.3821	248.53056	16.570996
Natural land transformation	m2	32.765295	0	0.06804878	28.812262	3.7670226	0.11796115
Water depletion	m3	1583.941	0	0.53492757	217.17674	1357.0714	9.1579268
Metal depletion	kg Fe eq	12855.117	0	7.0954684	6752.814	5941.6604	153.54737
Fossil depletion	kg oil eq	14914.726	0	50.256037	8990.5819	5769.8115	104.07658

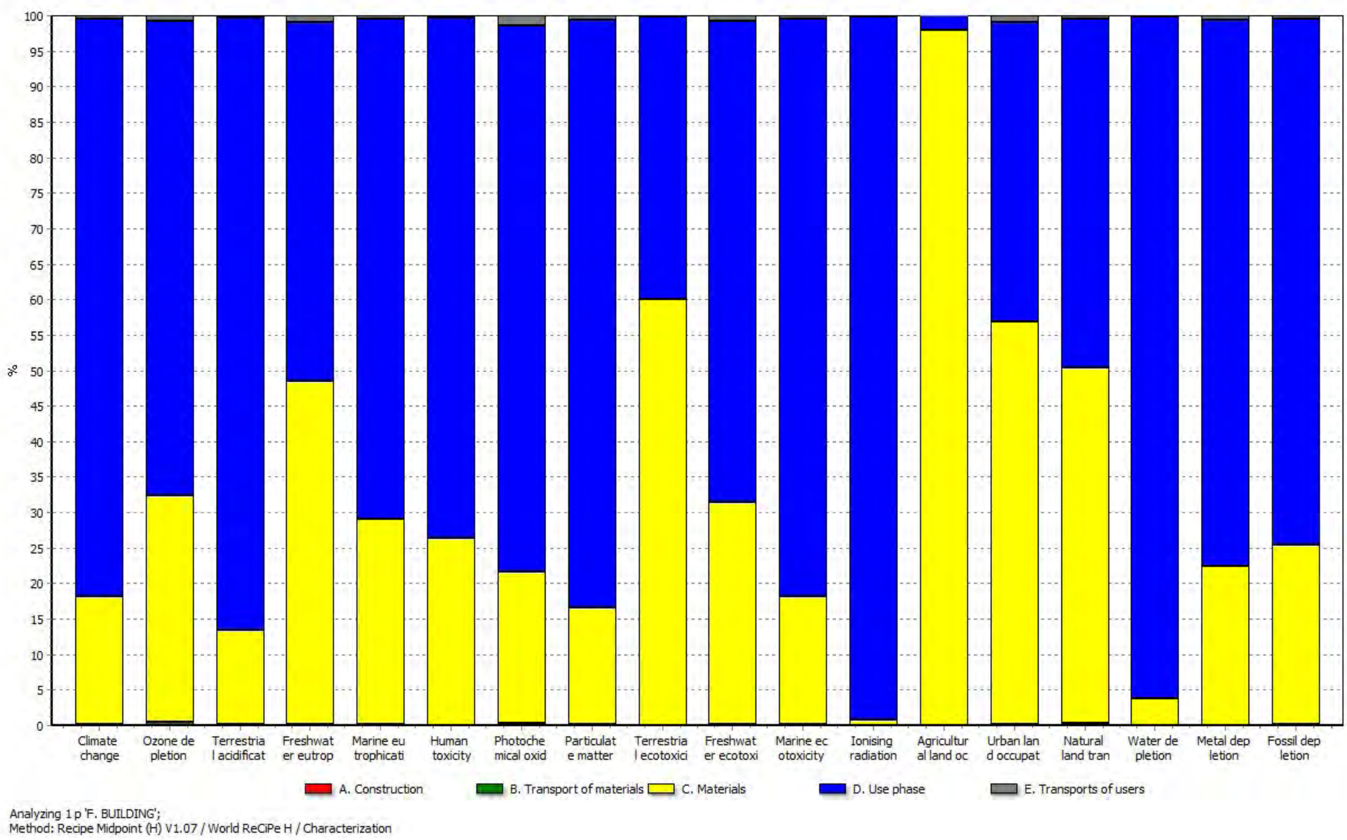


Chart 3. Project Building Impact Assessment proportion from individual building stages

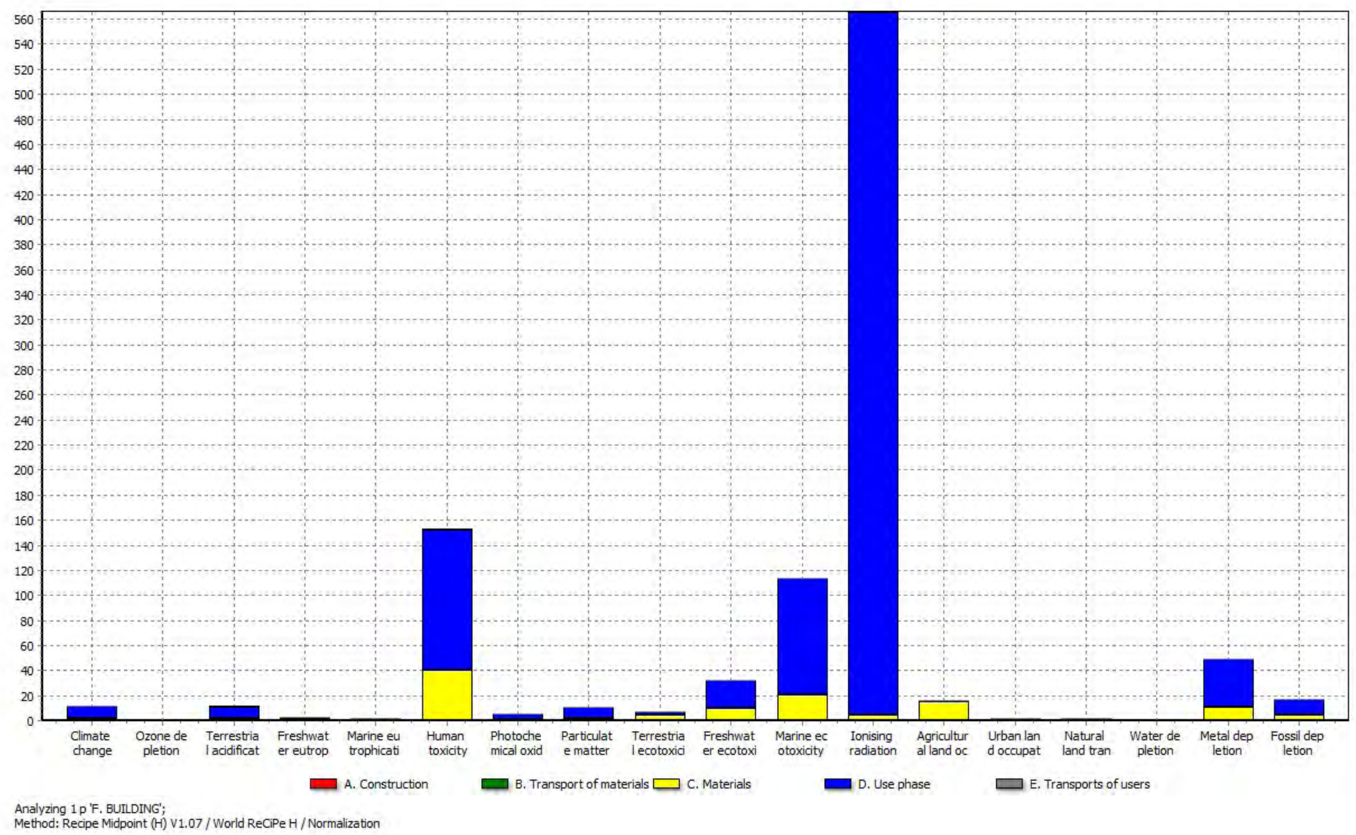


Chart 4. Project Building Impact Assessment from individual building stages (Normalized)

Results Analysis: The results show that the transport of materials and transport of users has limited environmental impact throughout the life cycle of the entire building project. The majority of impact stems from the use phase and materials of the building. We expect the impact of materials and transport of materials to rise as we continue to collect additional materials data.

Energy Cumulative Demand: Building

Using the same parameters described above, the energy cumulative demand method was performed, results as follows:

Table3 . Project Building Cumulative Energy Demand

Impact category	Unit	Total	A. Construction	B. Transport of materials	C. Materials	D. Use phase	E. Transports of users
Total	Pt	4097391.4	0	2407.7025	1211996.3	2865017.7	17969.712
Non renewable, fossil	Pt	673388.88	0	2222.6225	408312.27	258217.51	4636.4781
Non-renewable,	Pt	2607505	0	151.49028	109722.0	2486692.	10938.618

nuclear					5	9	
Renewable, biomass	Pt	696355.67	0	4.7925383	682270.33	14003.164	77.389281
Renewable, wind, solar, geothe	Pt	2811.8379	0	1.5409413	1162.7168	1610.2362	37.343956
Renewable, water	Pt	117330.02	0	27.256234	10528.904	104493.98	2279.8822

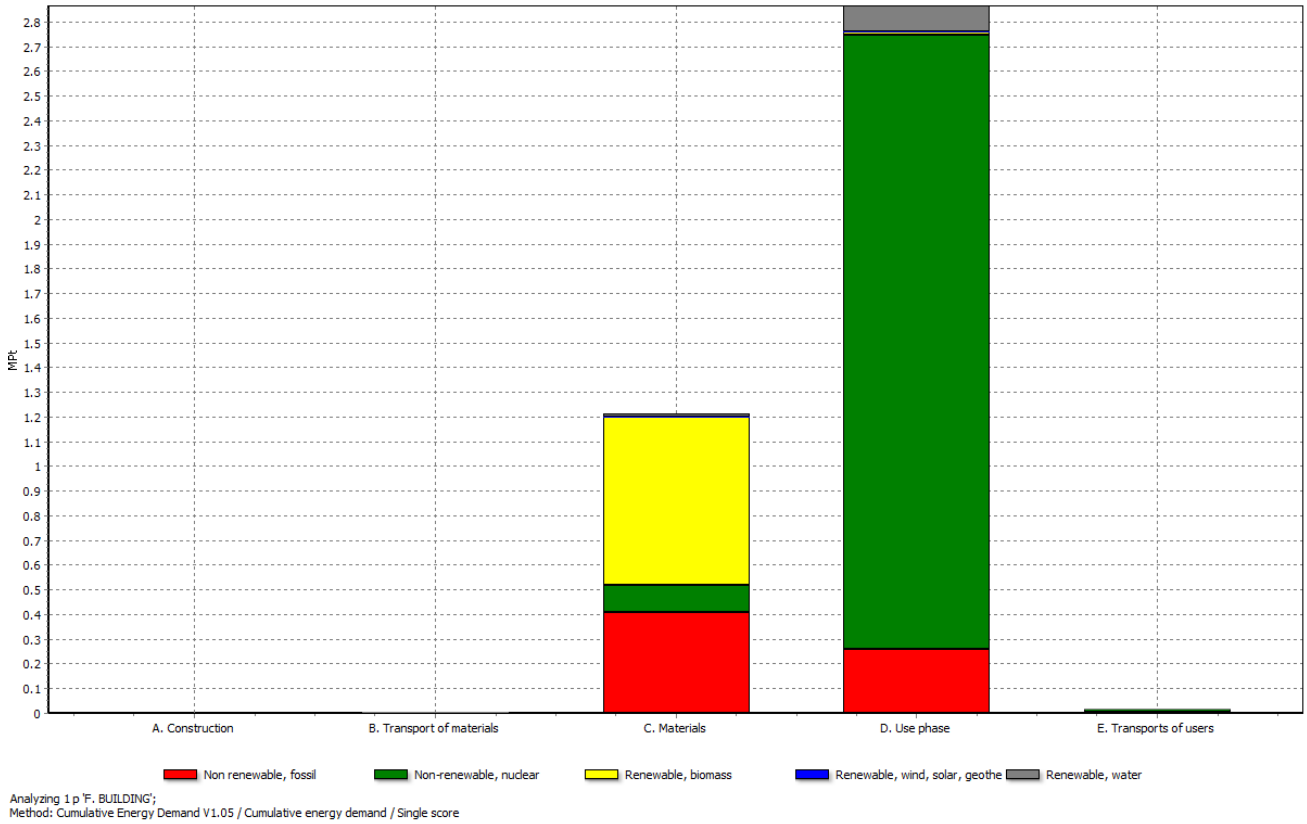


Chart 5. Project Building Cumulative Energy Demand data from individual building stages (Normalized)

Results Analysis: The results show a high proportion of energy derived from non-renewable nuclear energy, this is more reflective of the European energy grid as oppose to the energy supply in Taiwan (where nuclear energy consists of less than 5% of the total energy supply). This figure will therefore need to be adjusted in order to reflect the energy demand for Taiwan.

Conclusion: LCA analysis using Simapro reveals relevant data, however additional data and customized parameters need to be added for improved accuracy.

5.7 Communications Plan

5.7.1 Introduction

The communication plan is an important part of the Orchid House project. It is the main documentary of all the process of our project, and it records the information in design, the relationship with the sponsors and the reference in media. The main purpose is to raise the awareness of the general public and to present the messages of our urban strategies through all the events.

5.7.2 Communication Project

Abstract

With our highly integrated marketing and communications strategy, we target to generate strong publicity for our participation in the Solar Decathlon Europe (SDE) 2014, as well as to increase the public awareness regarding the specific objectives for a more sustainable future in our cities. Most importantly, our implementation are so planed that it is to take place prior and post the SDE 2014!

For the 18 months working periods towards SDE 2014, our actions rolls out into four phases:

Phase 1 - the Design (July 2013 to the end of January 2014)
Phase 2 - the Construction (February 2014 to the end of May 2014)
Phase 3 - the Competition (June 2014 to August 2014).
Phase 4 - the Enhancement (August 2014 and onwards)

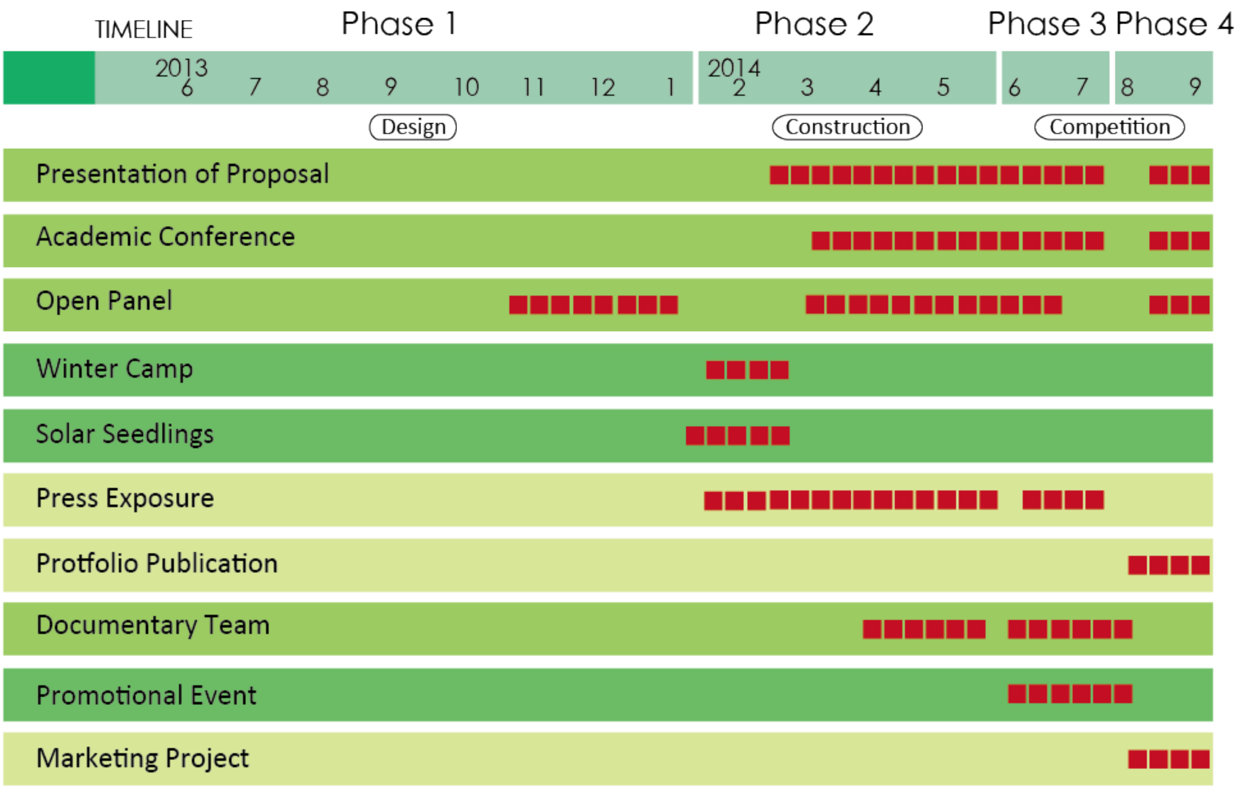
This is spepcifically designed to encourage and raise continuing interests in sustainable practices in Taiwan. By participating in SDE, one of our commitments is to demonstrate to the government and the public that alternative energy, specifically solar energy, and green technology are highly pratical and applicable. Therefore, one of the most important missions is that we do not stop our PR actions at the end of the competition, but rather to continue for months to come in order to ensure that our messages and achievements will continue its influences throughout the country.

Our Integrated Marketing and Communications Plan covers six major Aspects related to SDE's mission: Exchange, Outreach, News, Production, Issues, and Marketing. These aspects may be executed individually or synergistically with one another so to achieve holistic results. Out of the six Aspects, we will launch four major Actions for implementation (detailed description in later pages):

1) Forum,
2) Media,
3) Publishing, and
4) Workshop.

Through the execution of the above four Actions, we will communicate with the public that the following Objectives are demonstrated in our solar house:
1) Adaptive Strategy,
2) Modulized Assembly
3) Smart Living,
4) Self-Sufficiency,
5) Social Benefit, and
6) Collaborative Approach

Exchange - Awareness Platform



SWOT ANALYSIS

The SWOT analysis includes and summarized all relevant information gathered during the analytical phase of the marketing plan and categorizes them in:

Strengths:
characteristics of the Orchid House that may provide it with competitive advantage over others.

Weaknesses:
characteristics that may place the Orchid House at a disadvantage relative to others.

Opportunities:
elements ot trend that may represent chances to improve performance in the external environment.

Threats:
elements or trends in the external environment that could cause trouble for the Orchid House.

Strengths	Weaknesses
1. Hosue projected for subtropical weather condition 2. A solution for stormwater run-off 3. A solution for urban regeneration 4. Deal with social housing issue 5. Improving the urban landscape by design but ramain the original urban context 6. To save energy 7. To solve heat island effect 8. To innovate the modularized products by development of social housing in prefabricated houses, economical construction method and ecological materials 9. To collaborate with enterprise and academic 10. We have hign technology support 11. The innovative green core system	1. Difficult to adapt to various type of rooftop 2. limited financial resources 3. Hard to convinced by those who occupy the rooftop
Opportunities	**Threats**
1. Taiwan social housing ratio is low 2. The increasing population of younger generation cannot afford a house in city 3. Integrating single house system into city network system 4. Improve the urban landscape - city beauttiful movement 5. The excellent enterprise devote to the green field 6. To encourage city government modify the inapplicable law and policy 7. To systematize the old building	1. How to comply with social justice 2. The market would be pessimistic 3. Highly fragmented sectors need to integrate 4. Limited awareness of the necessity of green building 5. Reducing the private space of certain group 6. Difficulty of the household in Orchid House to pay-back the money they earn from the energy saving 7. Limited awareness of Team Unicode brand to general public

Analysis of the situation
New city aesthetics – Taipei rooftop urban regeneration

The primary goal in SDE aims to promote a better urban environment, architecture, and greener energy practice. We believe we should actively share and exchange with the public what we have learned and experienced through our research and design. There are three primary target groups in this concern: 1) the government, 2) the Academia, and 3) the general public. It will take place mostly in Phases 1, 2, and 4.

- **Definition of the Communication Objective / Message**
  Promoting knowledge of urban cities, architecture, and green energy.
- **Identitfication of the Target Group:**
  the government, academia, those interested in architecture and sustainable energy.
- **Message/s Establishment**
  We will use Orchid House as a prototype to disseminate our research for the house and the urban issue.
- **Action's description / Projects**

i. Presentation of Proposal:
• Project: New city aesthetics – Urban rooftop regeneration
• Objectives: to offer a proposal to city government about the integration of social housing issue and urban regeneration
• Time: March-September
• Channel: publication, exhibition and workshop held by government
• Audience: Department of Urban Development, Taipei City Government
• Leader: David Tseng, Professor; Shuchang Kung, Associate Professor
• Execution: To propose and demonstrate, via our solar house pototype, the possibility that it can transform the rooftops and increase the provision of social housing. It has been a common practice for city housing to extend upwards by utilizing the roof area which was idle. This is most evident in urban row-houses and duplex-houses in order to gain more livable space. However, we see this as an opportunity to convince the government to provide policy support in such build up but prescribe the use for affordable housing to those who are in need. Currently, the supply of social housing in Taiwan is relatively low, at a mere 0.8%, when compared to other neighboring countries such as Japan (6.06%). The possibility lies in the fact that the government is motivated to provide such incentives for existing housing owners to collaborate. Therefore, we strongly believe our roof-top transformation via the Orchid House approach is a fantastic solution. The values created via Orchid House are listed below:

1. Adaptive Strategy
2. Modulized Assembly
3. Smart Living
4. Self-Sufficiency
5. Social Benefit
6. Collaborative Approach

ii. Academic Conference:
• Project: Innovated, industrialized construction progress via academic collaboration with enter prises - modularized and pre-fabrication system.
• Objectives: To offer a combination of seminar and forum to the community of academia and professionals who are committed to sustainability and green practices in order to generate more awareness and discussion.

• Time: March~September 2014
• Channel: Publication, seminar, forum
• Audience: Academia such as NCKU, NTUST, delegates from enterprises, professionals from associations of architects, engineers, and students
• Execution: The focus of the conference will be - for the conservation and efficiency of energy we developed the Green Core System which serve as the heart inside the Orchid House. It provides not only the cooling effect but also helps ventilation. The most unique part is that it also maintains a comfortable balance between air and moisture for the interior. We wish to share this result of research with the audience and, via exchange and dialogues, messages and innovative concepts will be spread around the professional community.

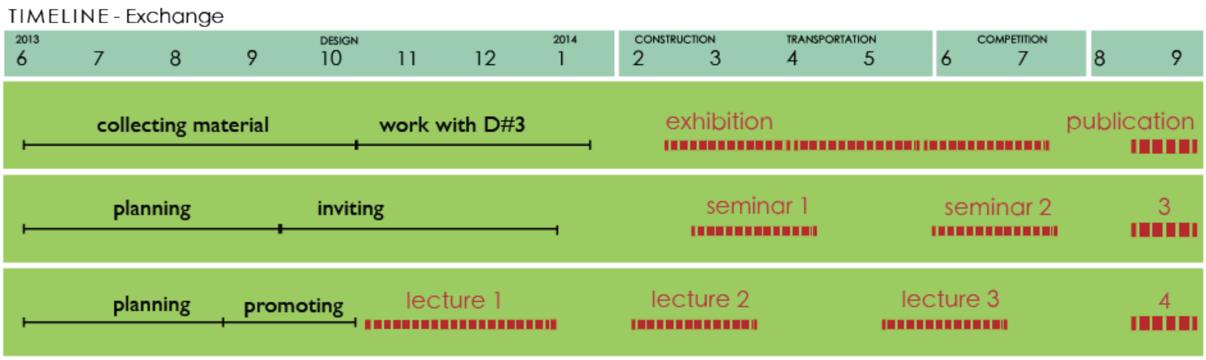
iii. Open Panel – the Orchid House and Current Technology:
• Project: New Living Container - the Orchid House
• Objectives: To create an open channel for the general public and continue to promote the basics of the sustainable practices and the Orchid House
• Time: October 2013, January, March-September 2014
• Channel: Publication, forum
• Audience: General public who are interested in architecture and sustainability
• Execution: Forums and lectures will be offer at several government-backed locations

1. Taipei URS (Urban Regeneration Station) , three forums will be held to general public. Professors from NCTU who are involved in the SDE project will be the speakers. This forum presents the general background of SDE and the knowledge of the green field, energy, urban, as well as the design. The topics will include sustainability, urban, and innovation.
- 2014/01/23: Architects' Midnight-Oasis-Bistrot Light-Forum
Location: URS-21/FUT Foundation
Lecturer: Shuchang Kung, Associate Professor; Chia-Hao Lin, Student Leader

2. NCTU, seminars on Transdisciplinary Integration and Innovation is a class designed for every Tuesday in Graduation Institute of Architecture. This seminar offers series of lectures on various topics and subjects and hands-on workshops related to how urban and architectual issues to be solved through cross-boundary integration and innovation. Listed below information are sample lectures:
- 2013/10/01: Arts & Digital Technology - acoustic exploration through digital interaction
- 2013/10/15: Big Data & Open Resources
- 2013/10/22: Hackathon & Design Thinking
- 2013/10/29: Smarter City
- 2013/11/10: Urban Location-based Services
- 2013/11/24: New business model and transdisciplinary innovation
- 2013/12/01: The Possibility of Future Media
- 2013/12/08: Money Flow and Business Model

3. NCTU YA Talk is the one that has been enjoying the greatest popularity. It is the best platform to share the updates and knowledge with students. It is regularily held on Tuesday on a monthly basis.
- 2013/10/15: Thomas Tsang
- 2013/12/12: Andrew Huang-
- 2013/12/21: Open Studio
- 2013/01/07: John C.H. Lin
- 2013/02/26: Chen-Yu, Chiu

We are confident, with these three platforms of information sharing, we can effectively reach out to a broad range of audience whether general public or professional.



Outreach - Education Strategy

Planting the solar seeds (for a better future)

We regard education as the most important communication strategy in our plan since it directly reaches our next generation – the foundation for our future. Therefore, we have designed such strategy to aim at mainly the high school students who have the basic interest in architecture, urban living, sustainability, and renewable energy. It will be executed in Phase 2.

- **Definition of the Communication Objective / Message**
  Encourage interchange of knowledge and techniques involved with the creation of the Orchid House
- **Identitfication of the Target Group:**
  High school students
- **Message/s Establishment**
  To promote the six Values within our Orchid House design.
- **Action's description / Projects**
  i.NCTU Orchid House Winter Camp:
  • *Project: Introduce and demonstrate the Orchid House, idea exchange and discussion, workshop and exhibition*
  • *Objectives: To impress and to influence*
  • *Time: 2014/02/07-2014/02/09*
  • *Channel: Exhibition, lectures and workshop*
  • *Audience: High schoolers*
  • *Leader: NCTU/Unicode students and faculty, Senior High School Teachers*
  • Execution: We invite high school students who express interests in sustainable practices as well as high school science/art teachers to a highly interactive camp at Taipei. We wish to ignite their curiosities and aspiration for a better future. The camp is a high-energy, intensive task-based campaign - Members are introduced to the basic of environmental and sustainable issues and an orientation of the Orchid House design is offered. Members then are prompted to participate in a charrette, basically a reduced-version of solar decathlon competition. The competition focus on the process more than its result, aiming at using their imagination and innovative ideas. The workshop activities are also designed to promote teamwork and collaborations with each other. In addition, Four lectures provide to generate higher interest in continue the pursuit in this field when they plan for their college education. At the end of the winter camp, it is the apex of

the entire activity – a final presentation of their ideas! Various types of presentation methods encouraged, whether drawing, collage, model, slides, animations, or any type of performing arts. Finally, we choose one of them to be an ambassador to Versaille with Team Unicode. Listed are further details for reference:

Mission:
(i) To Publicize - the information of SDE through public events
(ii) To Inspire - the younger generation
(iii) To Interact - exchange and dialogue among public
(iv) To Generate – extended interest and support

Lecture:
A forum in roundtable fashion that starts with moderator's lead commentary of major agenda. Participating members will be invited to participate by sharing their ideas regarding green energy, smart living and their vision of the future city.

Recruit:
The recruitment of members to join the Winter Camp will be conducted in the form of presentations made at various selected high schools as well on our website to the general public. Primary targets are those who have been highly interested in environmental and sustainability issues. Some members may also participate on referal basis from credited sources, such as:
(i) Teachers
(ii) SDE assistant staff
(iii) High school students

Workshop:
(i) Members divide into smaller groups (7 senior hign schoolers per group) , one young architect and one SDE studio student.(ii) Each group guides to start generating visions, ideas, and concepts, followed by discussion and the physical production of presentation by using any material pertinent to their needs.

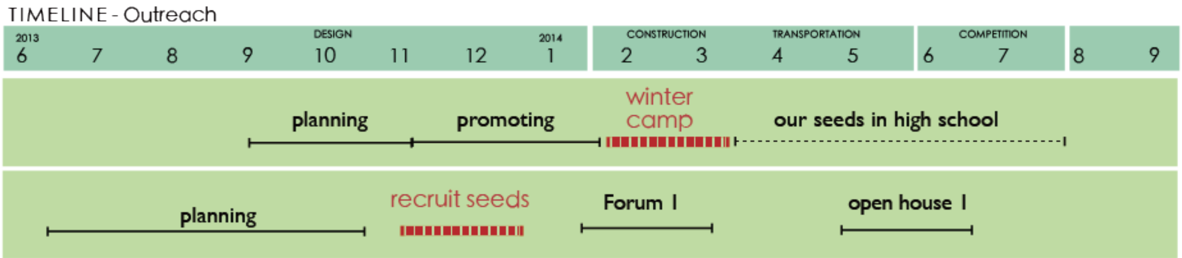
Exhibition:
Following the Winter Camp, an exhibition of their projects as well as other information of Orchid House design hold and open to the general public.

Objectives:
(i) Publicity for SDE 2014 and our project - Orchid House
(ii) Opportunity to participate in an activity related to sustainability
(iii) Exchange of vision, idea, and solutions
(iv) A showcase to rally for government policy support
(v) A bridging channel between the acedemia and enterprise
(vi) An opportunity to raise public awareness on sustainability issues and efforts

ii. NCTU/UNICODE Orchid House Solar Seedlings Foundation:
• Project: Planting the solar seeds (for a better future).
• Objectives: To influence the architecture school students who had interested in the Orchid House and expect them to be our event volunteers.
• Time: February, 2014
• Channel: Lecture, open house.

• Audience: 20 NCTU students and other architecture school students
• Leader: Team Unicode students.
• Execution: In order to recruit the best qualified volunteers, we will conduct three types of activities in schools to“plant the seeds”.

(i) High schools attended by current college architecture students. They serve as the best ambassdors to encourage junior schoolmates to participate.
(ii) NCTU Leadership Course students will be encouraged to join us and help with the communication related works.
(iii) Social network such as Facebook friends and fans will also be exposed to daily renewed news, messages, updates, and records of activities such as photos and videos.



News - Strategic Press Exposure

Analysis of the situation
Revival of solar energy in the anti-nuclear age.

The main goal is to maximize media exposure with organized strategies. Various research articles will be publicized in synch with major milestones, news conference, and PR events. This will be implemented through Phases 2 and 3.

- **Definition of the Communication Objective**
  Maximize the public exposure to SDE and NCTU/UNICODE Team and the Orchid House
- **Identitfication of the Target Group:**
  General public, subscribers and readers of our selected media platforms.
- **Action’s description / Projects**

i. Media Platform Lists
• Newspaper:
The following newspaper are the most popular ones:
CTNews: http://www.chinatimes.com/
UDN: http://udn.com/NEWS/mainpage.shtml
The Liberty Times: http://www.libertytimes.com.tw/
NextMedia: http://tw.nextmedia.com/
Upaper: http://reading.udn.com/upaper/
Sharpdaily: http://sharpdaily.tw/
PowerNews: http://www.twpowernews.com/home/index.php
Pots Weekly: http://www.pots.tw/
Economic Daily News: http://edn.udn.com/

• Magazine:
To encourage curiosity and debate about renewable energy through columns written by well-known people. These selected magazines are as following:

BUSINESS WEEKLY: http://www.businessweekly.com.tw/
CommonWealth: http://english.cw.com.tw/front.do?action=index
Global Views: http://www.gvm.com.tw/
Interior: http://www.interior-mj.com.tw/
DFUN: http://www.dfunmag.com.tw/
La Vie: http://www.wowlavie.com/

• Website:
To spread the news of Solar Decathlon Europe 2014 and encourage public excitement over NCTU/UNICODE's participation via internet. The platform and website such as youtube, FB, Blog, google, Yahoo.
IOH: http://ioh.tw/
XIN Forum: http://www.xinmedia.com/xinforum/
Forgemind ArchiMedia: http://www.forgemind.net/xoops/modules/news/
ArchicultureForum: http://www.archiforum.org.tw/
JUT Foundation For Arts and Architecture: http://www.jut-arts.org.tw/cht/index.php
City yeast: http://www.cityyeast.com/
Archicake: http://www.mmag.com.tw/ad/
Change Taipei: http://changetaipei.net/
Village Taipei: http://www.urstaipei.net/

• TV/Radio:
To increase the exposure and spark widespread interest in Orchid House project. The TV program or the radio such as ICRT will play an important role to spread the information. We expect to have some interview with well-known architects.
- 2013/12/16: FM97.5 IC Broadcasting
- 2013/12/25: FM97.5 IC Broadcasting

• PR:
Creating the public relationship with sponsors as well as French Institute in Taipei, aim to have a collaboration with each other.

• Activities:
We are going to hold workshop as well as exhibition during winter vacation for senior high school students, in addition to having forum to general public.

ii. Portfolio Publication - Orchid House
• Project: A documentary portfolio of the entire process participating in SDE 2014.
• Objectives: To document and to publicize.
• Time: August, 2014
• Channel: NCTU or a mjaor publisher in Taiwan.
• Audience: General public and professionals.
• Leader: David Tseng, Professor.
• Execution: The portfoilio shall focus on the following four agenda:

(i) Building - What does a building do? To explore and discuss the role of a building in today's urban context, what are the meanings to the inhabitants? How does a building perform as the interface between living space and public space?

EXPECTED MEDIA LIST

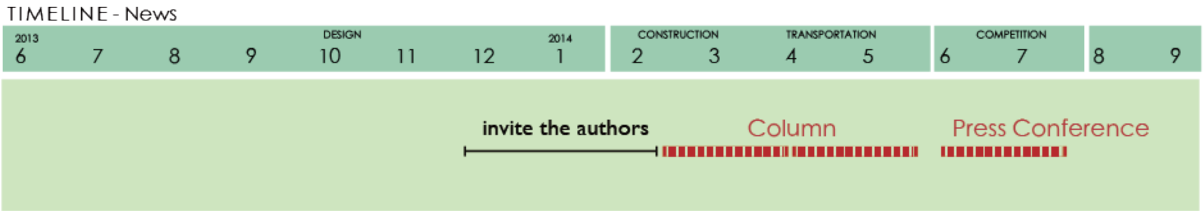
Media	Type of Media	Date of Publication	Type of Publication	Website address
NCTU News	newspaper	2013.04.01	print, online	http://www.chss.nctu.edu.tw/News/news-more.php?id=54
		2013.06.19	online	
		2013.11.07	online	
CTNews	newspaper	2014.02.07	print, online	http://www.chinatimes.com/
UDN	newspaper	2014.02.10	print, online	http://udn.com/NEWS/mainpage.shtml
		2014.02.07	print, online	
		2014.01.25	print, online	
The Liberty Times	newspaper	2014.02.08	print	http://www.libertytimes.com.tw/
NextMedia	newspaper	2014.02.07	print	http://tw.nextmedia.com/
Upaper	newspaper	2014.02.07	print	http://reading.udn.com/upaper/
Sharpdaily	newspaper		print	http://sharpdaily.tw
PowerNews	newspaper		print	http://www.twpowernews.com/home/index.php
Pots Weekly	newspaper		print	http://www.pots.tw/
Economic Daily News	newspaper	2014.02.09	print	http://edn.udn.com/
Taipei Times	newspaper	2014.02.07	print, online	http://www.taipeitimes.com/
Merit Times	newspaper	2013.11.08	print, online	http://www.merit-times.com/
BUSINESS WEEKLY	magazine		print	http://www.businessweekly.com.tw/
CommonWealth	magazine		print	http://english.cw.com.tw/front.do?action=index
Global Views	magazine		print	http://www.gvm.com.tw/
Interior	magazine	2014.03.01	print	http://www.interior-mj.com.tw/
DFUN	magazine		print	http://www.dfunmag.com.tw/
La Vie	magazine	2014.02.01	print	http://www.wowlavie.com/
Taiwan Today	website	2013.11.08	online	http://www.taiwantoday.tw/mp.asp?mp=9
Cdnews	website	2014.02.07	online	http://www.cdnews.com.tw/cdnews_site/
WorldJournal	website	2014.02.07	online	http://www.worldjournal.com/
YonthDailyNews	website	2013.11.08	online	http://gpwd.mnd.gov.tw/onweb.jsp?webno=3333333613
Radio Taiwan International	website	2013.11.07	online	http://www.rti.org.tw/index.aspx
PCHomeNews	website	2013.12.31	online	http://news.pchome.com.tw/
EpochTimes	website	2013.11.07	online	http://www.epochtimes.com/b5/ncnews.htm
SeniorNews	website	2014.02.13	online	http://www.srnews.com.tw/main.asp
IOH	website	2014.02.09	online	http://ioh.tw/
xin forum	website	2014.02.09	online	http://www.xinmedia.com/xinforum/
Forgemind ArchiMedia	website	2014.02.09	online	http://www.forgemind.net/xoops/modules/news/
		2014.12.14	online	
JUT Foundation For Arts and Architecture	website		online	http://www.jut-arts.org.tw/cht/index.php
City yeast	website	2014.02.09	online	http://www.cityyeast.com/
Archicake	website		online	http://www.mmag.com.tw/ad/
Change Taipei	website		online	http://changetaipei.net/
LowestCarbon	website	2013.12.23	online	http://lowestc.blogspot.tw/
IC975Radio	website	2013.12.23	online, Radio	http://www.ic975.com/
MoneyDJ	website	2014.02.09	online	http://www.moneydj.com/KMDJ/
Village Taipei	website		online	http://www.urstaipei.net/
C N A	website	2014.02.09	online	http://www.cna.com.tw/

- *Appendix 1 _ Expected Media List*

(ii) Sustainability - What does sustainability truly mean?
NCTU/UNICODE use the rooftop as a penertrating object to explore the social significance of a building componant. Roofscape aside, discussion will also evolve around its influence in the future. We will further investigate the feasibility of reviving the existing buildings with the least impact, as well as the various alternatives. We shall emphasize that the significance of sustainability are revealed not only in technical terms but also in social terms.

(iii) Possibility - How is it done?
The prototype we designed and to be built in Versaille, France 2014 is an attempt to probe the possibilities in solving several serious pressing issue – How are the green concepts be translated into reality? How do solar energy, water, and other natural resources work together to achieve more efficient result? Are there better ways to both reduce the consumption of energy as well as to provide safer, greener energy?

(iv) Reality – What does the Orchid House Do for us?
The process of planning, design, and building the Orchid House will be a pioneering example in Taiwan and we wish to leave our footprints for the next generation to follow.



Production - Documentary Team (information production team)

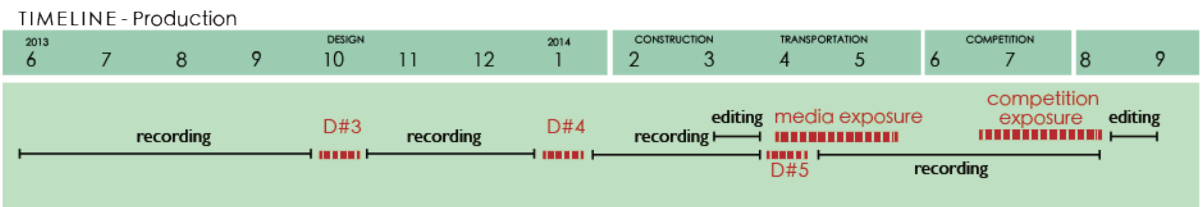
Analysis of the situation
Interactive and entertaining documentaries about urban rooftop regeneration.

The main goal is to provide records in various forms such as text, charts, drawings, photograph, and video. We have been carefully keeping records and documents through the process. Additionally, images and videos will be used in the presentation of the Orchid House during the competition. This will take place in Phase 3.

- **Definition of the Communication Objective**
  Provide documented records for the Public Relations Team.
- **Identitfication of the Target Group:**
  General public, subscribers over various media platforms.
  i. Social Media Management
  Official website, Facebook, Instagram, Pinterest, and Twitter are to be utilized as primary channels. Progress update, countdown weeks posters, milestones demonstrations, event documents, etc., will be posted and to generate regular viewership. Special announcement or PR opportunities will be rallied throughout the entire process to generate discussions, opinions, and social exchange over these networks.

  ii. Print and Images Media Management
  The print team will be responsible for all text-based releases and event announcements. They will also manage all image-based materials for a variety of uses.

  iii. Video Recordings
  The Video Team is to be responsible for all documentation of the audio and video format materials.



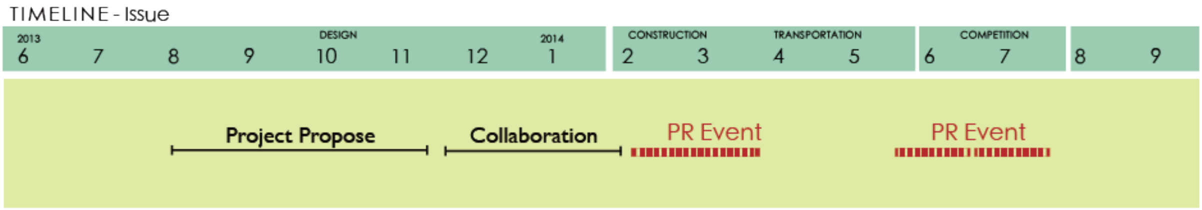
Issues - Promotional Events

Analysis of the situation
Exhibition at NCTU Campus, Hsinchu

One part of the Orchid House shows up at NCTU Campus, locates at the end of the University Boulevard, acts as a hub for gather students together and form a creative social space. Activities in this aspect will take place in Phase 3.

- **Definition of the Communication Objective / Message**
  To publicize the project and to interact with the general public
- **Identitfication of the Target Group:**
  General public.
- **Action's description / Projects**

  i. Exhibition at NCTU Campus, Hsinchu
  • Project: Public exhibition
  • Objectives: To demonstrate and showcase our commitment and achievement pursuing SDE 2014.
  • Time: February 2014-May 2014
  • Channel: Exhibition, lectures and workshop
  • Audience: General public
  • Leader: Team NCTU/UNICODE
  • Execution: This will be the outreach period before the competition, we may promote sustainable issues with special activities such as workshop or press conference with sponsor's foundation. Images and videos from the event will be shown through media channels within our plan.



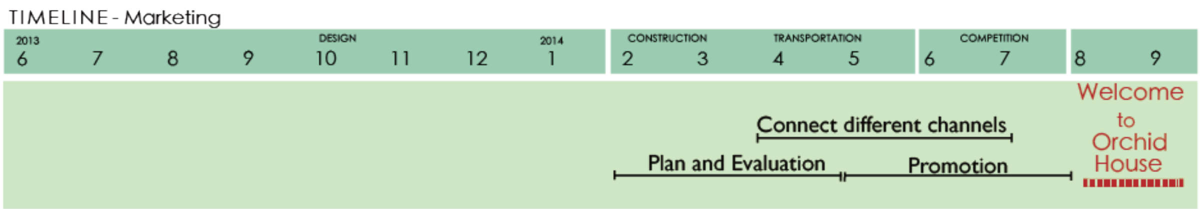
Marketing - Marketing Projects

Analysis of the situation
Huashan 1914 Creative Park is a renewed urban industrial site with historical significance. It is now the hotspot for cultural activities in Taipei. It is also a major sponsor for our SDE project. Sponsors and our team will be using this platform as the base for all major promotional activities. The primary goal for marketing is to extend the promotion of SDE's theme subjects post-competition. The focal subject is the re-assembled Orchid House to be located in Huashan 1914 Creative Park, Taipei. It will serve as the base for exhibition of SDE competition, continuing updates of our research at NCTU, and other design achievements done by other institutions in Taiwan. The key concept is to maintain the presense of agenda and a permanent milestone display. The marketing projects will take place in phase 4, after the SDE competition.

- **Definition of the Communication Objective / Message**
  Maintain the focus on sustainable energy, urban renewal, and improvements on social housing after the competition.
- **Identitfication of the Target Group:**
  Travelers, those who are interested in architecture and general public.
- **Messages / Establishment**
  A showcase of commitment to sustainability and social housing agenda.
- **Action's description / Projects**

i.NCTU Orchid House Display:
• Time: September 2014~
• Channel: Exhibition, actual house on-site display
• Audience: Travelers, those who are interested in architecture and general public
• Leader: Team NCTU/UNICODE

ii. Orchid House – related products:
To provide souvenirs, which can also be used in the previous five strategies for PR's purpose. Potential items of merchandising may be the Orchid House portfolio book, scaled model of the Orchid House, postcard with Versailles campus, mug, notebook, DVD, etc. The design and production of these merchandising may be done via collaborations between our students and sponsoring enterprises.



Previous to the competition

Before the Competition is phase 1 and 2, in these two phases we develop our design and disseminate to general public. firstly, we focus on sharing and exchanging with the public what we have learned and experienced through our research and design. There will be held in Seminar and Forum. Secondly, we focus on the academic part and regard education as the most important communication strategy in our plan since it directly reaches our next generation – the foundation for our future. Therefore, we hold the winter camp, find the solar seedlings to aim at mainly the high schoolers who have the basic interest in architecture, urban living, sustainability, and renewable energy.

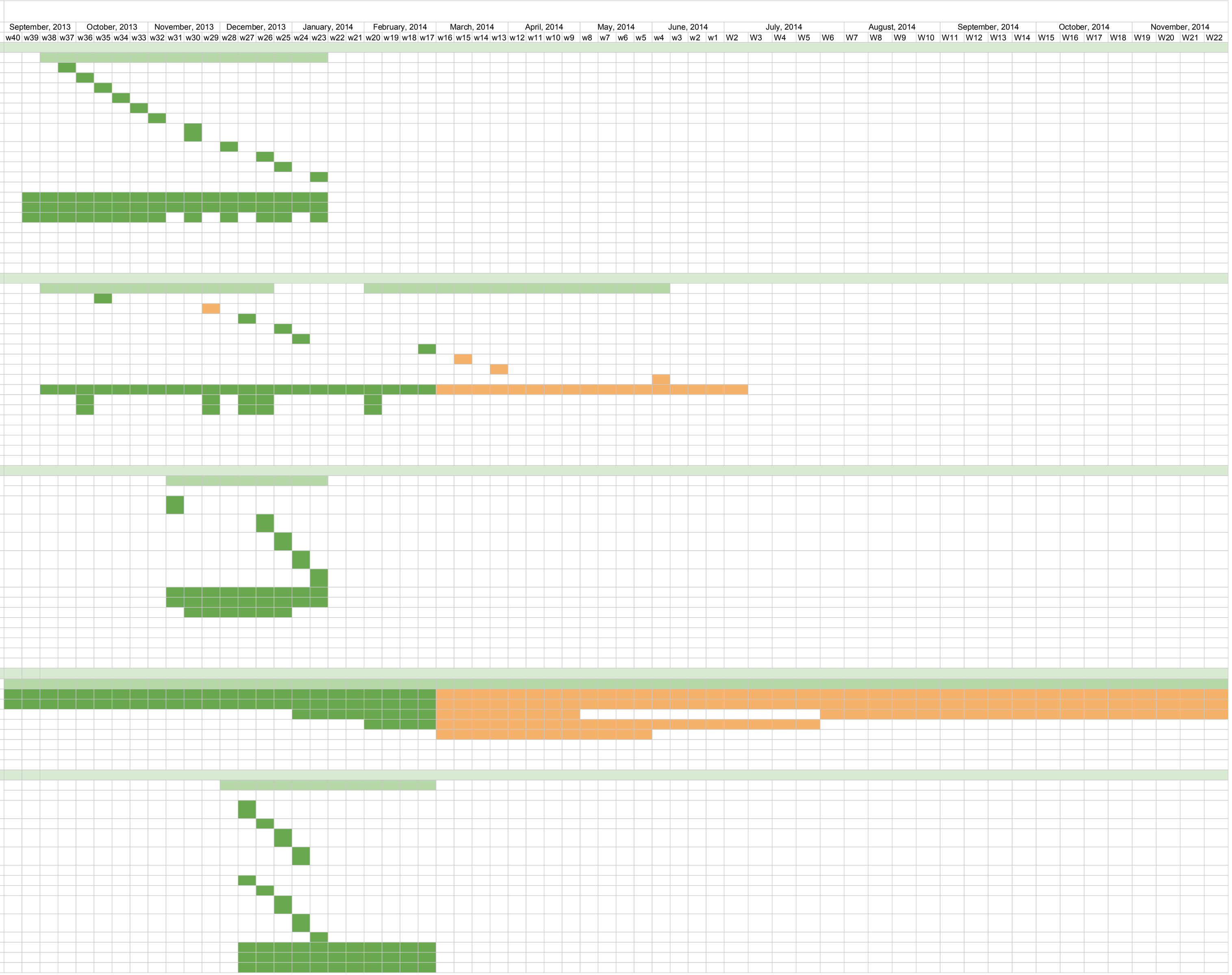
During the Competition

During the Competition, we provide the public tour for the general public in site. We think that visitors will be guided throughout the House to experience, feel, and appreciate this project from all perspectives. Besides, we will provide a brochure while general public is visiting Orchid House.

Tracking Table of the Communication actions

Tracking Table of Communication Plan

ITEM	PERSON IN CHARGE
Open Panel 1 - NCTU Seminar	Eric Chuang
Arts & Digital Technology	Eric Chuang
Big Data & Open Resources	Eric Chuang
Hackathon & Design Thinking	Eric Chuang
Smarter City	Eric Chuang
Urban Location-based Services	Eric Chuang
Proposal Review 1	Eric Chuang
New Business Model and transdisciplinary innovation	Eric Chuang
The Possibility of Future Media	Eric Chuang
Proposal Review 2	Eric Chuang
Money Flow and Business Model	Eric Chuang
Final Review	Eric Chuang
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Open Panel 2 - YA Talk	Shu Chang Kung
Lecture 1_Thomas Tsang	Shu Chang Kung
Lecture 2_TED X NCTU	Shu Chang Kung
Lecture 3_Andrew Huang	David Tseng
Open Studio	David Tseng
Lecture 4_Lin, John C.H.	David Tseng
Lecture 5_Chiu, Chen-Yu	David Tseng
Lecture 6_	David Tseng
Lecture 7_	David Tseng
Lecture 8_TED X Taipei	Eric Chuang
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Orchid House Solar Seedling Recruitment_High School	Shu Chang Kung
Forum 1_Taipei Municipal Jianguo High School	Shu Chang Kung
Forum 2_The Affiliated Senior Hign School of NTNU	Shu Chang Kung
Forum 3_Taipei Municipal Zhong-zheng Senior High School	Shu Chang Kung
Forum 4_National Hsinchu Senior High School	Shu Chang Kung
Forum 5_Taipei Municipal Zhong Shan Girls Senior High School	Shu Chang Kung
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Perspective - Orchid House	Eric Chuang
Video Recordings	Eric Chuang
Photo shoots	Eric Chuang
model display in 1:25	Eric Chuang
Delta Foundation Display	Eric Chuang
Video clips	Eric Chuang
Others	Eric Chuang
Orchid House Solar Seedling Actions	Shu Chang Kung
Lecture 1_General Information of Orchid House Project	David Tseng
Lecture 2_Monolithic	David Tseng
Lecture 3_Power House-Social Engineering	David Tseng
Lecture 4_Urban Regeneration, Social Design	Shu Chang Kung
Lecture 5_The Imagination of City	Shu Chang Kung
Training Course-Carpenter	B Benjimin Tang
Training Course-Carpenter	B Benjimin Tang
Training Course-Plumbing and Mechanical	B Benjimin Tang
Training Course-Plumbing and Mechanical	B Benjimin Tang
Training Course-HVAC	B Benjimin Tang
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang



Tracking Table of Communication Plan

September, 2013 | October, 2013 | November, 2013 | December, 2013 | January, 2014 | February, 2014 | March, 2014 | April, 2014 | May, 2014 | June, 2014 | July, 2014 | August, 2014 | September, 2014 | October, 2014 | November, 2014

w40 w39 w38 w37 w36 w35 w34 w33 w32 w31 w30 w29 w28 w27 w26 w25 w24 w23 w22 w21 w20 w19 w18 w17 w16 w15 w14 w13 w12 w11 w10 w9 w8 w7 w6 w5 w4 w3 w2 w1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22

ITEM	PERSON IN CHARGE
newsletters	Eric Chuang
others	Eric Chuang
Orchid House Winter Camp	Eric Chuang
Opening Ceremony	Eric Chuang
PR1	Eric Chuang
PR2	Eric Chuang
PR3	Eric Chuang
Closing Ceremony	Eric Chuang
Press Conference 1	Eric Chuang
Exhibition 1_A Class of General Educaton on City	Shu Chang Kung
Exhibition 2_Orchid House	Shu Chang Kung
Video_A Documentary of A Class of General Educaton on City	Shu Chang Kung
Dissemination	Eric Chuang
Advertisement_bus	Eric Chuang
Advertisement_website_keywords website	Eric Chuang
posteres	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Open Panel 3 -Taipei URS	C David Tseng
Taipei URS 1_Architects' Midnight-Oasis-Bistrot Light-Forum	Shu Chang Kung
Taipei URS 2	C David Tseng
Presentation of Proposal	C David Tseng
Academic Conference 1	C David Tseng
Academic Conference 2	C David Tseng
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Orchid House Pre-assembly	B Benjimin Tang
Pre-assembly Training	B Benjimin Tang
Simulation Training	B Benjimin Tang
Disassembly Training	B Benjimin Tang
Press Conference	Eric Chuang
Exhibition_Section Display	B Benjimin Tang
Forum 1	C David Tseng
Public Tour in Pre-assembly Site	B Benjimin Tang
The Orchid-House-Documentary Project-Premiere	Eric Chuang
The Orchid-House-Documentary Project-Producing	Eric Chuang
The Orchid-House-Documentary Project-Behind the Scene	Eric Chuang
Educational Column 1_Information	C David Tseng
Educational Column 2_Media	C David Tseng
Press Conference	C David Tseng
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Public Tour in Competition	B Benjimin Tang
PR1	Eric Chuang
PR2	Eric Chuang
Public Tour 1_VIP for SDE	C David Tseng
Public Tour 2_VIP for Sponsor/general public	C David Tseng
Public Tour 3_VIP for School	C David Tseng
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Video Display in Competition	C David Tseng
Video Display in Taipei_PT1	C David Tseng
Video Display in Taipei_PT2	C David Tseng
Video Display in Taipei_PT3	C David Tseng
Video Display in Taipei_Behind the Scene	C David Tseng
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang

Tracking Table of Communication Plan

		September, 2013				October, 2013				November, 2013				December, 2013				January, 2014				February, 2014				March, 2014				April, 2014				May, 2014				June, 2014				July, 2014					August, 2014			September, 2014					October, 2014				November, 2014			
ITEM	PERSON IN CHARGE	w40	w39	w38	w37	w36	w35	w34	w33	w32	w31	w30	w29	w28	w27	w26	w25	w24	w23	w22	w21	w20	w19	w18	w17	w16	w15	w14	w13	w12	w11	w10	w9	w8	w7	w6	w5	w4	w3	w2	w1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20	W21	W22
Disassembly after Competition	B Benjimin Tang																																																													
Dissemination	Eric Chuang																																																													
website	Eric Chuang																																																													
posters	Eric Chuang																																																													
newsletters	Eric Chuang																																																													
others	Eric Chuang																																																													
Orchid House Display in Taiwan	C David Tseng																																																													
Public Tour	C David Tseng																																																													
PR 1	C David Tseng																																																													
PR 2	C David Tseng																																																													
Press Conference 1	C David Tseng																																																													
Press Conference 2	C David Tseng																																																													
Grand Opening Ceremony	C David Tseng																																																													
Closing Ceremony	C David Tseng																																																													
Disassembly after Event	C David Tseng																																																													
Dissemination	Eric Chuang																																																													
website	Eric Chuang																																																													
posters	Eric Chuang																																																													
newsletters	Eric Chuang																																																													
others	Eric Chuang																																																													
Orchid House Portfolio	C David Tseng																																																													
PR 1	C David Tseng																																																													
Press Conference	C David Tseng																																																													
Forum 1	C David Tseng																																																													
others	C David Tseng																																																													
Dissemination	Eric Chuang																																																													
website	Eric Chuang																																																													
posters	Eric Chuang																																																													
newsletters	Eric Chuang																																																													

5.7.3 Public Tour Description

The Orchid House was designed for all who have an interest in sustainable future. Visitors will be guided throughout the House to experience, feel, and appreciate this project from all perspectives. The guided tour reveals in progression of important aspects related to its concept, design, material, and the attempt behind it to provide a social, accessible solution to urban issues.

Description of Tour Rout

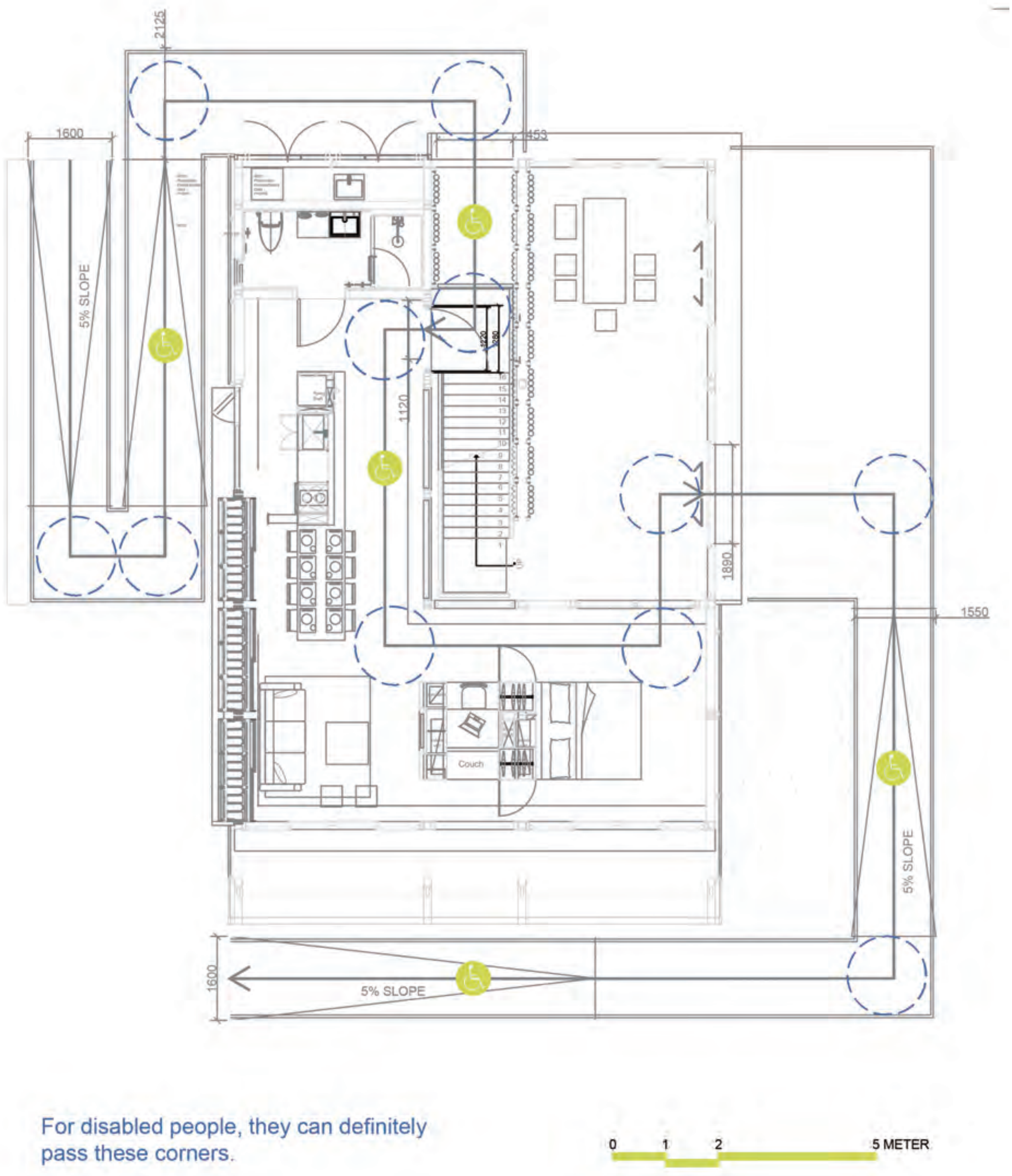
Visitors will be mostly drawn towards our house from the west of the site in queue and be greeted by exterior wall creatively made with recycled material. Attention will be immediately drawn to an interactive displays on the wall which is triggered by the variation of temperature. Turning at the middle of the west wall, the window offers the translucent glimpse into the house through the opening over the facade.

When reaching the north corner, visitors will be invited to take a special photo shot agianst the elegant backdrop of the House. They will proceed to be entertained by a demonstration of the mechanical room – a hub of building and be briefed of its functionalities. At the end of the ramp, visitors will provide a green experience before entering the Orchid House.

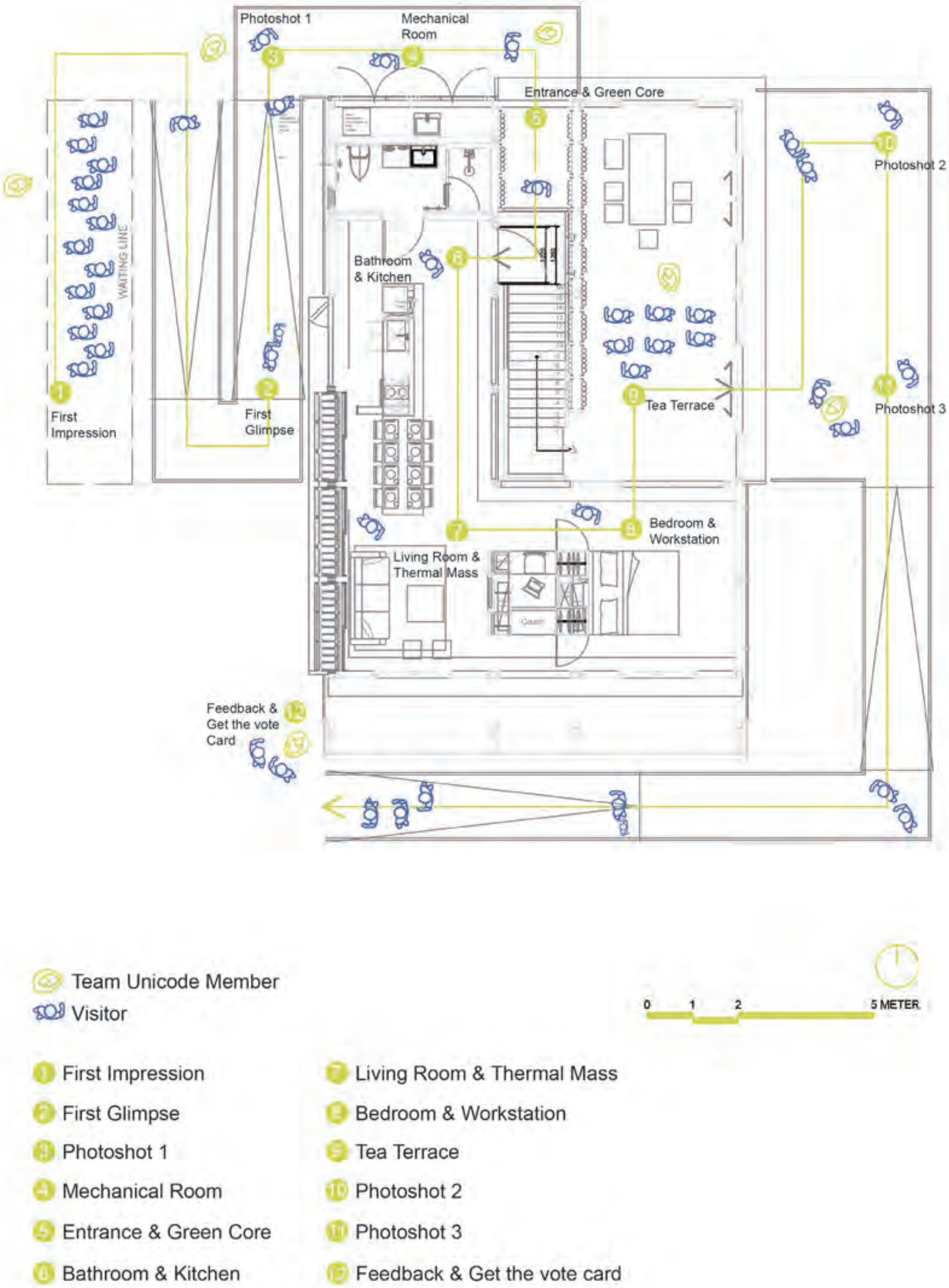
Inside the House, visitors are organized to tour along a prescribed route and our team members will be stationed and offering the highlights at each area as well as answering any questions.

Drawings Showing the route and contouring

For Disable People



For General Public



Tour for General Public

Spot	Name	Duration	Description
1	First Impression	depends on the visitors in queue	Visitors will get a general view of Orchid House. Then experience the passage designed to access the house.
2	First Glimpse	10 secs	At the middle of the west ramp, we provide a translucent glimpse into the House through the window.
3	Photoshot 1	1 min	Experience the northwest side of Orchid house. Guide will explain the concept, design and background knowledge of Orchid house and the city issue in Taipei. Friendly guide will start the tour from this spot, introducing the concept of Orchid House.
4	Mechanical Room	3 mins	Guide will explain the machine system including.
5	Entrance & Green Core	3 mins	Guide will introduce the concept of Green Core and Taiwanese orchid.
6	Bathroom & Kitchen	2 mins	The kitchen serves a multifunctional task – the center piece is an island that can be converted into a dining table for formal occasions.
7	Living room & Thermal mass	2 mins	The Living Room features abundant natural light and can be filtered and adjusted by louvers as well as the liquid thermal mass wall on the west side. Further details will be provided to explain how the thermal wall conserves energy and maintains comfortable temperatures both day and night.
8	Bedroom & Workstation	2 mins	Guide will explain how we conceived the L-shape house and how it serves as a prototypical solution to Taipei rooftop. Some general description of city issues will be provided.
9	Tea Terrace	5 mins	The space offers visitors shading comfort while they enjoy traditional Chinese Tea and appreciating the conceptual model from the winter camp made by the senior high schoolers.
10	Photoshot 2 & Garden	2 mins	After experiencing the tea terrace, this deck offers a space for occasional rest.
11	Photoshot 3 & Garden	2 mins	Experience the southeast side of the house, seeing the well-designed garden.

12	Feedback & Get the vote card	3 mins	Get more Q&A before finish the tour and get a vote card.
Total		Estimate 25 mins	

Tour for Judges

Spot	Name	Duration	Description
1	First Impression	depends on the visitors in queue	Visitors will get a general view of Orchid House. Then experience the passage designed to access the house.
2	First Glimpse	10 secs	At the middle of the west ramp, we provide a transluscent glimpse into the House through the window.
3	Photoshot 1	1 min	Experience the northwest side of Orchid house. Guide will explain the concept, design and background knowledge of Orchid house and the city issue in Taipei. Friendly guide will start the tour from this spot, introducing the concept of Orchid House.
4	Mechanical Room	3 mins	Guide will explain the machine system including.
5	Entrance & Green Core	3 mins	Guide will introduce the concept of Green Core and Taiwanese orchid.
6	Bathroom & Kitchen	2 mins	The kitchen serves a multifunctional task – the center piece is an island that can be converted into a dining table for formal occasions.
7	Living room & Thermal mass	2 mins	The Living Room features abundant natural light and can be filtered and adjusted by louvers as well as the liquid thermal mass wall on the west side. Further details will be provided to explain how the thermal wall conserves energy and maintains comfortable temperatures both day and night.
8	Bedroom & Workstation	2 mins	Guide will explain how we conceived the L-shape house and how it serves as a prototypical solution to Taipei rooftop. Some general description of city issues will be provided.
9	Go upstairs through the Green Core	1 min	Get more further information of Green Core and the water system.
10	Tea Lounge	3 mins	Invite judges to enjoy traditional Chinese Tea.

11	Smart Skin Show	1 mins	They will proceed to be entertained by a demonstration of the “smart skin” – a showcase of another interactive building exterior design.
12	Tea Terrace	3 mins	The space offers visitors shading comfort and appreciating the conceptual model from the winter camp made by the senior high schoolers.
13	Photoshot 2 & Garden	2 mins	After experiencing the tea terrace, this deck offers a space for occasional rest.
14	Photoshot 3 & Garden	2 mins	Experience the southeast side of the house, seeing the well-designed garden.
15	Feedback & Get the vote card	3 mins	Get more Q&A before finish the tour and get a vote card.
Total		Estimate 30 mins	

Visit Description

1)Tour for General Public:
The overall guided tour will conducted in both English and Mandarin/French. Each tour will be organized up to eight people at a time. The entire tour is estimated to take 23 minutes, with two to four minutes scheduled for each station inside the House.

i. First Impression (duration depends on the visitors in queue)
By working over the ramp, visitors will be invited to our journey in Orchid House.

ii. First glimpse (10 secs)
At the middle of the west ramp, we provide a transluscent glimpse into the House through the window.

iii. Photoshot 1 (1 min)
At the end of the ramp, we will provide a selected photos opportunity before entering the Orchid House.

iv. Mechanical Room (3 mins)
Prior to entering the Orchid House, visitors will be able to see the engine/hub of the Orchid House-mechanical room and be briefed of its functionalities.

v. Entrance and Green Core (3 mins) The Green Core serves as the heart/engine of the House - it keeps the temperature in balance, provides the exchange of fresh air, and kicks off recycling system for the irrigation of plants. The difference in temperature will be immediately sensible to visitors who enter the House and they will be briefed in details by our team how the Green Core performs and functions to achieve such result.

vi. Bathroom, Kitchen and Living Room (4 mins) Our members will explain the feature and design related to each of the areas. The kitchen serves a multifunctional task – the center piece is an island that can be converted into a dining table for formal occasions. The Living Room features abundant natural light and can be filtered and adjusted by louvers as well as the liquid thermal mass wall on the west side. Further details will be provided to explain how the thermal wall conserves energy and maintains comfortable temperatures both day and night.

vii. Working Station and Bedroom (2 mins) Other than the general features, our member will specifically explain how we concieved the L-shape house and how it serves as a prototypical solution to Taipei rooftop. Towards the end of the tour, visitors are able to exit via the bedroom and onto the Tea Terrace.
viii. Tea Terrace (3 mins) This is a semi-outdoor area with multifunctional purposes. It is sheltered by a double-height canopy which is also used for exhibition but also offers visitors shading comfort while they enjoy traditional Chinese Tea. Conceptual models from the Winter Camp will be displayed here taking the opportunity to showcase the imagination and innovation by the younger generation from Taiwan.

ix. Photoshot 2,3 & Garden (4 mins) After touring the house, should the traffic allowed, visitors will be encouraged to go about the house to fruther experience and appreciate in a more casual fashion. This deck also offers a space for occasional rest.

x. Feedback & Get the vote card (4 mins)

At the end of the tour in Orchid House, we will like to provide a Q&A for visitors who are interested in the project. Finally, a brochure with surprising format will be provided.

2)Tour for VIP-Judges:
The overall guided tour will conducted in both English and Mandarin/French. The judges will tour the House along the same route as the normal visitors. The only exception is a detoured visit up to the mezzanine after passing the Green Core, where our guide member will provide information regarding the garden plot and the potential for the area as a socializing space. The entire tour is estimated to take 30 minutes, with two to four minutes scheduled for each station inside the House.

Life Demonstrations
NCTU/UNICODE has no intention of giving live demonstrations of mobile elements.

Brochure and handout
We will include it in the next deliverable.

5.7.4 Visual Identity Manual

Name of Team and House

NCTU/UNICODE was so named to stress the unique integration of our team which consists of of members from multiple disciplines. “UNICODE” fruther impress the unified nature not just among the team members but also the universal application of the solution to urban issues. ORCHID HOUSE depicts as well such universal prototype offers adaptive strategy generated from domestic environment. Orchid, being a sensitive planet, is also a strong iconic representation of our commitments to create an organic, livable residential solution that maintain sustainable balance with natural light and water.

Rule of Use

The NCTU/UNICODE logo and the Orchid House logo should only be applied to relevant and appropriate material by NCTU or SDE 2014. Any other parties that wish to use the logos must contact the NCTU/UNICODE team for negotiations.

Main Logo and Chosen Typography

ORCHID HOUSE

PANTONE	PANTONE 380 C
CMYK	C:23 M:4 Y:81 K:0
RGB	R:219 G:227 B:65
Transparency	70%
PANTONE	PANTONE 7683 C
CMYK	C:79 M:58 Y:15 K:0
RGB	R:68 G:107 B:168
Transparency	70%
PANTONE	PANTONE 375 C
CMYK	C:49 M:0 Y:98 K:0
RGB	R:148 G:213 B:0
Transparency	70%

NCTUNICODE

PANTONE	PANTONE 380 C
CMYK	C:23 M:4 Y:81 K:0
RGB	R:219 G:227 B:65
PANTONE	PANTONE 7683 C
CMYK	C:79 M:58 Y:15 K:0
RGB	R:68 G:107 B:168

BACK GOTHIC / LIGHT FOR NCTU
DINPro / Black for ORCHID HOUSE

Supporting institutions and Sponsor`s Logos

Three Logo Versions

Sticker & Screen saver

New Year Special Screen

New Year Special Card Design

Keyword, Slogan and Uniform

Slogan

Uniform Design

5.7.5 Sponsorship Manual

Supporting institutions and companies' tracking

The Orchid House project brings academic institution and technology industries in Taiwan together. NCTU/UNICODE provides Taiwanese institutions and companies an opportunity to present their ideas and products to global market during the competition process. Depending on the contribution to the project, each sponsor is entitled as SDE partner, platinum, gold, silver, bronze and citation. Each category can enjoy the different degree of benefit from the project.

PARTNERSHIP MANUAL

Partner	Type of sponsorship	Team contact's name	Team contact's phone	Team contact's mail
AUTHORITIES				
Solar Decathlon Europe	financial support	David Tseng	03-5712121 #58468	cdtseng@arch.nctu.edu.tw
Bureau France in Taipei	cultural support	David Tseng	03-5712121 #58468	cdtseng@arch.nctu.edu.tw
University System of Taiwan	financial, cultural support	David Tseng	03-5712121 #58468	cdtseng@arch.nctu.edu.tw
STRUCTURE AND CONSTRUCTION				
Ruentex	financial, design and construction support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
Tung Ho Steel	financial, design and construction support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
ELECTRICITY				
Delta	financial, design and construction support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
MECHANICAL				
SGS	technical support	Minnie Jan	03-5712121 #58467	mjan@nctu.edu.tw
UIS	technical support	Chenwu Chung	03-5712121 #58468	chenwu_chung@yahoo.com
Mason Universal Enterprise	technical support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
MATERIAL				
Bayer	product support	Minnie Jan	03-5712121 #58467	mjan@nctu.edu.tw
Miniwiz	product support	David Tseng	03-5712121 #58468	cdtseng@arch.nctu.edu.tw
Berlin Co., Ltd.	product support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
Mega Master Technology	product support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
Spring Pool	product support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
Fuh Shan co.,Ltd.	product support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
COMPUTER DEVICES				
Asus	devices support	Minnie Jan	03-5712121 #58467	mjan@nctu.edu.tw
ORCHID				
Grand Biotechnology	product support	Minnie Jan	03-5712121 #58467	mjan@nctu.edu.tw
Orchid4All	product support	Minnie Jan	03-5712121 #58467	mjan@nctu.edu.tw
BATHROOM				
HCG	product support	Eric Chuang	03-5712121 #58467	ec2331@gmail.com
SOFTWARE				
Autodesk	software support	Pei Hsien Hsu	03-5712121 #31977	phsu@arch.nctu.edu.tw
LOGISTIC				
EVA Airways	ticket support	Bojiun Tang	03-5712121 #31895	benjamin@arch.nctu.edu.tw
Evergreen Marine	logistic support			
SITE/ACTIVITY				
Huashan 1914, Creative Park	site, activities support	David Tseng	03-5712121 #58468	cdtseng@arch.nctu.edu.tw

SPONSORSHIP MANUAL

		co-sponsor	Promotion + all PR event	Logo in poaphlet	video demo on site	Logo in team suit	Logo in PR publications	Invitation to event
20 million +	SDE partner	o	o	o	o	o	o	o
10 million ~ 20 million	Platinum		o	o	o	o	o	o
5 million ~ 10 million	Gold			o	o	o	o	o
1 million ~ 5 million	Silver				o	o	o	o
500 K ~1 million	Bronze					o	o	o

Presentation used to raise sponsorships

5.7.6 Budget Plan

The financial structure of NCTUUNICODE has been divided into 3 sources: subsidies from SDE Europe (€100,000), monetary and material donation from private sector and NGOs, government research funds and local government spatial and cultural authorities.

In terms of monetary and material donation from private sector and NGOs, UNICODE team have fortunately secured €500K from Dr. Samuel Yin, President of Ruentax Group(http://www.ruentex.com.tw/). UNICODE team enjoys the sponsorship from Delta group (http://www.deltaww.com/) for Photovoltaic panels and energy system, and Delta Foundation for education, Public relations and outreach programme. Ruentax and Delta are the equal partners of Orchid House Projects. Significant sponsors include wall and painting sponsor IT & communication sponsor ASUS (www.asus.com/) Bayer Taiwan (www.bayer.com.tw/), Logistic sponsor Evergreen Group and Eva Air (www.evergreen-group.com/), Cultural and Media sponsor Huashan 1914 Creative Park (www.huashan1914.com/) ,domestic appliance sponsor HCG (www.hcg.com.tw). More sponsorship is listed in the Orchid House Posters.

The post competition of Orchid House will have larger impacts on urban policies and regeneration. Local spatial and cultural authorities are closed working with NCTU CODE who will study the way of relaxing regulation on rooftop construction, and demonstrate its contribution to green life and sustainable urban governance. National Science Council is the highest research institute in Taiwan who is the target for UNICODE to communicate for wider application and introduction of solar technology into building design and construction.

The cost of Communication Plan is €37000 exVAT in which architectural model(€3000), video(€2000), web(€2000),communication document(€5000), exhibition(€25000) . The Budget for Communication Plan is largely contributed by sponsor Huashan 1914 Creative Park for space provision for Winter Camp, ASUS for web and computer assistance for Web networking and promotion.

COMMUNICATION BUDGET

Item	Type of Participation	Location	Number	Unit		Budget		Budget
					Subtotal	VAT	Total	
				EURO		EURO		TWD
ACADEMIC CONFERENCES								
Presentation of proposal	Formal Presentation	Taipei	10	0	0	0	0	0
Forum_academic and enterprise	Forum	Taipei	1	1,475	1,475	74	1,549	61,950
Taipei URS	Lecture and Forum	Taipei	3	75	225	11	236	9,450
NCTU Seminar	Lecture and Forum	Hsinchu	11	75	825	41	866	34,650
YA Talk	Lecture	Hsinchu	8	75	600	30	630	25,200
ACTIONS & EXHIBITIONS								
Recurit of Seedlings	Forum and Recruitment	Taipei	5	0	0	0	0	0
Orchid House Winter Camp	Workshop	Taipei	1	10,000	10,000	500	10,500	420,000
Orchid House Winter Camp Fair	Exhibition	Taipei	1	0	0	0	0	0
Orchid House Pre-Assembly Display	Orchid House Prototype Exhibition	Hsinchu	1	1,000	1,000	50	1,050	42,000
Orchid House 2014	Orchid House Prototype Exhibition and on-site display	Taipei	1	14,000	14,000	700	14,700	588,000
PRESS CONFERENCE								
Orchid House Official Press Conference 1	Press Conference	Taipei	1	0	0	0	0	0
Orchid House Official Press Conference 2	Press Conference	Hsinchu	1	0	0	0	0	0
Orchid House Award	Press Conference	Taipei	1	500	500	25	525	21,000
Orchid House Shipping Ceremony	Press Conference	Taipei	1	0	0	0	0	0
Orchid House Taipei	Press Conference	Taipei	1	0	0	0	0	0
Orchid House Portfolio Publication	Press Conference	Taipei	1	500	500	25	525	21,000
Orchid House 2014	TV interview	Taipei	1	0	0	0	0	0
COMMUNICATION MATERIAL								
Perspective - Orchid House	Video Recordings	Taipei, Hsinchu	1	2,000	2,000	100	2,100	84,000
Documentation: printing poster, newletters, T-shirts, stickers, brochures,	Documentation		1	5,000	5,000	250	5,250	210,000
Prototype models material,	Model		1	3,000	3,000	150	3,150	126,000
								Grand Total
				37,700	39,125	1,956	41,081	1,643,250

5.7.7 Winter Camp

NCTU Graduation Institute of Architecture and the cross-boundary team, NCTU/ UNICODE isone of the 20 university teams which are selected by Solar Decathlon Europe 2014 organization. We will participate in the competition in Versaille, France on June to July 2014.

The first Solar Decathlon was held in 2002; the competition has since occurred biennially in 2005, 2007, 2009, 2011 and 2013. The winner of the competition is the team that best blends affordability, consumer appeal, and design excellence with optimal energy production and maximum efficiency.
website (http://www.solardecathlon.gov/about.html)

NCTU/ UNICODE wants to spark students about the sustainability issue and create an opportunity for them by holding the winter camp. We hope that all the students can provide their unique idea and concern about the environment as well as encourage them to discuss the ideas with others.

NCTU Orchid House Winter Camp

- Host: NCTU / UNICODE
- Site: Delta Foundation Building
- Time: 2014/02/07-2014/02/09
- Audience: High schoolers
- Leader: NCTU/Unicode students and faculty
- e-mail: sde@arch.nctu.edu.tw

- Mission:

To Publicize - the information of SDE through public events
To Inspire - the younger generation
To Interact - exchange and dialogue among public
To Generate – extended interest and support

We are planning to invite high school students who express interests in sustainable practices as well as high school science teachers to an highly interactive camp at NCTU campus. We wish to ignite their curiosities and aspiration for a better future. The camp will be a high-energy, intensive task-based campaign-Members will be introduced to the basic of environmental and sustainable issues and an orientation of the OrchidHouse design will be offered.

Members will then be prompted to participate in a charrette, basically a reduced-version of solar decathlon competition. The competition focus on the process more than its result, aiming at using their imagination and innovative ideas. The workshop activities will also be deisgned to promote teamwork and collaborations with each others. In addition, two to three lectures will be provided to generate higher interest in continue the pursuit in this field when they plan for their college education.

At the end of the winter camp, it will be the apex of the entire activity – a final presentation of their ideas! Various types of presentation methods will be encouraged, whether drawing, collage, model, slides, animations, or any type of performing arts.


ORCHID
HOUSE
Solar
Decathlon
Europe
GREEN CORE
BLUE SKY
POWER HOUSE
2014
太陽種子冬令營
台達陽光能源教育基地 台北市內湖區陽光街256號
2014/02/07 - 2014/02/09
www.facebook.com/TWSDE | sde.tw
主辦單位
承辦單位
DELTA 台達
台達電子文教基金會
國立交通大學
National Chiao Tung University
NCTU Architecture
國立交通大學建築研究所
NCTUNICODE

15

2014

大陽種子冬令營-冬令營時程

DAY1

2/7	
09:00-09:15	開幕式/主持人：龔書章老師
09:15-09:30	UNICODE團隊介紹：龔書章老師
09:30-09:45	SDE發表：SDE競賽簡介
09:45-10:00	
10:00-10:15	SDE發表：永續建築設計
10:15-10:30	
10:30-10:45	SDE發表：智慧生活
10:45-11:00	
11:00-11:15	Q & A
11:15-11:30	
11:30-12:00	歡迎PARTY
12:00-12:30	
12:30-12:45	冬令營精神及參與人員介紹：龔書章老師
12:45-13:00	冬令營實作發題：屋頂上的100種生活方式
13:00-13:30	屋頂上的100種生活方式 屋頂生活型態CASE STUDY
13:30-14:00	
14:00-14:30	
14:30-15:00	
15:00-15:30	小型分享會
15:30-16:00	
16:00-16:15	參觀「關於城市的一堂通識課」展覽
16:15-16:30	
16:30-17:00	屋頂的100種生活： 16:30-17:30 基地配置討論/屋頂認養 17:30-18:30 屋頂元件配置/想像
17:00-17:30	
17:30-18:00	
18:00-18:30	
18:30-19:00	晚餐
19:00-19:30	小電影播映會：鳥目台灣 對談：齊柏林導演/曾瓏瑤製片/張稚乾/龔書章
19:30-20:00	
20:00-20:30	

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2014

大陽種子冬令營-冬令營時程

DAY2

2/8	
09:00-09:15	簽到/歡迎早餐會
09:15-09:30	
09:30-09:45	氣候、都市、創新演講系列(一)
09:45-10:00	
10:00-10:15	Q & A
10:15-10:30	氣候、都市、創新演講系列(二)
10:30-10:45	
10:45-11:00	Q & A
11:00-11:15	氣候、都市、創新演講系列(三)
11:15-11:30	
11:30-11:45	Q & A
11:45-12:00	氣候、都市、創新演講系列(四)
12:00-12:15	
12:15-12:30	Q & A
12:30-13:00	午餐
13:00-14:00	屋頂上的100種生活：配置討論 / 模型製作
14:00-14:30	
14:30-14:45	休息
14:45-15:30	屋頂上的100種生活：模型製作 / 設計收尾
15:30-16:00	
16:00-16:15	
16:15-16:30	
16:30-17:00	
17:00-17:30	小型發表會
17:30-18:00	
18:00-18:30	晚餐
18:30-19:00	
19:00-19:30	屋頂上的100種生活：隔日簡報製作準備
19:30-20:00	
20:00-20:30	

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2014

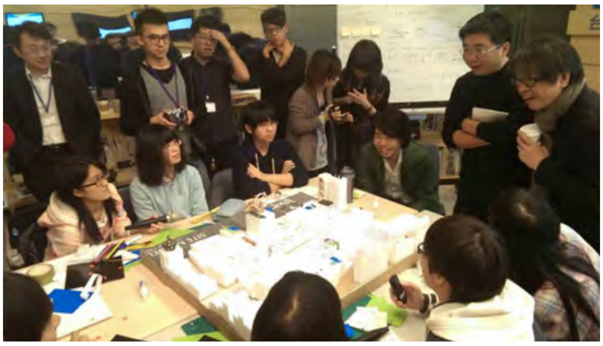
大陽種子冬令營-冬令營時程

DAY3

2/9	
09:00-09:15	簽到/歡迎早餐會
09:15-09:30	
09:30-09:45	發表會前排演： 工作營評圖準備
09:45-10:00	
10:00-10:15	
10:15-10:30	
10:30-10:45	
10:45-11:00	
11:00-11:15	
11:15-11:30	
11:30-12:00	
12:00-12:30	午餐
12:30-12:45	中正高中 發表 / 12:45-13:00評審講評
12:45-13:00	
13:00-13:15	師大附中 發表 / 13:15-13:30評審講評
13:15-13:30	
13:30-13:45	新竹高中 發表 / 13:45-14:00評審講評
13:45-14:00	
14:00-14:15	中山女中 發表 / 14:15-14:30評審講評
14:15-14:30	
14:30-14:45	聯隊 發表 / 14:45-15:00評審講評
14:45-15:00	
15:00-15:10	交大蘭花屋計劃團隊致詞
15:10-15:20	台達電子文教基金會致詞
15:20-15:30	頒獎典禮 / 合照
15:30-15:45	記者發問
15:45-16:00	邀請記者看「關於一堂城市的通識課」展覽
16:00-16:15	總結
16:15-16:45	參加學員心得分享
16:45-17:00	閉幕致詞
17:00-17:15	拍照

SITE 1 - Twatutia

The mention of “Twatutia” inevitably conjures up the imagery of New-Year Vendors Avenue, Dihua Street, where multitudes of wholesale merchants and retailers hawk Taiwanese products, produce and bulk commodities. From a bird’s-eye view, one can clearly see the long row houses and the small courtyards that separate the business buildings from the residential ones, which are characteristics distinctive of this neighborhood. Under the influence of urban regeneration, many of the historic townhouses are gradually being converted into modernity. As a result, we consider both the present-day architectural characteristics of Twatutia with the needs of residents and tourists in the design of our model.



SITE 2 - Minsheng neighborhood

The Minsheng neighborhood is the first example of an American-style neighborhood in Taiwan, with all the necessary community facilities, such as post offices, banks, parking lots, locations for leisure activities, and exercise facilities. There are also residential building apartments ranging from three to five stories high that are shaded by trees. The neighborhood is linked by green bands formed by the two parks, resulting in an atmosphere separate from that of the adjacent main roads such as Minsheng East Road. Pedestrians can feel the calm atmosphere at every corner of this neighborhood.

SITE 3 - Ximending

After surveying the actual location, we offer our own perspective of Ximending: the youth culture is prevalent, there are many abandoned houses, rooftops are of uneven heights, there are quiet spaces for relaxation, etc. With a starting point of “create an aerial space that reflects and contrasts to the Ximending on the ground level,” we hope to give new life to the high-lofted “aerial Ximending.” We have delineated the region into four regions: “Extreme Challenges,” “Art Village,” “Mountain City,” and “Eye of the Storm.”

SITE 4 - Renai Traffic Circle Area

Bustling crowds, busy streets, time is of the essence here. This area is the epitome of Taipei City, with skyscrapers encircling a cluster of buildings 4-5 stories high. The people who live in these buildings, office workers and university students, are also typical of those who live in Taipei City, leading busy lives. And thus our concept was born – the best way to escape from Taipei City.

Sunlight, water, and wind. We hope that our method of "leaving" the city will bring people of the city closer to these natural elements and help them find a healthier and more intimate lifestyle.

SITE 5 - NanJiChang

The regeneration of old houses has roots in the rooftop-NanJiChang
The future of the South Airport apartment complex begins with the rooftop. A greener space; the linking of a community; unobstructed movement. The regeneration of old houses has roots in the rooftop. The future of the South Airport apartment complex begins with the rooftop. A greener space; the linking of a community; unobstructed movement. The regeneration of old houses has roots in the rooftop. Under the advice of the teacher, I was inspired to shape the chaotic ordering of sheet-metal roofs into a structured and aesthetically pleasing wave pattern. After analyzing, we found within the chaotic design of the South Airport complex a common and unifying characteristic.


ORCHID HOUSE
Orchid House Winter Camp 2014
Sponsors Display
Solar Decathlon Europe
東和鋼鐵
TUNG HO STEEL
-75% CO_2
uis
United Integrated Services
漢唐集成
SGS
Bayer MaterialScience
Science For A Better Life
ASUS
IN SEARCH OF INCREDIBLE
DELTA 台達
台達電子文教基金會

Solar Ambassador

From the winter camp, we will select an elite student to compete for the Solar Ambassador position. The winner is Tim Chen, a student from Hsin-Chu High School. He is a 10th grader, who is extremely enthusiastic during the workshop, and speak fluent English. Tim will participate the Solar Decathlon Europe 2014, with scholarship provided by Delta Electronics. During the competition, solar ambassador will visit and record for all solar houses, and share his experience with other students after coming back to Taiwan.

NCTU Newspaper
April 2013

本期內容

交大人文通訊

APRIL 2013 第六期

發行人 | 人文社會學院 郭良文 院長
客家文化學院 張維安 院長
通識教育委員會 楊永良 主委
主編 | 人文社會學院 孫于智 副院長
編輯 | 劉駿逸．吳孟芯

交通大學建築研究所入圍 Solar Decathlon Europe 國際太陽能建築決賽，2014 年將赴凡爾賽為校爭光

人社院訊

人社三館新建工程重新招標

人社三館新建工程工程(資格標)已於 102 年 3 月 28 日第一次開標，投標廠商僅有一家，因未達三家所以流標。學校已於 3 月 28 日重新上網公告，工程(資格標)預計於 102 年 4 月 16 日第二次開標。

院長遴選委員會籌組事項

本院郭良文院長任期將於 102 年 12 月 31 日屆滿，為籌組院長遴選委員會，已於 3 月 21 日推選八名院內委員，分別為傳播所李秀珠教授、教育所周倩教授、英教所葉修文教授、外文系劉辰生教授、社文所劉紀蕙教授、音樂所李子聲副教授、應藝所陳一平副教授及建築所龔書章副教授。另 3 月 29 日校長已簽示意見，由林副校長擔任主任委員，並預訂聘請本校蔡文祥教授、張維安教授及中研院語言所曾志朗院士、民族所黃樹民院士擔任院外委員。後續本院將儘快連絡委員，以召開院長遴選委員會，進行院長遴選作業。

1

【建築所】恭喜交大建築所及跨領域團隊入選 Solar Decathlon Europe 決賽

交大建築所及校內跨領域團隊 NCTU Team Unicode 於 Solar Decathlon Europe 2014 與世界各大學角逐競賽，本賽事共有 44 個隊伍提出參賽計畫書，最後篩選出 20 個隊伍入選，包含瑞士、西班牙、日本、法國等參賽國家及學校，交大的建築所跨領域團隊也在其中取得了參賽權。

Solar Decathlon 首次於 2002 年自美國首府華盛頓特區的國家廣場 (National Mall) 前舉辦。“十項全[能]” Solar Decathlon 由美國能源總署推動，研發新世紀永續社會之智慧生活環境與居住實驗方案，是參賽大學展現其前瞻研發能力並落實與社會接軌的指標性競賽型博覽會，目標為設計並建造出高度能源效率的全太陽能住屋，並考量實際應用。

本屆 Solar Decathlon Europe 決賽將於 2014 年 6/7 月間假法國巴黎羅浮宮前舉行，目前已由校長帶領建築所曾成德教授向尹衍樑董事長募款兩千萬元以補助團隊為校爭光。

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Taiwan Today
8 Nov. 2013

Maisons solaires : une équipe taiwanaise sur la ligne de départ du Solar Decathlon Europe

- Publication Date：11/08/2013

Une équipe taiwanaise de l’Université nationale Chiao Tung (NTCU) participera du 28 juin au 15 juillet 2014 à la compétition internationale Solar Decathlon Europe 2014 qui se tiendra à Versailles, en France. Ce prestigieux concours universitaire, placé sous l’égide de l’Etat français, mettra en compétition 20 équipes d’étudiants venus du monde entier, autour d’un défi : concevoir et construire une maison solaire autonome en énergie.

Annoncée l’an dernier, la sélection comprend des équipes originaires de 16 pays dont la France, les Pays-Bas, l’Inde, l’Allemagne, l’Espagne, le Japon et le Mexique. L’échéance arrive à grands pas et une délégation de la NTCU, menée par le professeur Zeng Cheng-de [曾成德], a participé cette semaine à un atelier de présentation des maquettes des projets à la Cité de l'architecture, à Paris, en présence de Cécile Duflot, la ministre française de l’Egalité des territoires et du Logement.

Déjà, à la fin du mois de juillet, les 20 équipes avaient pu choisir la parcelle où leur projet sera assemblé, au sein du domaine du Château de Versailles. Là, il sera exposé au grand public, aux professionnels, à la presse, et bien sûr aux membres d’un jury international.

Le Solar Decathlon a été créé en 2002 par le Département d’Etat de l’énergie des Etats-Unis. « Cette compétition est non seulement un facteur d’émulation scientifique et d’innovation, mais aussi un outil formidable de sensibilisation du grand public aux enjeux de l’habitat de demain », notent les organisateurs. Cette prestigieuse compétition a lieu tous les deux ans aux États-Unis les années impaires, et a désormais aussi lieu en Europe les années paires.

Delta Foundation News
23 Dec. 2013


2014年2月20日 低碳生活部落格: 當頂樓加蓋 成綠建築符碼

低碳生活部落格

2013年12月23日 星期一

當頂樓加蓋 成綠建築符碼

這座企圖改寫台灣頂樓加蓋史的綠建築小屋，除了屋頂採用太陽能發電、整棟建築可協助吸納極端化的降雨外，也透過植物來調節室內的溫度與空氣品質。

文／張楊乾(台達電子文教基金會副執行長，本文原刊於12月22日聯合報元氣周報)

http://lowestc.blogspot.tw/2013/12/blog-post_23.html 1/3

udn e-news
25 Jan. 2014


2014年2月20日 udn閱讀藝文 - 建築

聯合新聞網 閱讀藝文

udn / 閱讀藝文 / 文化藝術 / 建築 / 友善列印

天際一抹綠 頂樓加蓋變能源屋

【聯合報╱記者陳宛茜／台北報導】

布滿違章建築的屋頂，是台灣令人搖頭的城市風景；房價太高造成年輕人無法進駐市中心，則是影響台灣城市創造力的關鍵問題。建築師龔書章帶領交大建築所學生設計「交大能源屋」，計畫以綠建築取代屋頂違章建築，並成為青年住宅。

交大建築所學生設計「能源屋」，計畫以其取代屋頂上的違章建築，並成為青年住宅。 圖／交大建築所提供非報系

龔書章曾獲遠東建築獎，在建築界十多年後轉戰學界，出任交大建築研究所所長。他與交大人文社會學院院長曾成德以多年實務經驗，協助學生發想設計「交大能源屋」，企圖一次解決台灣都市景觀與居住問題。

紐約、柏林、東京等大城近年掀起「屋頂運動」，改造高樓屋頂成為公園或綠色能源中心，打造「綠色天際線」。這波屋頂運動促使龔書章思索「台灣新的屋頂風景是什麼？」

龔書章指出，台灣的頂樓加蓋歷史悠久，這些違章建築多以低廉租金租給學生或社會新鮮人，「可不可能轉型為青年住宅？」許多老房子拆除的原因是缺少節能設施，「可不可以在屋頂加蓋能源屋補足？」在交大師生的靈感激盪之下，誕生「交大能源屋」。

「交大能源屋」基地設定為城市中四到七層的老公寓屋頂，屋內空間一半做為綠能機電空間，讓底下的老房子不必拆除，便能蛻變成「綠色住宅」。其設計核心類似溫室，透過植物來調節室內溫度與空氣品質，減緩熱島效應。

能源屋另一半做青年住宅，只租不賣。龔書章說，年輕人以便宜房租進駐，但須負管理責任，使其成為居民休閒交流、種花種菜的公共空間。

「交大能源屋」構想大膽，卻非紙上談兵。該計畫已獲台達電等企業贊助經費，七月將先到巴黎凡爾賽宮廣場展出成品，參加「歐洲盃永續能源十項全能建築競賽決賽」，與十九所全球頂尖大學團隊所設計的綠建築競賽。

龔書章說，「交大能源屋」返國後，他們將設定「三年計畫」。先與北市府合作，找到一兩處老城區的屋頂改造，成為二○一六年台北做為「世界設計之都」的創意展示，再推展至全台。他估算，全台符合能源屋基地條件的老房子，若皆能在屋頂加蓋一間能源屋，將使社會

http://mag.udn.com/mag/reading/printpage.jsp?f_ART_ID=496473 1/2

CDNews
7 Feb. 2014


2014年2月20日 中央日報網路報-教育藝文

中央日報 網路報 www.CDNEWS.com.tw

2014 Smart City Summit & Expo 智慧城市展 2/19～22 南港展覽館

交大綠能蘭花屋 前進凡爾賽宮

【中央網路報】

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http://www.cdnews.com.tw/cdnews_site/docDetail.jsp?coluid=121&docid=102634817 1/2

China Times
7 Feb. 2014


2014年2月20日 交大師生 將在凡爾賽宮前蓋蘭花屋 - 中時電子報

預約好禮週週抽

交大師生 將在凡爾賽宮前蓋蘭花屋

中時電子報 2014年02月07日 12:29

記者會前，團隊成員曾聖凱（左）向台達電董事長鄭崇華（右）介紹交大蘭花屋的建造理念。（劉宗龍攝）

台灣搜房

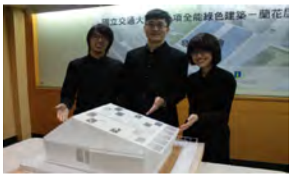
http://www.chinatimes.com/realtimenews/20140207003021-260412 1/3

Awakening News Networks
7 Feb. 2014 / 9 Feb. 2014

台 灣 醒 報

交大綠能蘭花屋 將蓋在凡爾賽宮

邱惠恩　2014/02/07 15:38　點閱 197 次



由30位交大學生組成的「UNICODE」團隊，以「台灣蘭花」為設計主軸，打造出一棟漂亮、工法簡單、材料在地化，又能代替鐵皮屋功能的〈綠能蘭花屋〉（photo by 交通大學、邱惠恩/台灣醒報）

【台灣醒報記者邱惠恩台北報導】台灣常見的鐵皮屋將走進歷史了！由30位交大學生組成的「UNICODE」團隊，以「台灣蘭花」為設計主軸，打造出一棟漂亮、工法簡單、材料在地化，又能代替鐵皮屋功能的「綠能蘭花屋」，成為東南亞華人圈第一個拿到「十項全能綠色建築競賽」入圍門票的國家，「綠能蘭花屋」將於今年6月蓋在法國凡爾賽宮花園。

為了隔熱與防漏水，台灣幾乎隨處可見以鐵皮屋加蓋的現象，這也成為台灣特有的都市屋頂奇觀。但造價便宜的鐵皮屋卻也帶來冬冷夏熱、不符環保的問題。交通大學人文社會學院院長曾成德，率領30位交大學組成的「UNICODE」團隊，以「台灣蘭花」為設計發想，打造出兼顧美學及功能性的「綠能蘭花屋」。

「我們想解決鐵皮屋這個必要之惡的屋頂亂象，並帶來一種『新都市天際線』。」「綠能蘭花屋」可代替蓋在舊建築屋頂上的鐵皮屋，利用綠色植物與蘭花達到空間的美感，並兼具調節室內溫度、進行室內外換氣，再利用回收水資源來澆灌植物。

為了進一步達到「綠」建築的需求，利用回收鋼鐵、環保木材、裝水的寶特瓶作為材料的蓄熱牆等方式，達到減少建築碳足跡，「UNICODE」團隊表示，最熱的西曬面，室內外溫差可達2到3度溫度。太陽能板也可以「租用」或「電價回饋」等方式降低成本。

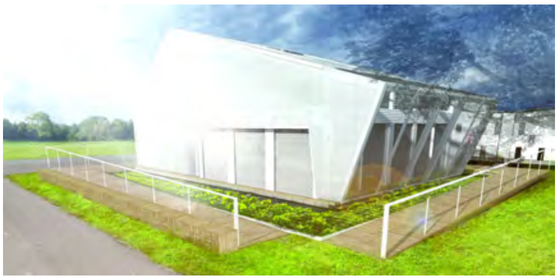
除了綠建築考量外，設計團隊指出，希望將「綠能蘭花屋」，進一步推廣成「社會住宅」、「老宅再生」，

China Times
7 Feb. 2014

台 灣 醒 報
(http://anntw.com/)

推銷綠建築 蘭花屋將赴法參賽

廖政貿 (/author/liao)　2014/02/09 19:16　點閱 784 次



交通大學的能源屋計畫即將到法國參與世界綠色建築大賽，新竹高中學生陳彥廷將陪同觀摩。（photo by廖政貿/台灣醒報）

【台灣醒報記者廖政貿台北報導】交通大學即將到法國參與世界綠色建築大賽！台達電子文教基金會與交通大學合辦的「太陽種子冬令營」成果發表，新竹高中學生陳彥廷獲選與交大團隊一同至法國參與競賽。交大能源屋計畫成員曾聖凱表示，本次競賽機會十分難得，他們會透過綠色建築把屬於台灣的意象帶出去。

台達電子文教基金會與交通大學合辦的「太陽種子冬令營」9日舉辦成果發表，有來自全國6所高中共計35名高中生參與他們透過分組競賽，對台灣的城市建築與環境問題提出意見，並實際設計出相關的改革方案。這次活動也將選出一名學生，和交大能源屋團隊一同至法國凡爾賽宮參與「2014十

udn e-news
9 Feb. 2014 / 10 Feb. 2014

聯合新聞網 udn.com

太陽種子冬令營 推廣環境意識與綠能教育

【聯合報系攝影中心／記者林伯東／即時報導】　2014.02.09 03:51 pm

台達電子文教基金會與交通大學合辦「太陽種子冬令營」，推廣環境意識與綠能教育，吸引來自建中、北一女、師大附中、中山女中、中正高中、新竹高中等35位優秀高中生參與。圖為中山女中學生與她們製作的模型。

記者林伯東／攝影　分享

【2014/02/09 聯合報系攝影中心】 @ http://udn.com/

TOP

聯合新聞網 校園博覽會

打造空中西門町 竹中生奪冠

【聯合報／記者陳皓嫣／台北報導】

如果西門町有空中花園，會是什麼樣子？一群過去從未去過西門町的新竹中學學生，打造出充滿創意的空中西門町，驚豔評審，奪得都市屋頂改造競賽冠軍。團隊成員之一陳彥廷更獲選為能源教育親善大使，將赴法觀摩歐洲「十項全能綠色建築競賽」。

台達電子文教基金會與交大合辦「太陽種子冬令營」，新竹高中獲選為最佳團隊，成員陳彥廷（右一）更獲選為「能源教育青年大使」，將赴法觀摩「十項全能綠色建築競賽」。 記者林伯東／攝影

台達電文教基金會和交通大學日前合辦「太陽種子冬令營」，讓高中生以實驗、和建築專家討論，以屋頂上的100種生活為題，打造台灣節能屋頂。

竹中團隊實地觀察西門町，發現該區一樓都是商店，但二樓及以上的樓層多處於廢棄狀態，未加利用。於是創意發想，要用天橋將各樓的屋頂串連起來，設環狀空中步道，民眾可以散步、騎腳踏車，步道上還有發電裝置，人車踩踏時就能發電。

街區東北角規畫為青少年活動專區，可在屋頂上玩極限運動、練街舞，還有大片可追趕跑跳的草地和露天電影院。

西北角的老舊大樓被打通，作為文創中心，藝術家、刺青師們擁有自己的工作室，屋頂除裝有太陽能板供電，更有空中農園，可種植作物，樓頂則是種植景觀植物的梯田。

陳彥廷是設計團隊的靈魂人物，他還因外語、表達能力佳，想法清晰且環境意識突出，被選為能源教育親善大使，去凡爾賽宮觀摩國際比賽。

陳彥廷說，他很喜歡具實用性的設計，對生活事物也常有許多設計想法，「像竹中的制服外套型垮易髒，就可重新設計。」

TOP

The Liberty Times
8 Feb. 2014

2014年2月20日

自由時報 電子報
The Liberty Times

交大綠能蘭花屋 前進凡爾賽宮 (2014-2-8)

〔記者陳怡靜／台北報導〕台灣綠能屋前進法國凡爾賽宮！交通大學建築所師生組成UNICODE團隊，入圍「Solar Decathlon Europe，ＳＤＥ（十項全能綠建築競賽）」，六月將在法國凡爾賽宮花園中打造「蘭花屋」，交大也是華人圈大學唯一入圍者。


交大師生6月底將於法國凡爾賽宮打造概念屋「蘭花屋」。（交大提供）

華人圈唯一入圍大學

首屆ＳＤＥ於二○○二年在美國華盛頓特區國家廣場舉辦以來，全球已有一百五十二個大學參與這項永續綠能住宅原型研發賽，包括麻省理工學院、史丹佛大學等頂尖大學。今年有十九國、二十個團隊入圍，將於六月底挑戰十天搭建綠能屋。

交大UNICODE團隊計畫打造地坪五十坪、兩層樓、可快速組裝的綠能「蘭花屋」。以太陽能板做為屋頂，西曬牆面採用含水寶特瓶組成的「蓄熱牆」，可有效調節屋內外的溫度，做到「冬暖夏涼」或「日涼夜暖」。

盼解決頂樓加蓋問題

交大建築所學生吳雅婷說，台灣許多建築物頂樓有高溫與漏水等問題，加蓋情形普遍，但實在不美觀，團隊希望以蘭花屋解決頂樓加蓋問題。

蘭花屋設計概念來自蘭花生存環境的溫濕度都適合人居住，並根據台灣在地環境設計，採用輕鋼架與太陽能整合系統，以可組式結構板牆取代隔間，讓房屋可快速組裝，並如蘭花依附在其他植物般、依附在原本建築物上。

蘭花屋擁有好比心臟的「綠核（Green Core）」，團隊以蘭花與其他植物栽植成直立於室內的「綠核」，可以調節室內溫度並提升空氣品質。計畫經費約五千萬到六千萬元，潤泰集團總裁尹衍樑與台達電董事長鄭崇華等人將贊助。

1/1

NextMedia
7 Feb. 2014

2014年2月20日 交大「猴塞雷」 出國比蓋屋1打17國 | 即時新聞 | 20140207 | 蘋果日報

即時新聞

最新 推薦 熱門 瘋啥 影片 總覽 社會
娛樂 時尚 生活 財經 國際 體育 政治

生活 字級： 分享：

20140220 11:19 全國唯一蚵殼島 登島擬收費(0)
20140220 11:14 招陸生再鬆綁 開放國立大學學士班(0)
20140220 11:08 2度惡意解僱勞工？！金鐘獎主持人今控中廣(173)
20140220 11:03 發票查詢門檻高 消費明細成「隱藏版」！(482)
20140220 11:02 退費龜速 別報名學誠電腦、崴爾斯美語！(309)
20140220 10:52 【台灣最美】噓～不想讓人知道的6個海洋遺跡(852)
20140220 10:42 給無名氏按讚 助弱勢捐百萬(741)
20140220 10:30 【科學月刊】三十年計畫的雄心－志業與豪情(434)
20140220 10:24 冷爆了！獼猴抱抱取暖 (725)
20140220 10:23 有下背痛嗎？ 這樣做你就不會痛(1408)

交大「猴塞雷」 出國比蓋屋1打17國

2014年02月07日12:24 讚 285 g+1 0

交通大學建築所師生組成UNICODE團隊，以「蘭花屋計畫」參賽，領先全台首度入選參加具有國際級國家研發實力的建築奧運賽─「十項全能綠建築競賽」，今年6月底在法國凡爾賽宮花園裡舉行，將以10天時間蓋出一棟未來概念屋，和來自全球的20個學生團隊爭奪桂冠。

交大表示，「十項全能綠建築競賽」由美國能源總署推動，2002年首次在美國舉行，該比賽已成為世界第一流大學與研發團隊，展現其前瞻的研發能力並落實與社會接軌的指標性競賽型博覽會，交大在全球800餘名學生中脫穎而出，將有來自17個國家、20個團隊參加6月底在法國巴黎凡爾賽宮花園裡舉行的決賽。

團隊成員之一的吳雅婷說，蘭花屋造價超過5000萬元，還好有企業支持，才得以實現，該建築以太陽能板作為屋頂，最大特色是屋內以蘭花和其他植物栽植而成的「綠核」，也就是蘭花屋的心臟，可以調節調節室內溫度、提昇室內空氣品質，蘭花屋也設計自動澆灌系統，可蒐集雨水澆灌植物，解決台灣夏季降雨密集的排水問題。（許敏溶／台北報導）

【更多生活新聞訊息，請加入《蘋果生活八爪魚》粉絲團】

http://www.appledaily.com.tw/realtimenews/article/life/20140207/340034/ 1/3

Taipei Times
8 Feb. 2014

2014年2月20日 Taipei Times

TAIPEI TIMES

‘Orchid house’ vies for award

WINNING DESIGN?: The prototype includes rooftop solar panels, a ‘Green Core,’ which is composed of orchids regulating temperature, and an automatic watering system

By Lee I-chia / Staff reporter
Sat, Feb 08, 2014 - Page 3

A squad from National Chiao Tung University (NCTU) has become the first Taiwanese team to be selected for the Solar Decathlon Europe (SDE) competition with its Solar Decathlon-Orchid House — an ecological prototype house that incorporates progressive greenhouse technology in the cultivation of Taiwanese orchids.

The Solar Decathlon is an international competition, first held by the US Department of Energy in 2002, which challenges collegiate teams to design, build and operate solar-powered houses that are cost-effective, energy-efficient and attractive.

After a memorandum of understanding was signed between the US and Spain, the SDE was established in 2007.

Judges will be looking for the winning team to best blend affordability, consumer appeal and design excellence with optimal energy production and maximum efficiency over the course of the competition’s 10 contests.

At a press conference held by the NCTU in Taipei yesterday, the school said its UNICODE Lab, consisting of professors and students in architecture, engineering, science, design, management and several other disciplines, was selected in December last year out of a pool of many teams from around the world to compete at the SDE this summer.

The school said the team plans to set off to Versailles, France, where the competition is held this year, in late June to compete among 20 teams from 17 countries.

The team’s task is to rebuild the solar house within 10 days.

Team member Wu Ya-ting (吳雅婷), a student at NCTU’s Graduate Institute of Architecture, said because the living space in densely populated metropolitan areas is often limited, rooftop additions are a popular scene in Taiwan, and the team hopes to redefine Taiwan’s city skyline with its new design.

Wu said the orchid is an important Taiwanese export crop, for which a high-tech cultivation method is used, which made it appropriate to be feature as the theme for the team’s Solar Decathlon-Orchid House.

Wu added that the house uses rooftop solar panels, but its best feature is its “Green Core” —

http://www.taipeitimes.com/News/taiwan/print/2014/02/08/2003583028 1/2

ChinTimes
8 Feb. 2014

參加綠建築競賽

交大蘭花屋 進軍凡爾賽宮

建屋成本12年回收

東南亞華人大學首例

綠能環保

National Chiao-Tung University will build an ecological prototype “Orchid house” at Palace of Versailles for the Solar Decathlon Europe competition.

話題 A12 中國時報

中華民國103年2月8日／星期六

6. DINNER PARTY MENU

1.0 Introduction

At the Orchid House, we would like to bring our guests an unforgettable and spectacular dinner, Taiwanese style. Taiwan is a country of food, we hope our guests can enjoy not only food, but the special drinks which make Taiwanese cuisine known in the world.

Gaoliang

Mullet Roe

Chinese Ckicken Salad

To welcome our guests, we begin with a toast to a more sustainable future, with Taiwan made special Gaoliang Liquor, which is often drunk during celebration. The cook then takes the liquor and start making the first appetizer, which is the Mullet Roe. It is best soaked in Gaoliang for a minute then put in the pan to cook with slow heat, until it is golden brown. The delicate texture of Mullet Roe is tangy and soft. 2nd course would be the Chinese Chicken Salad, which is an Asian flavored dish, specially prepared with the freshest ingredients.

Bubble Tea

Shiao-Long-Boa

Our 3rd course is the famous Shiao-Long-Bao (stuffed steam buns), which is delicious soup dumplings served in bamboo steamer. The buns are small, but it sure will leave a great impression to our guests.

Now it’s time to bring out the most popular bubble tea in the world, with a little bit milk added for a nice, smooth taste.

Dongbo Pork

Almond Tofu

Our main dish of the night would be Dongbo Pork (Braised Pork), served with steamed bread to balance the savory flavor. The dish is named after the Song Dynasty poet, artist and calligrapher Su Dongpo, to celebrate the health and prosperity.

Finally, we bring the sweet Almond Tofu to satisfy the taste pallet of everyone. It is often decorate with flower paddles, and this time, we will use the beautiful orchid paddle on the plate. It does not only tastes great, it is visually pleasing, too.

Taiwan High Mountain Tea

Pineapple Cake

To conclude our dinner party, we would like to invite our guests to the Tea terrace. In Taiwan, families and friends often enjoy tea and chitchat after dinner. Our guests will enjoy the Taiwanese high mountain tea and have a relaxing time. Taiwanese is also famous for our hospitalities, and we never let our guests go home empty handed. Thus, guests can go home with a box of pineapple cake to share with their friends.

2.0 Name of courses and drinks

Courses	*Drinks*	*Dessert*
Mullet Roe	Gaoliang	Almond Tofu
Chinese Ckicken Salad	Bubble Tea	Pineapple Cake
Shiao-Long-Boa (stuffed steam buns)	Taiwan High Mountain Tea	-

3.0 List of ingredients and quantities per course

Food Preparation

Enclosing an image of every course

This will be included in the next deliverables.

4.0 Cost evaluation of the menu

This will be included in the next deliverables.

5.0 Energy Consumption for cooking evaluation

This will be included in the next deliverables.

6.0 Nutrition data compared to guest needs

This will be included in the next deliverables.

7.0 Local content of ingredients

This will be included in the next deliverables.

ORCHID HOUSE

8. COST ESTIMATE AND PROJECT FINANCIAL SUMMARY

Business and Fund-Rasing Plan:

1. Description of overall project

NCTU / UNICODE, team of National Chiao Tung University, is taking Solar Decathlon Europe as the opportunity to develop a prototype house for co-existing with nature by focusing on the green house technology that has been developed for cultivating orchid in Taiwan combining with the research institute here in NCTU. The university's main campus is located at the center of the Hsinchu Science Park, Taiwan's national research center. The area is referred to as the Silicon Valley of Asia. More than 400 technology companies have been established in the park.

2. Project Budget

See the list below

3. Interaction with other departments

In terms of inter-university departmental collaborations, NCTU/NICODE tem is base in The Graduate School of Architecture and is in the process of collaborating with the following schools in various aspects related to SDE 2014 project:

NCTU President's Office
1. Administrative and overall support
2. Alumni relations and resource advice
3. School-wide and nation-wide media, communication, and press release

NCTU School of Engineering
1. General engineering solutions and prototyping
2. Database management and technology advice
3. Simulation and specifications

NCTU School of Management
1. Multidisciplinary coordination management
2. Risks management advice
3. Communication planning and strategy

NCTU School of Science
1. Research on various subjects related to horticulture, nursery, and industry
2. Database sourcing related to weather, environment, and other academies

4. Fund-Raising Plan

4.1 Goals and Objectives

4.1.1 To engage the leading industry leaders in each of the key areas of our design as strategic support

4.1.2 To engage the most relevant technology/capacity providers that are capable of extending our research into materialization and commercialization

4.1.3 To engage leaders of sustainability promoters for expanding the public and market awareness of our design

4.2 Strategy
4.2.1 To identify key merits and values in our design and the overall SDE-related activities – by consolidating the driving values inside and out of our design of the solar house project, we will then leverage these key merits for the entire fund-raising activities as our Core Values.
4.2.2 To establish database and contact information - which includes government agencies, private corporations, research-backing institutions, and special interest communities and groups.

4.2.3 To research and engage initial contact – based on internal research of target candidate's creditability, relevance, and likelihood of support, the team will engage initial contact and communication towards a short-list of candidates for in-depth communication and fund-raising activities.
4.2.4 To solicit government or special interest group's endorsement and reference in approaching potential candidates.

4.3 Target Candidates (categorized by sector)
4.3.1 Solar/PV Technology
4.3.2 General Building Construction
4.3.3 General Mechanical, Electric, Environmental Control Provider
4.3.4 Housing Builder
4.3.5 Orchid Horticulture Enabler
4.3.6 Urban Regeneration/Renewal Promoter
4.3.7 Logistics
4.3.8 Alumni Office and Development Office at NCTU
4.3.9 Media, PR Agencies and Advertiser

Cost Estimate:

Solar Decathlon Europe 2014 EN FRANCE		SDE 2014 COMPETITION EN FRANCE			
		Team's Abbreviations	UNI		
		School's Name	NCTU		
		Team's Name	UNICODE		
Nº	Name	Description	Budget		% Total
			ex VAT	VAT	on ex VAT
1	Direct Material				
	Photovoltaic Energy (Solar Panel) system	Solar Panel/ Electronic Convertor/ monitor port/ distribution panel/ Patented product by Delta	125,000 €	6,250 €	
	Domestic Appliance	2 sets: European and Taiwan Spacifications Washing Machine, Television, Refrigerator, , Projectors, Oven/ Grill, Air Ventilator, Microwave	30,000 €	1,500 €	
	Electronic Converter	110V/220V Converter AC/DC Converter	50,000 €	2,500 €	
	ASUS IT Solutions	Server/ Computers/ LED HD Monitor/ Padphone/ Nexus Pad/Laptop	27,000 €	1,350 €	
	Insulation Panel	VIP eco-foam	16,500 €	825 €	
	Aaluminum Window & Frame	YKK Window/Door Frame and Glass	20,000 €	1,000 €	
	Vacuum thermal material	BAYER Thermal Panel & Vacuum Tech	36,000 €	1,800 €	
	Auto-controlled Louvre	Fuh Shan electronic Louvre & Sensor	10,000 €	500 €	
	Steel Frame & Construction	TUNG HO STEEL House Frame	50,000 €	2,500 €	
	External Walls with Water Tank	Miniwiz Thermal Wall and Water Tank	20,000 €	1,000 €	
	Connection Units (Floor-Wall)	Construction Joints	7,500 €	375 €	
	Foundation Units	Independent Foundation Footing	10,000 €	500 €	
	Indoor Staircases & Railing	Steel Staircase & Railings	9,000 €	450 €	
	Glass/ Insulation material	Spring Pool Glass & Eco-Foam Material Applied on Walls/ Floor/ Ceiling	11,000 €	550 €	
	Wood panel for interior design	4 ft*6 ft(120cm*240cm, T=18mm) *360 sheets 4 ft*6 ft(120cm*240cm, T=12mm) *170 sheets 4 ft*6 ft(120cm*240cm, T=6.5mm) *80 sheets etc	20,000 €	1,000 €	
	Indoor Wooden Floor	KD Wooden Floor	6,500 €	325 €	
	Outdoor Recycled Floor	UA Floor	4,000 €	200 €	
	Garden Lamps	Solar Energy lamps	1,100 €	55 €	
	Landscape (Versailles)	Greenery on Open Spaces/ Greencore	15,000 €	750 €	
	Landscape (Taipei)	Greenery on Open Spaces/ Greencore	5,000 €	250 €	
	Interior Wooden Doors/ Handrail	Wooden Units	1,000 €	50 €	
	Restroom Units & Kitchen Decoration	HCG Life Design Products (Sink, toilet, shower..)	8,500 €	425 €	
	Orchid for Greencore	"Orchid 4 All" Orchid	3,800 €	190 €	
	Uniform Suits/ T-shirt for Team Members	Uniform Suits/ T-shirt	5,000 €	250 €	
		Total Direct Material	**491,900 €**	**24,595 €**	**36.61%**
2	Material Overhead				
	Material Overhead	5% Estimated Rate * Total Direct Materials	24,595	1,230	
		Total Material Overhead	**24,595 €**	**1,230 €**	**1.83%**
3	Direct Labor				
	Professors & Researchers	10 persons* 60 hours/month *12 months* €12 Hourly Rate	86,400 €	4,320 €	
	Advisors (incl. French Architect)	5 persons* 15 hours/month *12 months* €8 Hourly Rate	7,200 €	360 €	
	Granted Students	35 persons* 120 hours/month *6 months* €6 Hourly Rate	151,200 €	7,560 €	
	Technicians/ Labourers (incl. French translator)	6 persons* 176 hours/month *3 months* €8 Hourly Rate	25,344 €	1,267 €	
	Administratives	1 person* 176 hours/month *8 months* €6 Hourly Rate	8,448 €	422 €	
		Total Direct Labor	**278,592 €**	**13,930 €**	**20.73%**
4	Labor Overhead & Fringe Benefits				
	Professors & Researchers	6% Salary for Pension Fund 10* 60 *12* €12*6%	5,184 €	259 €	
	Advisors (incl. French Architect)	6% Salary for Pension Fund 5* 15 *12* €8* 6%	432 €	22 €	
	Granted Students	10% Overhead & Benefits 35 * 120 *6 * €6 *10%	15,120 €	756 €	
	Technicians/ Labourers	15% Overhead/ weekend & Benefit 6* 176 *3 * €8*15%	3,802 €	190 €	
	Administratives	6% Salary for Pension Fund 1* 176 *8* €6* 6%	507 €	25 €	

SDE 2014 COMPETITION EN FRANCE

Team's Abbreviations	UNI
School's Name	NCTU
Team's Name	UNICODE

Nº	Name	Description	Budget ex VAT	Budget VAT	% Total on ex VAT
	Volunteer guide & Stewards	5 persons *60 days* €15 benefits	4,500 €	225 €	
		Total Labor Overhead & Fringe Benefits	**29,544 €**	**1,477 €**	**2.20%**
5	**Lower - Tier Subcontractors**				
	Subcontractor for electricity installation		3,600 €	180 €	
	Subcontractor for HVAC installation		1,200 €	60 €	
	Leveling & Footing & Steel Frame Assembly		2,000 €	100 €	
	Carpenter		20,000 €	1,000 €	
		Total Lower - Tier Subcontractors	**26,800 €**	**1,340 €**	**1.99%**
6	**Consultants**				
	Local architectural advisors	TC Lee Architect	1,600 €	80 €	
	Building Code advisors	Runtex Developer	2,400 €	120 €	
	Structural Engineer (licensed engineer certificate)	Runtex Building Structural Consultation	1,200 €	60 €	
	Delta PV and electricity design and installation advisor	Delta Consultation	1,800 €	90 €	
	HVAC and plumbing engineer	UIS Electronic & AC design	2,000 €	100 €	
	Graphic design	UNICODE Team	200 €	10 €	
	Landscape and vegetation consultant	Orchid 4 All	600 €	30 €	
	Energy Efficiency Design and Monitor	GIS Building technology & Analysis	1,500 €	75 €	
		Total Consultants	**11,300 €**	**565 €**	**0.84%**
7	**Other Direct Costs**				
	Construction Site Temporary Work		3,600 €	180 €	
	On Site Security and Public Hygiene		600 €	30 €	
	Lighting/Furniture/ Kitchenware/ Curtain/ Painting		8,000 €	400 €	
	Water Supply & Clean		600 €	30 €	
		Total Consultants	**12,800 €**	**640 €**	**0.95%**
8	**Communication**				
	Winter Camp	Co-organised with Delta Foundation A 4-days camp of students from 6 high schools	14,000 €	700 €	
	Videos		2,000 €	100 €	
	Web Page (creation and maintenance)		2,000 €	100 €	
	Communication documentation		5,000 €	250 €	
	Exhibitions & Video		25,000 €	1,250 €	
	VIP Dinner *3		1,800 €	90 €	
	Press Conference		800 €	40 €	
	UNICODE Ambassador in Versailles		2,500 €	125 €	
	Post Competition Events in Taiwan (as a part of 2016 World Design CapitalSeries Event)	Proposed a Joint Event with National Research Committee/ Taipei City Government	40,000 €	2,000 €	
		Total Communication	**93,100 €**	**4,655 €**	**6.93%**
9	**Travel & Costs for workshops & Final Phase in Paris**				
9.1	**First Workshop**				
	Travel & Transport	Team Members 4 * Unit Cost €1000	4,000 €	200 €	
	Lodging	Team Members 4* Unit Cost €600	2,400 €	120 €	
	Expenses Allowance	Team Members 4 * Unit Cost €250	1,000 €	50 €	
	Miscellaneous Expenses	Team Members 4 * Unit Cost €100	400 €	20 €	
		First Workshop in Paris	**7,800 €**	**390 €**	
9.2	**Second Workshop**				
	Travel & Transport	Team Members 10* Unit Cost €1000	10,000 €	500 €	
	Lodging	Team Members 10* Unit Cost €800	8,000 €	400 €	
	Expenses Allowance	Team Members 10* Unit Cost €400	4,000 €	200 €	
	Miscellaneous Expenses	Team Members 10* Unit Cost €250	2,500 €	125 €	
		Second Workshop in Paris	**24,500 €**	**1,225 €**	
9.3	**Final Phase**				
	Travel & Transport (Professors/ advisors)	Eva Air-Team Members 10* flight €1000	10,000 €	500 €	
	Travel & Transport (students)	Eva Air-Team Members 35* flight €1000	35,000 €	1,750 €	
	Lodging(Professors/ advisors)	Team Members 10* €200* 30days	60,000 €	3,000 €	

		SDE 2014 COMPETITION EN FRANCE			
	Solar Decathlon Europe 2014 EN FRANCE	Team's Abbreviations	UNI		
		School's Name	NCTU		
		Team's Name	UNICODE		
Nº	Name	Description	Budget		% Total
			ex VAT	VAT	on ex VAT
	Lodging(students)	Free Rooms offered by SDE Organisation			
	Expenses Allowance (Professors/ advisors)	Team Members 10* €50* 30days	15,000 €	750 €	
	Expenses Allowance (students)	Team Members 35* €50* 40days	70,000 €	3,500 €	
	Miscellaneous Expenses (Professors/ advisors)	Local transportation/ Peer meeting €1000	1,000 €	50 €	
	Miscellaneous Expenses (students)	Local transportation/ Peer meeting €2000	2,000 €	100 €	
		Final Phase in Versallies	193,000 €	9,650 €	
		Total Travel & Costs for workshops & Final Phase	225,300 €	11,265 €	16.77%
10	Assembly, Disassembly Processes				
10.1	Trail Assembly and Disassembly (Taiwan)				
	Rent for Warehouse		5,000 €	250 €	
	Crane/ Fork Lift Trucks		8,000 €	400 €	
	Fences/ Supports Racks		2,000 €	100 €	
	Site Leveling		800 €	40 €	
		Total Trail Assembly and Disassembly (Taiwan)	15,800 €	790 €	
10.2	Trail Assembly (Le Havre, France) French VAT=19.6%				
	Rent for Warehouse		6,000 €	1,176 €	
	Crane/ Fork Lift Trucks		8,000 €	1,568 €	
	Fences/ Supports Racks		600 €	118 €	
	Personnel/ Local Technician	Estimated 6persons*8 Hours*10 Days*€20 Hourly Rate (Assembly 7 days/ Disassembly 3 days)	9,600 €	1,882 €	
	Material and equipment		600 €	118 €	
	Other Expenses	package/ protection/ QR code	1,800 €	353 €	
		Total Trail Assembly (Le Havre, France)	26,600 €	5,214 €	
10.3	Competition Assembly/ Disassembly (Versailles, France) French VAT=19.6%				
	Crane/ Fork Lift Trucks		8,000 €	1,568 €	
	Fences/ Supports Racks		600 €	118 €	
	Site Leveling		400 €	78 €	
	Personnel	Estimated 3persons*8 Hours*10 Days*€20 Hourly Rate	4,800 €	941 €	
	Material and equipment		600 €	118 €	
	Other Expenses	package/ protection/ QR code	1,200 €	235 €	
		Total Competition Assembly/ Disassembly (Versailles, France)	15,600 €	3,058 €	
10.4	Exhibition Assembly and Disassembly (Taiwan)				
	Site Shelter		2,000 €	100 €	
	Crane/ Fork Lift Trucks		6,000 €	300 €	
	Fences/ Supports Racks		600 €	30 €	
	Site Leveling		1,000 €	50 €	
	Other Expenses	package/ protection/ QR code	2,200 €	110 €	
		Total Exhibition Assembly and Disassembly (Taiwan)	11,800 €	590 €	
10.5	Long term Assembly (Taiwan)				
	Site Shelter		2,000 €	100 €	
	Crane/ Fork Lift Trucks		6,000 €	300 €	
	Fences/ Supports Racks		600 €	30 €	
	Site Leveling		1,000 €	50 €	
	Other Expenses		1,200 €	60 €	
		Total Long term Assembly (Taiwan)	10,800 €	540 €	
		Total Assembly, Disassembly Processes	80,600 €	10,191 €	6.00%
11	Transaportation/ Shipping (Taiwan-France)				
	Transport	Shlpping & customs (freights and land transport) EVERGREEN/ EVA Air -Frieght Shipping FATTON Logistics- Local truck/ Containers	65,000 €	3,250 €	
	Transport Insurance		1,500 €	75 €	
		Total Transaportation/ Shipping (Taiwan-France)	66,500 €	3,325 €	4.95%
12	Insurance Policies/ French VAT=19.6%				

SDE 2014 COMPETITION EN FRANCE

Team's Abbreviations	UNI	
School's Name	NCTU	
Team's Name	UNICODE	

Nº	Name	Description	Budget ex VAT	Budget VAT	% Total on ex VAT
	Liability Insurance		400 €	78 €	
	Transport Insurance		600 €	118 €	
	Accident Insurance		1,200 €	235 €	
	Medical Insurance		400 €	78 €	
		Total Insurance Policies	2,600 €	510 €	0.19%
		Total Price / Cost Estimated	1,343,631.48 €	73,722.37 €	100 % Total
Please CHECK (X) your status >>>	x	If you benefit VAT Recovering			
		If you don't	0.00 €		
		Total Price / Cost Estimated included VAT	1,343,631.48 €		

		SDE 2014 COMPETITION EN FRANCE				
Solar Decathlon Europe 2014 EN FRANCE		Team's Abbreviations	UNI			
		School's Name	NCTU			
		Team's Name	UNICODE			
	SDE 2014 _ Construction Cost Budget					
cod.	descriptions	UNIT OF MEAS.	QUANTITY	PRICE €	TOTAL	
1	**STRUCTURE**					
1.1	**FOUNDATION**					
	Wooden Beams 400x600x120 and fitting elements	n.	102		2,000 €	
	Wooden Beams - **BASEMENT**					
	N. 2 size = 200x200x5240	m³	2	1,500 €	3,000 €	
	N. 2 size = 200x200x4010	m³	1.6	1,500 €	2,400 €	
	N. 2 size = 200x200x2200	m³	1	1,500 €	1,500 €	
	Wooden Beams 200x200 - **Skylight structure**	m³	0.32	1,800 €	576 €	
	Fixing and hooks for wooden structure (25% of Timber structure costs)	a corpo			1,500 €	**10,976 €**
1.2	**STRUCTURE FLOORS SLABS**					
	Basement slabs (+0.00) - "RUBNER", Modular or customize (base module125*125) Thicknes s = 31.60 (OSB panel s = 18mm; PAVATEX timber beams S= 200mm; OSB s =18mm; Cork/STYRODUR CS 500 s=100mm; StamisolPACK 500 s=0.70mm)	m²	65.5	150 €	9,825 €	
	Roof Slabs 1 - "RUBNER", Modular or customize, Thickness s = 38.37 (OSB panel s = 18mm; Pavaflex and timber beams s=200mm; OSB panel s =18mm; PAVATHERM PLUS s = 80mm; Pavatex Isolair-L s = 0.35mm; STAMOSOL PACK 500 s=0.70mm; Ventilater cavity+wood battens s =70mm; OSB panel s =18mm; Waterproof layer Derbigum3=3mm;	m²	45.5	170 €	7,735 €	**17,560 €**
1.3	**PARTITION AND EXTERNAL**					
	WALL 01_Exterior Wall (EAST-WEST) -	m²	48.42	180 €	8,716 €	
	WALL 02_North Wall with Painting fresco "Catalano" -	m²	38.66	200 €	7,732 €	
	WALL 03_Wall Interior -	m²	14	120 €	1,680 €	
	WALL 04_Exterior Wall Technical core, tickness s= ……	m²	7.76	150 €	1,164 €	**19,292 €**

2	**ARCHITECTURE**					
2.1	**OPENINGS**					
	Inner doors-"Rubner" - doors in wood	n.	3	600 €	1,800 €	
	MAIN DOOR	n.	1	3,000 €	3,000 €	
	Windows - …………	m²	24	650 €	15,600 €	
	Windows - …………	m²	8.5	500 €	4,250 €	
	Windows - …………	m²	21.5	250 €	5,375 €	
	SHADING System- curtain linen finishing color: natural	m²	19	50 €	950 €	
	rainwater collecting eaves, finishing color: black	ml.	12	150 €	1,800 €	**32,775 €**
2.2	**FINISHES**					
	Interior Floor in Larch wood S=20mm	m²	60	30 €	1,800 €	
	Interior coating in Clay panels: Pro Crea Fondo	m²	100	40 €	4,000 €	
	Outer coatings	m²	70	60 €	4,200 €	**10,000 €**
2.3	**FURNISHING**					
	Wc_Bidet Washbasin Glaze finish	a corpo			1,500 €	1,500 €
3	**SYSTEMS INSTALLATION**					
3.1	**FIRE SUPPRESSION**					
	estinguishing	a corpo			800 €	800 €
3.2	**PLUMBING SYSTEM**					
	Pipes system is grouped into: Hot water piper will be … PET pipes The plumbing system…. ELEMENT: Piping system in the core module Piping system between house and tanks	a corpo			$ 8,000.00	**$ 8,000.00**
3.3	**HVAC**					
	HVAC-	a corpo			15,000 €	**15,000 €**
	radiant comfort systems "Eurotherm"	m²	30	100 €	3,000 €	**3,000 €**
	3D core	a corpo			1,000 €	**1,000 €**
3.4	**ELECTRICAL SYSTEM**					
	Electrical Plant:	a corpo			7,000 €	**7,000 €**
	LIGHTING 1. Ceiling 2. Suspension led	a corpo			6,000 €	**6,000 €**

3.5	**SOLAR SYSTEMS - PHOTOVOLTAIC**					
	PV PLANT					
	pv panel structure - modular elements in aluminium tickness s=15cm	a corpo			**12,000 €**	
	PV PLANT:	kwatt	3	**1,200 €**	**3,600 €**	
	fixing sistems	a corpo			**2,000 €**	**17,600 €**
3.6	**TELECOMUNICATIONS AND BUILDING AUTOMATIZATION**					
	HOME AUTOMATION -sensor network and Gateway -Sensor for: temperature with two dispositives: ... -Gateway -Power Control Board				10,000 €	**10,000 €**
						160,503 €
	COMPETITION FEATURES					
	Ground leveling	a corpo				
	Ramps	a corpo				
		m²	53.28	120 €	**6,394 €**	
	APPLIANCES	m²	180	60 €	**10,800 €**	
				TOTAL	**17,194 €**	

Solar Decathlon Europe 2014 EN FRANCE	SDE 2014 COMPETITION	
	Team's Abbreviations	UNI
	School's Name	National Chiao Tung Unive
	Team's Name	NCTU UNICODE

Company Name	Collaboration Details	Amount of support	% Tota
Institutional Support			
Solar Decathlon Europe	Organization	100000	
National Chiao Tung University	Founding for Scholars & Assistant	100000	
		200,000.00 €	17%
Industrial Partners & Sponsors			
Ruentex Construction	Financial Support	493657	
Delta Foundation	Financial Support	246828	
		740,485.00 €	63%
Other Income Details			
Delta Electronics	Material Donation	49365	
Bayer	Material Donation	28372	
HCG	Material Donation	12341	
ASUS	Computer Donation	24682	
Autodesk	Software Donation	21800	
UIS	Intellectual Service Donation	59401	
SGS	Intellectual Service Donation	29697	
Orchid 4 All	Orchid Donation at France	5000	
		230,658.00 €	20%
		1,171,143.00 €	100 % Total

9. SITE OPERATION REPORT

1.0 Objective

The main objective of Site Operation Plan is to provide clear processes and rules for all decathletes, advisors, truck driver, crane operator, contractors and sub-contractors. Together with H&S Plan, Site Operation Plan guides the process of assembly/ disassembly, in which team member, contractor, crane & truck, heavy machine & equipment, installation of PV and energy system are described with details. All members and contractors are required to carefully read through Site Operation Plan to ensure their safety and the order of construction site.

In addition to the construction in Versailles, the Orchid House will be built in Taiwan. The Site Operation Site is also served as construction manual for students and local contractor in Taiwan.

1.1 Safe Working Environment

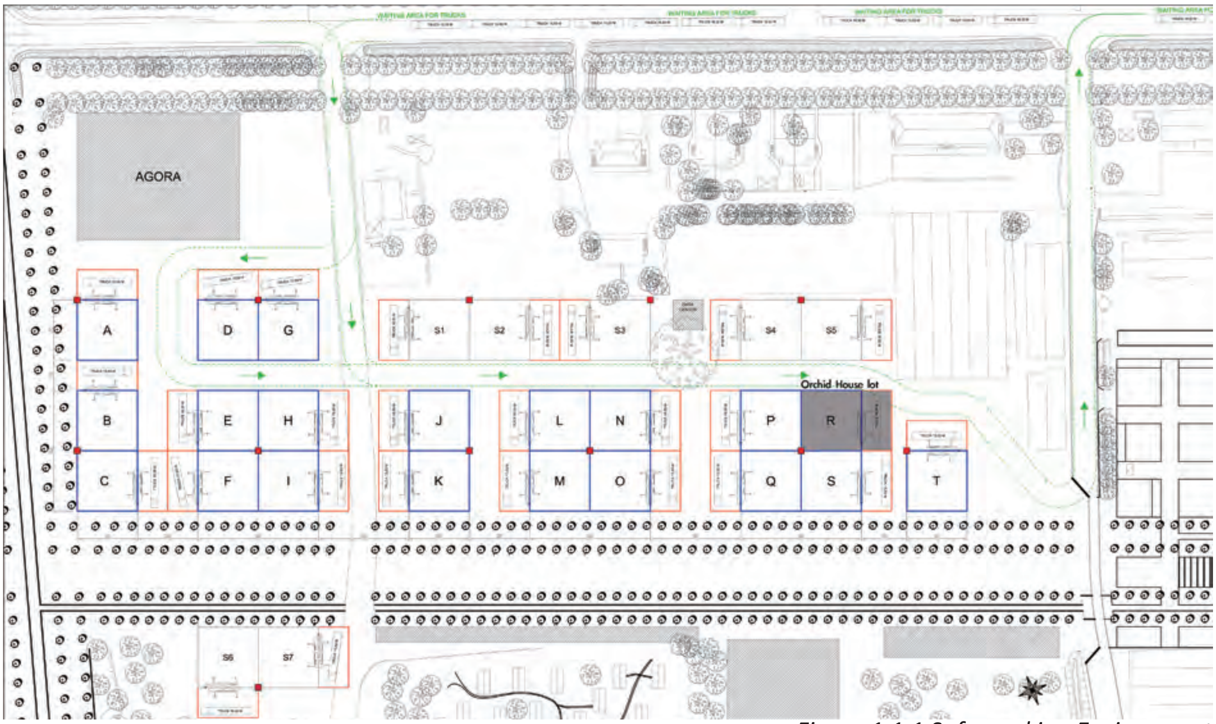


Figure 1.1.1 Safe working Environment

The site of NCTU UNICODE is adjacent to the major road of trucks and crane, which takes UNICODE team attention and dominates the priority of site operation. The safety of working members within the assembly site and road users are equally concerned and take action to ensure the procedure do not obstruct the road.
The access path and entrance zone are planned according site characters and avoid conflicts against the busy road. The H&S Plan provide further detail of access control and safety measures.

1.2 Assembly Sequence

The order of assembly is organized by the following logic:

- from foundation to upper level
- from exterior to interior
- from heavy structure to light domestic appliance

These logics guide the deployment of trucks order and construction processes.

1.3 Student Worker Structure

All decathletes are required to understand the whole structure and assembly process of orchid House. By this project, they receive fully professional trainning on solar energy and lateet building technology.

Professionals trainning and skills are provided to 3 student leaders who play as a team architect for Orchid House. Other students are assigned with a specific skills other than general construction knowledge. We do not divid students with groups but to to ask each of them take responsibilty on specific parts of Orich House, such as PV system, water system…etc. The student who are familiar on specific issues can be the tutor for others. This arrangement is to ensure the quality of education and deliver of construction on time, on quality and within budget.

STUDENT LEADER	STUDENT LEADER	STUDENT LEADER

Structure LEADER	Exterior WALL LEADER	Roof and Blinds LEADER	Insulation system LEADER	Appliance and electricity LEADER	PV System and Climate Control LEADER	Indoor member LEADER	Water system LEADER	Doors & windows additional member LEADER

1.4 Systematic Construction

The Orchid House will be assembled several times: trail assembly in Taipei, competition in Versailles, reassembly in Taipei and possibly reassembly as a exhibition tour in Taiwan cities. Hence it is necessary to assign a code of each element and materials. The QR Code is attached to each item by which connects to construction order, machine and tool needed, assembly worker needed, and its storage container order. It also provides information of maintenance and part exchange. The operator and users will easily to find exchange part or find our the process of changing it.

The advantage of using QR Code than RFID system is do not need sensor equipment, and it can connect to mobile phone of ordinary users. Furthermore, it can integrate into smart life system.

1.5 Content and Structure

Site Operation Plan is structured with site description and constraints in general data, identification of coordinator and its responsibility, shipping arrangement and logistic on delivery strategy, and assembly/ disassembly schedule for the competition. The content is shown below:

- Objective
- Content & Structure
- General Data
- Site Operation Coordinatiors
- Logistic outside of La Cite du Soleil
- Logistic in La Cite du Soleil
- Assembly / Disassembly schedules
- Equipment requirement chart
- Assembly & Disassembly
- Insurance Policies

2.0 General data

This section of General Data provides the size of assembly site, traffic requirement and arrangement, resources, restriction and solutions of NCTU UNICODE.

The size of assembly site: The assembly lot is 20meter (wide)x 20meter (long) next to a construction space of 10meter (wide)x 20meter (long) . This size provides restriction and also opportunity to practice rooftop structure in compact urban environment. The Orchid House is considered as a rooftop annex to old apartment, which is often illegal against building code, and require light but solid structure to against wind, rain and earthquake while not exceeding safe loading capacity of apartment. The rooftop area is also small and the size of assembly site provide an exercise for urban example of Orchid House.

Traffic requirement and arrangement: The construction material of Orchid House is prepared and shipped y 12 containers. The trucks with containers arrive and downloading area are plan in construction space. The road in front of assembly site is 10 meter wide which is enough for truck traffic. The arrangement for truck order is to select warehouse near Versailles where the departure time of each truck can be arranged according the procedure of downloading in assembly site.

Resources: A local warehouse is an importance strategy to adapt logistic schedule and UNICODE eam member training and preparation. Crane arranged by SDE Organization is essential to ensure the safe and undamaged of downloading materials.

Restrictions and Solutions: One character of NCTU UNICODE site is compromised land used by public truck, where UNICODE team members will pay special attention to protect all people and truck using the road. Another restriction is that there is no ground bearing capacity analysis of the assembly site which is a danger factor for construction. UNICODE team deploys 52 independent foundation to support the structure.

3.0 Site operations coordinators

Ming hung She
Tel: +886936075392
miluchopper@arch.nctu.edu.tw

4.0 Logistic outside of La Cité du Soleil®

NCTU UNICODE plans a route from Taiwan to France. The shipping schedule has 2 weeks advance time to avoid shipping lag or climate influences. However, it also means we need to find a temporary storage site in case of arriving earlier than schedule.

4.1 Trucks route

Distance: 191 km, 1 hour 56mins

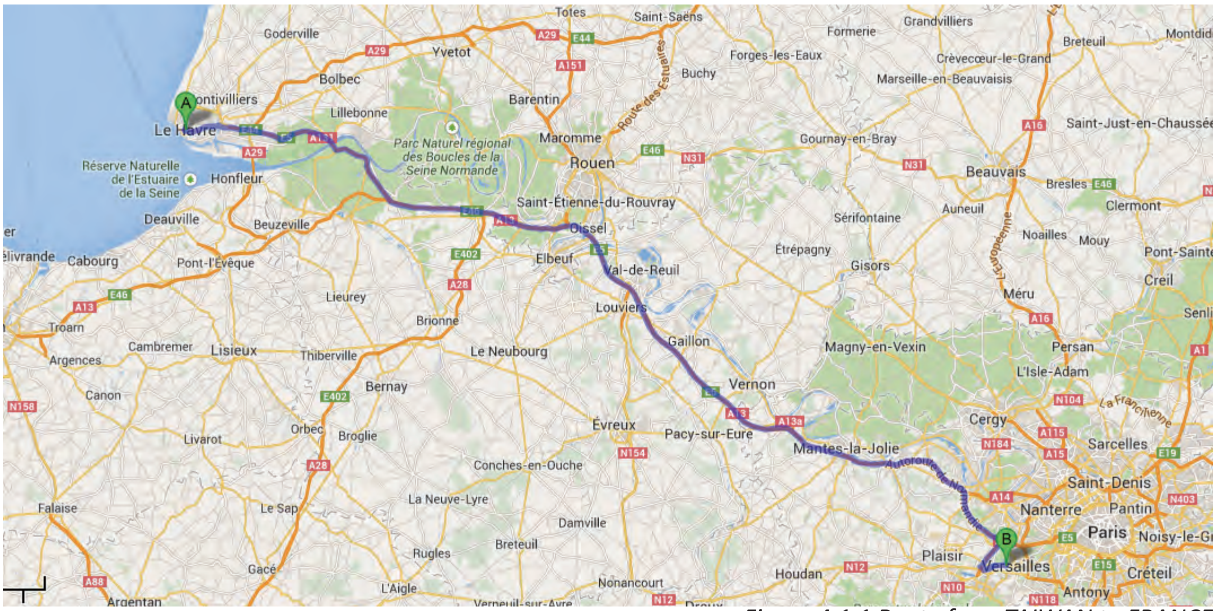


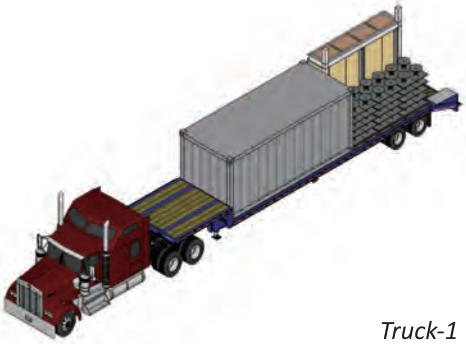
Figure 4.1.1 Route from TAIWAN to FRANCE

Figure 4.1.2 Route from TAIWAN to FRANCE

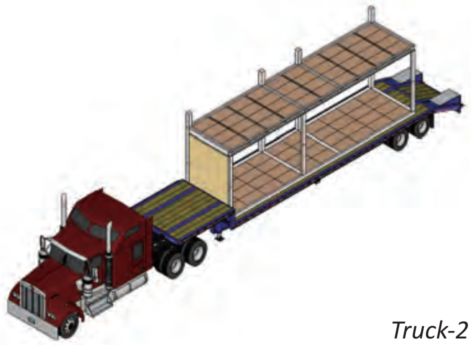
4.1.1 Shipping Timetable

Shipping, Freight, Demand, Process Timetable				
Date	*Local*	*Project target*	*Demand Help*	*Self assist*
Calculated time	Taiwan	Apply to customs	Declaration process guidance	Customs detail, customs declaration
Calculated time	Taiwan	Component packaging and protection	Packaging and protective materials to provide advice	Packaging and Protection
Calculated time	Taiwan	Component transport (Trailers Trucks *13)	Huashan→Container port	-
Calculated time	Taiwan	Component Loading(Container*12)	Loading location and Equipment evaluation	Component classification
Calculated time	Ship	Taiwan→France	Transport	The number of containers and the declaration content
Shipping Before 6/10	France	Immigration Customs	Declaration process guidance	Customs detail, the number of containers and the declaration
Before 6/10	France	Component Discharge (Container*12)(Trailers Trucks *13)	Component Discharge	Component Discharge
Before 6/10	France	Component transport (Trailers Trucks *13)	France transport (Trailers Trucks *13)	Trucks size
6/10~6/25 7/9~7/13	France	Pre Construction Temporary base (H-5M,400m2 Warehouse) Heavy equipment rental	Warehouse (Near Versailles) Lodging Near Warehouse Forklift ,Bridge Crane or small crane ,Scaffolding, air Compressors	Warehouse size
6/16~6/25	France	Transport sequence	Transport	Transport sequence in 10 Days
7/15~7/22	France	Disassembly Warehouse (H-5M,400m2 Warehouse)	Forklift, Bridge crane or small crane ,Scaffolding, air Compressors	-
7/19~7/22	France	Component packaging and protection	Packaging and protective materials to provide advice	Packaging and Protection

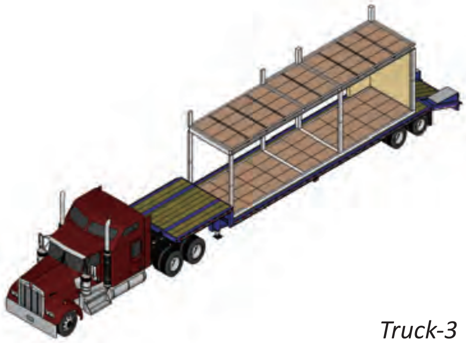
4.1.2 Trucks specifications and shipments



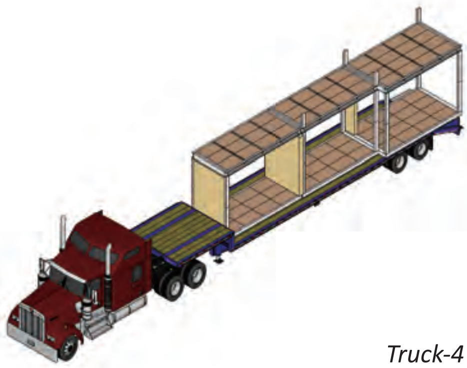
Truck-1



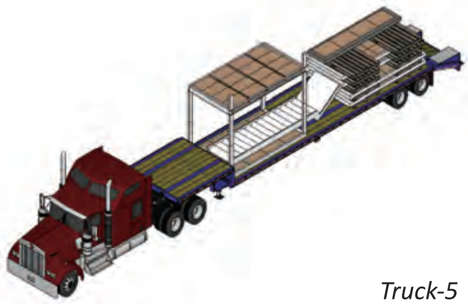
Truck-2



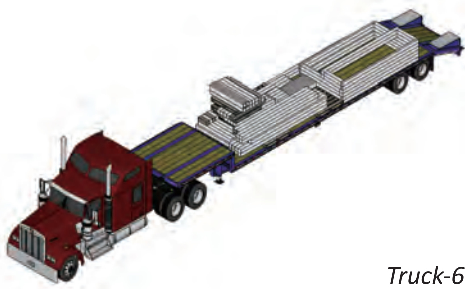
Truck-3



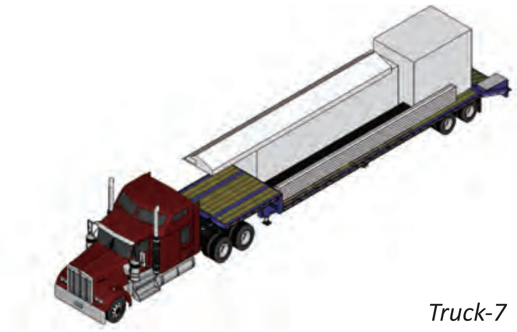
Truck-4



Truck-5

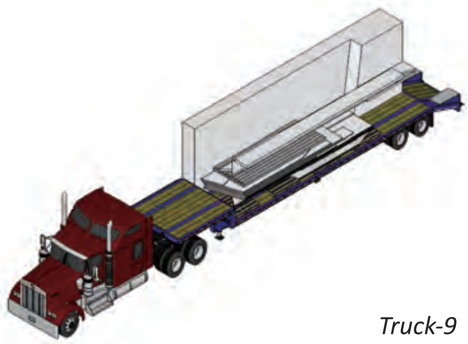


Truck-6

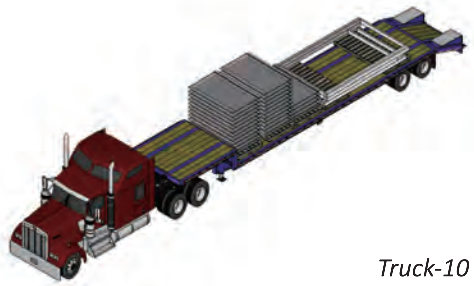


Truck-7

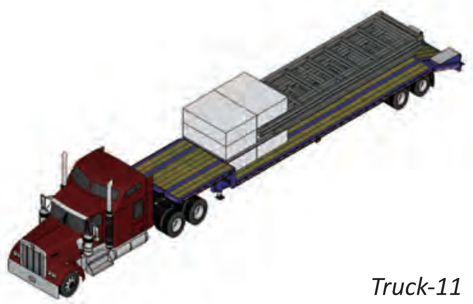
Truck-8



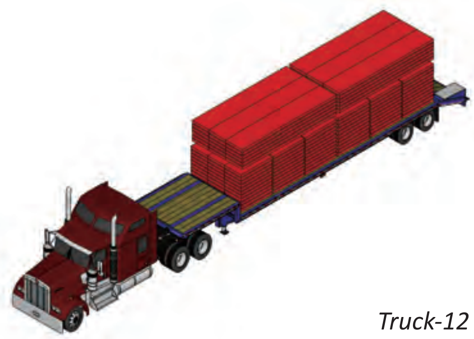
Truck-9



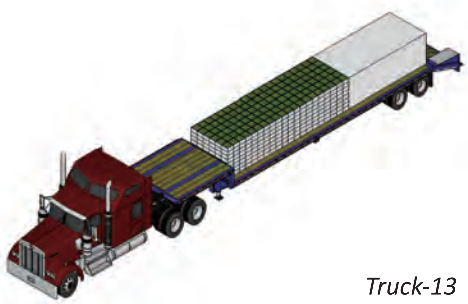
Truck-10



Truck-11



Truck-12



Truck-13

4.1.3 Trucks specifications and shipments List

Truck	Kind	Designation	QTY	Dimensions (mm)			Weight (kg)	Arrival
				L	W	H		
1	flat	Tool Container	1	3029	2438	2591	-	1
		Foundation	61	-	-	-	-	
		Construction Safety Box	1	3029	2438	2591	-	
		Unit-7	1	3750	875	3550	926	
2	Low	Unit-1	1	9150	2100	3550	5100	2
3	Low	Unit-2	1	9150	2100	3550	5100	3
4	Low	Unit-3	1	3600	2100	3550	4975	4
		Unit-4	1	3750	2100	3550		
		Unit-5	1	3750	2100	3550		
5	LOW	Unit-6	1	3750	2100	3550	-	5
		Unit-8	1	Unassembled			-	
		Stair	1	-	-	-	-	
6	Flat	Main frame Structure	-	-	-		-	6
7	Flat	wall	-	-	-	-	-	8
8	Flat	First Floor	52	900	525	400	-	7
	Flat	Second Floor	40	900	525	400	-	
9	Flat	Unit-Roof	9	9000	2100	150	2700	6
10	Flat	Ceiling panels	--	-	-	-	-	9
11	Flat	planter	-	-	-	-	-	10
12	Flat	Furniture	-	-	-	-	-	11
		Machines and tools	-	-	-	-	-	
13	Flat	Out door deck	1	6200	1600	150	723	12
			1	6375	1600	150	729	
			1	8350	2000	150	988	
			1	7750	2100	150	926	
			1	7750	2100	150	926	
			1	7475	2100	150	909	
			1	6250	1600	150	723	
			1	6250	1600	150	723	
			1	6250	1600	150	723	

5.0 Logistic outside of La Cité du Soleil®

5.1 Infrastructures

NCTU UNICODE employs steel structure in the consideration of lifecycle of steel and its capacity of assembly/ disassembly. This construction material and method is often been used in Taiwan for extend living space in rooftop. In order to speed up the process of assembly/disassembly, all materials have to been modular with units. Each unit can be pre-fabricated in factory to enhance its quality and precision. It also low the cost of Orchid House which make urban regeneration and urban aesthetics in Taiwan possible.

5.2 Construction working teams

A Team working

Name	Position	Mail
Dennis Lin	Student Leader	dennis01215@arch.nctu.edu.tw
Ming-Hong She	Construction leader	miluchopperr@arch.nctu.edu.tw
Chin-Yuan Fan	Site Operation Coordinator	cyfan@arch.nctu.edu.tw
Wan-Ling Cheng	Health and Safety Officer	minaling814@arch.nctu.edu.tw
Chester Hu	Decathlete	chian@arch.nctu.edu.tw
Trista Wang	Decathlete	jou-hsuan@arch.nctu.edu.tw
Chin-Ju Chen	Decathlete	chen.chin.ju@arch.nctu.edu.tw
Yu-Ming Su	Decathlete	ymsu@arch.nctu.edu.tw
I-Chi Chen	Decathlete	inaohlala@arch.nctu.edu.tw

B Team working

Name	Position	Mail
Chi-Ming Chien	Student Leader	s9390306@gmail.com
Sunny Chou	Construction Leader	cyt@arch.nctu.edu.tw
Jeff Lin	Decathlete	bluerice@arch.nctu.edu.tw
Jason Huang	Decathlete	jason@arch.nctu.edu.tw
Oswalt Ho	Decathlete	oswalt_mitsui@arch.nctu.edu.tw
Leslie Yen	Decathlete	lieles.yen@arch.nctu.edu.tw
Yiting Chen	Decathlete	annchen@arch.nctu.edu.tw
Sophie Chen	Health and Safety Officer	wantsi@arch.nctu.edu.tw
Rui Lin	Site Operation Officer	ruikisa@arch.nctu.edu.tw
Ruby Tu	Decathlete	Ruby_@arch.nctu.edu.tw

C Team working

Name	Position	Mail
Sky Tseng	Student leader	sky@arch.nctu.edu.tw
Cheng-Wei Wang	Construction leader	hanise@arch.nctu.edu.tw
Andrew Su	Site Operation Officer	andrewsudog@arch.nctu.edu.tw
Henry Ko	Decathlete	henryko@arch.nctu.edu.tw
Shao-yi Lu	Decathlete	theolu@arch.nctu.edu.tw
Summer Lee	Decathlete	siminlee@arch.nctu.edu.tw
Yung-Yen Teng	Decathlete	yungyen@arch.nctu.edu.tw
Pei-Ling Wu	Health and safety Officer	plhojita@arch.nctu.edu.tw
Tze-Chun Chen	Decathlete	tcchen@arch.nctu.edu.tw
Yating Wu	Decathlete	yatingwu@arch.nctu.edu.tw

5.3 Phases description

Phase 01 Site Preparation
At this stage we must ensure that the base of the soil stability and lofting precise when cargo unloaded to ensure security and stability

Phase 02 Module Unit
Continuous lifting seven units, and ensure that all units positioned in place on the basis of prior all units are fixed. Items should be lifted safety and precisely.

Phase 03 Main Structure
First: Installation terrace unit
Second: Fixed staircase structure with temporary structures
Third: Pillar lifting when the structure is positioned and fixed the main structural beams after removal of temporary structures
Continue lifting 2F main pillars and Roof Structure

Phase 04 Appliance & electricies
Lifting appliances and control equipment
Installation of an electronic system and control system
Treated water pipeline system

Phase 05 Roof
First: Installation of solar panel systems
Second: Install additional roof Electronics and water systems
Then install waterproof roof and roof drainage systems

Phase 06 Exterior wall
Wall support material unit needs to be fixed in advance of wall unit
The wall unit and the frame is very light so you can use manpower to move and install.

Phase 07 Floor & Ceiling & Windows
In the fixed floor and ceiling systems, We must complete the installation of electricity and water systems. Start installing ceiling systems.
Then install 1F flooring and outdoor flooring in all floors and ceilings finished
Window and door installation

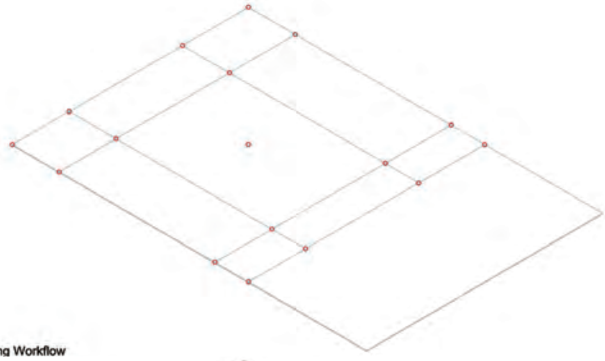
Phase 08 Furniture & Planting
The final installation is the positioning of plants and furniture

Phase 09 Lot clean & Test
Clean around the base
Environmental Systems Testing

5.3 Phases description

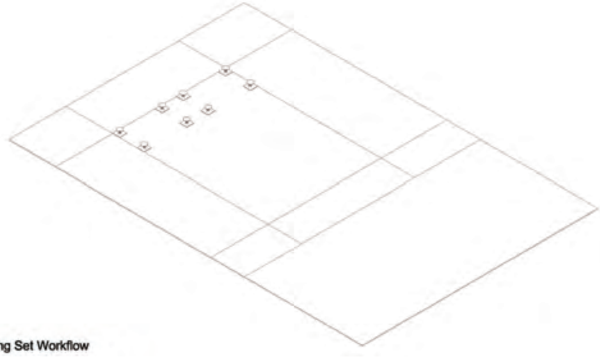
Phase 1: Site Preparation

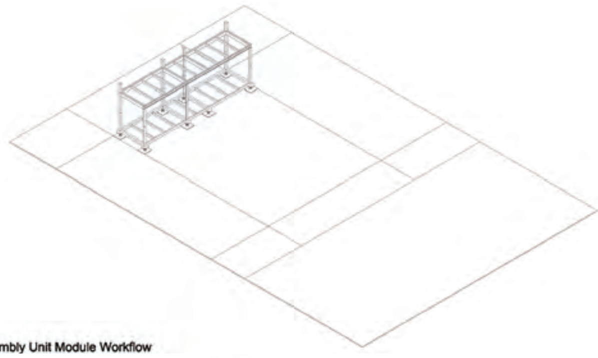
Truck-1
-Tool cantainer
-Foundation
-Construction Safety Box
-Unit-7

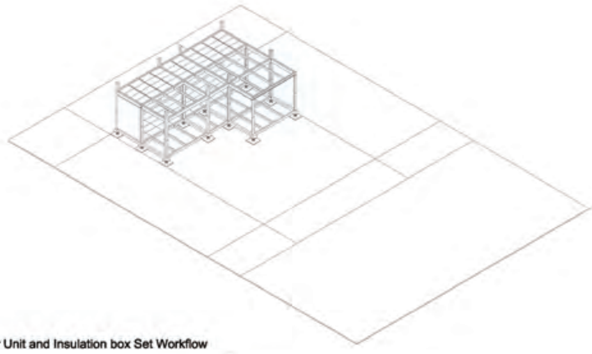

Lofting Workflow

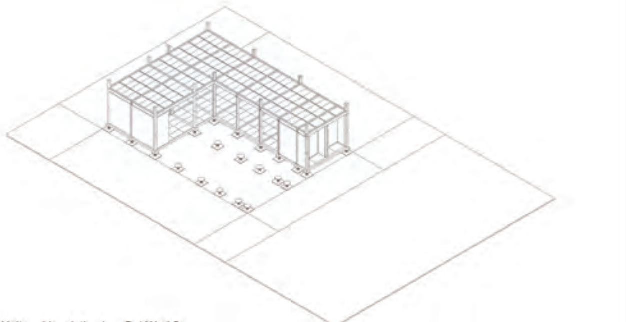
Phase 2: Establishment of the module unit

Truck-2.3.4.5
-Unit-1- L shape Unit
-Unit-2- L shape Unit
-Unit-3- L shape Unit
-Unit-4- L shape Unit
-Unit-5- L shape Unit
-Unit-6- L shape Unit
-Unit-8- Terrace and pillar
-Stair


Footing Set Workflow

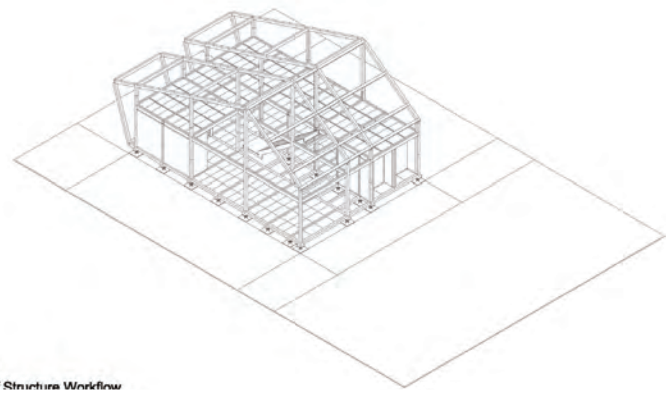

Assembly Unit Module Workflow


Other Unit and Insulation box Set Workflow


Other Unit and Insulation box Set Workflow

Phase 3: Installation of the main structure

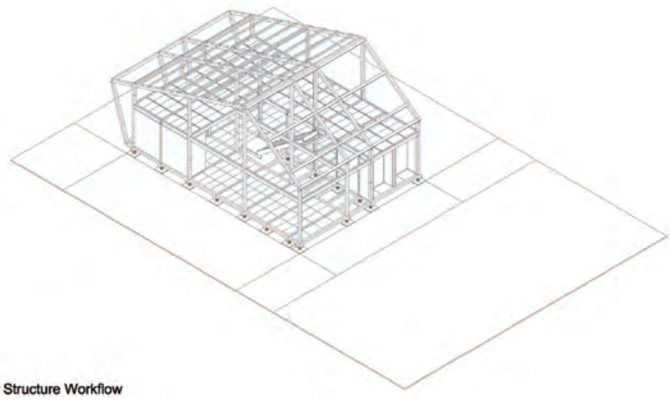
Truck-6
-Roof
-Structure frame



Roof Structure Workflow

Phase 4: Installation of the Appliance & electricity

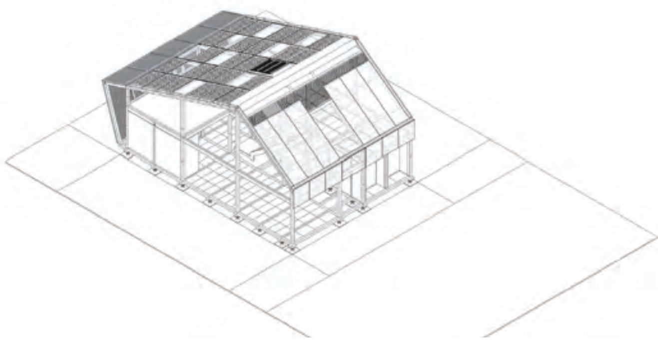
Truck-7
-Appliance & electricity
-Lifting and electricity Pipeline installation



Solar Structure Workflow

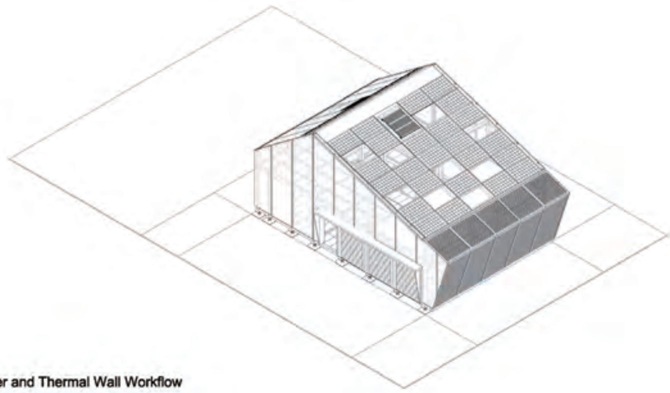
Phase 5: Building of the roof structure

Truck-8
-Solar panels and Roof panels
-Blinds



Phase 6: Installation of exterior wall

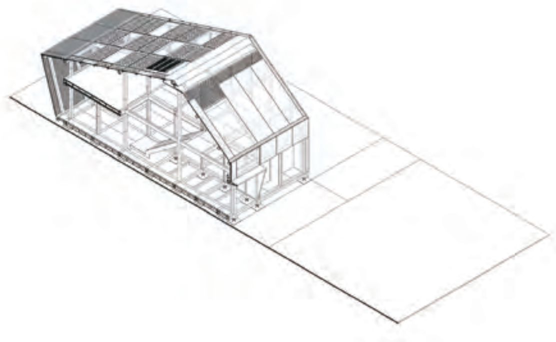
Truck-9
-Bayer
-Thermall Wall

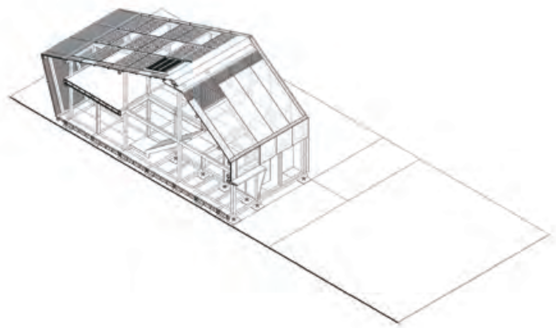


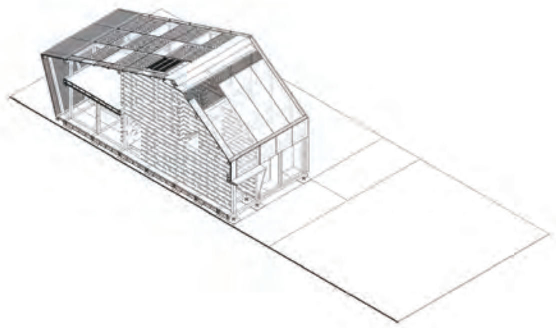
Bayer and Thermal Wall Workflow

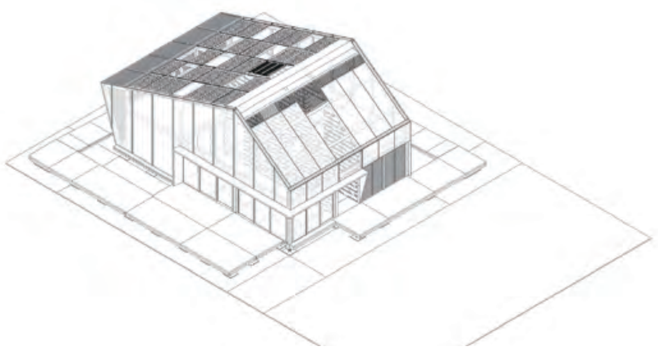
Phase 7: Installation of floors and windows

Truck-10,11,12
-Floor finish
-Ceiling
-windows

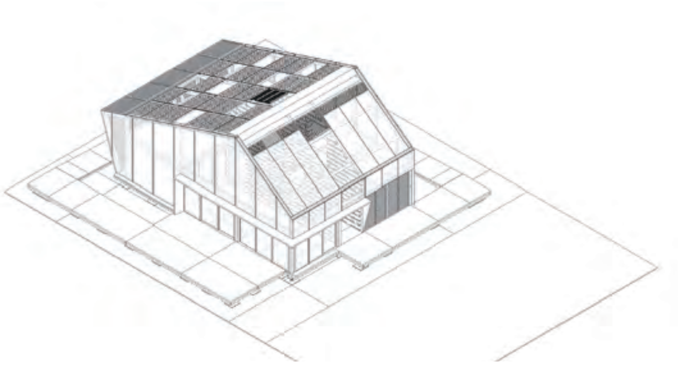






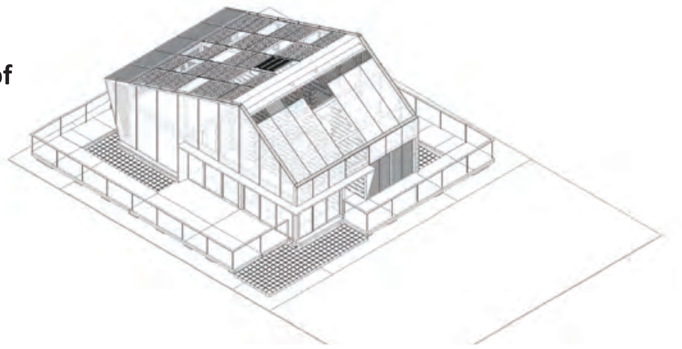


Phase 8: Installation of the furniture and planting



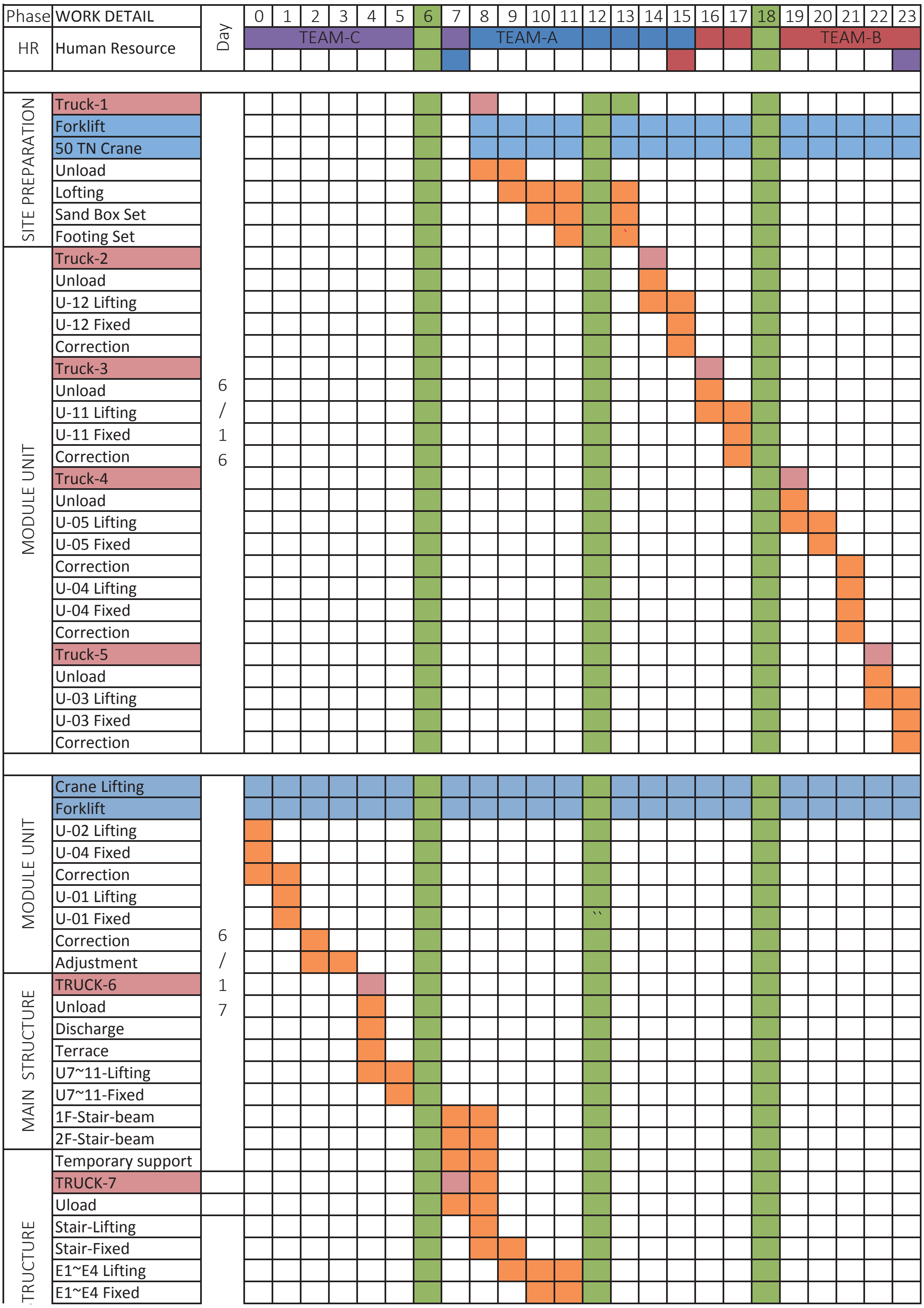
Truck-13
-Furniture
-Planting

Phase 9: Cleaning of the construction site and test of the house



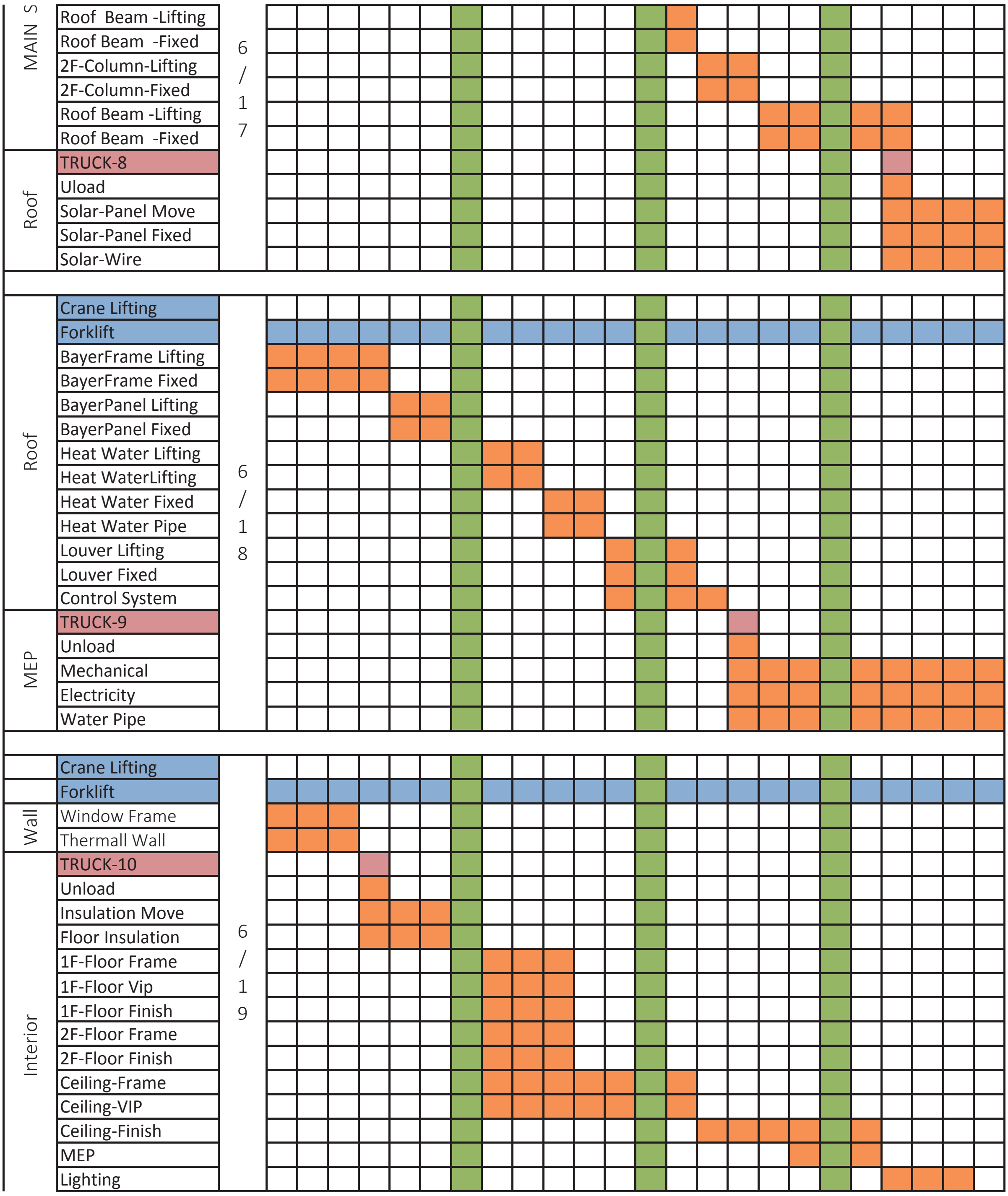
6.0 Assembly / Disassembly schedules

6.1 ASSEMBLY TIME TABLE
CHART TEAM UNI

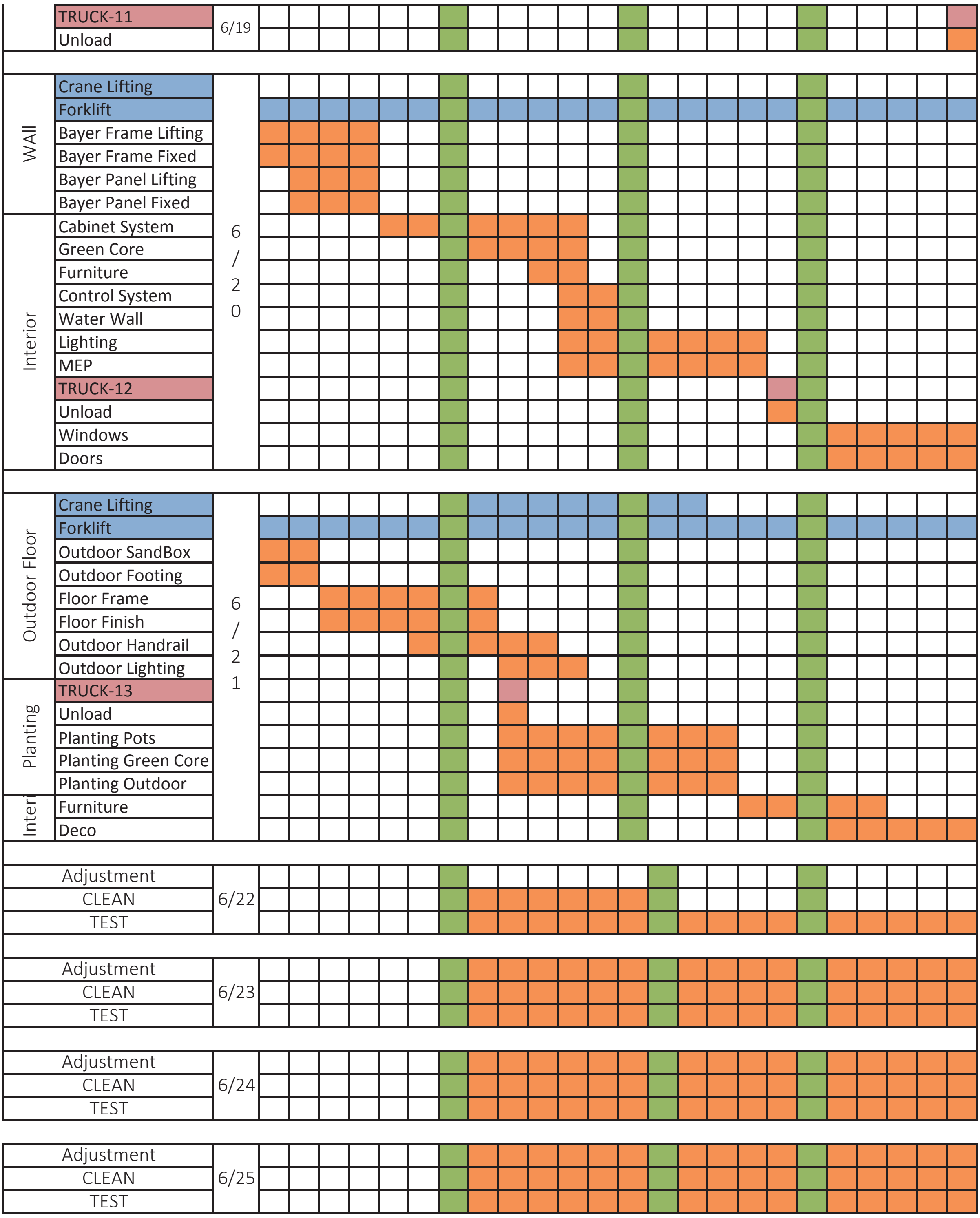


6.1 ASSEMBLY TIME TABLE

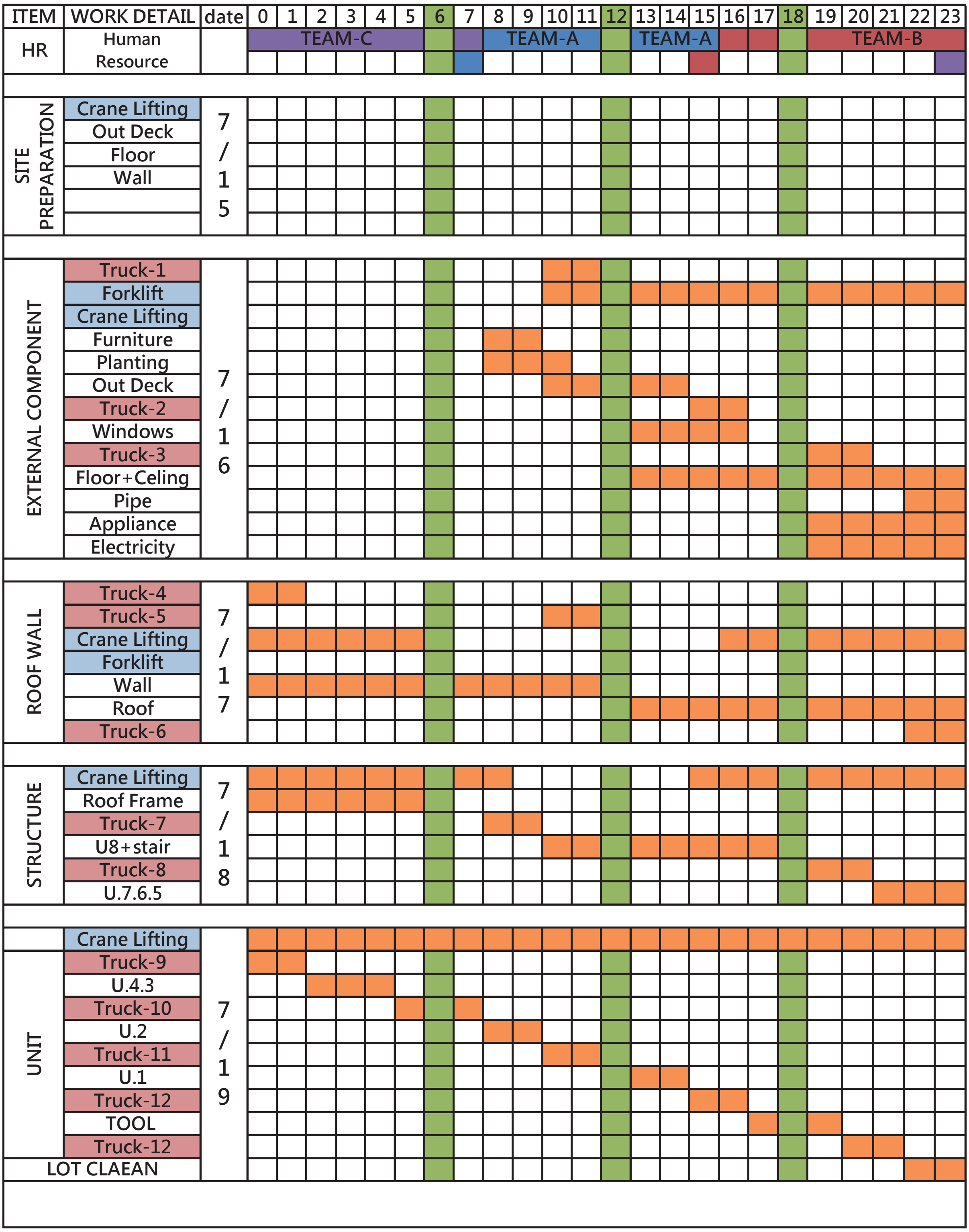
CHART TEAM UNI



6.1 ASSEMBLY TIME TABLE
CHART TEAM UNI



6.2 DISASSEMBLY TIMETABLE
CHART TEAM UNI



7.0 Equipment requirement Chart

As the SDE organization has not provide form “Site operations chart ”, we will include it in the next deliverable.

EQUIPMENT RENTAL CHART
TEAM UNICODE

CATEGORIE 1 : MOBILE CRANE

PLEASE COMPLETE THE ASSEMBLY & DISASSEMBLY CHARTS

CATEGORIE 2 : CONSTRUCTION EQUIPMENT

HANDLING			
DESIGNATION	REFERENCE	U	QUANTITY NEEDED
Forklift	H.FL.01	u	1
Telehandler	H.TH.01	u	

ELEVATION			
DESIGNATION	REFERENCE	U	QUANTITY NEEDED
Boom Lift	E.BL.01	u	2

CATEGORIE 3 : OTHER EQUIPMENT

EQUIPMENT			
DESIGNATION	REFERENCE	U	QUANTITY NEEDED
Pallet Truck	O.OE.01	u	0
Individual Platform 2,90m to 3,60m	O.OE.02	u	2
Scaffolding 5 m	O.OE.03	u	1
Fences HERAS (including plots)	O.OE.04	m	0

8.0 Assembly & Disassembly Chart

ASSEMBLY CHART

TEAM UNICODE

DAY 1 - 16.06.2014	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks	Truck-1						Truck-2		Truck3			Truck-4			Truck-5	
Crane																

DAY 2 - 17.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks					Truck-6				Truck-7											Truck-8				
Crane																								

DAY 3 - 18.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks																Truck-9								
Crane																								

DAY 4 - 19.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks				Truck-10																				
Crane																								

DAY 5 - 20.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks																							Truck-11	
Crane																								

DAY 6 - 21.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks	Truck-12								Truck-13															
Crane																								

DAY 7 - 22.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks																								
Crane																								

DAY 8 - 23.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks																								
Crane																								

DAY 9 - 24.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks																								
Crane																								

DAY 10 - 25.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks																								
Crane																								

DAY 11 - 26.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
INSPECTIONS DAY																								

USAGE OF THE CRANE	
Crane capacity	*Usage time*
50 TN Crane	48

9.0 Site Operations Chart

SITE OPERATION CHART
TEAM UNICODE

0. GENERAL INFORMATION		FUNCTION	CONSTRUCTION WORKING TEAM	NAME	TELEPHONE NUMBER
	1	Site Operations Coordinators	Working Team A	Chih-Ming Chien	+886 935-643-556
	2		Working Team B	Sheng-Kai Tseng	+886 988-204-763
	...		Working Team C	Chia-Hao Lin	+886 988-204-763

1. MODULES AND MAIN COMPONENTS		NAME	DIMENSIONS [m]	WEIGHT [kg]	MACHINERY USE FOR UNLOADING/LOADING
	1	Structure Unit 1	L 3.75 x W 0.87 x H 3.25	600	Crane
	2	Structure Unit 2	L 3.75 x W 1.69 x H 3.25	1640	Crane
	3	Structure Unit 3	L 3.75 x W 1.71 x H 3.25	1640	Crane
	4	Structure Unit 4	L 3.75 x W 2.1 x H 3.25	1640	Crane
	5	Structure Unit 5	L 3.75 x W 2.1 x H 3.25	4975	Crane
	6	Structure Unit 11	L 9.15 x W 2.1 x H 3.25	5000	Crane
	7	Structure Unit 12	L 9.15 x W 2.17 x H 3.25	5100	Crane
	8				
	...				

2. VEHICULES (Trucks, Vans, etc.)		TYPE	DIMENSIONS [m] (Tractor unit + Trailer)	WEIGHT [kg] (Truck + Loading)
	1	Flatbed	L : 13.6 x W : 3 x H : 4.2	5000
	2	Low Bed	L : 16 x W : 3 x H : 4.2	12100
	3	Low Bed	L : 16 x W : 3 x H : 4.2	12100
	4	Low Bed	L : 16 x W : 3 x H : 4.2	11975
	5	Low Bed	L : 16 x W : 3 x H : 4.2	11000
	6	Flatbed	L : 13.6 x W : 3 x H : 4.2	12721
	7	Flatbed	L : 13.6 x W : 3 x H : 4.2	10525
	8	Flatbed	L : 13.6 x W : 3 x H : 4.2	11750
	9	Flatbed	L : 13.6 x W : 3 x H : 4.2	9570
	10	Flatbed	L : 13.6 x W : 3 x H : 4.2	12021
	11	Flatbed	L : 13.6 x W : 3 x H : 4.2	11360
	12	Flatbed	L : 13.6 x W : 3 x H : 4.2	10500
	13	Flatbed	L : 13.6 x W : 3 x H : 4.2	9200

3. CRANES		CAPACITY	USAGE TIME
	1	50 TN Crane	
	...		

SITE OPERATION CHART
TEAM UNICODE

4. GENERAL DESCRIPTION OF THE PHASES			PHASE	MATERIAL AND EQUIPMENT RESOURCES	HUMAN RESOURCES	DURATION
	ASSEMBLY	1	Site-Preparation		10	6
		2	Structure		10	10
		3	MEP		10	12
		4	Roof		10	10
		5	Exterior		10	10
		6	Interior		10	36
		7	Outdoor Floor		10	15
		8	Planting		10	10
		9	Correction		10	10
		10	Clean & Test		10	24
	DISASSEMBLY	1	Out door & Furniture & Planting		10	10
		2	INTERIOR & WINDOWS		10	30
		3	Exterior		10	15
		4	Roof		10	10
		5	Main structure		10	22
		6	Module Unit		10	30
		7	Lot cleaning		10	3
		8				
		9				
		...				

5. WASTE MATERIALS			TYPE	VOLUM [m3] or WEIGHT [kg]
	ASSEMBLY	1	PVC Packaging Materials	10 KG
		2	Waste Wire material	1 KG
		...	Wood waste	1 KG
	DISASSEMBLY	1		
		2		
		3		
		...		

6. COMPONENTS TO BE STORED DURING COMPETITION PHASE		DESIGNATION	DIMENSIONS [m]	WEIGHT [kg]
	1	need to check and fill in deliverable 5		
	2			
	3			
	4			
	5			
	6			
	7			
	...			

10. HEALTH AND SAFETY PLAN

1.0 Health and Safety Plan Precedents and Aim

The primary purposes of H&S plan is to ensure the decathletes of NCTU UNICODE team construct and operate Orchid house with appropriate training and skills, are familiar with and follow the H&S rules during trial assembly, assembly and disassembly phases. All UNICODE decathletes has attended the first aid and CPR training courses in 10th October 2013, and passed the examination before receiving the certification. With the pre-competition training, decathletes are aware the importance of H&S plan.

H&S Plan is structured as i) key information of emergency and accident in Versailles; ii) health condition and requirement for decathletes; iii) safety information and condition of construction site; iv) risk identification and prevention for construction, critical work and operation; v) safety rules for visitors, contractor and sub-contractor; and vi)site clean and order during operation and post competition.

The Orchid House is considered as a prototype of urban regeneration method for the rooftop of old apartments in Taiwan. The H&S plan aims to demonstrate the constriction method of Orchid House has its potential to be widely applicable in compact urban environment and can be built and operated by trained ordinary apartment owners. Hence the H&S Plan has intentions to provide guidance to apartment owners on the possibility of self-built rooftop and the ways to prevent risks.

Health and Safety Checklist

LEGAL CONTENTS	LOCATION IN THE REPORT OR DRAWINGS
Name and address of SDE 2014, HS Coordinator, Prevention authorities, Team	PM: 10.2
Number of workers	PM: 10.5
Contact information of the Site Operations Coordinator	PM: 10.5
Description of works	PM: 10.4.8
First aid procedure	PM: 10.12
Name and number of first aid certificated worker	PM: 10.12
Description of the Team's first aid kit.	PM: 10.12.2
Description of hygiene conditions (toilet, changing room, restroom…)	SDE HS General Coordination Plan
Detailed description of operating modes	PM: 10.6
Risk assessment – risks generated by other	PD: HS-404 ~ HS-418
Risk assessment – risks generated by environment	PD: HS-404 ~ HS-418
Risk assessment – risks generated on other	PD: HS-404 ~ HS-418
Risk assessment – self generated risks	PD: HS-404 ~ HS-418
Procedures to adapt collective protection	PM: 10.8

2.0 General Data of the Project

This section provides primary information of Orchid House on its size, materials, structural methods and local information of E&A.

1.1 Prototype builder

NCTU / UNICODE, team of National Chiao Tung University, is taking Solar Decathlon Europe as the opportunity to develop a prototype house for co-existing with nature by focusing on the green house technology that has been developed for cultivating orchid in Taiwan combining with the research institute here in NCTU. The university's main campus is located at the center of the Hsinchu Science Park, Taiwan's national research center. The area is referred to as the Silicon Valley of Asia. More than 400 technology companies have been established in the park.

1.2 Nature of the project

Architectural footprint: 150m^2
Height: 7m
Length: 12.6m
Width: 9m
Assembly duration: 10 days
Disassembly duration: 4 days
Major material: Steel structure with insulation wall, wooden floor and French windows.
Construction method: Pre-fabricated units assembled on site.

1.3 HS team coordinator during design

Wan-Ling Cheng
Tel: +886 929 558 039
minaling814@gmail.com

1.4 Contruction site in Taiwan

Graduate Institute of Architecture,
1001 Ta Hsueh Road, Hsinchu City 300, Taiwan
Tel: +886 (3) 573 1977
Fax: +886 (3) 575 2308

1.5 The nearest hospital of Lot

Département d'Anesthésie-Réanimation - Hôpitaux Privés de Versailles
Address: 7bis A Rue de la Porte de Buc
78000 Versailles, France
Tel: +33 826 30 33 33
anesthesie-versailles.com

1.6 The nearest police office of Lot

Commissariat de Police (5.8km, 9mins)
Address:1 Rue de la Division Leclerc
8280 Guyancourt, France

1.7 The nearest fire station of Lot

Sapeurs Pompiers des Yvelines (11.3km, 18mins)
Address: Avenue de Pépinière
78450 Villepreux, France

3.0 Health and Safety plan Objectives

The Health and safety plan has crystal clear objectives to ensure the safety of all NCTU UNICODE decathletes, juries, visitors, and contractors. The language of H&S Plan is plain language with picture to guarantee all warning signs, notice items and message are clearly express on site and before entering the site. The H&S coordinator will request those who enter the site to read the signs and check their health condition, dressing, helmet, footwear and tools meet the safety requirement before permitting entering the assembly/ disassembly site.
These signs are standardized warning signs in French, which have detailed description in Project Drawing. The objectives include:

- Avoid risks: All possible risks are investigated and identified in H&S Plan. By preventing risk in advance, we can avoid risk and minimize conflict of works.
- Collective safety measures: All possible measures which contribute to safety are taken into account in H&S Plan. The pre-fabrication construction method reduces danger on site.
- Individual protection equipment: All decathletes and those people enter the site are required to wear helmet and protection equipment for safety.
- Use new safety technologies: Major construction units are labeled with QR Code in which the installation tools and safety notices are shown to decathletes. The QR Code enables time management and risk prevention.
- Demand to the sub-contractor to comply with the legal regulations: Contractor and consultants are required to follow H&S rules.

4.0 Conditions of the site

The focus here is the specific condition for the UNICODE site related to H&S, key concerns include site fences and access control, crane usage and its risk to road users, trucks loading area, and methods of assembly.

4.1 Constructive process

Constructive process	*Corresponding HS Drawings*
Lofting	HS-404
Footing	HS-405
Assembly Unit Module	HS-406
Second Row Footing	HS-407
Assembly Unit Module	HS-408
Other Unit and Insulation box	HS-409 HS-410
Terrace Unit	HS-411
Terrace Unit Lower Beam	HS-412
Stair Beam and Floor	HS-413
Terrace Structure	HS-414
Louver Frame	HS-415
Roof Structure	HS-416
Solar Structure	HS-417
Solar	HS-418
Roof Panel	HS-419
Additional structure	HS-420
Bayer and Thermal Wall	HS-421
Finish Floor, Celling, Wall Finish	HS-422
Green Core, MEP System	HS-423
Out Door FLoor, Window&Door	HS-424
Handrail, Planting	HS-425
Clean, Furniture Position	HS-426

4.2 Type and characteristics of the materials and elements

Material and elements	*Rick possible*	*Preventions*
Wood	Splinter Collision (very long pieces)	Follow the safety rules Protective equipment faultless
Steel	Change shape Cutting or skinning with sharp ends Collision	Follow the safety rules Protective equipment faultless
Electrical appliances	Collision Electric shock	Follow the safety rules Protective equipment faultless
Batteries	Collision Risks of burns due to the acid	Follow the safety rules Protective equipment faultless
Plant(Orchid)	Collision Withered during shipping	Follow the safety rules Protective equipment faultless

4.3 Site description

Localization

In the Southeast of Palace of Versailles, and the nearest station is Gare de Versailles – Chantiers.

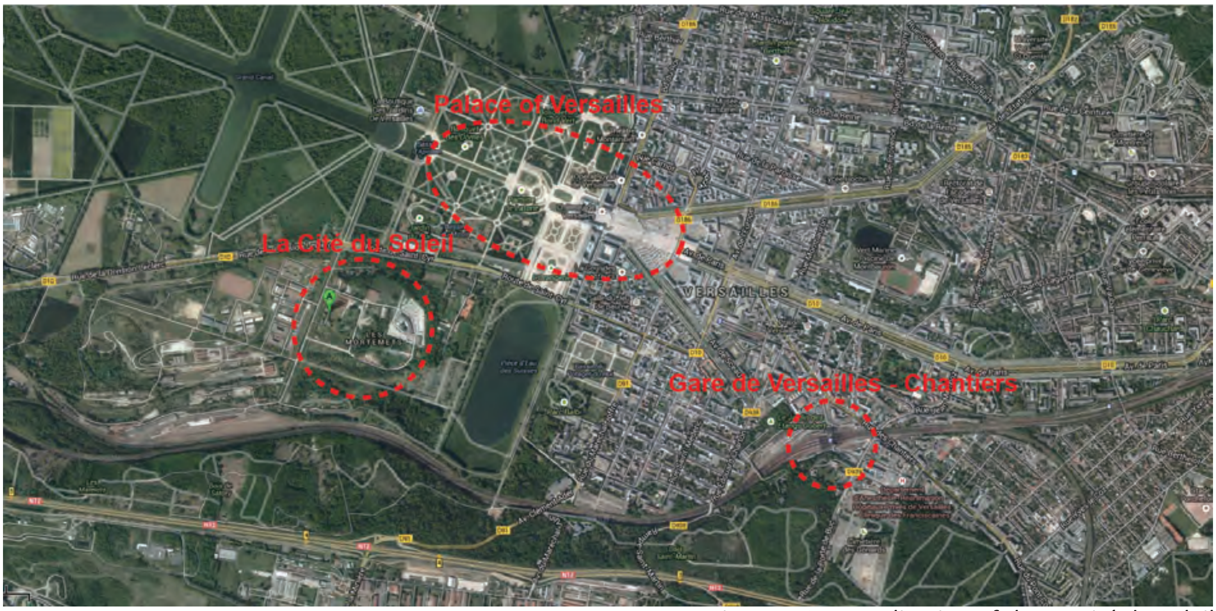


Figure 4.3.1 Lacalization of the La Cité du Soleil

Construction site

The site have two main entrances, UNICODE site is located in a block with four teams.

R- UNI , NCTU Unicode

P- LUC, Lucerne

Q- BUC, Bucharest

S- RHOM, Rh0ME

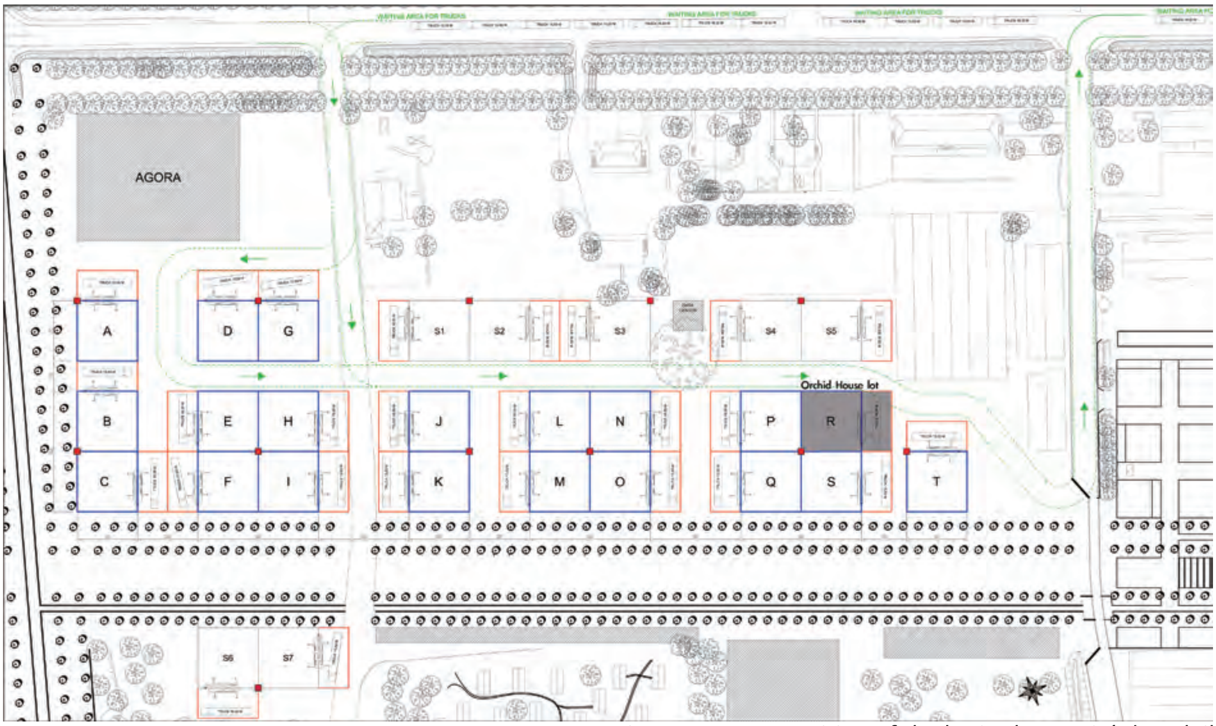


Figure 4.3.2 Repartition of the lot in the La Cité du Soleil

Lot number
R

Elements around the lot
We have a border with the lot number R and we are situated on the export of trucks' route

Lot size
20 x 20M


Figure 4.3.3 View of the La Cité du Soleil


Figure 4.3.4 View of the La Cité du Soleil


Figure 4.3.5 View of the La Cité du Soleil

4.4 Climate description

During the competition in July for Paris
Average High Temp: 25ºC
Average Low Temp: 15ºC
Average Rainfall Days: 7days
Precipitation: 21.4mm
Average Rainfall Days: 13m/s to 17m/s

4.5 Accesses and paths for vehicles

Sea transportation

Figure 4.5.1 Route from TAIWAN to FRANCE

Trucks route
distance: 191 km, 1 hour 56mins

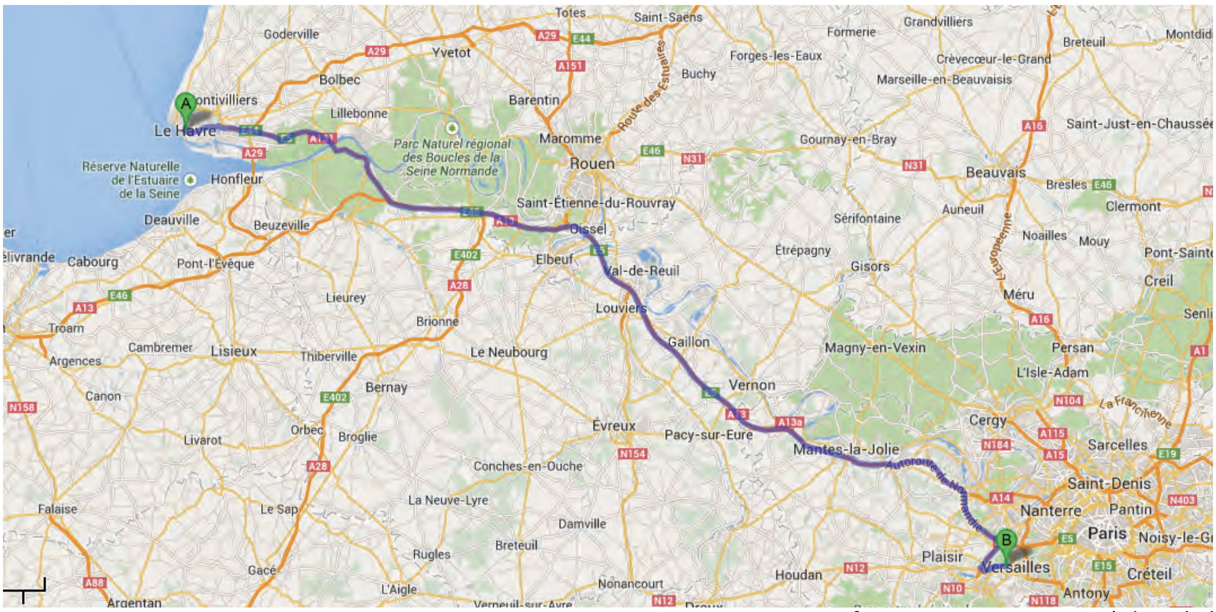


Figure 4.5.2 Route from LE HAVRE to La Cité du Soleil

Details of journey
Head west on Av. du Général Leclerc toward Pl. de l'Hôtel de ville
Take the 1st left onto Pl. de l'Hôtel de ville
Turn right onto Bd de Strasbourg
Continue onto Cours Lafayette
Continue onto Quai Colbert
Slight left onto D6015
Keep left to stay on D6015
Continue onto N282
Continue onto A131
At the roundabout, take the 3rd exit onto N182
Slight left onto E5
Continue onto A131/E5
Merge onto A13/E5
Take the exit onto A12 toward Saint-Quentin-en-Yvelines
Take the exit toward Évry/Lyon/Dreux/Saint-Quentin-en-Yvelines/Bois-D'Arcy/Versailles-Satory
Keep right at the fork, follow signs for Saint-Cyr-l'École
Turn left onto D129
Slight right onto Av. Volta/D129 Continue to follow D129
At the roundabout, take the 3rd exit onto Rue Emile Zola
Turn right onto Av. Pierre Curie/D10
Slight right to stay on Av. Pierre Curie/D10
Turn right onto Allée des Matelots
La Cité du Soleil

4.6 Determining factors for the house placing

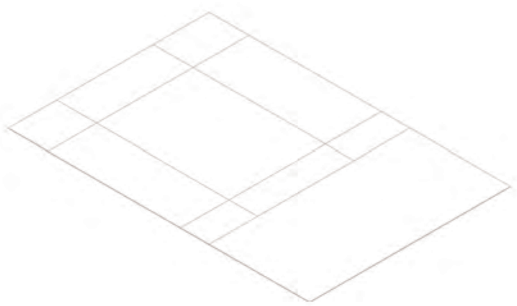
The Orchid House has adjusted its entrance and roof direction responding to the micro-climate condition and sun direction of Assembly Site. The site is benefit from short distance from main entrance of solar village, it is considered to draw visitors attention by install green core in entrance as a welcome sign.

4.7 Overlaps with the affected services and other circumstances or activities of the environment, able to cause risks during the construction

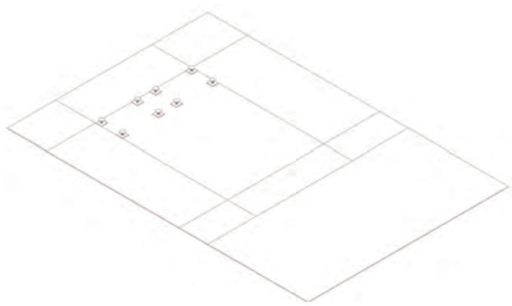
The possible assembly activities may cause conflicts are interface of crane, trucks, and electricity installation. Those activities are of danger and require highly skills. Hence the operators of these activities have been fully informed the risks and other team's process. This is to ensure all process are learned by each teams.

4.8 Planned activities

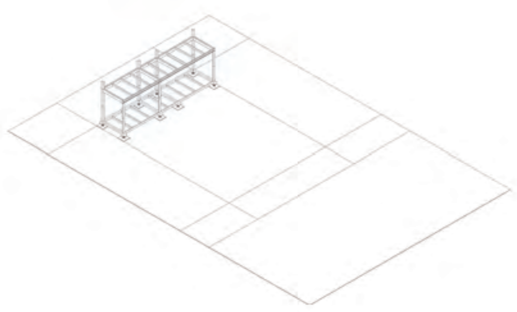
Assembly



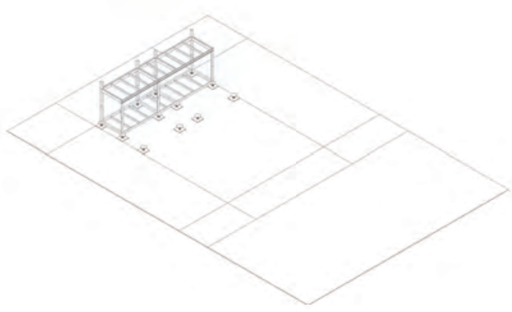
Phase 1: Lofting



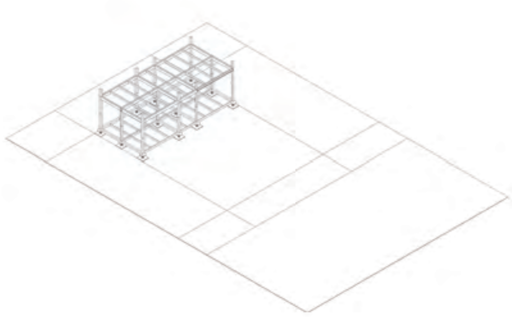
Phase 2: Footing



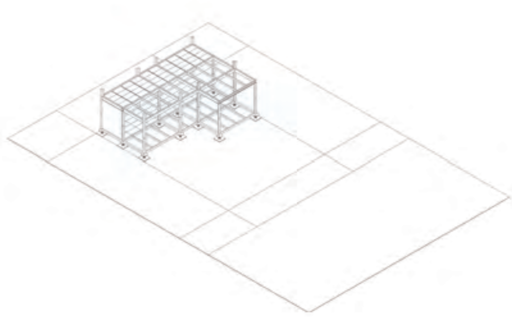
Phase 3: Assembly Unit Module



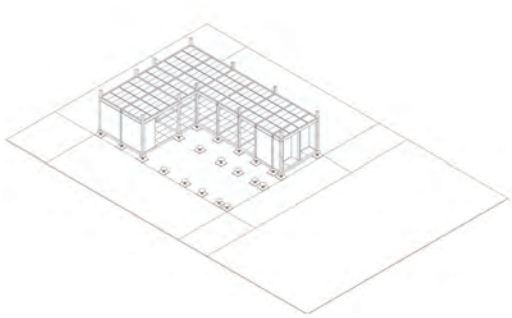
Phase 4: Second Row Footing



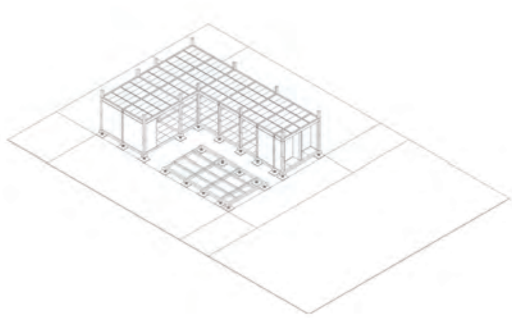
Phase 5: Assembly Unit Module



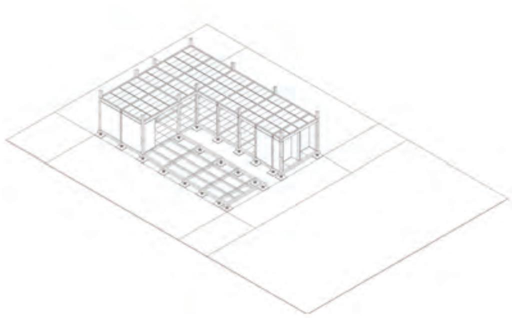
Phase 6: ther Unit and Insulation box



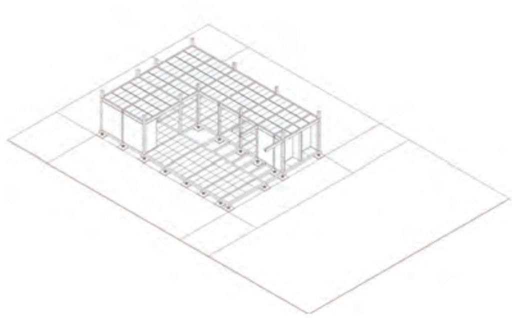
Phase 7: ther Unit and Insulation box



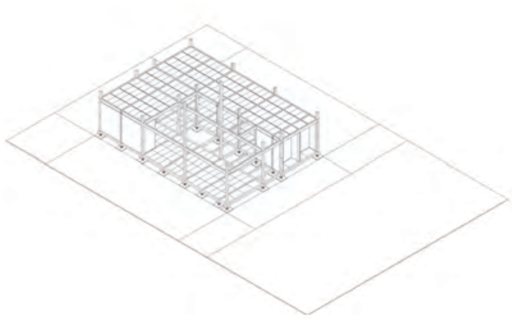
Phase 8: Terrace Unit



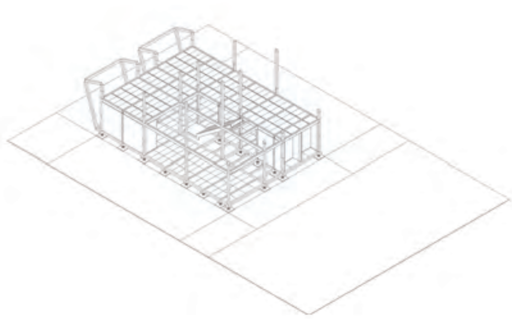
Phase 9: Terrace Unit Lower Beam



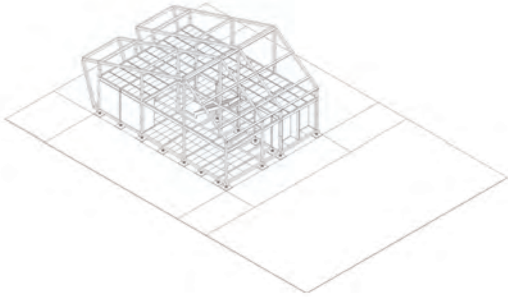
Phase 10: Stair Beam and Floor



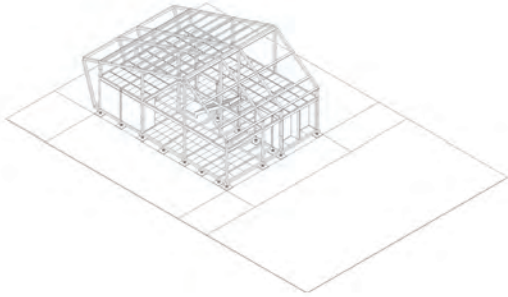
Phase 11: Terrace Structure



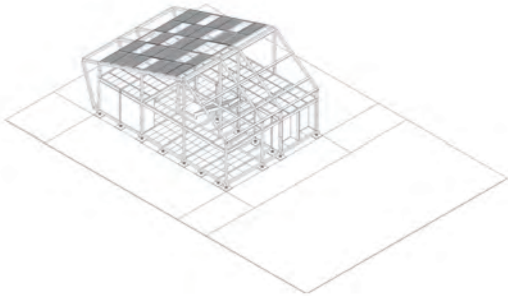
Phase 12: Louver Frame



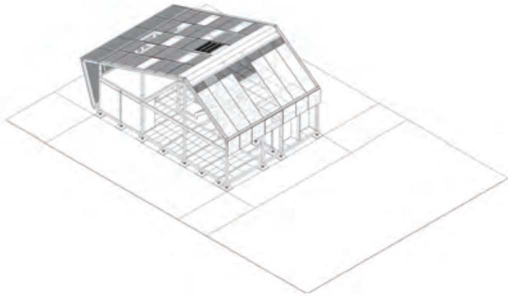
Phase 13: Roof Structure



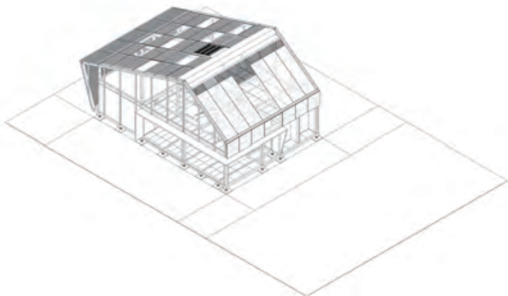
Phase 14: Solar Structure



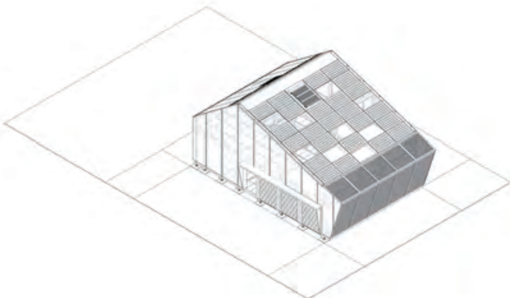
Phase 15: Solar Panel



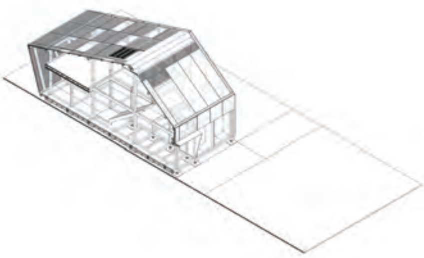
Phase 16: Roof Panel



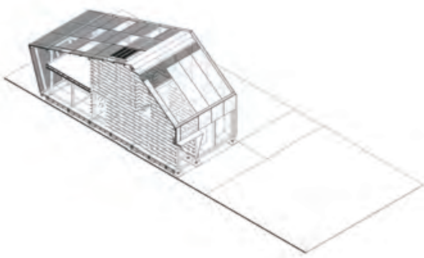
Phase 17: Additional structure



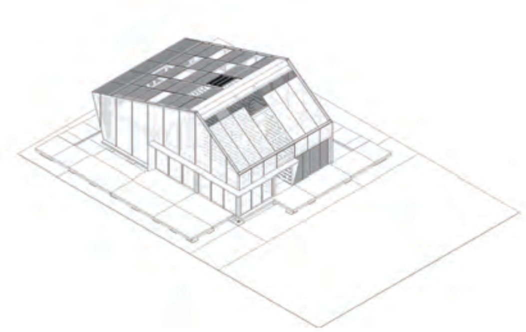
Phase 18: Bayer and Thermal Wall



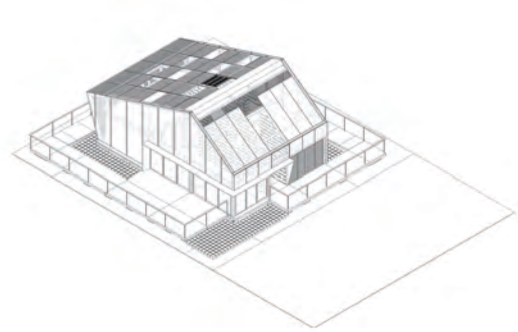
Phase 19: Finish Floor, Celling, Wall Finish



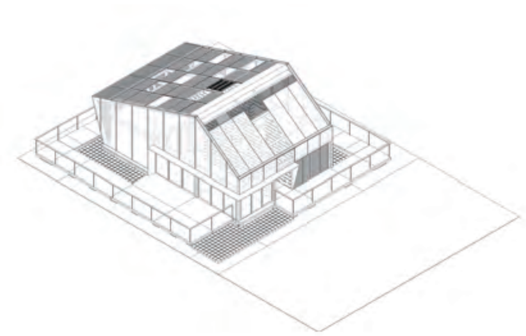
Phase 20: Green Core, MEP System



Phase 21: Out Door FLoor, Window&Door



Phase 22: Handrail, Planting



Phase 23: Clean, Furniture Position

After cleaning the site, the house function will be tested.

4.9 Trades whose intervention is affected by the risks prevention

All related workers & visitors who appear on the site should follow labour risk prevention

- For our own team
- With the teams who will be our direct neighbors and visiting workers
- With transport company
- With supporting companies working on-site
- With organizer
- Visitors and Guests
- Guides

4.10 Auxiliary resources planned for the construction

Local architect with engineering background is expected to join as a consultant during assembly and disassembly phase. Electricity installation may need local licensed technician t advise local electricity rules.

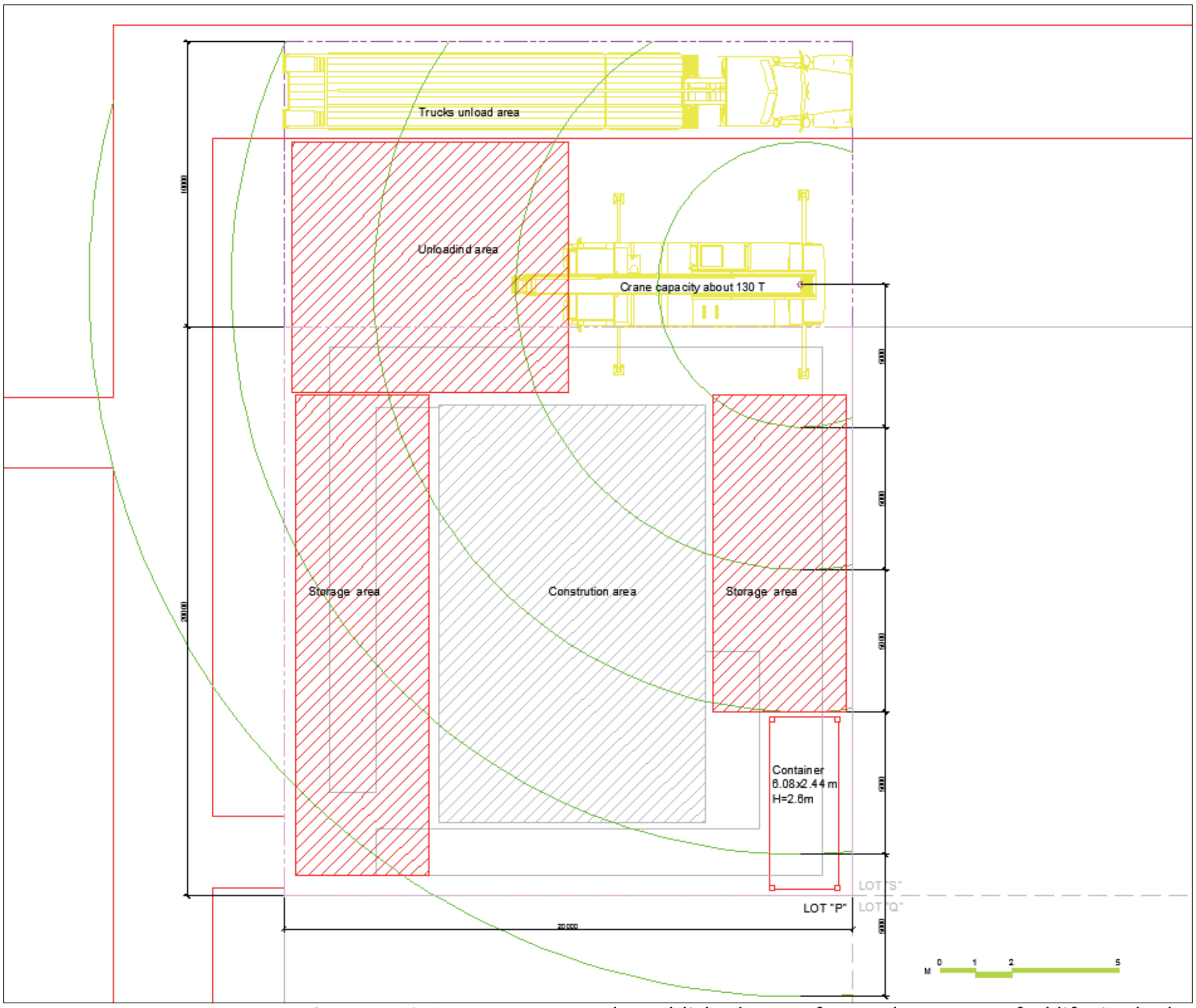


Figure 4.10.1 Movements and established areas for trucks, cranes, forklifts in the lot

Auxiliary Resources	*Where*	*When*
Trucks	At the north of the lot (see Project Drawing SO-102)	When a truck arrives and waits for being unload or load.
Crane	At the north of the lot (see Project Drawing SO-102)	During all the construction
Tools storage container	At the southeast of the lot (see Project Drawing SO-102)	During all the construction

4.11 Machinery planned for the construction

There are two categories of machinery may be used on site. One is heavy machine which requires local licensed person to operate, such as crane, truck, PV technicians. The other machines are used by decathletes such as domestic appliances.

4.12 Construction site installations

Three installations are required: PV and energy system installation, water and plumbing system installation.

4.13 Characteristics table for the stocks

Truck	*Kind*	*Designation*	*QTY*	*Dimensions (mm)*			*Weight (kg)*	*Arrival*
				L	*W*	*H*		
1	flat	Tool Container	1	3029	2438	2591	-	1
		Foundation	61	-	-	-	-	
		Construction Safety Box	1	3029	2438	2591	-	
		Unit-7	1	3750	875	3550	926	
2	Low	Unit-1	1	9150	2100	3550	5100	2
3	Low	Unit-2	1	9150	2100	3550	5100	3
4	Low	Unit-3	1	3600	2100	3550	4975	4
		Unit-4	1	3750	2100	3550		
		Unit-5	1	3750	2100	3550		
5	LOW	Unit-6	1	3750	2100	3550	-	5
		Unit-8	1	Unassembled			-	
		Stair	1	-	-	-	-	
6	Flat	Main frame Structure	-	-	-		-	6
7	Flat	wall	-	-	-	-	-	8
8	Flat	First Floor	52	900	525	400	-	7
	Flat	Second Floor	40	900	525	400	-	
9	Flat	Unit-Roof	9	9000	2100	150	2700	6
10	Flat	Ceiling panels	--	-	-	-	-	9
11	Flat	planter	-	-	-	-	-	10
12	Flat	Furniture	-	-	-	-	-	11
		Machines and tools	-	-	-	-	-	
13	Flat	Out door deck	1	6200	1600	150	723	12
			1	6375	1600	150	729	
			1	8350	2000	150	988	
			1	7750	2100	150	926	
			1	7750	2100	150	926	
			1	7475	2100	150	909	
			1	6250	1600	150	723	
			1	6250	1600	150	723	
			1	6250	1600	150	723	

5.0 Activities for risks prevention

Shift: 8 hours, breaks: 1 x 30 min and 2 x 15 min

We will work in three shifts, with 8 team members in every shift.

A Team working

Name	*Position*	*Mail*
Daisuke Nagatomo	Project Architect	dnagatomo@misosoupdesign.com
Yating Wu	Worker(student leader)	yatingwu@arch.nctu.edu.tw
Ching-Ju Chen	Worker 1	chen.chin.ju@arch.nctu.edu.tw
-	Worker 2	–
Kelly Chen	Worker 3	gooa1121@arch.nctu.edu.tw
Andrew Lu	Worker 4	happydada0810@arch.nctu.edu.tw
Ming-Hung She	Worker 5	miluchopperr@arch.nctu.edu.tw

B Team working

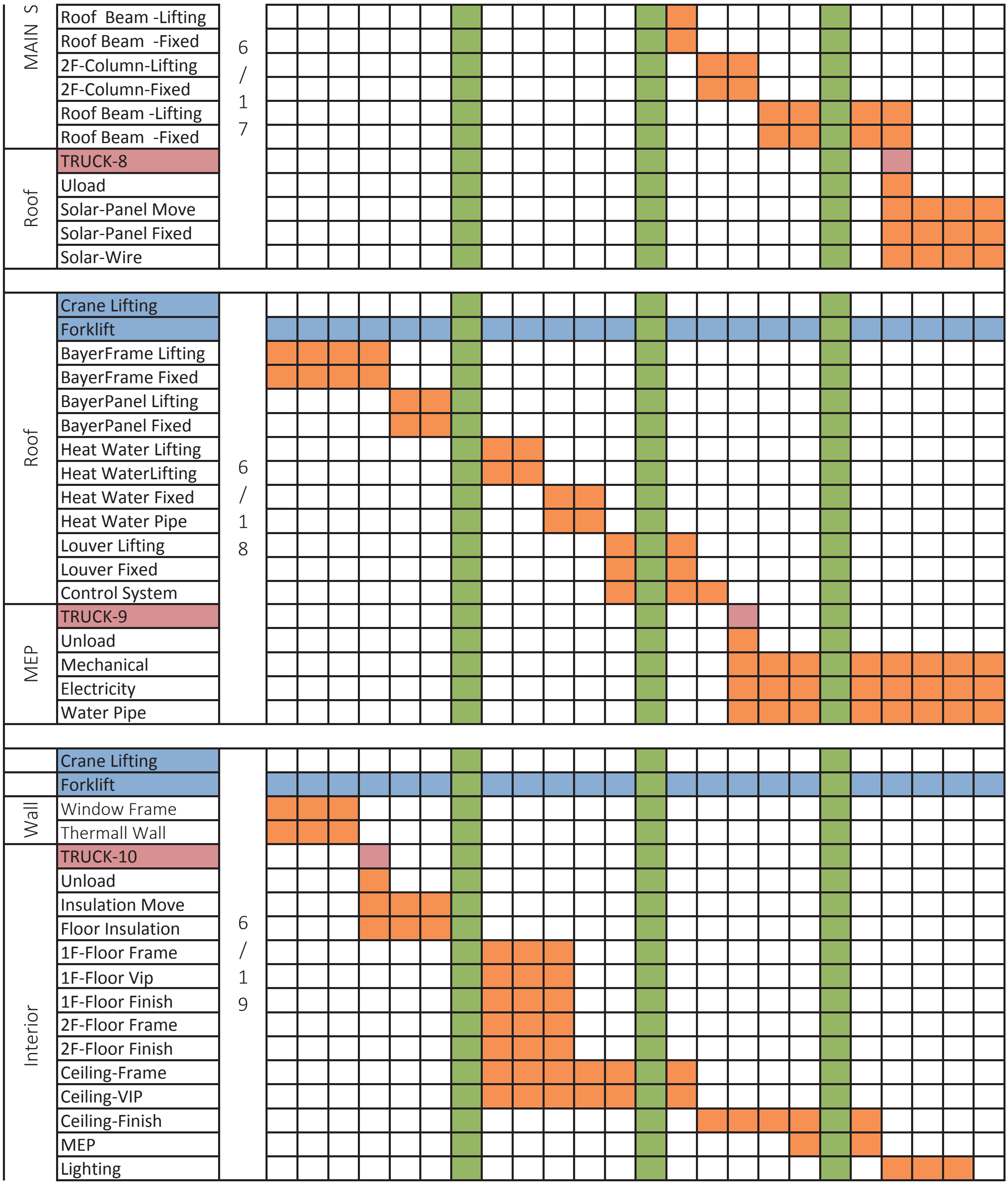
Name	*Position*	*Mail*
Minnie Jan	Project Manager	mjan@misosoupdesign.com
Sheng-Kai Sky Tseng	Worker(student leader)	sky@arch.nctu.edu.tw
Chester Hu	Worker 1	chian@arch.nctu.edu.tw
Yu-hsien Lin, Jeff	Worker 2	bluerice@arch.nctu.edu.tw
Rui Lin	Worker 3	ruikisa@arch.nctu.edu.tw
Bernard Yang	Worker 4	bernard1109@arch.nctu.edu.tw
Wan-Ling Cheng	Worker 5	minaling814@arch.nctu.edu.tw

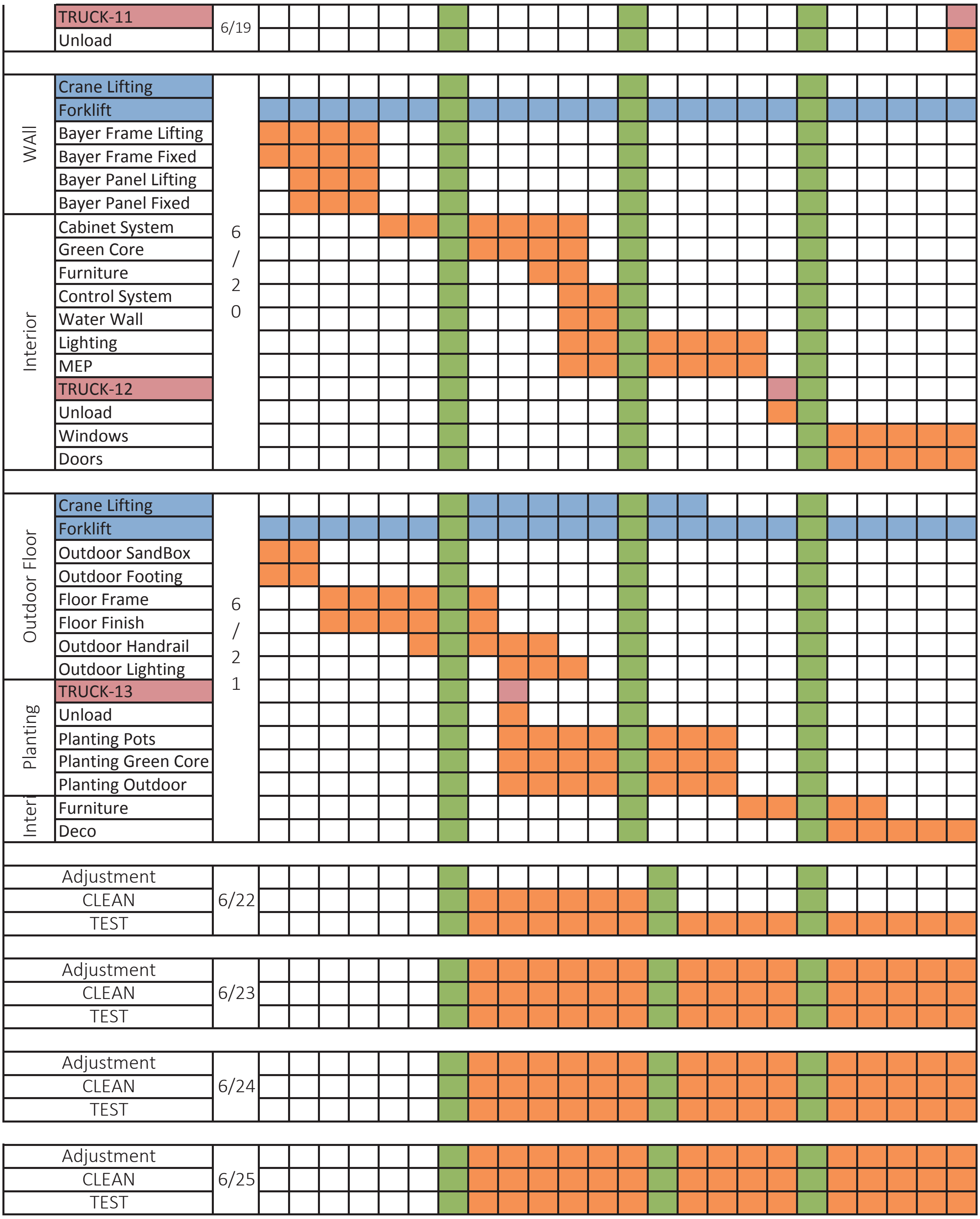
C Team working

Name	*Position*	*Mail*
Bojiun Tang	Project Manager	benjamin@arch.nctu.edu.tw
Dennis Lin	Worker(student leader)	dennis01215@arch.nctu.edu.tw
Chin Yuan Fan	Worker 1	cyfan@arch.nctu.edu.tw
Trista Wang	Worker 2	jou-hsuan@arch.nctu.edu.tw
Ruby Tu	Worker 3	Ruby_@arch.nctu.edu.tw
Sophie Chen	Worker 4	wantsi@arch.nctu.edu.tw
-	Worker 5	-

6.0 Critical work phases for risks prevention

Phase	WORK DETAIL	Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
HR	Human Resource		TEAM-C								TEAM-A											TEAM-B				
SITE PREPARATION	Truck-1	6/16																								
	Forklift																									
	50 TN Crane																									
	Unload																									
	Lofting																									
	Sand Box Set																									
	Footing Set																									
MODULE UNIT	Truck-2																									
	Unload																									
	U-12 Lifting																									
	U-12 Fixed																									
	Correction																									
	Truck-3																									
	Unload																									
	U-11 Lifting																									
	U-11 Fixed																									
	Correction																									
	Truck-4																									
	Unload																									
	U-05 Lifting																									
	U-05 Fixed																									
	Correction																									
	U-04 Lifting																									
	U-04 Fixed																									
	Correction																									
	Truck-5																									
	Unload																									
	U-03 Lifting																									
	U-03 Fixed																									
	Correction																									
MODULE UNIT	Crane Lifting	6/17																								
	Forklift																									
	U-02 Lifting																									
	U-04 Fixed																									
	Correction																									
	U-01 Lifting																									
	U-01 Fixed																									
	Correction																									
	Adjustment																									
MAIN STRUCTURE	TRUCK-6																									
	Unload																									
	Discharge																									
	Terrace																									
	U7~11-Lifting																									
	U7~11-Fixed																									
	1F-Stair-beam																									
	2F-Stair-beam																									
TRUCTURE	Temporary support																									
	TRUCK-7																									
	Uload																									
	Stair-Lifting																									
	Stair-Fixed																									
	E1~E4 Lifting																									
	E1~E4 Fixed																									


MAIN S
Roof Beam -Lifting
Roof Beam -Fixed
2F-Column-Lifting
2F-Column-Fixed
Roof Beam -Lifting
Roof Beam -Fixed
6/17
Roof
TRUCK-8
Uload
Solar-Panel Move
Solar-Panel Fixed
Solar-Wire
Roof
Crane Lifting
Forklift
BayerFrame Lifting
BayerFrame Fixed
BayerPanel Lifting
BayerPanel Fixed
Heat Water Lifting
Heat WaterLifting
Heat Water Fixed
Heat Water Pipe
Louver Lifting
Louver Fixed
Control System
6/18
MEP
TRUCK-9
Unload
Mechanical
Electricity
Water Pipe
Crane Lifting
Forklift
Wall
Window Frame
Thermall Wall
Interior
TRUCK-10
Unload
Insulation Move
Floor Insulation
1F-Floor Frame
1F-Floor Vip
1F-Floor Finish
2F-Floor Frame
2F-Floor Finish
Ceiling-Frame
Ceiling-VIP
Ceiling-Finish
MEP
Lighting
6/19


TRUCK-11
Unload
6/19
WAll
Crane Lifting
Forklift
Bayer Frame Lifting
Bayer Frame Fixed
Bayer Panel Lifting
Bayer Panel Fixed
Interior
Cabinet System
Green Core
Furniture
Control System
Water Wall
Lighting
MEP
TRUCK-12
Unload
Windows
Doors
6/20
Outdoor Floor
Crane Lifting
Forklift
Outdoor SandBox
Outdoor Footing
Floor Frame
Floor Finish
Outdoor Handrail
Outdoor Lighting
Planting
TRUCK-13
Unload
Planting Pots
Planting Green Core
Planting Outdoor
Interi
Furniture
Deco
6/21
Adjustment
CLEAN
TEST
6/22
Adjustment
CLEAN
TEST
6/23
Adjustment
CLEAN
TEST
6/24
Adjustment
CLEAN
TEST
6/25

7.0 Risks identification and efficiency evaluation of the adopted protections

7.1 Location and identification of the areas where the works involving special risks will be developed

- Fall of persons at a different level
- Fall of persons at the same level
- Fall of objects because of collapse
- Fall of objects because they come loose
- Fall of objects because of manipulation
- Stepping on objects
- Colliding with still objects
- Colliding with objects in motion
- Knocked by objects or tools
- Flying fragments or particles
- Accidents caused by living beings
- Trapped by or between objects13. Trapped by turned over machines, tractors or vehicles
- Overexertion
- Exposure to extreme environmental temperatures
- Thermal contact
- Exposure to electric connections
- Exposure to radiation
- Exposure to harmful substances
- Contact with caustic or corrosive substances
- Explosion
- Fire
- Run over or hit by vehicles
- Non traumatic pathologies

7.2 Risks identification and efficiency evaluation of the adopted protections

Check information see HS Drawing (HS-101, HS-201, HS-301, HS-401)

8.0 Collective protections to use

Give the assembly site is open space. Contractors of other team may enter the site in error. UNICODE plan corrective protection from site clearance, staff entrance check, temporary work, and health and medical assistance.

8.1 Site clearance

- Cones and ribbons: they will be used to mark critical areas like storage area or to indicate a hazard.

8.2 Staff entrance check

- Entrance check point: To check team member's identity and provide H&S information.
- Tent and sun-shelter: it will be used to provide shade for team members. We will put in this tent: drinking water, sunscreen, etc.

8.3 Temporary work

- Cones and ribbons: they will be used to mark critical areas like storage area or to indicate a hazard
- Waterproof plugs: it will be used to do outside connection.
- Railing: it will be include in the upper element to protect people doing the connection of power grids, air "ow and hydraulic.
- Rolling safety ladder
- Interior scaffolds
- Handrails: they will be handrails on the staircase to prevent fall

8.4 Health and medical assistance

- Drinking water
- First aid bag : a description is given in section 12
- Extinguisher: they will be « AB » Fire extinguisher in the container.

9.0 Individual protection resources to use

All safety rules must be followed

10.0 Safe working procedures of every Team member

The safe working procedures define the possible risk on the assembly/ disassembly phase and its prevention measure and equipments.
The procedures are written according to French building code & construction regulation. These involve, at lease, the following categories: Site and machinery / vehicle operation, emergency response, electricity supply & safety, general rules and protection on workers, safety on using temporary structure, warning and monitor system.

Safe working procedure	*Team member*
Site and machinery / vehicle operation	-Access control -Cranes and rigging -First and medical assistance -Heavy equipment operation -Motor vehicle operation -Truck movement
emergency response	-Accident report -Fire prevention and responses
electricity supply & safety	-Electrical and energy system -PV system
general rules and protection on team member / contractor	-Alcohol & drug -Hand and power tools -Hearing protection -Night work protection -House keeping -Personal protective equipment -Weather damage protection -Working time shift
safety on using temporary structure	-Ladders -Lifting -Fall protection -Scaffolds
warning and monitor system	-Hazard communication -Signs and barricades -Check & information for team member -Medical monitor

11.0 Machinery and auxiliary resources

We will obey the safe user's manual from the manufacturer of every machine, tool and/or auxiliary resource.

12.0 Planned Measures in case of accident

12.1 First aids

All of the team have the obtained a “Certificate of Basic Life Support Training” :

A team

Yating Wu
Ching-Ju Chen
Kelly Chen
Andrew Lu
Ming-Hung She

B team

Sheng-Kai Sky Tseng
Chester Hu
Yu-hsien Lin, Jeff
Rui Lin
Bernard Yang
Wan-Ling Cheng

C team

Dennis Lin
Chin Yuan Fan
Trista Wang
Ruby Tu
Sophie Chen


基本救命術合格證書
Certificate of Basic Life Support Training
姓名 (Name)： 曾聖凱
身分證字號 (ID No)： A128031568
出生年月日 (Date of Birth)： 1984/10/26
有效日期 (Valid Through)： 2015/10/10
證書字號 (Certificate No)： BLS0163626
臺灣急救教育推廣與諮詢中心
National Resuscitation Council of Taiwan

Figure 12.1.1 Certificate of Basic Life Support Training


姓名 (Name)	身分證字號 (ID No)	出生年月日 (Date of Birth)	有效日期 (Valid Through)	證書字號 (Certificate No)
陳姵頤	R223845273	1990/11/21	2015/10/10	BLS0163646
范欽媛	A226810009	1988/12/28	2015/10/10	BLS0163624
陳敬儒	B122372696	1988/03/29	2015/10/10	BLS0163621
吳雅婷	F225316543	1982/02/03	2015/10/10	BLS0163627
鄭婉伶	S223783322	1987/08/14	2015/10/10	BLS0163623
胡文謙	A126532900	1990/06/04	2015/10/10	BLS0163620
林家豪	A125683631	1987/10/04	2015/10/10	BLS0163625
林育賢	A127136493	1988/10/08	2015/10/10	BLS0163622
王柔玄	F226423869	1986/05/14	2015/10/10	BLS0163619
林育如	D222282299	1989/05/09	2015/10/10	BLS0163648
余明鴻	E123918288	1988/03/04	2015/10/10	BLS0163651
楊博輔	A126185287	1989/11/09	2015/10/10	BLS0163618
呂勇為	A126067819	1990/08/10	2015/10/10	BLS0163647
陳佑婷	G221684649	1986/06/01	2015/10/10	BLS0163649
杜懷茹	A225873324	1990/02/23	2015/10/10	BLS0163617

12.2 First aids bag

First aid kits available via normal retail routes have traditionally been intended for treatment of minor injuries only. Typical contents include adhesive bandages, regular strength pain medication, gauze and low grade disinfectant.

Contents:
- Arnica
- Adhesive tape
- Alcohol wipes or ethyl alcohol
- Antiseptic solution
- Assorted Washproof Plasters
- Elastic bandage
- Eyewash solution
- First aids manual
- Heated blanket (not sterile)
- Hemostatic dressing
- Hemostatic pads for the nos
- Moist Wipes
- Pairs of Gloves
- Plastic bag
- Resuscitation Mouth shield with Valve
- Safety pins
- Scissors
- Sterile gauze
- Sterile saline wipes
- Triangular bandage
- Tweezers

12.3 Preventive medicine

All workers have past a medical examination and are healthy; they are able to work on the construction site from a medical point. And all worker take their medicine by themselves.

12.4 Accident victims evacuation

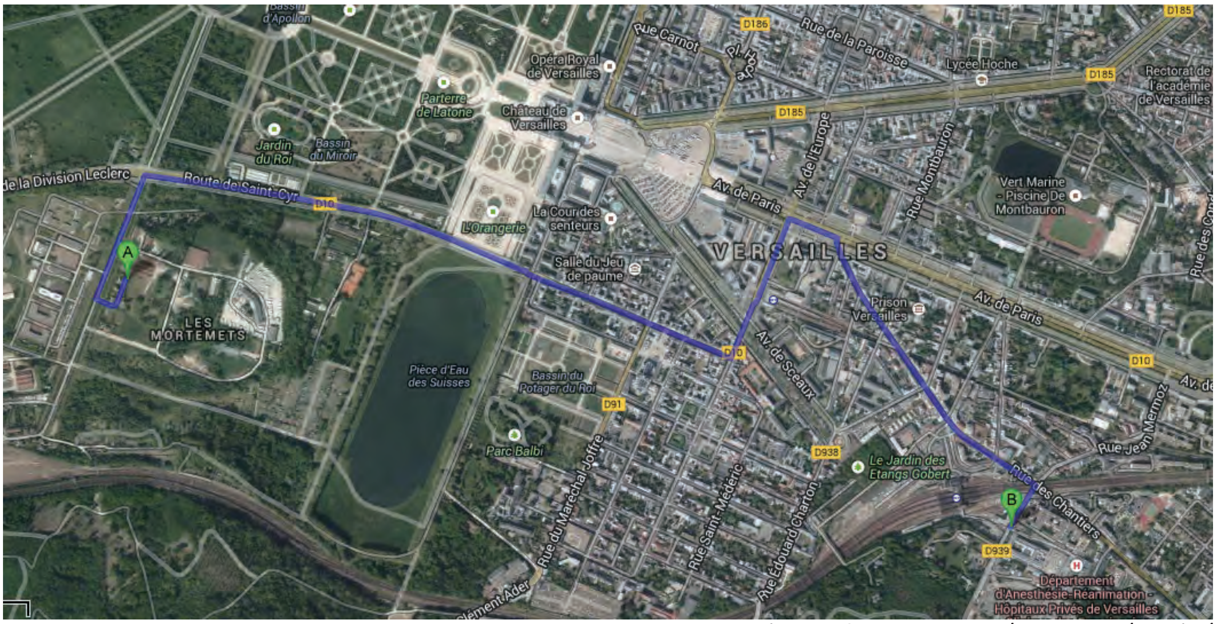


Figure 12.4.1 Route to the nearest hospital

A: La Cite du Soleil

-Head south on "Allée des Matelots"
-Turn right to stay on "Allée des Matelots"
-Turn right onto "D10"
-Turn left onto "Rue Royale/D10"
Continue to follow D10
-Turn right onto "Av. de Paris/D10"
-Turn right onto "Rue des États Généraux"
-Continue onto "Rue des Chantiers"
-Turn right onto "Pl. du 8 Mai 1945/D939"   Continue to follow D939
-Turn left

Distance: 3.4km , 8 mins

B: Département Anesthésie-Réanimation - Hôpitaux Privés de Versailles
Address: 7bis A Rue de la Porte de Buc
78000 Versailles, France
TLF: +33 826 30 33 33
anesthesie-versailles.com

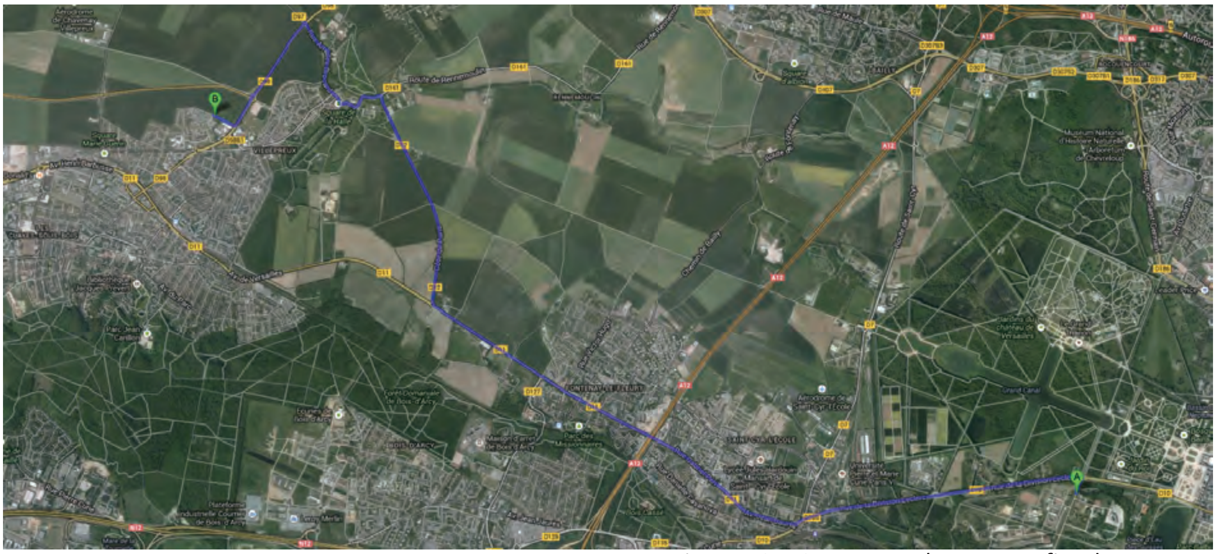


Figure 12.4.2 Route to the nearest fire department

A: La Cite du Soleil

-Head northeast on Allée des Matelotstoward D10
-Turn left onto D10
-Slight right onto Av. de la Division Leclerc/D10
-Turn right onto Av. Jean Jaurès/D11
Continue to follow D11
-At the roundabout, take the 2nd exit ontoRue Jules Massenet/D98
-Turn left onto D98

Distance: 11.3km , 18 mins

B: Sapeurs Pompiers des Yvelines
Address: Avenue de Pépinière
78450 Villepreux, France

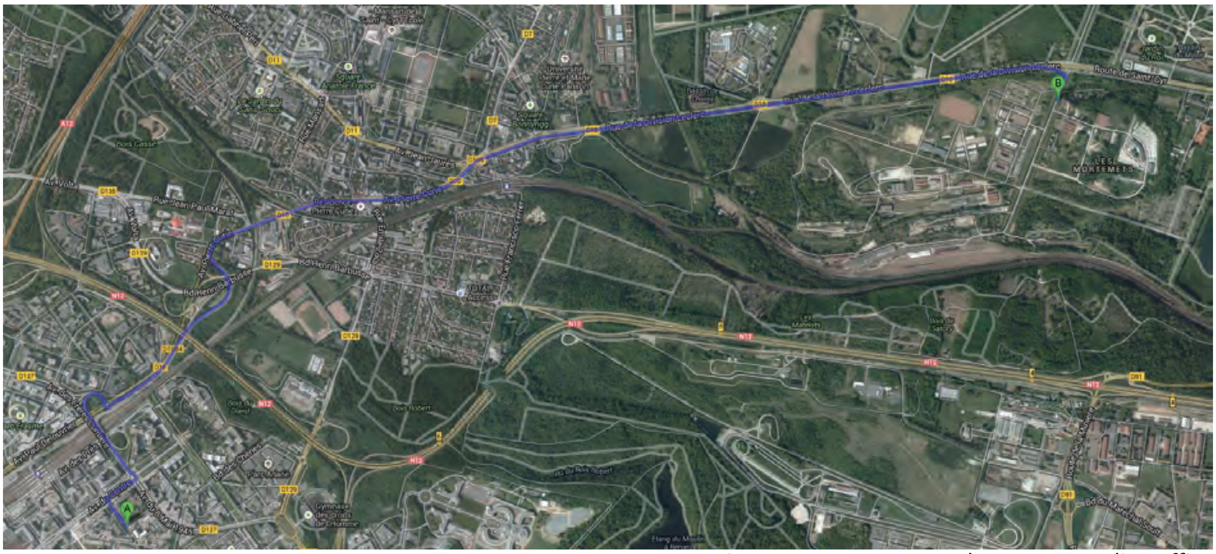


Figure 12.4.3 Route to the nearest police office

A: La Cite du Soleil

-Head northeast on Allée des Matelotstoward D10
-Turn left onto D10
-Slight right onto Av. de la Division Leclerc/D10
-At the roundabout, take the 1st exit onto the Av. des Frères Lumière/D127 ramp
- Keep left at the fork, follow signs for D127/Guyancourt/Quartier saint quentin
-Turn left onto Av. des Frères Lumière/D127
-Turn right onto Rue de la Division Leclerc

Distance: 5.8km , 9 mins

B: Commissariat de Police
Address: 1 Rue de la Division Leclerc
8280 Guyancourt, France

13.0 Risks identification for possible later works

See item 10.7.1 of this document to see the declaration about the efficacy of “Risks identification and efficiency evaluation of the adopted protections”.

14.0 Useful plans and information for possible later works

See item 10.7.1 of this document to see the declaration about the efficacy of “Risks identification and efficiency evaluation of the adopted protections”.

15.0 Adopted system for the level of health and safety control during works

Solar Decathlon Europe

ORCHID HOUSE

遵守勞工安全衛生紀律承諾書

Complying With Workplace Safety & Health Discipline Undertaking

承諾者姓名 Name	鄭婉伶 Cheng Wan-Ling	負責事項 Responsiblity	Safety & health PR
身分證字號 ID	S223783322	承諾日期 Date	2014.2.14

本人承諾遵守下列事項

I promise to comply with following rules.

承諾事項

Undertake item

1. 在工地除休息區外，我會戴好安全帽，並扣上繫帶。
I will wear a safety helmet with the chin strap buckle fastened at the construction site.
2. 在高處作業時，我會將我的安全帶扣在安全母索上。
I will fasten my safety belt to a lifeline while working at height.
3. 我絕不攜帶高度兩公尺以上的合梯進場工作。
I will never bring a stepladder which is two meters high or more into the construction site.
4. 在施工架上作業時，我絕不使用梯子、合梯或踏凳等從事作業。
I will never use ladders, stepladders or footstool while working on scaffold.
5. 我絕對遵從規定進出工地。
I will absolutely comply with rules while entering and exiting the construction site.
6. 未經主管許可，我絕不接近吊車吊舉範圍及作業車輛、機具之作業半徑內。
I will never get close to the lifting range of crane, vehicles that operated and working radius of machines without permission.
7. 我會遵照施工器具設備上標示牌索標示的安全事項辦理。
I will follow the general safety instructions labeled on equipment while operating the device.
8. 在工地我絕對不會隨意丟垃圾及拋棄口香糖殘渣。
I will never litter and split chewing gum at construction site.
9. 未經主管許可，我絕對不會在工地生火燃燒廢物。
I will never incinerate waste at construction site without permission.
10. 我會遵守識別證管制區之規定，在我的作業區內工作，未經報備，絕不到其他管制區。
I will stay and work at the permitted area under identity control. I will never go to those restricted zone unless authorized.
11. 未經主管許可，我絕不跨越護欄及警示帶。
I will never cross the guard rails and warning tapes without permission.
12. 在高處作業時，我絕對不會任意嬉戲冒險，或將物件任意拋落。
I will never play around or drop objects while working at height.
13. 我會將用電設備接在規定在電源插座上，絕不私自亂接。
I will plug power-consuming equipment in record receptacle.
14. 未經主管許可，我絕不拆除圍籬、大門、護欄、護蓋、安全網、安全母索、警示帶、施工架踏板、漏電斷路器、自動電擊防止裝置等安全防護裝置或使其失去功能。
Without permission, I will never dismantle or disable the safety protective equipment, such as fence, doors, guards , safety nets, lifeline, warring tapes, scaffold, residual current circuit breaker, voltage reducing device for AC arc welding.
15. 工作前及工作時我絕不飲用含酒精之飲料。
I will never drink alcoholic beverage before and during working.
16. 在公告禁止吸菸的區域，我絕不吸菸。
I will never smoke at non-smoking area.
17. 我絕對會將以上規定及其他有關的安全衛生守則，確實提醒本隊伍所有參與工程之工作人員共同遵守。
I will comply with and remind all the team members of the standard which is listed above and other related safety and health instructions.

* 此為代表國家之國際級重大比賽。如違反上列事項，本人願意接受交大建築所最嚴厲處分！
I understand it is an important international competition and we are a team which represents Taiwan. I promise to comply with the standards and rules. I will accept the responsibility for violations and sanctions by Graduate Institution of Architecture, National Chiao-Tung University.

此至Submitted to 交大 UNICODE 團隊

NCTUNICODE

承諾者Promisor（簽名Signature）： 鄭婉伶 Cheng Wan-Ling

16.0 Formation and information about health and safety

Title	Name	Address / Email / Phone
Faculty Advisor	David Tseng	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		cdavidtseng@gmail.com
		+886-3-571-2121 #58468
Project Manager	Chih-Ming Chien	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		s9390306@gmail.com
		+886-3-571-2121 #58467
Project Architect	Sheng-Kai Sky Tseng	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		sky@arch.nctu.edu.tw
		+886-3-571-2121 #58467
Project Engineer	Chia-Hao Lin	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		dennis01215@arch.nctu.edu.tw
		+886-3-571-2121 #58467
Structural Engineer	Sheng-I Yen	Ruentex Construction Group 10/F, No.308, Sec. 2, Bade Road, Taipei, Taiwan 10492
		+886-2-8161-9999 #7446
		rt009172@mail.ruentex.com.tw
Electrical Engineer	Robert Lour	Delta Electronics, Inc. 186 Ruey Kuang Rd, Neihu, Taipei 11491 Taiwan
		+886-2-8797-2088 #6000
		robert.luor@delta.com.tw
Student Team Leader	Sheng-Kai Sky Tseng	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		sky@arch.nctu.edu.tw
		+886-3-571-2121 #58467
Health & Safety Team Coordinator	Wan-Ling Cheng	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		minaling814@arch.nctu.edu.tw
		+886-3-571-2121 #58467
Safety Officers	Chin-Yuan Fan	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		cyfan@arch.nctu.edu.tw
		+886-3-571-2121 #58467
Site Operation Coordinators	Ming-Hung She	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		miluchopperr@arch.nctu.edu.tw
		+886-3-571-2121 #58467
Contest Captain	Chih-Ming Chien	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		s9390306@gmail.com
		+886-3-571-2121 #58467
Instrumentation Contact	Chia-Hao Lin	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		dennis01215@arch.nctu.edu.tw
		+886-3-571-2121 #58467
Communications Coordinator	Ya-Ting Wu	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		yatingwu@arch.nctu.edu.tw
		+886-3-571-2121 #58467
Sponsorship Manager	Ya-Ting Wu	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300
		yatingwu@arch.nctu.edu.tw
		+886-3-571-2121 #58467

17.0 Emergency evacuation plan during the assembly and disassembly periods

17.1 Emergency numbers

15 - medical emergency,
17 - police,
18 - fire brigade,
115 - social emergency,
119 - abused children,
116000 - missing children,
114 - National centre for emergency calls for deaf and people with hearing problems.
It is not possible to call 112 without a SIM card.

In addition to French, the calls can be answered in 40 languages thanks to the help of interpreters.

17.2 Telephone numbers of first aids members

Team A

Name	*Position*	*Phone Numbers*
Dennis Lin	Student Leader	0961-070-768
Ming-Hong She	Construction leader	0936-075-392
Chin-Yuan Fan	Site Operation Coordinator	0963-098-037
Wan-Ling Cheng	Health and Safety Officer	0929-558-039
Chester Hu	Decathlete	0961-106-633
Trista Wang	Decathlete	0926-379-838
Chin-Ju Chen	Decathlete	0910-651-371
Yu-Ming Su	Decathlete	0975-166-757
I-Chi Chen	Decathlete	0912-048-550

Team B

Name	*Position*	*Mail*
Chi-Ming Chien	Student Leader	0935-643-556
Sunny Chou	Construction Leader	0931-467-266
Jeff Lin	Decathlete	0939-752-075
Jason Huang	Decathlete	0988-717-111
Oswalt Ho	Decathlete	0912-989-157
Leslie Yen	Decathlete	0955-801-309
Yiting Chen	Decathlete	0937-656-385
Sophie Chen	Health and Safety Officer	0932-905-816
Rui Lin	Site Operation Officer	0975-503-591
Ruby Tu	Decathlete	0920-393-946

Team C

Name	Position	Mail
Sky Tseng	Student leader	0988-204-763
Cheng-Wei Wang	Construction leader	0917-781-232
Andrew Su	Site Operation Officer	0912-618-287
Henry Ko	Decathlete	0932-306-479
Shao-yi Lu	Decathlete	0984-340-701
Summer Lee	Decathlete	0975-166-757
Yung-Yen Teng	Decathlete	0936-056-176
Pei-Ling Wu	Health and safety Officer	0935-358-927
Tze-Chun Chen	Decathlete	0932-347-034
Yating Wu	Decathlete	0921-147-216

17.3 Annex 1: Identification of risks and evaluation of the efficiency of the adopted protections.

As the SDE organization has not provide “ Annes 1”, we will inclide it in the next deliverable.

17.4 Annex 2: Identification of risks for possible later works.

As the SDE organization has not provide “ Annes 2”, we will inclide it in the next deliverable.

11. DETAILED WATER BUDGET

- House usage estimate for 10 days

Use	Draws/Day (1)	Litres / Each Draw		Demand in Litres	
		Cold	Warm	Day	10 Days
Water Closet (2)	2	3.0 (L/f)		6.0	60.0
Water Closet (3)	10	1.5 (L/f)		15.0	150.0
Shower Head	2		50.0 (40°C)	100.0	1,000.0
Faucet (Hand Sink)	12		108.0 (35°C)	108.0	1,080.0
Kitchen Sink	2		36.0 (55°C)	36.0	360.0
Dishwashing	1		6.5 (50°C)	6.5	65.0
Cloth Washing	1		46.0 (45°C)	46.0	460.0
Gardening (4)	1				
Total				**317.5**	**3,175.0**

Note:
(1) The draws per day indicate the actions done by two persons.
(2) Water closet is flushed in full flow.
(3) Water closet is flushed in water – conservation flow.
(4) Gardening is assumed by using greywater.

Water budget total

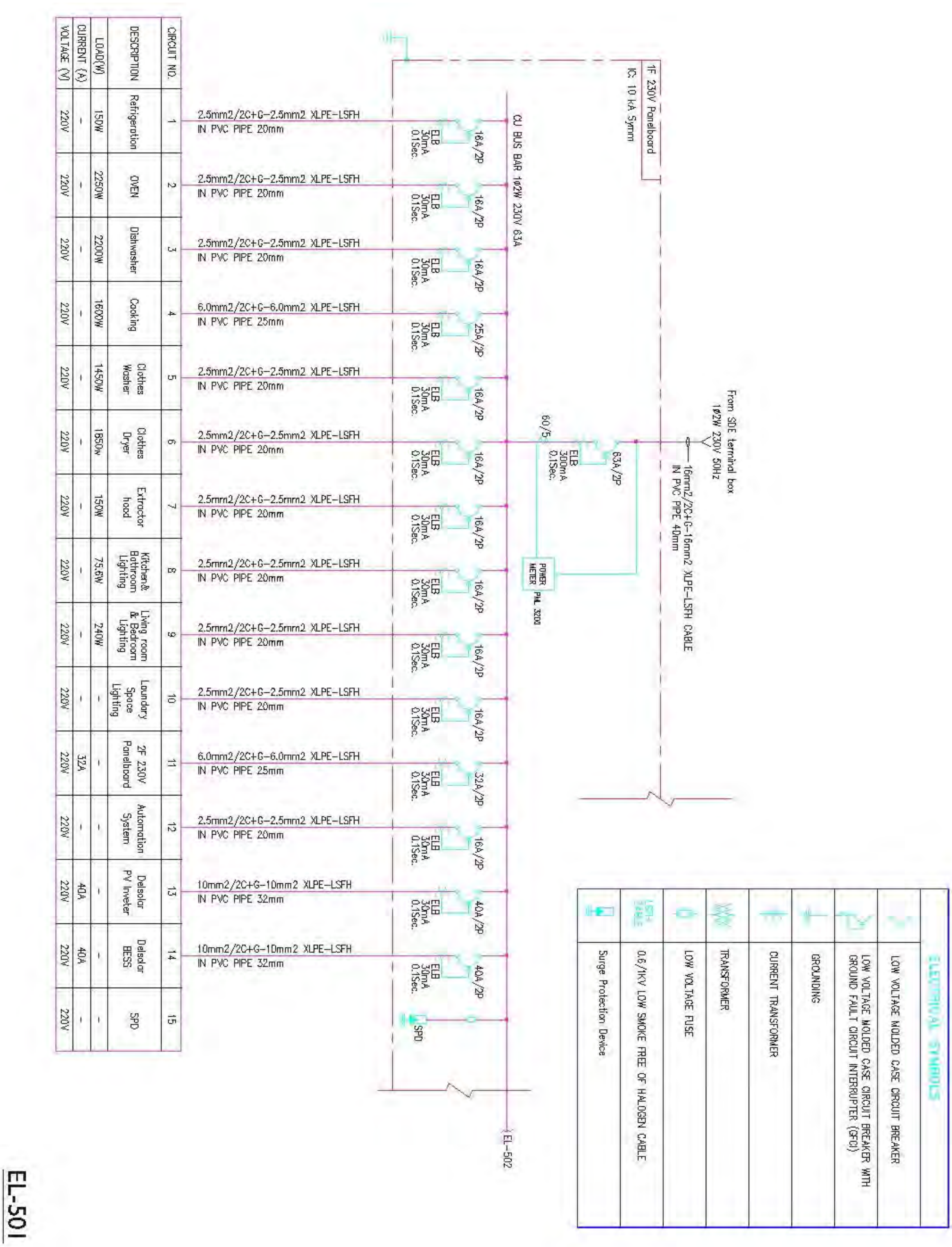
- House usage 3,175 litres
- Solar thermal system and tank 1,000 litres
  TOTAL 4,275 litres

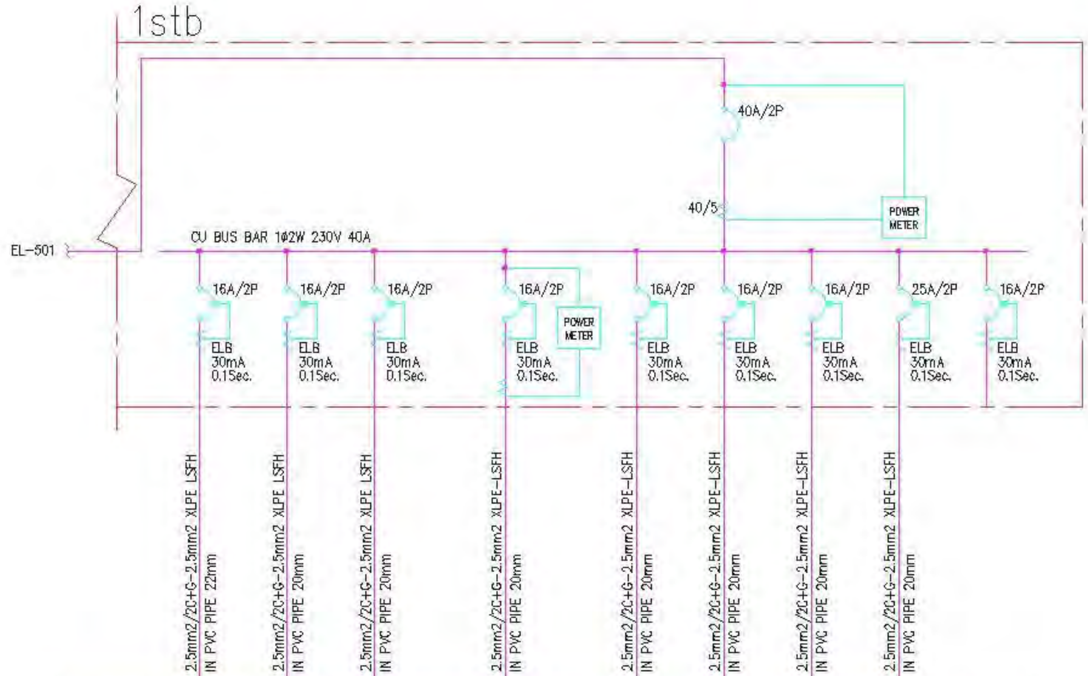
Fill requested

- Initial fill requested
  First 2,000 litres
  Top-off 900 litres
- Second fill requested 1,500 litres

12. ELECTRIC AND PV DESIGN SYSTEMS INFORMATION

One-Line Diagram

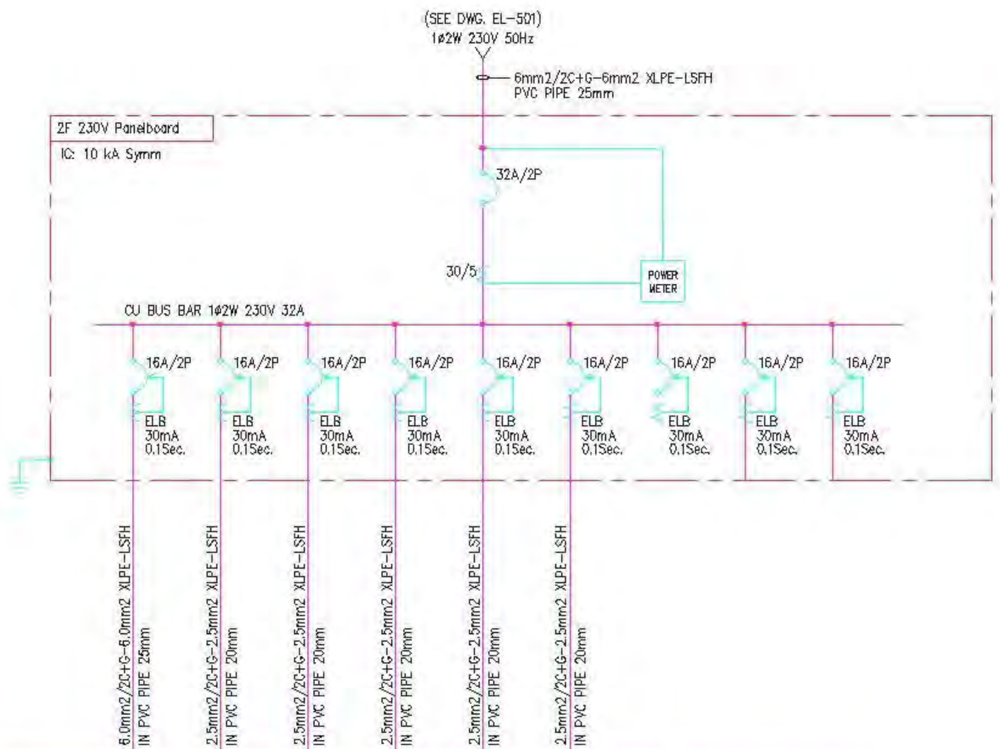




CIRCUIT NO.	16	17	18	19	20	21	22	23	24
DESCRIPTION	Domestic Water Pump	Gray Water Pump	BathRoom & Tea Terrace Receptacle	Lving Room & Workstation Receptacle (Home Electronics)	Pump 01 –	Pump 02 –	Pump 03 –	ELECTRIC CAR CHARGER	SPARE
LOAD(W)	373W	200W	–	–	435W	435W	435W	–	–
CURRENT (A)			–	–				16A	
VOLTAGE (V)	220V	220V	220V	220V	220V	220V	220V	220V	220V

ELECTRICAL SYMBOLS	
	LOW VOLTAGE MOLDED CASE CIRCUIT BREAKER
	LOW VOLTAGE MOLDED CASE CIRCUIT BREAKER WITH GROUND FAULT CIRCUIT INTERRUPTER (GFCI)
	GROUNDING
	CURRENT TRANSFORMER
	TRANSFORMER
	LOW VOLTAGE FUSE
LSFH CABLE	0.6/1KV LOW SMOKE FREE OF HALOGEN CABLE
	Surge Protection Device

EL-502



CIRCUIT NO.	1	2	3	4	5	6	7	8	9
DESCRIPTION	VRV	HRV & PCM –	Heat Pump –	Laundary Space Receptacle	Water wall Pump	Circulation FAN	Spare	Spare	Spare
LOAD(W)	2760W	100W	2100W	–	373W	40W	–	–	–
CURRENT (A)	–	–	–	–	–	–	–	–	–
VOLTAGE (V)	220V	220V	220V	220V	220V	220V	220V	220V	220V

ELECTRICAL SYMBOLS	
	LOW VOLTAGE MOLDED CASE CIRCUIT BREAKER
	LOW VOLTAGE MOLDED CASE CIRCUIT BREAKER WITH GROUND FAULT CIRCUIT INTERRUPTER (GFCI)
	GROUNDING
	CURRENT TRANSFORMER
	TRANSFORMER
	LOW VOLTAGE FUSE
LSFH CABLE	0.6/1KV LOW SMOKE FREE OF HALOGEN CABLE
	Surge Protection Device

EL-503

Table of Contents

Electric System Design Checklist

Team ID	Team Name	Country
UNI	UNICODE	Taiwan
	University	Date
	National Chiao Tung University	02/12/2014

Subject	Element	Required specification or information	Comment	Location
Connection to grid	Individual branch cable	Cross section of 3x16 mm2	Compliant	EL-001
		way taken by the conduit between General Box and Distribution Board	Partially Compliant To be update when the exact location of the SDE connection box will be known.	EL-001
		cable reference and specifications	Compliant	PM Chap 13.4
Distribution board and circuits	Main circuit breaker	The Main circuit breaker must have:	Compliant	
		breaking capacity of 6kA minimum	Compliant	EL-501
		rated current of 63A maximum	Compliant	EL-501
		overload and short circuit trip mechanism	Compliant	EL-501
		RCD of medium sensitivity(300mA)		EL-501
	Circuit separation	It's necessary to have an independent circuit breaker for lighting, for sockets (general use and refrigerator), for the hob, for the oven, for the washing machine, for the dishwasher, for the electric water heater, for Ventilation and Air-Conditioning.	Compliant	EL-501
	Socket outlet circuit	Specify the number (and the nominal current) of socket for general use per circuit. (8 sockets maximum with a cross section of 2,5mm² or 5 for 1,5mm²)	Compliant	EL-501
	Lighting point circuit	French standard recommend 8 lighting point maximum per circuit. (With wire cross section 1,5mm² at 230V)	Compliant	EL-501
	Specific circuit	Sections must be in accordance with the consumptions and assigned protections. (Use 6 mm² wire for electric hob circuit at 230V)	Compliant	EL-501
Wiring	Wire insulation	Wires to use must be insulated, made of copper and have a minimum nominal voltage of 450/750V.	Compliant	PM 13.3.4
	Wire mechanical protection	Single insulated conductors must be drawn into conduits	Compliant	PM 5.2.4
Bathroom and shower	Electrical equipment	Respect the prescription of French standard for the choice and the installation of the electrical devices in accordance with the volume classification.	Compliant	PM 5.2.4 + EL-301

		(insulation class and IP codes of equipment and conduit)		
Protection against overcurrent	Against overload	In accordance with the section of the conductor, specify the rated current of the protection. In specific circuit, justify the conductor support the rated continuous thermal current of the protection device.	Compliant	EL-501 + PM 5.2.4
	Against Short circuit	Justify each circuit breaker have a sufficient breaking capacity. The maximum current short circuit at the beginning of the installation is 6kA. In specific circuit justify magnetic current is under the minimum short circuit current.	Compliant	EL-501 + PM 5.2.4
Protection against direct contact	General	No possibility of direct contact is allowed, all electrical equipment must have a minimum IP code = 2 or be placed in the appropriate envelop		PM Chap 13.4
	Insulation class	Class 0 not allowed		PM Chap 13.4
	Socket	Socket must have children protection	Compliant	PM Chap 13.4
	Residual current device	Obligatory protection by 30 mA sensitive RCDs for all the circuit except :		
		- Circuit with a insulation transformer		EL-501
		- Surge protection device which is under the main RCD Type S	Compliant	EL-501
		- If equipment current has a DC component, used an RCD type A		EL-501
Protection against indirect contact	Strategy	Description of strategy used for indirect contact protection (circuit-breaker or switch, type, sensitivity, Safety Extra-Low Voltage, …)	Compliant	PM Chap 5.2.4
	Protective conductor	Where class I insulated appliances and equipment are installed, circuit include a protective conductor. The protective conductors must connect the earthing-pin contact in each socket outlet, and the earthing connection in class I equipment, to the main earthing terminal at the origin of the installation.	Compliant	EL-501
	Equipotential bonding	All metallic mass existing in the installation area and the accessible metallic mass of the receiving devices must be connected to the grounding, as well as those metallic parts of deposits, general heating and plumbing systems, TV and radio aerials.		EL-601-2
Exterior equipment	IP code	Justify the IP code of the exterior electrical equipment		PM Chap 13.4

Photovoltaic Checklist

Team ID	Team Name	Country
UNI	UNICODE	Taiwan
	University	**Date**
	National Chiao Tung University	01/28/2014

Important:

• In what follows, "C" means "Compliant"; "NC" means "Not Compliant"; "PC" means "Partially Compliant"; "MI" means "More information needed"; and "NA" means "Not Applicable". Answers must be provided to the "NC", "PC" and "MI" issues listed in this document.

• Teams are kindly requested to include their answers/comments in this document and create a new version that will be sent back to the SDE Organization together with updated versions of the Project Manual (Contest Support Document) and Drawings specific sections of the Photovoltaic installation.

• This process will be repeated until the electrical safety of the photovoltaic installation is guaranteed, leading to the documentation approval by the SDE Organization.

• Approval of the Photovoltaic installation (Project manual and Drawings— and *in situ* in the Cité du Soleil is a necessary condition for participating in contest 4 (Electrical Energy Balance) during the Contest week. Non-approved Photovoltaic installations will remain safely disconnected during that period.

General

Description	Comments
Photovoltaic electricity generation	
Photovoltaic installation size (nominal power of all power conditioning connected to PV generation (units: kW)	5 kW SDE comment:
Brand(s), model(s) and nominal power (units: kW) of DC/AC power conditioning equipment (inverters)	Delta Electronics, Inc Solivia 5.0 EU G4 Output 5,000 VA See PM#13.3.5b
Not Photovoltaic electricity generation	
Technology used	Not used
Installation size. Nominal power of all power conditioning (units: kW)	Not used
Brand(s), model(s) and nominal power (units: kW) of DC/AC power conditioning equipment (inverters)	Not used
Battery bank	
Brand, model and nominal power of battery inverter or inverter charger (units: kVA)	Deleco, DDP260AB-1A, 0.260 kVA
Battery inverter manufacturer certificate: compatibility with TT distribution grid	VDE-AR-N 4105:2011 ; VDE V 0124-100:2012 ; EN61000-6-3 ; EN61000-3-2 ; EN61000-3-3 ; EN61000-6-1 ; IEC 61000-4 SDE comment: See certificate of compliance PM# 13.3.5c
Nominal operation voltage of the battery bank (units: V)	48 V
Nominal capacity of the battery bank (units: Ah)	120 Ah
Small "stand-alone" Secondary batteries	
Utilisation of secondary batteries	Not used
Brand, model and nominal power of secondary batteries charger, inverter, or inverter	Not used

charger (units: kVA)	
Nominal operation voltage of the secondary batteries (units: V)	Not used
Nominal capacity of the secondary batteries (units: Ah)	Not used

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Photovoltaic system design – Compliance with standard UTE C 15-712-1

Chapter	Description		Comments
6	**Earthing**		
6.1	Earthing on AC side is compatible with TT distribution grid	Team	*PV-031 is updated as well as in PM#4 section 4.3* *See earthing in PM#5.3.4d*
		SDE	
6.2	Earthing on DC side	Team	Describe the earthing on Project Manual *PV-031 is updated as well as in PM#4 section 4.3*
		SDE	
6.3	Grounding system	Team	*See grounding in PM#5.3.4d*
		SDE	
7	**Protection against electric shock**		
7.2	Protection against direct contact	Team	See PM# 5.3.6
		SDE	
7.3	Protection against indirect contact	Team	See PM# 5.3.6
		SDE	SDE comment:
8	**Protection against short circuit and overload**		
8.1	Protection on DC side	Team	C
		SDE	SDE comment: C You use less than 3 string, so protection against short circuit is not compulsory
8.2	Protection on AC side	Team	See PM# 5.3.6
		SDE	
9	**Anti islanding protection**		
	Compliance with standard DIN VDE 0126-1-1	Team	C
		SDE	SDE comment: C If inverter use dis a Solivia 5.0 TR
10	**Protection on DC and AC side when a live conductor on DC side is directly earthed or not**	Team	MI (not directly earthed, grounding terminal is connected to DC protection box and AC switch panel, then common grounded to AC ground)
		SDE	SDE comment: C Not used
11	**Drop in voltage**		
11.2	Drop in voltage is less than 3% at I_{mppSTC}on DC side (demonstrate with calculation)	Team	C (V_{DV}%= 0.777%) (1) Module Voc=37.37V, Isc=8.63A, Temp. Coeff. of Voc=-0.131 V/°C, Temp. Coeff. of Isc=0.0043 A/°C (2) Voc@50oC=Voc(STC)+(50°C-

			25°C)*(ΔVoc/°C)=37.37+25*(-0.131) =34.095V (3) Isc@50oC=Isc(STC)+(50°C-25°C)*(ΔIsc/°C)= 8.63+25*(0.0043)= 8.74A (4) solar cable 4mm2 resistance R50=5.69Ω/km (5) module line 1m, 12 modules in series,total line length L1=12m (6) module to NVERTER length L2=20m (7) solar cable 4mm2 voltage drop VDV=2*R50*(L1+L2)*Isc= 2*5.69Ω/km*32m*8.74A=3.18V (8) module string Voc-string= 12pcs*Voc=12*34.095V=409.14V (9) DC line voltage drop DV%= VDV/Voc-string*100% =3.18/409.14*100%=0.777% *Calculation is updated in drawing PVS-011 and PM#5.3.6*
		SDE	
11.3	Drop in voltage is less than 3% at I_{mppSTC} on AC side (demonstrate with calculation)	Team	C (V_{AV}%=0.298%) (1) XLPE-LSFH 16mm2 resistance R50=1.26Ω/km (2) INVERTER to Main panel L=10m (3) INVERTER Max. current = 27.2 Aac (4) XLPE-LSFH 16mm2 voltage drop VDV=2*R50*L*I= 2*1.26Ω/km*10m*27.2A= 0.685V (5) AC line voltage drop VDV%= VDV/VGrid *100% =0.685/230*100%=0.298% *PM#5.3.6*
		SDE	SDE comment: C Put your calculations on project manual, part “electrical system design”
12	**Breaking and isolation devices**		
12.2	Isolation device	Team	C (with DC switch) *Please refer to drawing of PVS-011 and PVS-021, PV-031 as well as PM#4 section 4.3* (140128 36.6 R2.doc)
		SDE	
12.3	Emergency cut-off device	Team	C (with DC switch and NFB)
		SDE	
12.4	Cut-off for firemen	Team	C (with NFB)
		SDE	
13	**Protection against electromagnetic interference in buildings**		
13.1.1.1	Protection earth equipotentiality	Team	C (common ground of PV and AC grid, as system is TT type, neutral line is grounded so the whole system is earth equipotentiality. *Module frame is grounded with metallic roof structure*
		SDE	

13.2.1	Surge arrester on AC side	Team	*Please refer to drawing of PVS-011 and PVS-021 as well as PM#4 section 4.3* (140128 36.6 R2.doc)
		SDE	SDE comment: PC Provide your criterion for the choice of the AC surge arrester.
13.2.2	Surge arrester on DC side	Team	*Please refer to drawing of PVS-011 and PVS-021 as well as PM#4 section 4.3* (140128 36.6 R2.doc)
		SDE	
14	**Wiring**		
		Team	*Please refer to drawing of PVS-011 and PVS-021 as well as PM#4 section 4.3* (140128 36.6 R2.doc)
		SDE	SDE comment: NC Demonstrate with calculation the choice of DC cables Provide data sheet of the cables used
		Team	*Please refer to drawing of PVS-011 and PVS-021 as well as PM#4 section 4.3* (140128 36.6 R2.doc)
		SDE	
		Team	*Please refer to drawing of PVS-011 and PVS-021 as well as PM#4 section 4.3* (140128 36.6 R2.doc)
		SDE	
		Team	C
		SDE	*Please refer to drawing PV-011, PV-021, PV-031, PV-042 and PM#4 section 4.3* (140128 36.6 R2.doc)
		Team	Please refer to drawing PVS-031
		SDE	Minimize loop between live conductors and protection earth cable.
		Team	REF MANUAL 36.5
		SDE	SDE comment: C PM3, Page 267
		Team	C
		SDE	SDE comment: C PM3, Page 267
	Compliance with standard EN61646 for amorphous silicon solar panels	Team	NA
		SDE	
14.5	Electrical devices on DC side	Team	C

		SDE	SDE comment: NC Demonstrate with calculation the choice of all DC side devices. *Please refer to drawing PV-011, PV-021, PV-031 and PM#4 section 4.3* (140128 36.6 R2.doc)
14.6	Accessibility Location of electrical equipment (PV modules, junction boxes, inverter, protection devices, etc.) must guarantee proper operation and maintenance, according to good design & installation practices and manufacturers' indications.	Team	C
		SDE	SDE comment: PC Provide inverters location and layout and electrical cabinet layout *Please refer to drawing AR-021 for electrical equipment location. Electrical cabinet drawing will be provided later when manufacturer provides to us.*
14.7	Photovoltaic connector: Compliance with standard EN50521	Team	C
		SDE	SDE comment: NC Provide certificate of compliance and data sheet. *Will provide later when vendor data received.*
14.8	Surge arrester	Team	C
		SDE	SDE comment: PC Provide surge arrester data sheet and criterion of choice *Will provide later when vendor data received.*
14.8.1	Compliance with standard EN61643-11 for surge arrester on AC side	Team	C
		SDE	SDE comment: NC Provide certificate of compliance. *Will provide later when vendor data received.*
14.8.1	Compliance with standard UTE C 61-740-51 for surge arrester on DC side	Team	C
		SDE	SDE comment: NC Provide certificate of compliance. *Will provide later when vendor data received.*
14.8.2	Wiring of surge arresters	Team	C REF DRAWING
		SDE	SDE comment: NC Provide a multi-wire drawing in PV031 Specify the cross section of the protection earth cable Be careful with the length of cable while wiring a surge arrester (50 cm max) *Please refer to PV-031*
15	**Photovoltaic warning labels**		
15.1	All devices and cables are identified	Team	C
		SDE	SDE comment: NC Provide all cables and devices identification *Please refer to PV drawings.*
15.2	Label on DC side, AC side and on the inverter	Team	C
		SDE	SDE comment: NC

			Provide all labels necessary on DC and AC side *Please refer to PV drawings. All panel and equipment will be labeled with name and hazard warning.*
16	**Dossier technique**	Team	C drawing, certification and supplemental document
		SDE	SDE comment: NC Provide a technical document containing - a one line electric diagram, - an electric cabinet layout - a PV layout - the electric wiring *Please refer to EL-501~503, PV-001~002, PV-011, PV-021, PV-031, PV-041~042*
17	**Maintenance plan** Photovoltaic modules/generator(s), supporting structure, inverter(s), cables and wiring methods, protections and earthing system	Team	C REF MANUAL 36.5
		SDE	SDE comment: NC Provide maintenance plan. *Please refer to PM#4 section 6.5* (140128 36.8 R1.doc)

Photovoltaic system design – Compliance with standards for the inverters

Description		Comments
Compliance with standard DIN VDE 126-1-1	Team	C
	SDE	SDE comment: C If inverter use dis a Solivia 5.0 TR *Inverter used is Solivia 5.0 TR*
Voltage operating range (230 V – 20% < V < 230 V + 15%)	Team	C (195 V < V < 253 V)
	SDE	SDE comment: C
Frequency operating range (50 Hz – 2.5 Hz < f < 50 Hz + 0.2 Hz)	Team	C (47.5 Hz < f < 50.2 Hz)
	SDE	SDE comment: C
Harmonics		
Compliance with standard CEI 61000-3-2	Team	C (EN61000-3-2)
	SDE	SDE comment: C
Compliance with standard CEI 62109	Team	C (IEC62109-1 / -2)
	SDE	SDE comment: C

Photovoltaic system drawings

• Teams must complete the drawings according to the specifications given below.
• Drawings reference numbers shown below indicate the minimum drawings required for approval. Additional drawings can be included, provided that they respect the corresponding section, for example: for particular details of the complete PV system, new drawings with reference numbers PV-002 to PV-009 can be added. The same applies for details of the DC circuits (new drawings: PV-012 to PV-019), AC circuits (PV-022 to PV-029) and Grounding system (PV-031 to PV-039)

PV-001	**Photovoltaic system: General**	Team	

	This drawing shall be electrical and include the interfaces with the electrical installation of the house and the electricity distribution network	SDE	SDE comment: PC PV-001 must be an electrical diagram. Indicate string lengths Indicate cross section of all conductors Draw all devices used on DC side and on AC side *Please refer to drawing PVS-011, PVS-021, PVS-031 and PVS-041 for all details*
PV-002	Photovoltaic system: General 2		SDE comment: C
PV-011	**Photovoltaic system: DC circuits** This drawing shall be electrical and include information about wiring (section, type), protections (current characteristics) and wiring methods of DC circuits	Team	
		SDE	SDE comment: NC On DC side you must use an emergency cut-off device. This device must isolate the DC side too. Use one bipolar emergency cut-off device per string. All PV panels must be drawn with the layout. Indicate to all devices a marker Indicate string length *Please refer to drawing PVS-011 and PVS-042*
PV-021	**Photovoltaic system: AC circuits** This drawing shall be electrical include information about wiring (section, type), protections (current characteristics) and wiring methods of AC circuits	Team	
		SDE	SDE comment: NC You must use a RCD breaker or switch with a sensivity of 30 mA and a high immunity You have to provide the internal electric diagram of your BESS and specify protections used Indicate to all devices an identifier *Please refer to PM#4 section 4.3* (140128 36.6 R2.doc) *and drawing PVS-021*
PV-031	**Photovoltaic system: Grounding system** This drawing shall include information about wiring (section, type) and wiring methods of the grounding system, including DC and AC circuits	Team	
		SDE	SDE comment: NC All PV panels must be connected to the ground. Indicate to all devices an identifier All the devices grounded must be drawn Take care about the possible loop that can create overvoltage induced by lightning *Module frame is grounded to metallic structure of the roof, please refer to drawing PVS-011, PVS-021, PVS-031 and PVS-042*
PV-041	Photovoltaic system: Module Layout		SDE comment: C

PV-042 Photovoltaic system: Module string Layout

SDE comment: C

Team ID	Team Name	Country
UNI	UNICODE	Taiwan
	University	Date
	National Chiao Tung University	01/28/14

The standard to which this document refers is the EN 50272-2 (European Norm): “Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries”. The first column of this table indicates the specific section of the norm to which it refers.

Important:

• In what follows, “C” means “Compliant”; “NC” means “Not Compliant”; “PC” means “Partially Compliant”; “MI” means “More information needed”; and “NA” means “Not Applicable”. Answers must be provided to the “NC”, “PC” and “MI” issues listed in this document.

• Teams must write the required information and theirs comments in the correspondent yellow area.

• Teams are requested to include their answers/comments in this document and create a new version that will be sent back to the SDE Organization together with updated versions of the Project Manual and Drawings (specific sections of the electrical storage system.)

• This process will be repeated until safety of the electrical storage system is guaranteed, leading to its approval by the SDE Organization. Approval of the electrical storage system (documents —Project manual and Drawings— and in situ in the Solar Village) is a necessary condition for its use in contest 4 (Electrical Energy Balance) during the Contest week. Non-approved electrical storage systems will remain safely disconnected during that period.

Main characteristics		
Hard-wired battery bank	Nominal voltage (units: V)	48 V SDE comment: In the PM3 (p 42) you specify 8*12 V * 60 Ah *Confirmed as 48V, update PM3 with specification*
	Nominal capacity (units: Ah)	*120*
	Type	*$LiFePO_4$*
	Brand and model	*DENSIS 48120T*
Battery inverter	Nominal power (units: kW)	0.260 kVA *0.260 kVA/unit x 12 units = 3.120 kVA* *The battery inverter is part of the BESS system and is used for transferring battery DC power to AC power* SDE comment: In the PM3 (p 42) you specify 5.76 kWh) *5.76 kWh listed in PM3 (p42) is the total capacity of the battery bank. Not necessary relevant to battery inverter.*
	Brand and model	Deleco DDP260AB-1A

ID	Section of the norm		Comments
	Protections against electrical discharge (section 5)		
1	Protection against direct contact.	Team	Terminal is covered for direct contact protection. Grounding is in place.
		SDE	
2	Protection against indirect contact.	Team	Protective device such as Low Voltage Dis-connector is in place.
		SDE	SDE comment: Use RCD to protect on AC side *Changed to RCD device for protection*
3	Grounding: system of hard-wired battery bank and battery inverter.	Team	positive grounded
		SDE	SDE comment: Why do you ground the plus conductor?

			In our BESS we use many telecom components and that positive grounding is a common practice in such systems. However, grounding of the positive conductor is optional as DC voltage is used only inside of the BESS. The enclosure grounding is a must.
	Disconnection and battery separation (section 6)		
4	Devices to disconnect the input, output, and grounding of batteries	Team	Low Voltage Disconnector (LVD) on negative battery wire controlled by system controller
		SDE	
.			
	Short-circuit prevention and protection against other effects of the electrical current (section 7)		
5	Protection devices against short-circuits.	Team	MCB 120
		SDE	SDE comment: Demonstrate your choice with calculation *Changed to MCB 120A* *MCB 120A is used to protect a negative conductor of the battery as the maximal battery current is 120 A. On the AC side we use MCB32A because a maximal BESS AC input power is 6000W*
6	Selection criteria for the DC and AC cables, in order to minimize the risk of grounding faults or short-circuits.	Team	Follow national electrical code
		SDE	SDE comment: Demonstrate your choice with calculation *The maximal battery current is 120 A and DC battery cables cross section is 35mm2. AC maximal current is 32 A and a AC cable cross section is 6 mm2. That is according to IEC60364-5-523. The battery cables are double-insulated and fire-proof.*
7	Selection criteria of DC and AC wire conducts.	Team	Follow national electrical code
		SDE	SDE comment: Demonstrate your choice with calculation *See comment above. The cables are made of cooper.*
	Precautions against possible explosions (section 8)		
8	Minimal ventilation flux for the used battery rack.	Team	System is placed in indoor cabinet without additional ventilation. Rectifiers are equipped with fans. Inverters are convection-cooled
		SDE	SDE comment: Demonstrate your choice with calculation *Maximal operating temperature of the battery used in the system is 60 °C, Maximal expected ambient temperature is 30 °C, maximal power dissipation during charging/discharging is 350W, thermal conductivity of the cabinet is 30W/K. Expected maximal battery temperature is 350W/30W/K+30°C=42°C, which is much below the limit. No additional ventilation system is needed for the battery compartment.*
9	Ventilation system used.	Team	System is placed in indoor cabinet without additional ventilation.
		SDE	SDE comment:

			Describe in the electrical storage system checklist answer the location of your battery bank, the ventilation system used… *Please see PM#3 4.3 for picture which demonstrates the location of each component.*
10	Proximity to the battery.	Team	The battery cabinet is stand alone
		SDE	
	Battery housing, battery covering (section 10)		
11	Battery housing	Team	Metal
		SDE	SDE comment: C
12	Battery sealing	Team	Need more information from the selected vendor
		SDE	SDE comment: *Battery cells come from Winston Battery - see additional file of catalog and MSDS.*
	General labels and danger labels (section 12)		
13	General labels and danger labels.	Team	As standard from vendor
		SDE	SDE comment: *We use standard labeling for low voltage electrical equipment (DC up to 60V, AC up to 230V) and additional danger labels on the LiON battery.*
	General Security		
14	Material Safety Data Sheet (MSDS) of the batteries.	Team	comply
		SDE	SDE comment: *Please find MSDS document PM#13.3.5c_MSDS (p.xx)*

13. CONSTRUCTION SPECIFICATIONS

11. Footing Design

The reactions of single footing are obtained by SAP2000 analysis results. The following list shows the reactions for footing design and soil bearing check.

TABLE: Joint Reactions								
Joint	OutputCase	CaseType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm
1	101	Combination	105.87	37.87	2379.82	0	0	0
1	201	Combination	38.63	33.96	2122.53	0	0	0
1	202	Combination	156.54	39.82	2333.76	0	0	0
1	203	Combination	-27.71	19.85	1100.37	0	0	0
1	204	Combination	129.52	27.67	1382	0	0	0
1	301	Combination	100.52	-28.28	1850.53	0	0	0
1	302	Combination	156.54	39.82	2333.76	0	0	0
1	303	Combination	54.82	-63.13	737.69	0	0	0
1	304	Combination	46.99	110.65	1744.68	0	0	0
5	101	Combination	-34.46	93.99	3445.95	0	0	0
5	201	Combination	-132.97	78.4	2917.99	0	0	0
5	202	Combination	66.96	80	3262.45	0	0	0
5	203	Combination	-153.34	23.3	1186.5	0	0	0
5	204	Combination	113.24	25.45	1645.78	0	0	0
5	301	Combination	-26.14	15	2717.66	0	0	0
5	302	Combination	66.96	80	3262.45	0	0	0
5	303	Combination	-10.9	-61.23	919.39	0	0	0
5	304	Combination	-29.2	109.98	1912.88	0	0	0
6	101	Combination	63.36	-20.07	2653.56	0	0	0
6	201	Combination	-39.9	-20.69	2531	0	0	0
6	202	Combination	156.95	-18.03	2224.32	0	0	0
6	203	Combination	-100.41	-13.84	1289.43	0	0	0
6	204	Combination	162.06	-10.29	880.53	0	0	0
6	301	Combination	65.55	-96.36	1480.64	0	0	0
6	302	Combination	156.95	-18.03	2224.32	0	0	0
6	303	Combination	40.19	-114.73	-111.06	0	0	0
6	304	Combination	21.46	90.6	2281.02	0	0	0
10	101	Combination	-96.77	-2.97	1955	0	0	0
10	201	Combination	-151.07	-1.71	1910.27	0	0	0
10	202	Combination	-27.13	-4.33	1681.06	0	0	0
10	203	Combination	-128.9	-0.47	1075.15	0	0	0
10	204	Combination	36.37	-3.96	769.54	0	0	0
10	301	Combination	-80.9	-62.82	1083.24	0	0	0
10	302	Combination	-27.13	-4.33	1681.06	0	0	0
10	303	Combination	-35.33	-81.95	-27.55	0	0	0
10	304	Combination	-57.2	77.52	1872.25	0	0	0
11	101	Combination	-8.04	1.79	900.74	0	0	0
11	201	Combination	-13.73	3.33	802.77	0	0	0
11	202	Combination	0.27	-0.32	798.88	0	0	0
11	203	Combination	-11.29	2.89	353.35	0	0	0
11	204	Combination	7.37	-1.98	348.17	0	0	0
11	301	Combination	-6.02	1.35	1001.39	0	0	0
11	302	Combination	0.27	-0.32	798.88	0	0	0
11	303	Combination	-1.02	0.26	618.18	0	0	0
11	304	Combination	-2.9	0.66	83.34	0	0	0

TABLE: Joint Reactions								
Joint	OutputCase	CaseType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm
81	101	Combination	188.28	118.26	4398.78	0	0	0
81	201	Combination	74.45	106.03	3835.41	0	0	0
81	202	Combination	257.96	117.92	4154.09	0	0	0
81	203	Combination	-52.35	57.26	1735.4	0	0	0
81	204	Combination	192.34	73.12	2160.3	0	0	0
81	301	Combination	162.2	19.82	4249.47	0	0	0
81	302	Combination	257.96	117.92	4154.09	0	0	0
81	303	Combination	64.65	-57.69	2287.47	0	0	0
81	304	Combination	75.34	188.07	1608.23	0	0	0
85	101	Combination	-82.86	178.89	5284.11	0	0	0
85	201	Combination	-205.95	164.29	4515.84	0	0	0
85	202	Combination	55.99	170.77	4830.78	0	0	0
85	203	Combination	-210.58	89.08	1778.69	0	0	0
85	204	Combination	138.67	97.73	2198.61	0	0	0
85	301	Combination	-80.63	78.11	4917.86	0	0	0
85	302	Combination	55.99	170.77	4830.78	0	0	0
85	303	Combination	-43.48	-25.82	2314.71	0	0	0
85	304	Combination	-28.43	212.63	1662.59	0	0	0
87	101	Combination	132.29	77.18	5946.94	0	0	0
87	201	Combination	-15.19	83.45	5383.88	0	0	0
87	202	Combination	247.57	80.39	5078.13	0	0	0
87	203	Combination	-127.65	69.33	2362.05	0	0	0
87	204	Combination	222.7	65.25	1954.39	0	0	0
87	301	Combination	110.8	13.14	5348.31	0	0	0
87	302	Combination	247.57	80.39	5078.13	0	0	0
87	303	Combination	40.33	-24.42	2314.64	0	0	0
87	304	Combination	54.71	159.01	2001.8	0	0	0
91	101	Combination	-154.83	137.02	4277.53	0	0	0
91	201	Combination	-230.34	136.22	4041.9	0	0	0
91	202	Combination	-46.45	121.59	3723.64	0	0	0
91	203	Combination	-184.97	82.94	2101.12	0	0	0
91	204	Combination	60.22	63.43	1676.76	0	0	0
91	301	Combination	-143.02	68.08	4071.1	0	0	0
91	302	Combination	-46.45	121.59	3723.64	0	0	0
91	303	Combination	-68.53	-7.91	2140.04	0	0	0
91	304	Combination	-56.21	154.28	1637.84	0	0	0

In the previous list, the maximum vertical force is 6475kgf and uplift force is 111kgf. The uplift force does not include the footing base. After considering the footing weight (near 70kgf), the uplift force is reduced to 41kgf. It is too small and can be ignored. Therefore, we only consider the maximum compressive force 6475kgf for footing design.

(A) Axial Capacity Check

The M40 screw bar is 300mm long and its both ends (100mm in length) are constrained in a series of stiffness plates. Therefore, its axial allowable compressive load is $0.6F_y \times A_b$ = 18.85tf. It is quite enough to resist the above-mentioned force, 6429kgf.

(B) Soil bearing check

The allowable soil bearing stress is $4tf/m^2$ for short term loading in site. Therefore, the footing plate size 60x60cm is not enough, so sandbox in size of 120x120cm will adopted under the footing plate with 12cm THK. Then the soil bearing, $6.429/((1.2+0.12*2)x(1.2+0.12*2))= 3.1\ tf/m^2$, is less than the allowable soil bearing stress.

Steel Sections

(1) Steel Column (Box-150x150x6)

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignTyp	Status	Ratio	RatioTyp	Combo
105	BOX150x150x6	Column	No Messages	17.4%	PMM	202
106	BOX150x150x6	Column	No Messages	19.9%	PMM	201
107	BOX150x150x6	Column	No Messages	15.5%	PMM	202
108	BOX150x150x6	Column	No Messages	14.1%	PMM	201
113	BOX150x150x6	Column	No Messages	28.6%	PMM	301
114	BOX150x150x6	Column	No Messages	21.2%	PMM	301
115	BOX150x150x6	Column	No Messages	26.9%	PMM	301
116	BOX150x150x6	Column	No Messages	25.5%	PMM	301
119	BOX150x150x6	Column	No Messages	30.0%	PMM	301
120	BOX150x150x6	Column	No Messages	23.4%	PMM	201
121	BOX150x150x6	Column	No Messages	29.4%	PMM	202
122	BOX150x150x6	Column	No Messages	28.3%	PMM	201
126	BOX150x150x6	Column	No Messages	22.8%	PMM	202
127	BOX150x150x6	Column	No Messages	19.5%	PMM	201
128	BOX150x150x6	Column	No Messages	27.6%	PMM	202
129	BOX150x150x6	Column	No Messages	20.8%	PMM	201
205	BOX150x150x6	Column	No Messages	28.2%	PMM	101
206	BOX150x150x6	Column	No Messages	25.9%	PMM	101
207	BOX150x150x6	Column	No Messages	30.6%	PMM	101
208	BOX150x150x6	Column	No Messages	29.5%	PMM	101
246	BOX150x150x6	Column	No Messages	18.3%	PMM	202
247	BOX150x150x6	Column	No Messages	23.3%	PMM	202
248	BOX150x150x6	Column	No Messages	19.4%	PMM	202
249	BOX150x150x6	Column	No Messages	20.1%	PMM	201
212	BOX150x150x6	Column	No Messages	28.5%	PMM	101
213	BOX150x150x6	Column	No Messages	29.1%	PMM	101
214	BOX150x150x6	Column	No Messages	33.7%	PMM	101
215	BOX150x150x6	Column	No Messages	27.6%	PMM	101
230	BOX150x150x6	Column	No Messages	14.4%	PMM	202
231	BOX150x150x6	Column	No Messages	15.6%	PMM	201
232	BOX150x150x6	Column	No Messages	24.7%	PMM	202
233	BOX150x150x6	Column	No Messages	17.2%	PMM	201
109	BOX150x150x6	Column	No Messages	22.7%	PMM	301
110	BOX150x150x6	Column	No Messages	19.6%	PMM	301
111	BOX150x150x6	Column	No Messages	25.2%	PMM	301
112	BOX150x150x6	Column	No Messages	21.7%	PMM	301
117	BOX150x150x6	Column	No Messages	28.7%	PMM	301
118	BOX150x150x6	Column	No Messages	25.7%	PMM	201
123	BOX150x150x6	Column	No Messages	30.2%	PMM	301
124	BOX150x150x6	Column	No Messages	21.4%	PMM	301
125	BOX150x150x6	Column	No Messages	33.6%	PMM	101

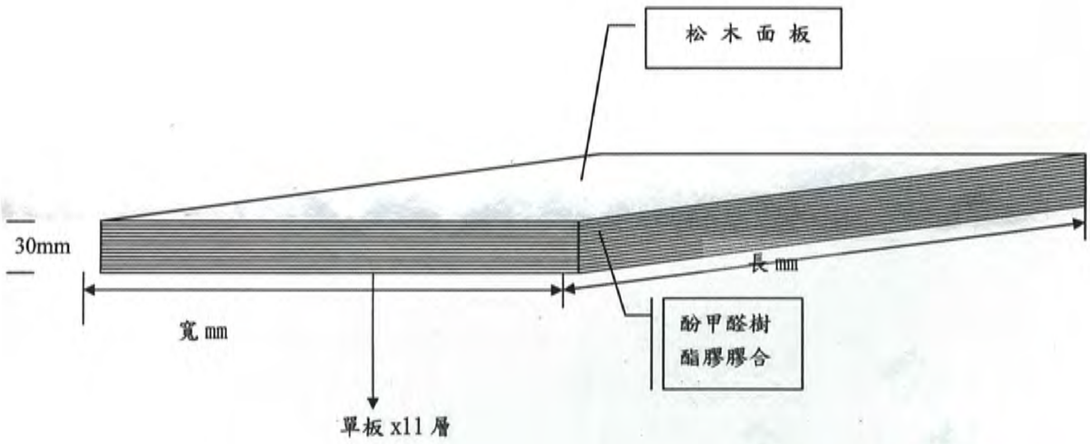
(2) Steel Girders & Beams

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignType	Status	Ratio	RatioType	Combo
134	H150x150x7x9	Beam	No Messages	8.8%	PMM	201
135	H150x150x7x9	Beam	No Messages	7.1%	PMM	201
136	H150x150x7x9	Beam	No Messages	12.5%	PMM	202
160	H150x150x7x9	Beam	No Messages	18.0%	PMM	201
161	H150x150x7x9	Beam	No Messages	23.0%	PMM	202
175	H150x150x7x9	Beam	No Messages	16.9%	PMM	201
177	H150x150x7x9	Beam	No Messages	24.6%	PMM	202
202	H150x150x7x9	Beam	No Messages	17.7%	PMM	201
204	H150x150x7x9	Beam	No Messages	17.4%	PMM	201
150	H150x150x7x9	Beam	See WarnMsg	24.0%	PMM	301
167	H150x150x7x9	Beam	No Messages	16.5%	PMM	301
151	H150x150x7x9	Beam	No Messages	16.8%	PMM	301
168	H150x150x7x9	Beam	No Messages	5.8%	PMM	101
190	H150x150x7x9	Beam	No Messages	36.1%	PMM	101
143	H150x150x7x9	Beam	No Messages	14.4%	PMM	101
153	H150x150x7x9	Beam	No Messages	19.4%	PMM	101
169	H150x150x7x9	Beam	No Messages	23.8%	PMM	101
188	H150x150x7x9	Beam	No Messages	24.2%	PMM	201
191	H150x150x7x9	Beam	No Messages	25.8%	PMM	101
159	H150x150x7x9	Beam	No Messages	6.8%	PMM	301
166	H150x150x7x9	Beam	No Messages	7.6%	PMM	301
174	H150x150x7x9	Beam	No Messages	7.2%	PMM	201
187	H150x150x7x9	Beam	No Messages	9.5%	PMM	301
201	H150x150x7x9	Beam	No Messages	10.9%	PMM	301
141	H150x150x7x9	Beam	No Messages	13.4%	PMM	301
149	H150x150x7x9	Beam	No Messages	6.5%	PMM	301
178	H150x150x7x9	Beam	No Messages	9.0%	PMM	301
192	H150x150x7x9	Beam	No Messages	14.0%	PMM	301
182	H150x150x7x9	Beam	No Messages	10.6%	PMM	301
196	H150x150x7x9	Beam	No Messages	13.4%	PMM	301
137	H150x150x7x9	Beam	No Messages	13.9%	PMM	301
145	H150x150x7x9	Beam	No Messages	7.5%	PMM	301
155	H150x150x7x9	Beam	No Messages	7.4%	PMM	202
162	H150x150x7x9	Beam	No Messages	6.1%	PMM	301
170	H150x150x7x9	Beam	No Messages	14.7%	PMM	202

型號	厚度(mm)	層數	材料	膠合劑
BW30	30	11	松木	酚甲醛樹酯膠
BW25	25	9	松木	酚甲醛樹酯膠

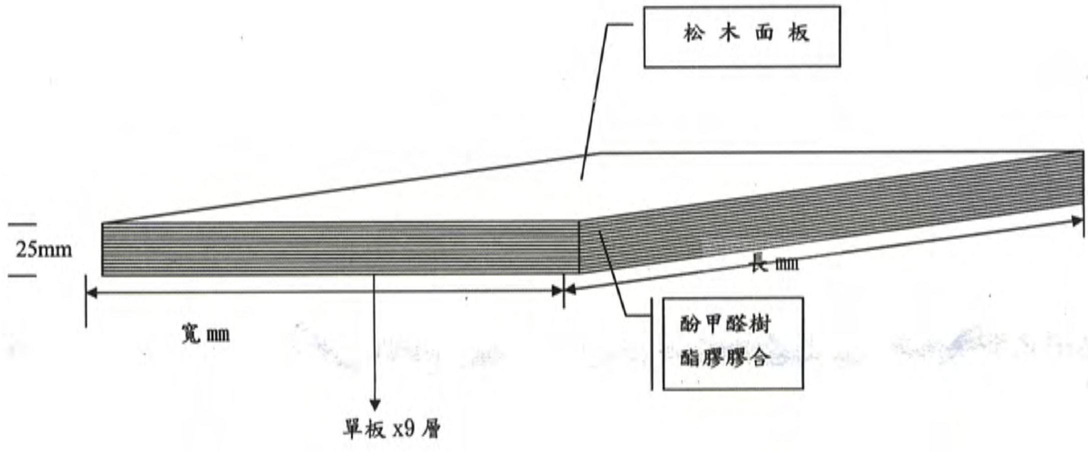
BW30

商品斷面圖(主要型式)

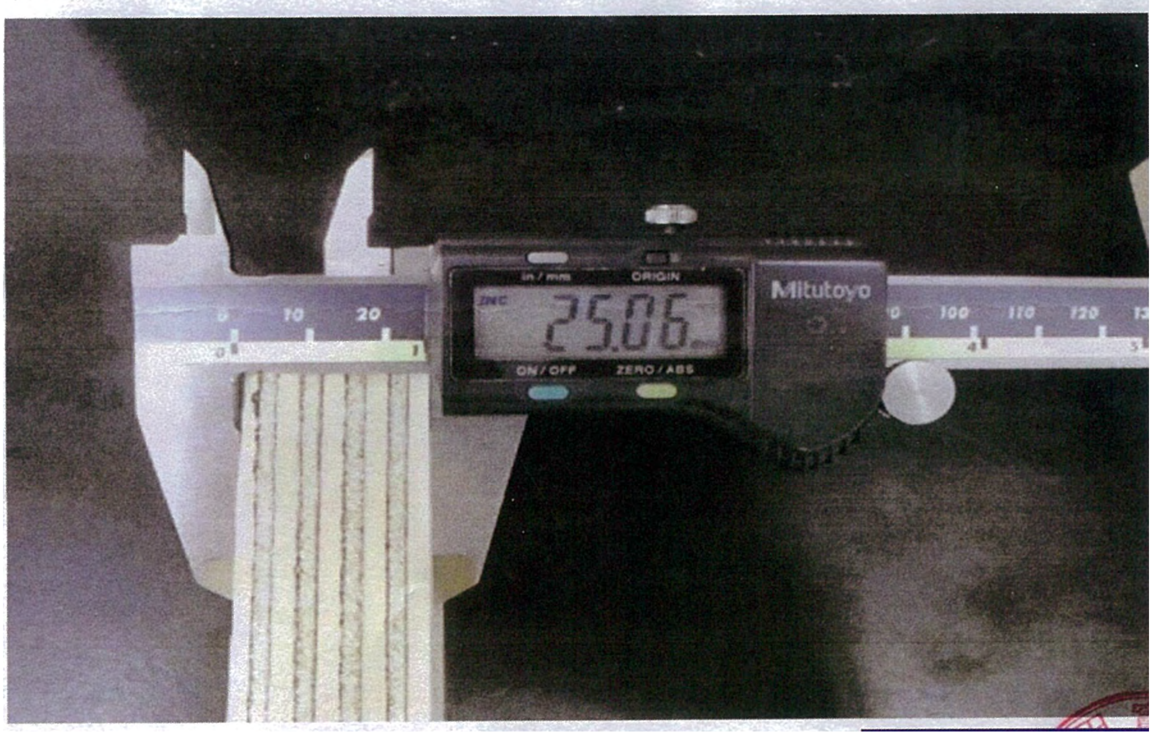


BW25

商品斷面圖(系列型式)



(BW30)



Construction

Product Data Sheet
Edition 4, 2012
Sika® Unitherm® Steel S exterior

Sika® Unitherm® Steel S exterior
(formerly Sika® Unitherm® 38091 exterior)
Solvent based fire protection coating for steel, fast dry, interior/exterior use

Product Description	Sika® Unitherm® Steel S exterior is an ecological thin film fire protection coating system which has to be used for structural steelwork which is subject to weathering, high humidity, maritime environment etc. (exterior condition). Sika® Unitherm® Steel S exterior can also be used for interior steel construction. Sika® Unitherm® Steel S exterior is forming a heat insulating layer under the influence of fire and improves the fire resistance of steel parts like columns, girders and framework. Sika® Unitherm® Steel S exterior is independently tested to BS 476: Part 21.
Uses	For exterior use on structural steel members like columns, girders and framework with a highly effective protection to delay the steel from reaching critical temperatures. Note : With critical situation i.e. frequent formation of condensation and/or heating up of surfaces above 45°C, possible special measures should be taken.
Characteristics / Advantages	■ Fast drying intumescent coating ■ Applicable on steel constructions exposed to weathering ■ Preserves the appearance of a steel construction ■ Applicable to filigree and complex steel building elements ■ Simple application, does not increase static load ■ Individual coloration possible with corresponding topcoat, various colour shades in RAL, others available

Tests

Approval / Standards	BS 476: Part 21: 1987 30 minutes up to 120 minutes.

Product Data

Form

Colour	White
Packaging	25 kg/pail

Storage

Storage Conditions / Shelf-Life	18 months from date of production if stored properly in undamaged and unopened original sealed packaging in cool and dry conditions. Protect from direct sunlight and frost.

Technical Data

Density	Approx. 1.31 g/cm^3
Solid by Volume	71 ± 3% (according BCF Guidance Methode)
Flash point	+ 32°C
VOC Data	VOC content (ready to use) not exceeding 350 gm/litre [Type of regulated paint under the Air Pollution Control (volatile organic compounds). Regulation of Hong Kong.

System Information

Coating system

Steel

Primer:	SikaCor® EG 1 (Two component epoxy) or SikaCor® Zine R (Zinc rich epoxy)
Intumescent coating:	Sika® Unitherm® Steel S exterior
Topcoat:	Sika® Unitherm® Top S (Optional)

Galvanised steel

Primer:	SikaCor® EG 1
Intumescent coating:	Sika® Unitherm® Steel S exterior
Topcoat:	Sika® Unitherm® Top S (Optional)

Surface pre-treatment

Steel
Blast cleaning to Sa 2½ according to EN ISO 12944, Part 4.

Galvanised steel
Free from dirt, oil, grease and corrosion products.

Existent anticorrosive primer/coatings
A compatibility test with the fire protection system is recommended.
For testing and surface pre-treatment, please see special technical information sheet "Primers and surface testing for Sika® Unitherm® steel fire protection systems."

Any damage (impact, corrosion, etc.) should be repaired prior to the application of coating.

Consumption / Coverage

Approx. 1.85 kg/m^2 for 1000 μm dry film thickness (1350-1400 μm wet film thickness). The fire rate of Sika® Unitherm® Steel S exterior depends on national standard, please refer to corresponding separate consumption table/diagram.

Note : Ratio of dry film thickness or wet film thickness varies depending on application method.

Application Instructions

Preparation of coating material	Stir thoroughly with slowly turning mechanical stirrer, free of lumps. Addition of thinner is not necessary.
Application conditions	Object temperature not below + 5°C, to max. + 40°C Relative humidity max. 80% Application temperature shall be at least ≥ 3°C above dew point. During application and drying of total Sika® Unitherm® coating system including Sika® Unitherm® Top S as well as transportation special protection measures must be taken against weathering. Furthermore, proper ventilation is recommended.
Application Method / Tools	Airless spraying : - material shall be applied undiluted - airless spraying machine with pressure ratio ≥ 45 : 1 - filters should be removed - hose diameter not below 3/8" - recommended nozzle size 0.46 - 0.66 mm or 0.019 - 0.027" - solvent resistant hoses must be used ! Brushing/rolling : - material shall be applied undiluted - a ribbed appearance may observed due to the nature of material - solvent resistant brush or roller must be used - more than one coat may be necessary to give equivalent dry film thickness of a single spray applied coat. Note : The Sika® Unitherm® basecoat shall be applied in several coats up to the final dry film thickness required. Wet film thickness max. 400 µm for 1st application coat on primer. Wet film thickness approx. 750 µm for each subsequent application coat is recommended.
Drying	Average drying time at 23°C : - touch-dry : < 1 hour - overcoatable : approx. 4 hours - dry-to-handle : this will depend on the total thickness of Sika® Unitherm® Steel S exterior to be applied Different temperature and relative humidity have an influence on drying time. Sika® Unitherm® Steel S exterior requires a minimum of 24 hours drying prior to application of topcoat Sika® Unitherm® Top S. Through-drying of Sika® Unitherm® Steel S exterior can be checked by "finger-nail-test"
Topcoat	Sika® Unitherm® Top S topcoat produced in RAL colour shades or on request for other colour shades. - interior use (decorative) : 1 x 160 g/m² - exterior use (exposed to weathering) : 2 x 140 g/m² (see separate product data sheet for topcoat).
Cleaning of Tools	Immediately after use with Sika® Unitherm® thinner.
Value Base	All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

Construction

Health and Safety Information

Safety precautions

Please observe safety instruction on container labels and local regulations.

Dangerous Goods regulations have to be followed.

During application in closed rooms, pits and shafts etc., sufficient ventilation must be provided. Keep away open light, including welding.

In poorly lit rooms only electric safety lamps are permitted. The installed ventilation equipment must be spark-proof.

In a liquid, or not fully cured state, the thinner and the products contaminate water and should not be allowed to enter drains or be spilled onto open ground. All spillages and liquid waste must be removed according to local Health and Safety regulations.

Further details are contained in our instruction "Health protection and the prevention of accidents".

For information and advice on the safe handling, storage and disposal of chemical products, users shall refer to the Material Safety Data Sheet (available upon request) containing physical, ecological, toxicological and other safety-related data.

Legal Notes

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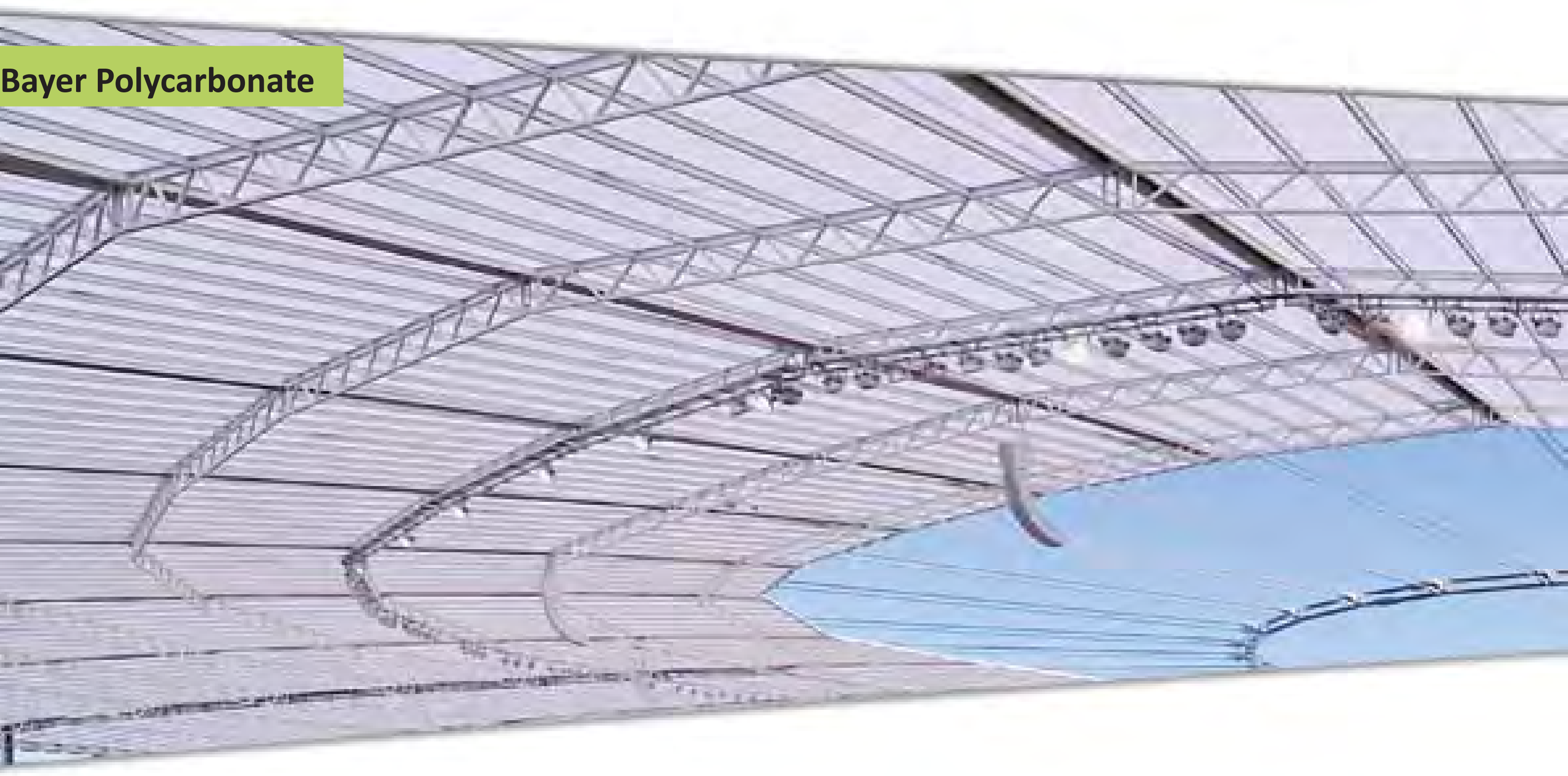
HONG KONG

Tel +852 2686 8108
Fax +852 2645 3671
email marketing@hk.sika.com
website www.sika.com.hk

ISO 9001 : 2008 Certificate No.: CC 446
ISO 14001 : 2004 Certificate No.: CC 2042

The product is manufactured under a HKQAA ISO 9001 / ISO 14001 certified quality / environmental management system.

Innovation & Consistency | since 1910



Base resins

The Makrolon® ET resin portfolio is divided into two subgroups: the base resins and the functional materials. The base resins follow the well-known Makrolon® nomenclature[1] as shown in the following scheme:

Makrolon®

ET 3 1 1 3 550115

6 digit color number

Additive composition:
... 3 UV base stabilizer
... 7 Slip agent + UV base stabilizer

Polymer structure:
... 1 linear resin
... 2 branched resin

Viscosity value

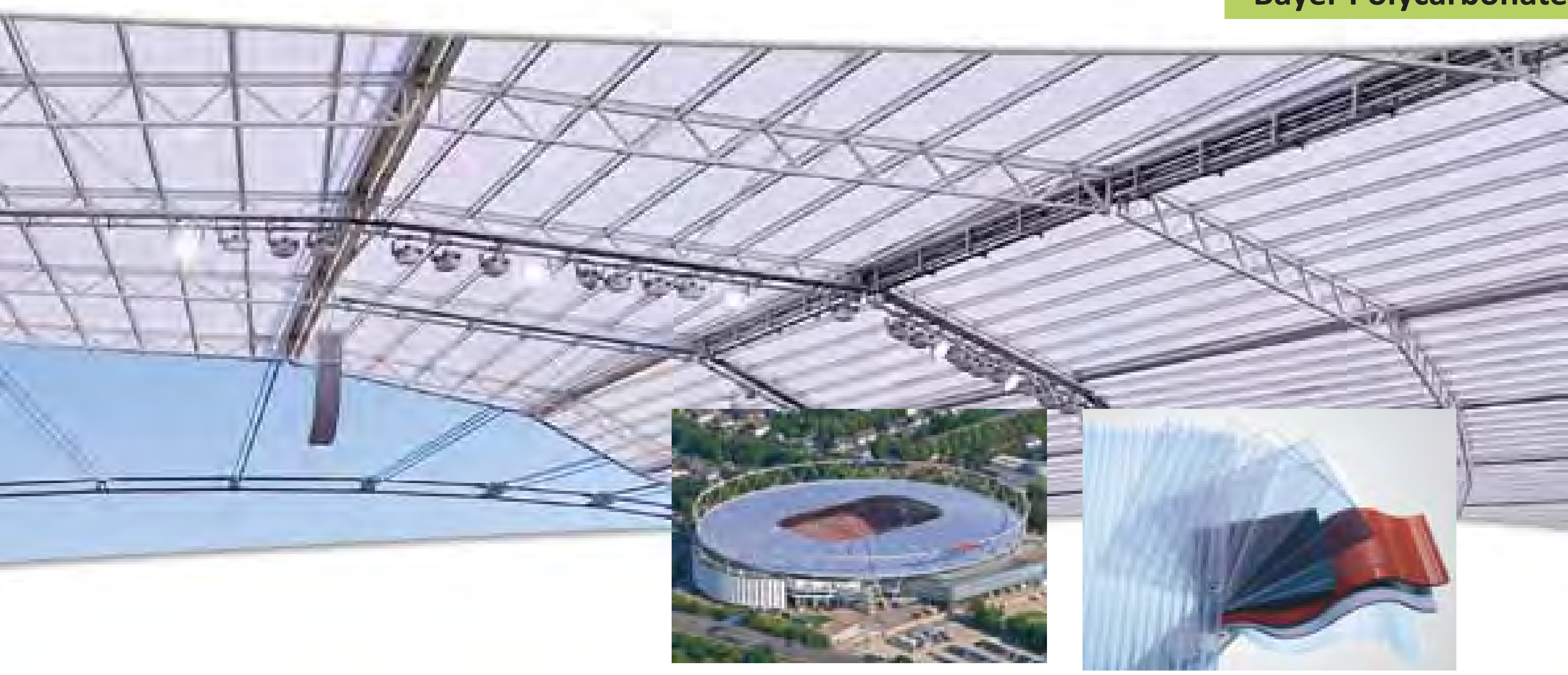
"Extrusion and Thermoforming"

[1] For additional information pls. refer to the general Makrolon® Product Brochure:
http://plastics.bayer.com/plastics/emea/en/product/makrolon/Product_description.html

Makrolon® Grade	Old Name	Linear/ Branched	MVR	
ET2613	2603 MAS157	Linear	12.5	
ET3113	3103 MAS157	Linear	6.0	
ET3117	DP1-1883	Linear	6.0	
ET3127	1243 MAS157	Branched	6.0	
ET3227	1143 MAS157	Branched	3.0	

excellent fit

can be advantageous under certain conditions/ machine setups

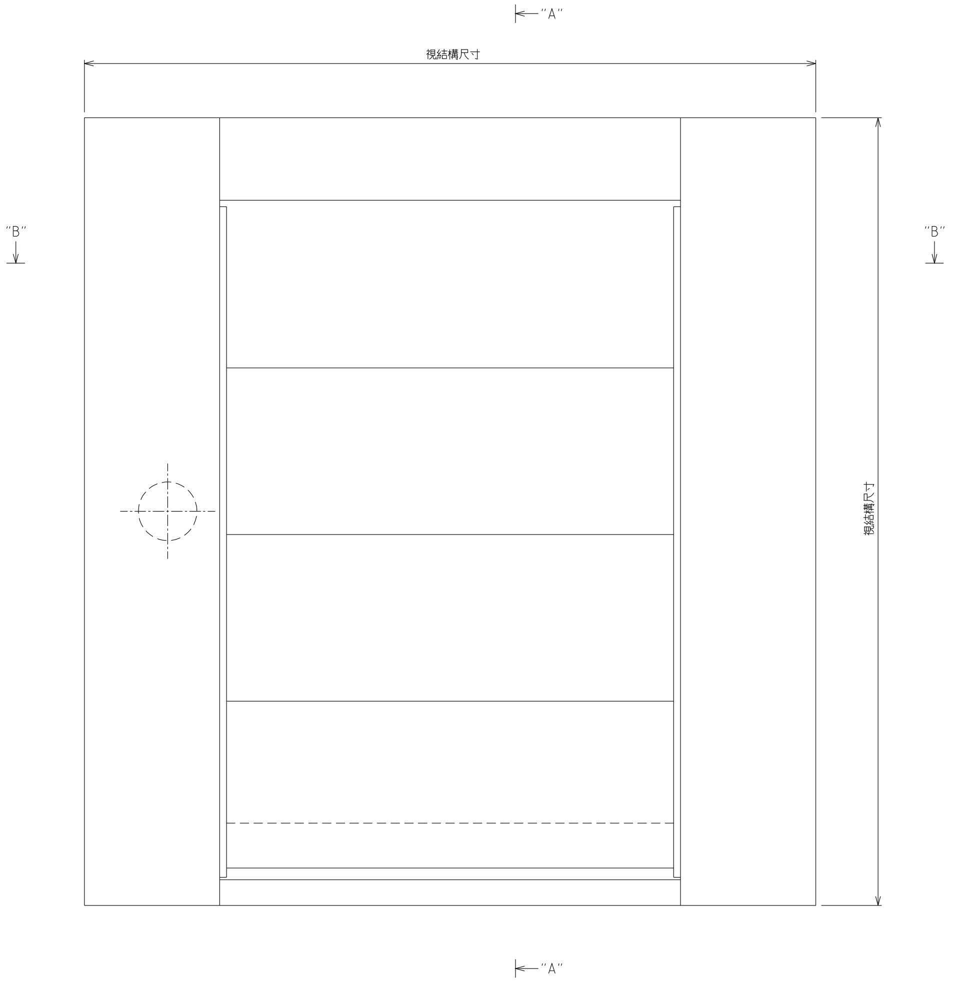


The Makrolon® ET base resins are equipped with a low-volatile additive package to provide low plate-out and less deposits. All resins are available in clear transparent colors[2]; custom colors are available upon request. The following table gives an overview of the resins available, their basic properties and designated fields of application:

	UV base stabilizer[3]	Slip agent	Suitable for					Remarks
			Solid	Multi	Corr.	Panel	Profile	
	Yes	No						Advantageous for very thin sheets (‹ 1.5 mm)
	Yes	No						Standard resin for solid sheets
	Yes	Yes						For standard multiwall sheets; excellent mixing partner for branched Makrolon® ET grades for more complex sheet geometries
	Yes	Yes						For more complex multiwall sheet geometries
	Yes	Yes						Similar to Makrolon® ET3127; higher viscosity supports processing of multiwall sheets with very complex geometries

[2] The color of all Bayer MaterialScience materials is described by a 6 digit color number. This system is based largely on the RAL color system: the first two digits specify the basic color, while the other four digits indicate the various shades

[3] The UV base stabilization provides sufficient protection for most indoor applications. For outdoor use, additional protective measures are necessary, see "UV Protection"



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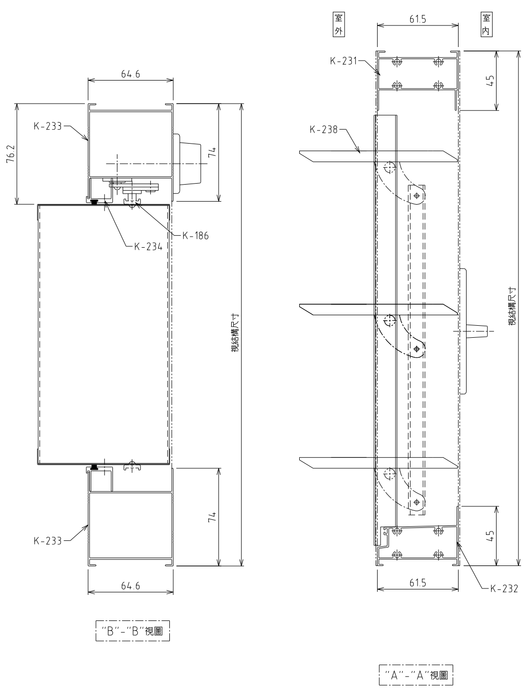
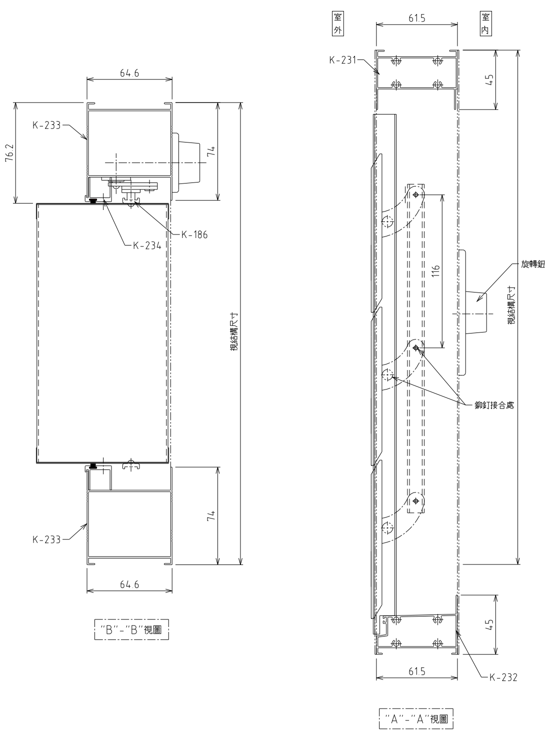
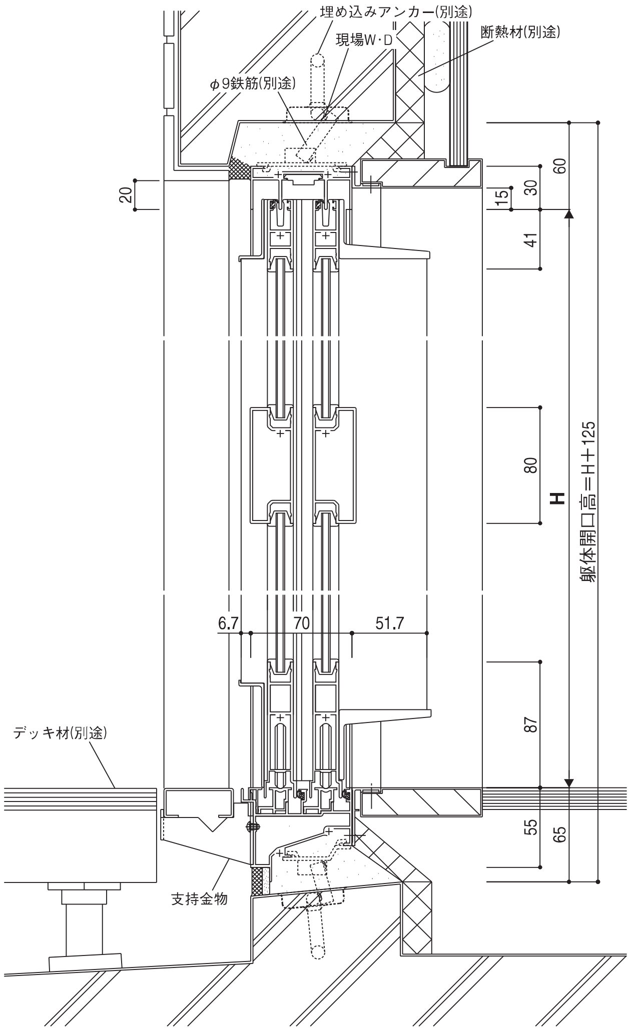
開啓狀態

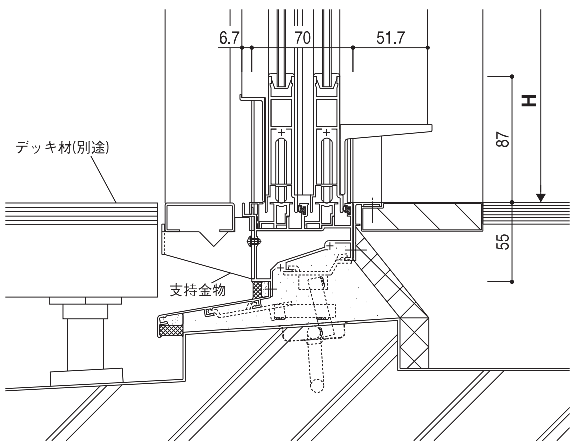


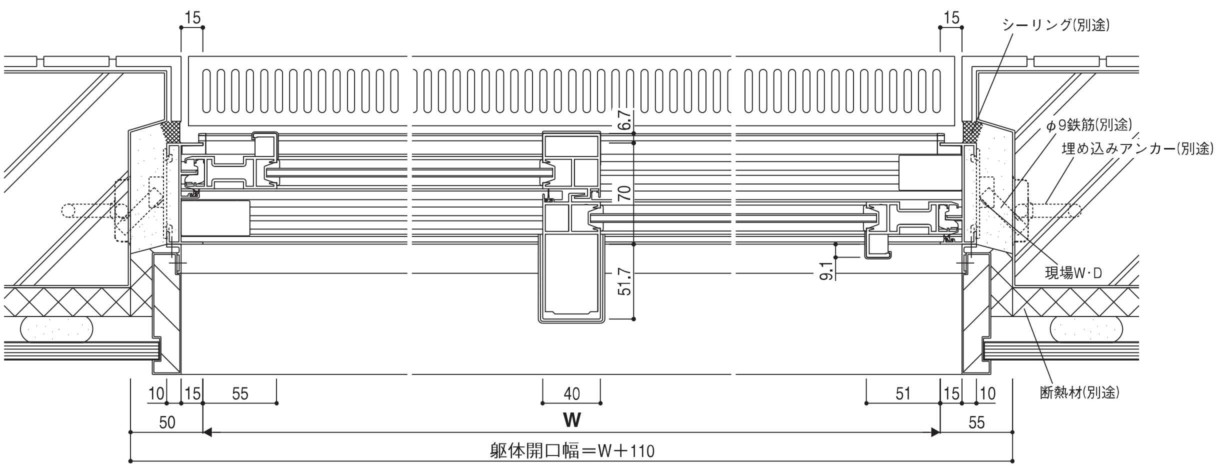
閉合狀態



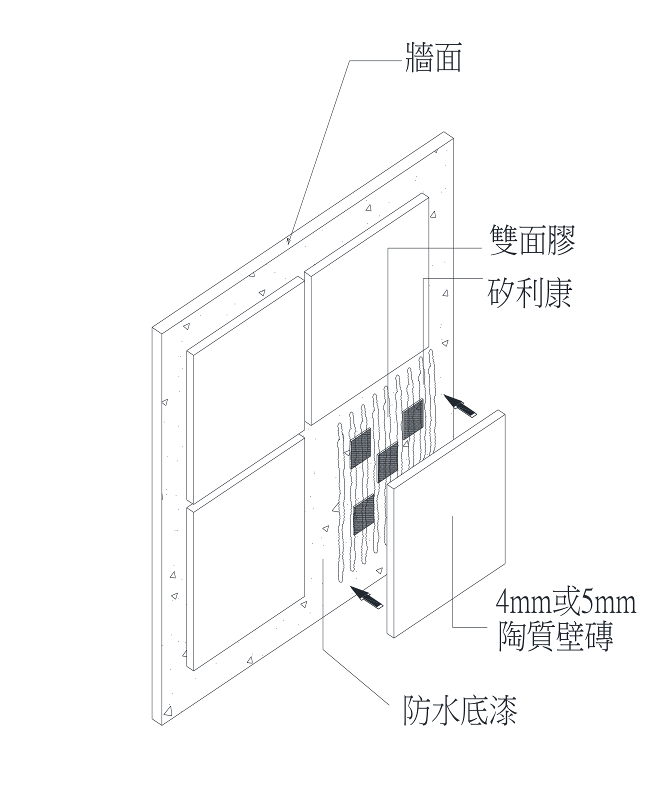
RC納まり 引違い窓【フラット下枠仕様】(2枚建) Eタイプ／14mm溝幅 外装:タイル 【CAD_No.】H13200_E3RR07 S=1／5(単位:mm)



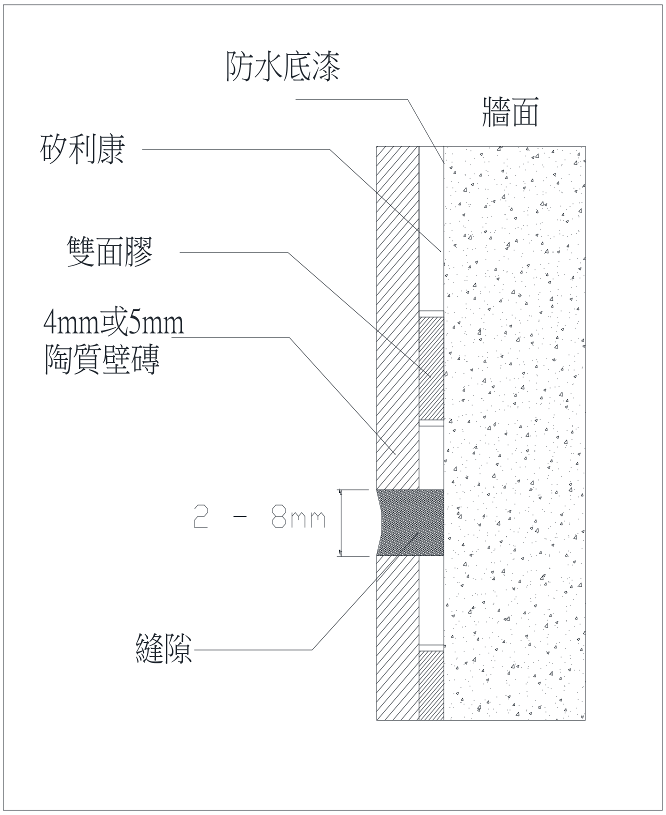


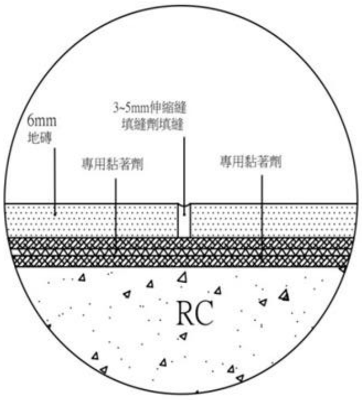


概要圖

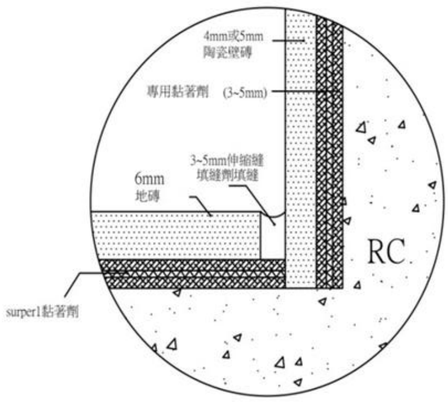


詳細斷面圖

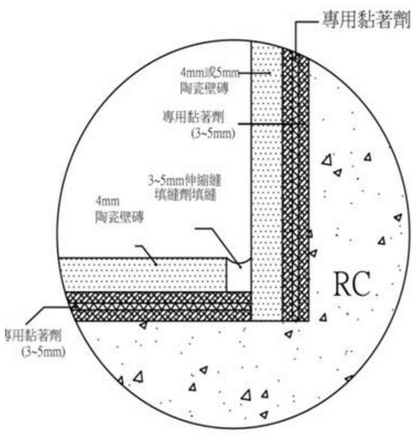




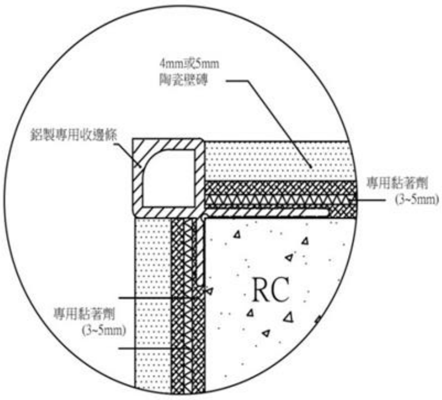
地板縱斷面圖



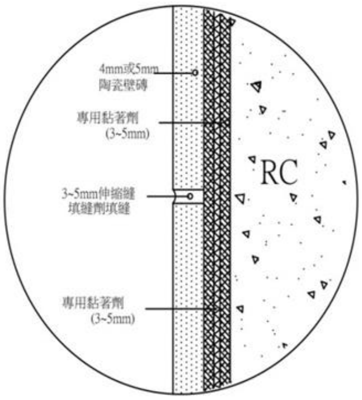
地板與牆面縱斷面圖



內牆內轉角平斷面圖



內牆外轉角平斷面圖



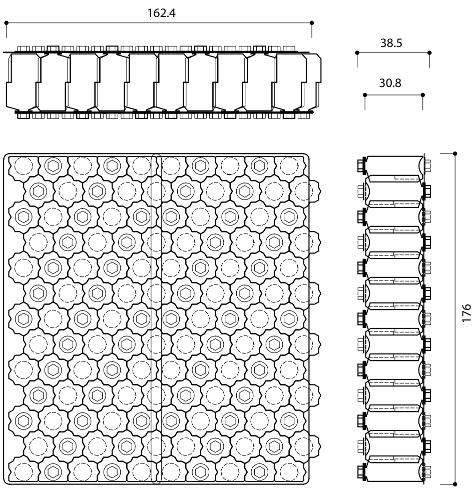
內牆平斷面圖

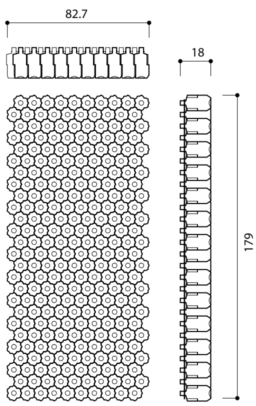
Standard POLLI-Brick™ Size

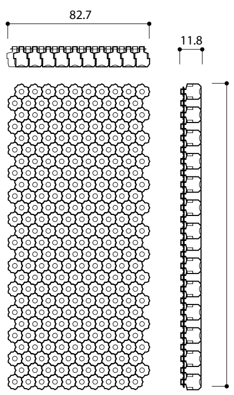
6,000mL

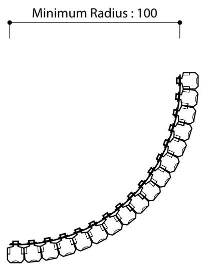
690mL

400mL









Standard Module

Type	Exterior / Interior	Interior	
Components	- POLLI-Brick™ : made from 100% Recycled PET (Polyethylene terephthalate) - High Gloss PC (Polycarbonate) film - HDPE Cap + Washer		
Reinforcements	Welded wire fabric / PC sheet		
Wall Module Dimension*	162.4cm x 176cm	82.7cm x 179cm	82.7cm x 179cm
Wall Module Thickness	38.5cm	17.8cm	11.8cm
Wall Module Weight**	63kg approx.	17.4kg approx.	8.7kg approx.
Insulation (SI units) R value, Thermal Resistance Rate	12.0 K·m²/W	4.8 K·m²/W	2.4 K·m²/W
Color Options	Translucent/Semi Translucent/ White ***		
Loading	345kg/m²		
Wind Pressure	3300 Pascal / Category 5 Hurricane Sustained Winds		
Option Figure	- Integrated RGB/Single color LED tube - Solar Panel integration	- Backlight RGB/Single color LED	
Fireproof Performance Options	Self-extinguishing, fire retardant and flame retardant to Specification (translucency may vary)	B2/B1 Level (brick by brick/panelized)	

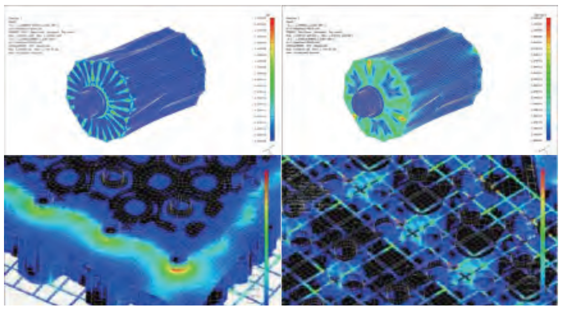
* Module can be modified into customized dimensions.
** Wall module weight may vary by design.
*** POLLI-Brick™ can be customized to different colors if a minimum quantity is met.

US & International Patent 12/869757

ASTM E-330/331
Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

AAMA 501.4
Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

UL Certification E 98658
Plastics Component



Device	Miele W 664
Brand	Miele
Location	Freestanding
Load Type	Top load
Load Capacity	5.5 kg
Dryer	No
Control	Electronic control
Color	White
Dimensions	17.94 x 23.4 x 35.1 in.
Energy Efficiency Class	A++
Washing Efficiency Class	A
Spin Efficiency Class	B
Power Consumption	0.14 kW*h/kg
Water Consumption	46 L
Spin Speed	1200 RPM
Spin Control	Yes
Leak Protection	Full protection
Child Control	No
Out-of-balance Control	Yes
Anti-Foam Control	Yes
Wool Wash Program	Yes

Dryer

Gemiddelde condensatie-efficiëntie, maximale belading	86 %
Gemiddelde condensatie-efficiëntie, gedeeltelijke belading	86 %
Merk	Bosch
Vulgewicht katoen	7 kg
Keurmerken	CE, VDE
Productnaam	WTW84363NL
Aansluitwaarde (W)	1.000 W
Lengte aansluitkabel (cm)	145,0 cm
Minimale smeltveiligheid (A)	10 A
Afmetingen van het apparaat h(min/max)xbxd (mm)	842 x 598 x 636 mm
Afmetingen inclusief verpakking hxbxd (mm)	890 x 625 x 680 mm

Miele
IMMER BESSER

KFN 37452 i DE

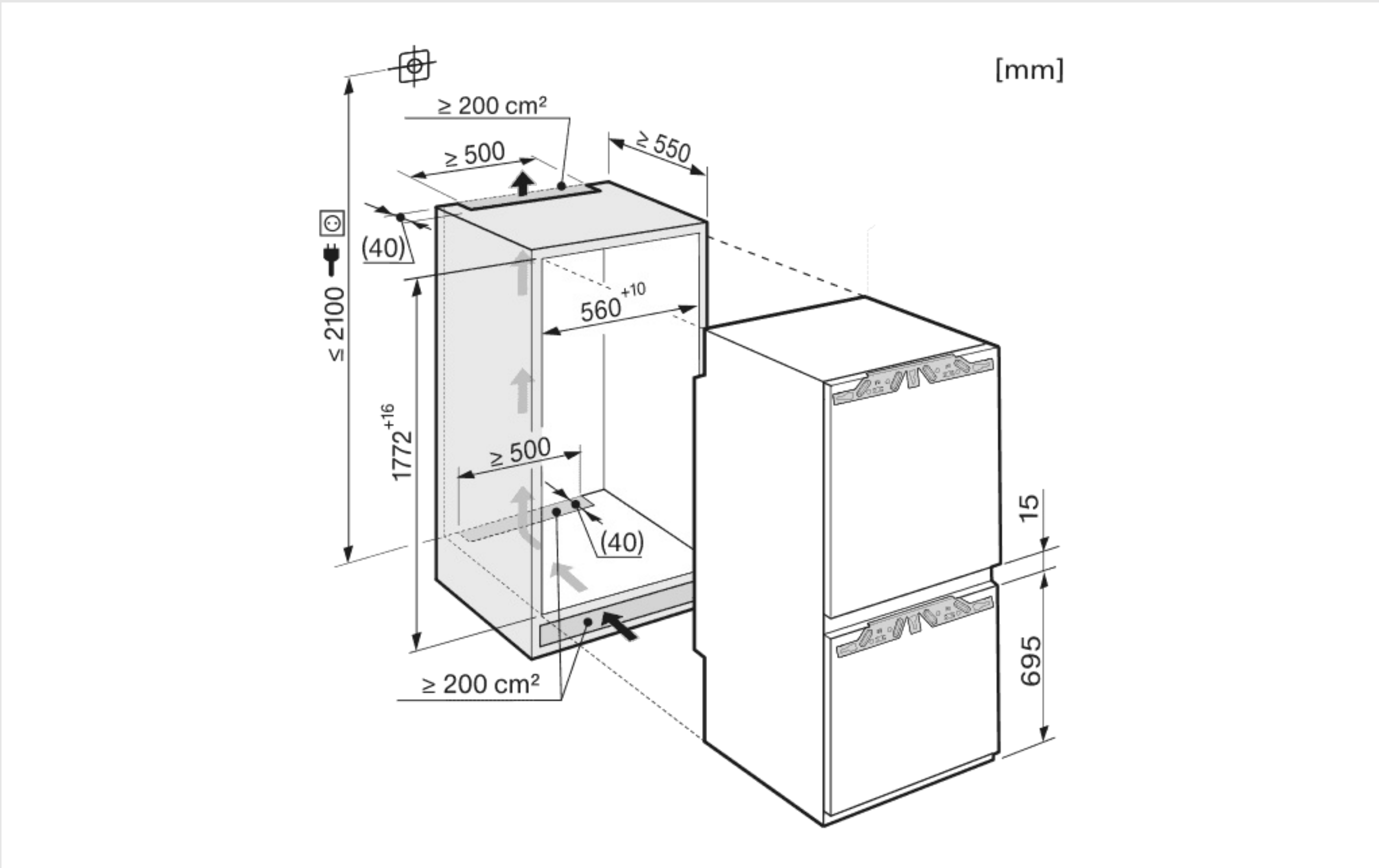
Combiné réfrigérateur/congélateur encastrable

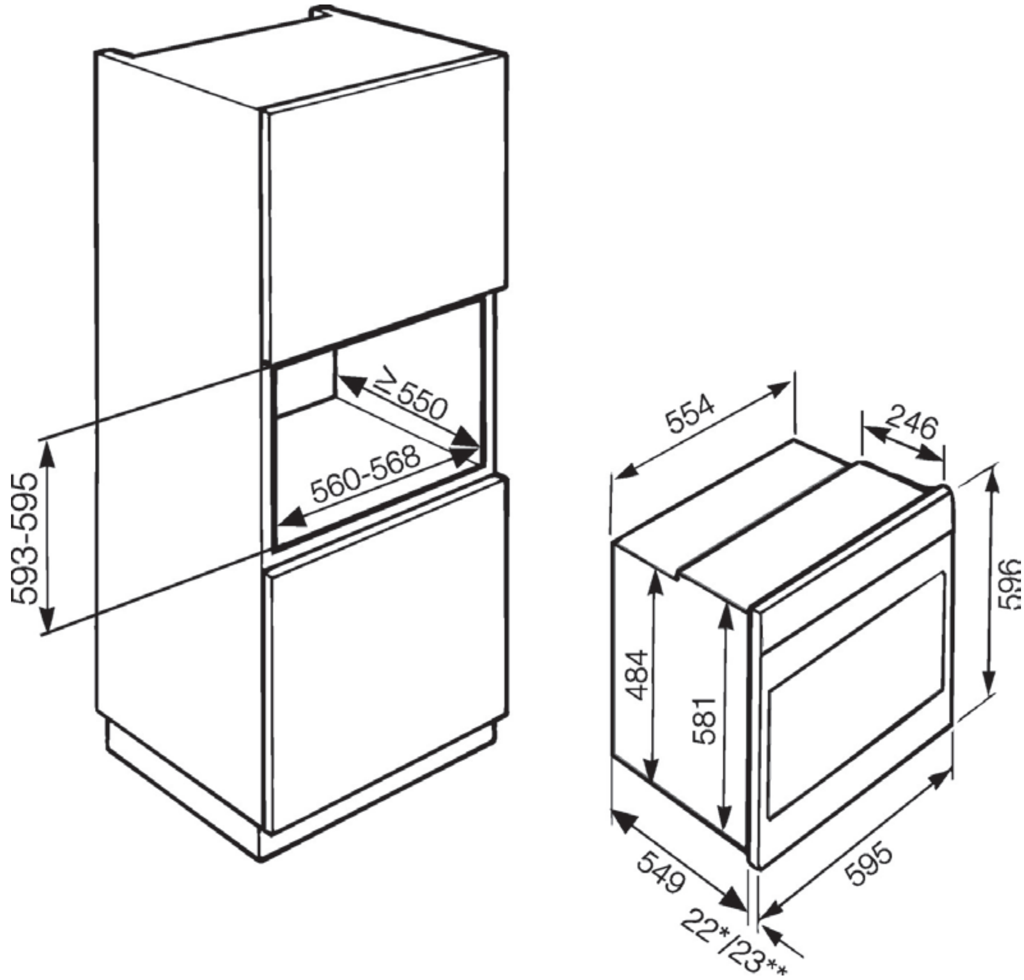
avec la touche personnelle grâce à l'éclairage des clayettes FlexiLight et IceMaker

- Eclairage des clayettes réglable individuellement grâce à FlexiLight
- Dégivrage automatique grâce au système NoFrost
- Entreposage des aliments où vous le souhaitez - DynaCool
- Nettoyage des compartiments de porte au lave-vaisselle - ComfortClean
- Préparation de glaçons grâce à la fabrique de glaçons indépendante

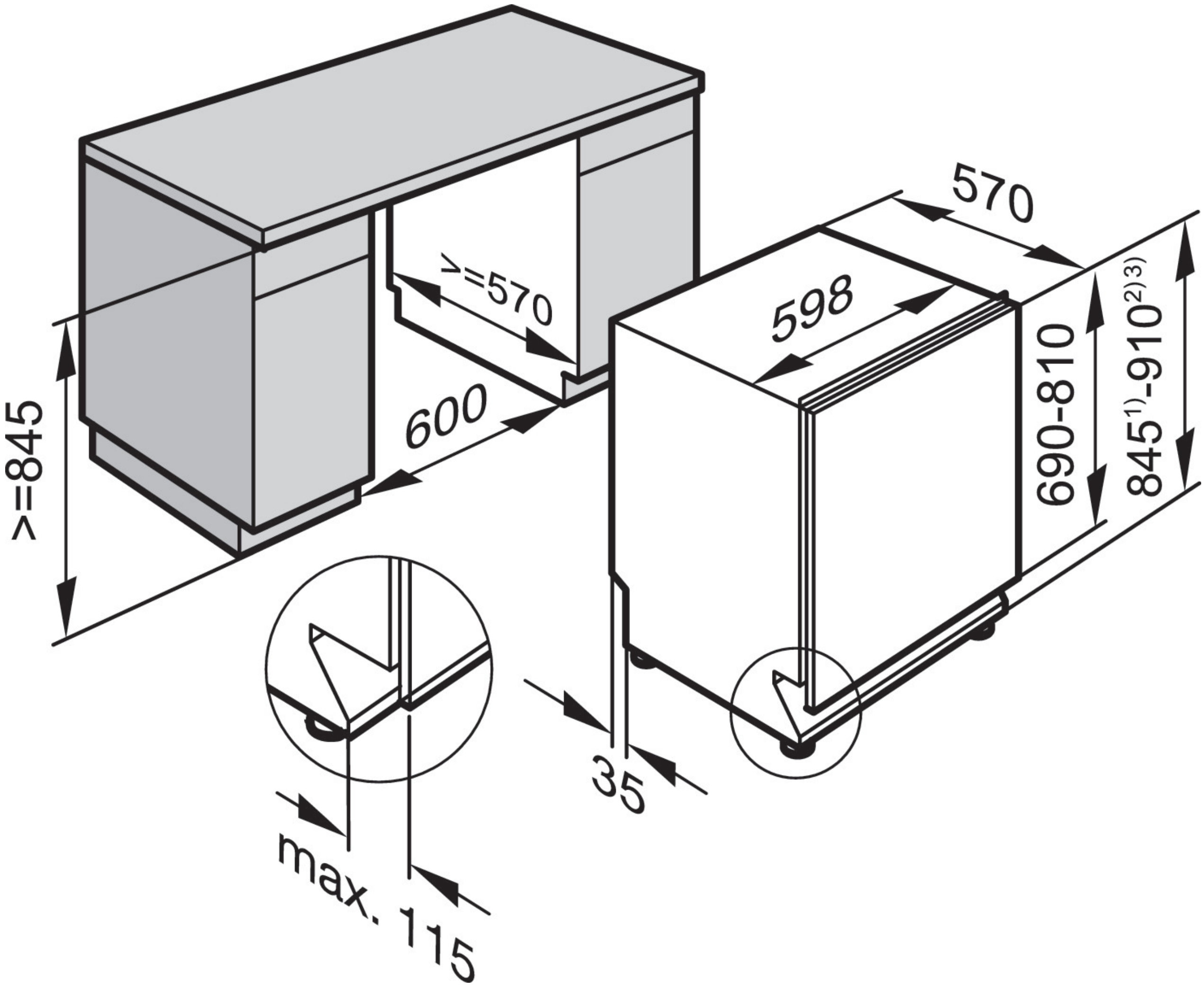
Ligne	
Ligne	Elégance
Type d'appareil	
Réfrigérateur	•
Modèle	
Intégrable/encastrable/habillable	•/–/–
Charnières de porte/modifiables/Montage Side-by-Side	droite/•/–
Eclairage zone de réfrigération	
Type d'éclairage	FlexiLight
Éclairage PerfectFresh Pro LED	–
Confort d'utilisation	
MasterFresh/PerfectFresh/SelfClose	•/–/•
PerfectFresh Pro avec système d'information	–
Fabrique à glaçons/Raccordement à eau fixe/Réservoir d'eau MyIce	•/–/•
ComfortClean/Froid dynamique DynaCool/NoFrost/VarioRoom	•/•/•/•
Amortisseur de porte SoftClose/Drop & Lock	•/–
Bandeau de commande	
Affichage et réglage électronique de la température	Touch
Possibilité de désactiver le réfrigérateur	•
Réglage indépendant du réfrigérateur et du congélateur	•
SuperFroid/SuperFrost	•/•
Nombre de zones de températures	2
Réfrigérateur	
Tablettes en verre sécurit, réglables en hauteur	•
Nombre de tablettes/dont divisibles	3/–
Clayettes en métal chromé	•
Nombre de bacs à légumes extractibles	1
Compartiment pour beurre et fromage	–
Eléments amovibles dans la contre-porte	–
Balconnets continus/Demi-balconnets	2/–
Cloison pour bouteilles dans la contre-porte	1
Congélateur	
Nombre de tiroirs/bacs de congélation extractibles	2+2
Tablettes en verre sécurit, réglables en hauteur	•

Efficacité énergétique et consommations d'énergie	
Classe d'efficacité énergétique	A++
Consommation d'énergie par an/en 24 h en kWh	229/0,627
Sécurité	
Fonction de verrouillage	•/•
Alarme de porte/de température sonore	•/•
Alarme de porte/de température optique	•/•
Caractéristiques techniques	
Dimensions de la niche en mm (H x L)	1.772 – 1.788 x 560 – 570
Technique de fixation de la porte	Directe
Charge max. de la porte du réfrigérateur/congélateur en kg	20-Dec
Classe climatique	SN-T
Volume utile en l	256
Réfrigération en l/Zone PerfectFresh en l/Congélateur en l	196/0/60
Niveau sonore dB(A) re1pW	39
Autonomie en cas de panne (en h)/Puissance de congélation (en kg)	20/10,0
Courant en milliampères (mA)	1400
Accessoires fournis	
Beurrier/balconnet à œufs	•/•
Prix de vente maximal conseillé en € TTC dont 13 € éco-part	2512
Disponibilité	Dispo nov. 2013


[mm]
≥ 200 cm²
≥ 500
≥ 550
(40)
≤ 2100
560 +10
1772 +16
≥ 500
(40)
15
695
≥ 200 cm²


≥550
560-568
593-595
554
246
596
484
581
549
595
22*/23**

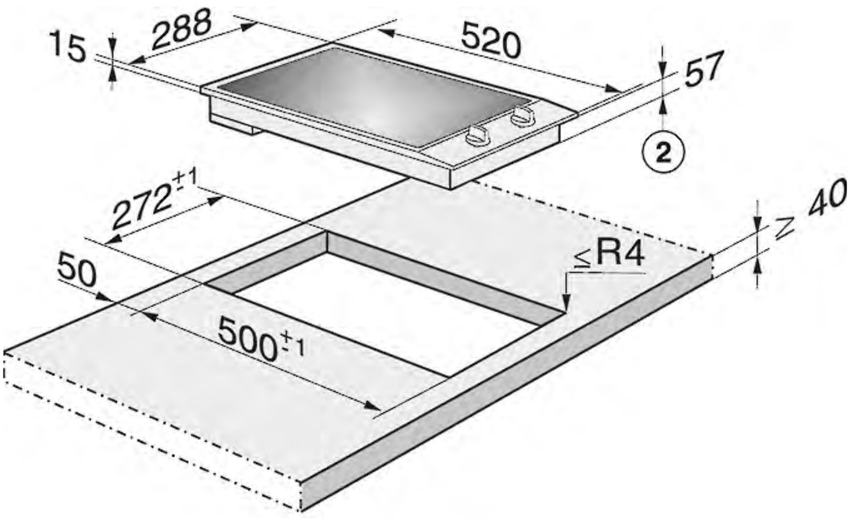

Miele
12:00

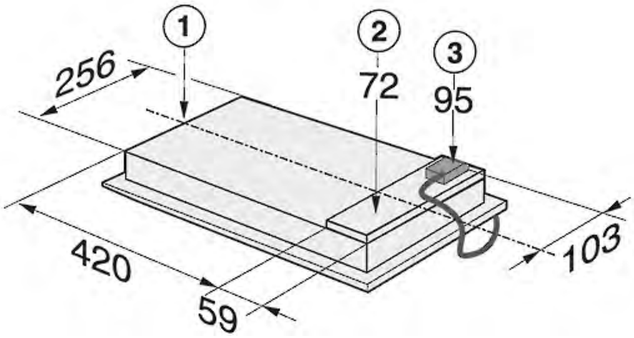

570
>=570
598
690-810
845 1)-910 2)3)
>=845
600
35
max. 115

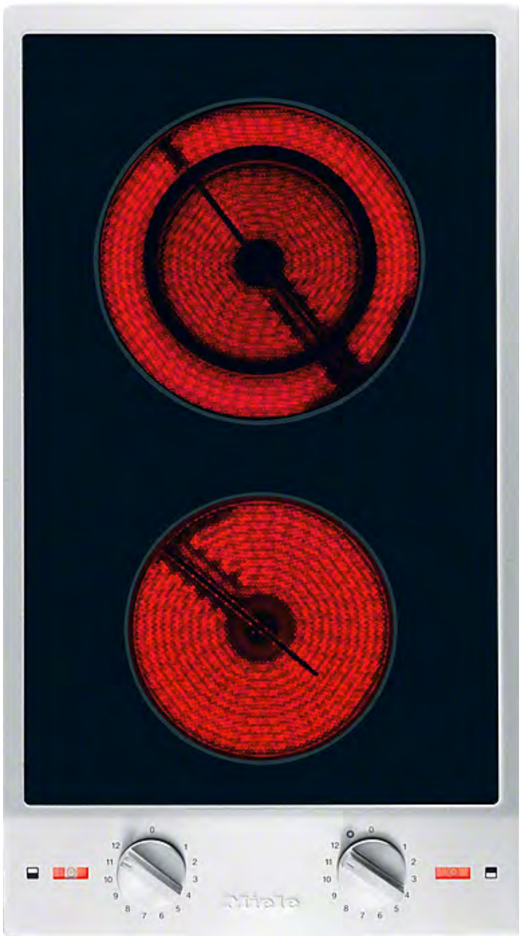
Name	LED TV
Set without Stand (WxHxD) (mm)	645 x 384.9 (389.4) x 49.5
Set with Stand (WxHxD) (mm)	645 x 435.6 x 252.6
Package (W x H x D) (mm)	931 x 462 x 143

PC

Operating System	Windows 8 (PC Station)
Display	18.4”(46.7cm), 16:9, Wide Screen, Full HD 1920x1080, LED-backlight, IPS, 178° wide viewing angle


15
288
520
57
2
272±1
≥ 40
≤R4
50
500±1


1
2
3
256
72
95
420
59
103



Gloss

Gloss

pg. 50 | 53

GLOSS plus
Tecnologia LED
Aspirazione Perimetrale
Timer

GLOSS plus
LED Technology
Perimeter Aspiration
Timer

Caratteristiche	
Installazione	Soffitto
Finitura	Acciaio Inox Lucido
Comandi	Elettronica Slim 4V
N. Motori	1
Portata IEC EN 61591	630 m³/h
Pressione	455 Pa
Rumorosità Max	66 dB (A) re 1pW
Rumorosità Min	49 dB (A) re 1pW
Assorbimento totale	260 W
Misure	455x435 mm
Illuminazione	Led 3x3W
Versione	Aspirante
Uscita	ø 150 mm
Filtro Grassi	Griglia filtro inox

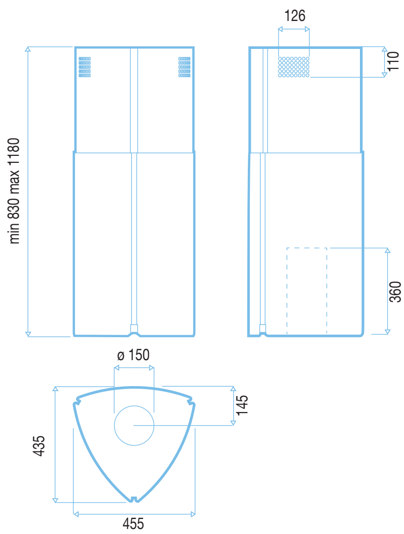
Features	
Installation	Ceiling
Finish	Shiny Stainless Steel
Controls	Electronic Slim 4S
No. Motors	1
Airflow IEC EN 61591	630 m³/h
Pressure	455 Pa
Max Noise Level	66 dB (A) re 1pW
Min Noise Level	49 dB (A) re 1pW
Total Absorption	260 W
Dimensions	455x435 mm
Lighting	Led 3x3W
Version	Duct-out
Duct Size	ø 150 mm
Grease Filter	Stainless Steel grid filter

Accessori	
Filtro Carbone	In opzione | Cod. 08999114

Accessories	
Charcoal filter	Optional | Cod. 08999114

Descrizione	
Gloss Inox	Cod. 07F50000

Description	
Gloss SS	Cod. 07F50000



Defibrillator Number	HeartStart Trainer (5085A)
Dimensions	2.8” H x 8.3” W x 8.3” D
Weight	2 lbs. with batteries
Batteries	4 AA cells
Training Scripts	Eight preconfigured scripts based on common training scenarios

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS
A. Submittals: Product Data (Refer to catalogue).

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS
A. Portable Fire extinguishers, listed and labeled for the type, rating, and classification of extinguisher.

1. Multipurpose Dry-chemical Type.
2. Fire-rated 21A: 113B:C, 4kg nominal capacity.
3. The cylinders are of steel construction, coated with epoxy powder for high corrosion resistance, and fitted with brass valves with pressure gauges.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install fire extinguishers in where indicated.

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Smoke alarms / detectors and wiring.

1.2 SECTION REQUIREMENTS

A. System description: Non-codes, conventional, hardwired, zoned, 220V AC loop system.
B. Submittals: Product data and system operation.
C. Comply with Approved document B (Fire Safety).
D. CE listed and labeled.
E. Electrical components, devices, and accessories: Listed and labeled as defined in CE, by a qualified testing agency, and marked for intended location and application.

1.3 MATERIALS AND SERVICES

A. The system shall include, but not be limited to the following elements:
1. Smoke alarms / detectors.
2. Power supplies and batteries.
3. Wiring and raceway.
4. Installation, testing, certification, and training of Owner's operators.

PART 2 - PRODUCTS

2.1 ALARM – INITIATING DEVICES

A. Smoke alarms / detectors: CE, 220V AC with 9V DC battery backup, light-scattering photoelectric type, plug-in arrangement.
1. Basis of design: Horing Lih, 220V AC with battery backup smoke alarm / detector.
a. Model No. NQ9S-3.

2.2 WIRE AND CABLE

A. General: 600V 380℃ (HR), 1.25mm2/2C, 1.25mm2/4C or larger.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and test fire detection system
Comply with Approved Document B (Fire Safety) and Approved Document P (Electrical Safety).
B. Wiring Method: Install wiring where indicated. All alarm are wired to a single, continuous (non-switched) power line, which is not protected by a ground fault interrupter.
C. Where more than one alarm is installed they should be linked so that the detection of smoke alarms / detectors by one unit operates the alarm signal in all of them. The manufacturers' instructions about the maximum number of units that can be linked should be observed.
D. Smoke alarms / detectors should be sited so that:

1. There is a smoke alarm in the circulation space within 7.5m of the door to every habitable room;

2. They are ceiling-mounted and at least 300mm from walls and light fittings (unless, in the case of light fittings, there is test evidence to prove that the proximity of the light fitting will not adversely affect the efficiency of the detector). Units designed for wall-mounting may also be used provided that the units are above the level of doorways opening into the space and they are fixed in accordance with manufacturers' instructions; and
3. The sensor in ceiling-mounted devices is between 25mm and 600mm below the ceiling.

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Comply with CNS for plastic, potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Stainless steel double compression & dual pressure over parts SUS304 (CNS 13392 G3258 SISG3448) stainless steel pressure pipe.
1. Joining Materials: Meet CSN 14645, KS B1547, JWWA G116 standards tested.
B. PVC Pipe: CNS 1298 K3004, type B
1. PVC Fittings: CNS 2334 K3011, socket type.
C. Transition fittings: Manufactured piping coupling or specified piping system fitting. Same size as pipes to be joined and pressure rating at least equal to pipes to be joined.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with requirements in section 15141 & 15151 of Public construction Commission for basic piping installation requirements.
B. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight.
C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance.
D. Install domestic water piping without pitch for horizontal piping and plumb for vertical piping.
E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.2 INSPECTION AND CLEANING

A. Inspect and test piping systems as follows:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired by visual inspection of all joints.
B. Clean and disinfect potable domestic water piping by filling system with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time by flushing out a volume equal to the system volume, then stopping the flow of water for one hour, and then flushing the sytem.

3.3 VALVE SCHEDULE

A. Drawing indicate valve types to be used.
B. Install ball valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated.
C. Install spring check valve on discharge side of each pump and elsewhere as indicated.
D. Install ball valves in each hot-water circulating loop and discharge side of each pump.

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Produce Data. Include certified performance operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Comply with section 15440 of Public Construction Commission for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 MAIN PRESSURIZING DOMESTIC WATER PUMP

A. GRUNDFOX
1. 270W, 220Volt, maximum flow rate is 3.5m3/hr and head maximum is 12m.
2. Part #: UPA 120.

2.2 CONTROLS

A. Pressure sensing pump: Electric; adjustable for control of hot and rain water circulation pump.
1. Type: Pressure tank combined with switch for installation in piping.
2. Settings: Pump turned on and off is actuating directly by pressure drop and raise.

PART 3 - EXECUTION

2.1 INSTALLATION

A. Install pumps with access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
B. Support pumps and piping so weight of piping is not supported by pump volute.
C. Install electrical connections for power, controls, and devices.
D. Connect piping with valves that are at least the same size as piping connecting to pumps.
E. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

PART 1 – GENERAL

1.1 SECTION REQUIREMENTS

A. The tanks of this section are custom produts.

PART 2 - PRODUCTS

A. Clean Water Tank
1. Material: FRP
2. Dimension: 1000L x 7000W x 300H (mm)
3. Thickness: Cover: 3mm; side wall: 5mm; Bottom of tank: 5mm
B. Greywater Tank
1. Material: FRP
2. Dimension: 1000L x 600W x 300H (mm)
3. Thickness: Cover: 3mm; side wall: 5mm; Bottom of tank: 5mm
C. Black Water Tank
1. Material: FRP
2. Dimension: 2000L x 1000W x 300H (mm)
3. Thickness: Cover: 3mm; side wall: 3mm; Bottom of tank: 3mm
D. Rainwater Tank
1. Material: FRP
2. Dimension: 1500L x 700W x 300H (mm)
3. Thickness: Cover: 3mm; side wall: 3mm; Bottom of tank: 3mm

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set units level, plumb, and true to line, without warp or rack of frames and panels and anchor securely in place.
B. Fasten securely in place, with provisions for thermal and structural movement. Install with concealed fasteners, unless otherwise indicated.
C. Separate dissimilar FRP and FRP products from contact with wood or cementitious materials.
D. Correct deficiencies in or remove and reinstall products that do not comply with requirements.
E. Repair, refinish, or replace products damaged during installation, as directed by Architect.
F. Adjust operating parts and hardware for smooth, quiet operation.

1.0 Heat Pump (Outdoor Unit)

Specifications

Heat pump 50/60 Hz <RXYMQ-PVE>

Model Name			**RXYMQ4PVE**
* 1 Cooling Capacity		Kcal/h	9,600
	Btu/h	38,200	
	kW	11.2	
* 2 Heating Capacity		Kcal/h	10,800
	Btu/h	42,700	
	kW	12.5	
Casing Color			Ivory White
Dimensions: (H×W×D)		mm	1,345 × 900 × 320
Heat Exchanger			Cross Fin Coil
Comp.	Type		Hermetically Sealed Scroll Type
	Piston Displacement	m^3/h	19.36
	Number of Revolutions	r.p.m	6,480
	Motor Output × Number of Units	kW	2.5 × 1
	Starting Method		Direct on line
Fan	Type		Propeller Fan
	Motor Output	W	70 × 2
	Air Flow Rate	m^3/min	106
	Drive		Direct Drive
Connecting Pipes	Liquid Pipe	Mm	ϕ9.5 (Flare Connection)
	Gas Pipe	Mm	Φ15.9 (Flare Connection)
Machine Weight		kg	125
Safety Devices			High pressure Switch, Fan Driver Overload Protector, Inverter Overload Protector, Fusible Plugs, Fuse
Defrost method			Reverse cycle defrosting
Capacity Control		%	24 ~ 100
Refrigerant	Refrigerant Name		R-410A
	Charge	Kg	4.0
	Control		Electronic Expansion Valve
Refrigerator Oil			DAPHNE FVC68D
	Charge Volume	L	1.5
Standard Accessories			Installation Manual, Operation Manual, Clamps

Note:

*1 Indoor temp. : 27°CDB, 19°CWB / outdoor temp. : 35°CDB / Equivalent piping length : 7.5 m, level difference : 0 m.

*2 Indoor temp. : 20°CDB / outdoor temp. : 7°CDB, 6°CWB / Equivalent piping length : 7.5 m, level difference : 0 m.

Dimensions

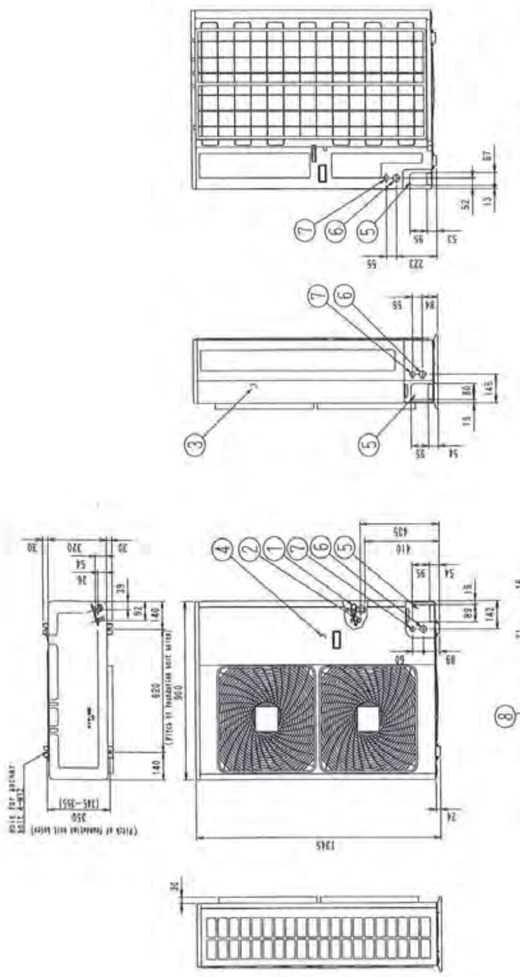
Unit: mm

2. Dimensions

RX(Y)MQ4 · 5PVE

Unit: mm

3D052615



NO.	Parts name	Remarks
8	Drain pipe connection	Outside Diameter φ26
7	Control wiring intake	φ27 knock hole
6	Power supply wiring intake	φ34 knock hole
5	Refrigerant piping intake	
4	Grounding terminal	In switch box (M5)
3	Service port	In the unit
2	Liquid pipe connection	φ9.5 Flare
1	Gas pipe connection	φ15.9 Flare

2.0 Heat Pump (Indoor Unit)

Specifications

Wall Mounted Type

Model Name			**FXAQ40MAVE**
* 1 Cooling Capacity (19.5°CWB)		Kcal/h	4,000
Btu/h		16,000	
kW		4.7	
* 2 Cooling Capacity (19.0°CWB)		kW	4.5
* 3 Heating Capacity		Kcal/h	4,300
Btu/h		17,000	
kW		5.0	
Casing Color			While (3.0Y8.5/0.5)
Dimensions: (H×W×D)		mm	290 × 1,050 × 230
Coil (Cross Fin Coil)	Rows × Stages × Fin Pitch	mm	2 × 14 × 1.4
	Face Area	m^2	0.213
Fan	Model		QCL9686M
			Cross Flow Fan
	Motor Output × Number of Units	W	43 × 1
	Air Flow Rate (H/L)	m^3/min	12/9
		cfm	424/318
	Drive		Direct Drive
Temperature Control			Microprocessor Thermostat for Cooling and Heatling
Sound Absorbing Thermal Insulation Material			Foamed polystyrene / Foamed Polyethylene
Air Filter			Resin Net (Washable)
Piping Con-necting	Liquid Pipe	mm	ϕ6.4 (Flare Connection)
	Gas Pipe	mm	Φ12.7 (Flare Connection)
	Drain Pipe	mm	VP13 (External Dia.18 Internal Dia.13)
Machine Weight (mass)		Kg	14
*5 Sound Level (H/L) (220-240V)		dBA	39/34
Safety Devices			Fuse
Refrigerant Control			Electronic Expansion Valve
Connectable Outdoor Unit			R-410A P Series
Standard Accessories			Operation Manual. Installation Manual. Installation Panel. Paper Pattem for Installation. Insulation Tape. Clamps. Screws.

Note:

*1 Indoor temp. : 27°CDB, 19.5°CWB / outdoor temp. : 35°CDB / Equivalent piping length : 7.5 m, level difference : 0 m.

*2 Indoor temp. : 27°CDB, 19.5°CWB / outdoor temp. : 35°CDB / Equivalent piping length : 7.5 m, level difference : 0 m.

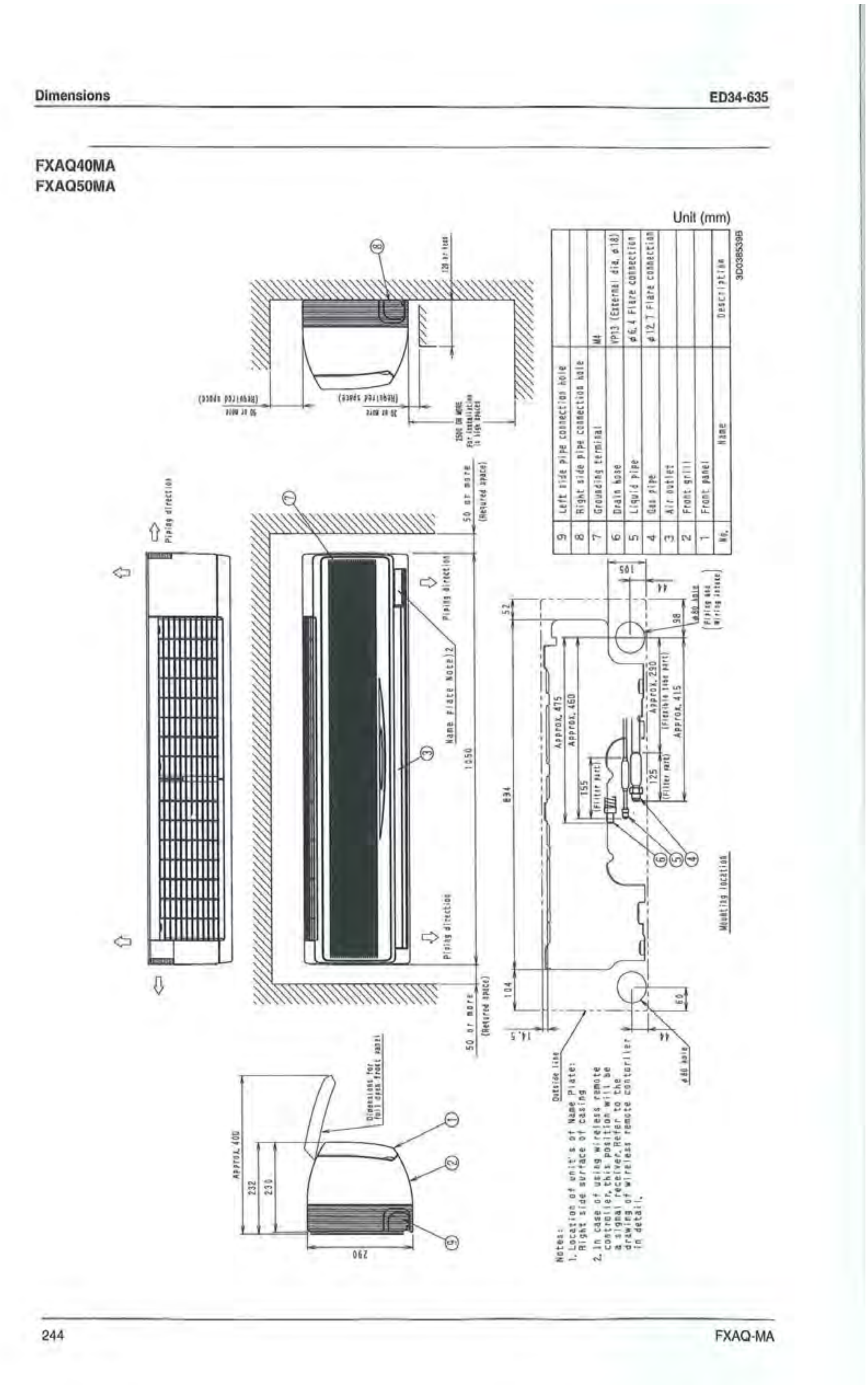
*3 Indoor temp. : 20°CDB / outdoor temp. : 7°CDB, 6°CWB / Equivalent piping length : 7.5 m, level difference : 0 m.

4 Capacities are net, including a deduction for cooling (an addition for heating) for indoor fan motor heat.

*5 Anechoic chamber conversion value, measured at a point 1 m in front of the unit and 1 m downward. During actual operation, these values are normally somewhat higher as a result of ambient conditions.

Dimensions

Unit: mm



Dimensions ED34-635

FXAQ40MA
FXAQ50MA

Unit (mm)

No.	Name	Description
1	Front panel	
2	Front grill	
3	Air outlet	
4	Gas pipe	ø12.7 Flare connection
5	Liquid pipe	ø6.4 Flare connection
6	Drain hose	VP13 (External dia. ø18)
7	Grounding terminal	M4
8	Right side pipe connection hole	
9	Left side pipe connection hole	

3D038539B

Notes:
1. Location of unit's of Name Plate: Right side surface of casing
2. In case of using wireless remote controller, this position will be a signal receiver. Refer to the drawing of wireless remote controller in detail.

244 FXAQ-MA

Specifications

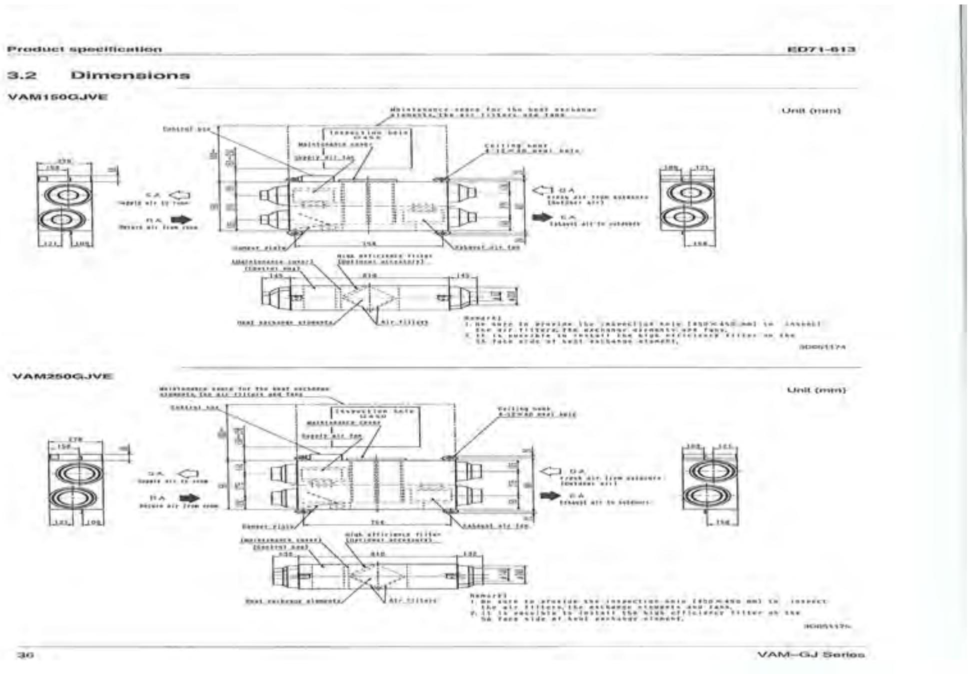
Model Name				**VAM150GJVE**
Power supply				Single phase 220-240V / 220V, 50/60 Hz
Temperature exchange efficiency		Ultra-High	%	79 / 79
		High	%	79 / 79
		Low	%	84 / 85
Enthalpy exchange efficiency	Cooling	Ultra-High	%	66 / 66
		High	%	66 / 66
		Low	%	70 / 70.5
	Heating	Ultra-High	%	72 / 72
		High	%	72 / 72
		Low	%	76 / 76.5
Casing				Galvanized steel plate
Insulation material				Self-extinguishable urethane foam
Dimensions		H × W × D	mm	278 × 810 × 551
Heat exchange system				Air to air cross flow total heat (sensible heat + latent heat) exchange
Heat exchange element				Specially processed nonflammable paper
Air filter				Multidirectional fibrous fleeces
Fan	Type			Sirroco fan
	Air flow rate	Ultra-High	m^3/h	150 / 150
		High	m^3/h	150 / 150
		Low	m^3/h	100 / 95
	External static pressure	Ultra-High	Pa	120 / 154
		High	Pa	106 / 131
		Low	Pa	56 / 6
Fan motor			Type	Open type capacitor permanent split-phase induction motor, 4 poles × 2
Motor output			kW	0.030 × 2
Operating sound	Heat exchange mode	Ultra-High	dBA	27 – 28.5 / 28.5
		High	dBA	26 – 27.5 / 27.5
		Low	dBA	20.5 – 21.5 / 21
	Bypass mode	Ultra-High	dBA	28.5 – 29.5 / 29.5
		High	dBA	27.5 – 28.5 / 28.5
		Low	dBA	22.5 – 23.5 /22
Operation range (Ambient)				-15°C to 50°CDB (80% RH or less)
Connection duct diameter			mm	ϕ100
Weight			kg	24

Test conditions are as follows.

Condition	Indoor		Outdoor	
	°CDB	R·H (%)	°CDB	R·H (%)
Cooling condition	27	50	35	60
Heating condition	20	40	7	70

Note:
operation sound is measured at 1.5 m below the center of the body.
Air flow rate can be changed over to Low mode or High mode.
Nomal AMP., input, efficiency depend on the other above conditions.
Operating sound is measured in an anechoic chamber.
Operating sound level generally may become greater than this value depending on the operating conditions, reflected sound, and peripheral noise.
The sound level at the air discharge port is about 8 dB higher than the unit's operating sound.
The specifications, designs and information here are subject to change without notice.
Temperature Exchange Efficiency is the mean value in cooling and heating.
Efficiency is measured under the following conditions.
Ratio of rated external static pressure has been kept as follows. Outdoor side to indoor side = 7 to 1.

Dimensions

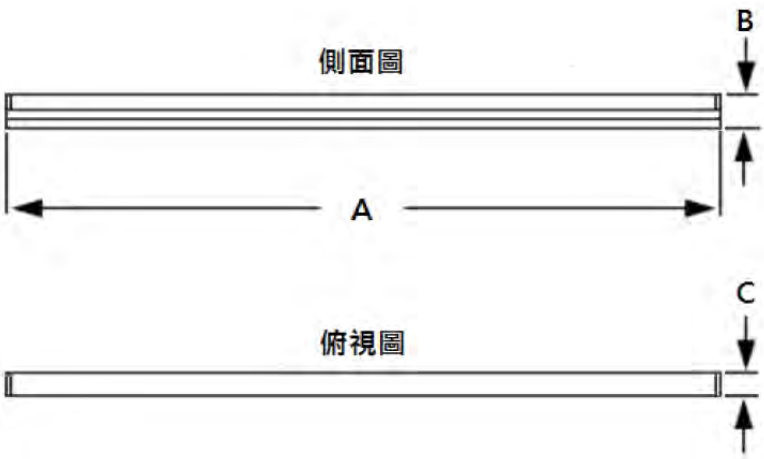

Product specification
ED71-613
3.2 Dimensions
VAM150GJVE
Unit (mm)
SA
RA
OA
EA
VAM250GJVE
Unit (mm)
SA
RA
OA
EA
36
VAM–GJ Series

T5 LED Link Light

➢ Feature 產品特性

- Aluminum heat-sink helps better feat dissipation
  鋁合金散熱器提高散熱效果，並確保產品壽命與光效維持
- Epistar Chip Inside 台灣晶元光電 LED 顆粒
- Energy saving than traditional fluorescent lamps 40%~50%, save more energy and Save more money
  較傳統燈管節能 40%至 50%，有效節約能源並節省更多電費
- Ecofriendly CO2 reduction, Mercury-free, No UV light
  符合綠色環保,減少二氧化碳排放,無汞汙染及無紫外線傷害
- Quick lighting up, no Glare, no Flicker 快速點燈，不眩光、不閃爍
- Meet CNS indoor lighting standard and Certified CNS
  燈光照度符合國家室內照明標準並通過 CNS 認證

➢ Dimension 尺寸



	A	B	C
FRVT5LED11	295 mm	32 mm	22 mm
FRVT5LED21	568 mm	32 mm	22 mm
FRVT5LED31	995 mm	32 mm	22 mm
FRVT5LED41	1270 mm	32 mm	22 mm

※ Tolerance is according to mechanical drawing unless otherwise noted (±3mm)
公差值依根據設計圖說規定，除非另有說明 (此為±3mm)

➢ Electronic Characteristic 電氣規格

	FRVT5LED11	FRVT5LED21	FRVT5LED31	FRVT5LED41
Net Weight 淨重 (零件包 70g)	燈具 90g (160g)	燈具 140g (210g)	燈具 190g (260g)	燈具 240g (310g)
Input Voltage 輸入電壓	100VAC~240VAC			
P.F(Power Factor) 功率因數	>90%			
LED Q'ty 顆數	4014 24ea(個)	4014 48ea(個)	4014 72ea(個)	4014 96ea(個)
Luminous Flux(lm) 全光束光通量(流明)	約 500 lm	約 1000 lm	約 1500 lm	約 2000 lm
Power Consumption(W) 消耗功率	5W±10% (瓦)	10W±10% (瓦)	15W±10% (瓦)	20W±10% (瓦)
Operating Temperature 使用環境溫度	0℃ ～ 40℃			
C.C.T. 色溫	3000K(暖白)、4000K(自然白)、6000K(晝白)±300K			
Beam Angle 發光角度 C.R.I. 演色性	150°± 10°(度) >76			
Lux @1M 1 米距離直下照度	約 350Lux	約 400Lux	約 450Lux	約 500Lux
Life Time @25℃ LED LED 晶片使用壽命	> 40000 hrs(小時)			

Recessed Ceiling Luminaires

嵌入式燈DA-503系列

- 高效輸出
- 性价比高

產品優勢

- 簡單容易的安裝設計，使施工過程節省時間，並確保燈具安裝穩固
- 精確的光學設計加上獨特光形處理技術，確保光傳輸效率高達85%以上，光形均勻圓潤
- 15度以上截光角設計，有效增加空間照明舒適度、享受悅到深處，美由心生的優質環境
- 固定式與擺動式兩種產品設計，可針對不同需求選擇應用
- 擺動式燈頭可雙向擺動30度，靈活調整照射方向
- 健康環保光源，使被照物免受紅、紫外線的危害

應用場所

- 適用於博物館、展覽館、美術館、畫廊、商業場所、居家場所及辦公室重點照明

DA-503AN	DA-504AN	DA-506AN	DA-509AN	DA-512AN	DA-515AN	DA-520AN
LEDx3(350mA)	LEDx4(350mA)	LEDx6(350mA)	LEDx9(350mA)	LEDx12(350mA)	LEDx15(350mA)	LEDx20(350mA)
LEDx3(700mA)	LEDx4(700mA)	LEDx6(700mA)	LEDx9(700mA)	LEDx12(700mA)	LEDx15(700mA)	LEDx20(700mA)
ø60	ø70	ø75	ø85	ø100	ø100	ø125

DA-503AD	DA-504AD	DA-506AD	DA-509AD	DA-512AD	DA-515AD	DA-520AD
LEDx3(350mA)	LEDx4(350mA)	LEDx6(350mA)	LEDx9(350mA)	LEDx12(350mA)	LEDx15(350mA)	LEDx20(350mA)
LEDx3(700mA)	LEDx4(700mA)	LEDx6(700mA)	LEDx9(700mA)	LEDx12(700mA)	LEDx15(700mA)	LEDx20(700mA)
ø75	ø80	ø90	ø100	ø125	ø125	ø150

■ 人性化防眩光設計

15度以上截光角設計搭配黑色前罩有效減少眩光，增加空間照明舒適感

■ 結構設計

固定式與可擺動式的結構設計滿足不同應用需求

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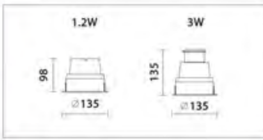
Recessed Ceiling Luminaires

嵌入式燈DA-503系列

DA-520AN



光源：OSRAM LED

功率：LEDx20(350mA) / (700mA)

輸入電壓：AC 220-240V

LED 光色：暖白 自然白 冷白

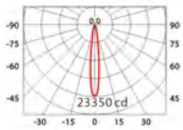
角度：12°、20°、30°

顏色：白色 黑色 銀灰

驅動器類型：外置

驅動器型號：PHILIPS 25W 0.3-0.7A I 230V(350mA)
PHILIPS 75W SH 0.3-1A 110V/230V(700mA)

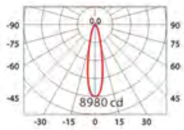
LEDx20 (700mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	23350
2.0	0.4	5838
3.0	0.6	2594

700mA : 39690 cd

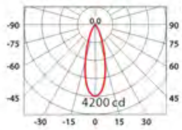
LEDx20 (700mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	8980
2.0	0.7	2245
3.0	1.1	998

700mA : 15300 cd

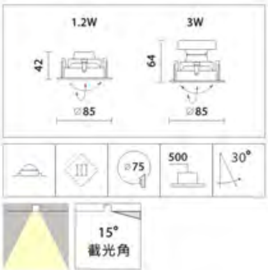
LEDx20 (700mA) WW 30°



H(m)	D(m)	E(lx)
1.0	0.5	4200
2.0	1.1	1050
3.0	1.6	467

700mA : 7110 cd

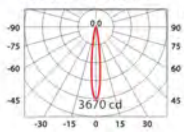
81



光源：OSRAM LED
功率：LEDx3(350mA) / (700mA)
輸入電壓：AC 100-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LSVC3AI-Z UNI(350mA)
LBVC9BI UNI(700mA)
垂直面雙向可30度調節

DA-503AD

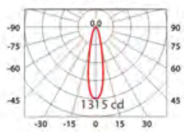
LEDx3 (350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	3670
2.0	0.4	918
3.0	0.6	408

700mA : 5960 cd

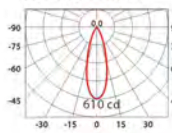
LEDx3 (350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	1315
2.0	0.7	329
3.0	1.1	146

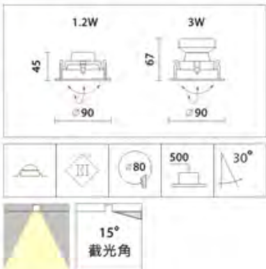
700mA : 2230 cd

LEDx3 (350mA) WW 30°



H(m)	D(m)	E(lx)
1.0	0.5	610
2.0	1.1	153
3.0	1.6	68

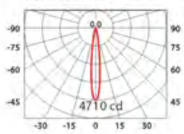
700mA : 1030 cd



光源：OSRAM LED
功率：LEDx4(350mA) / (700mA)
輸入電壓：AC 100-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LFVC4AI-Z UNI(350mA)
LLVC12B UNI(700mA)
垂直面雙向可30度調節

DA-504AD

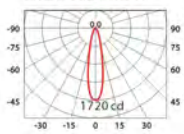
LEDx4 (350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	4710
2.0	0.4	1178
3.0	0.6	523

700mA : 8000 cd

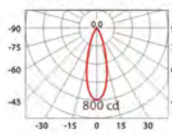
LEDx4 (350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	1720
2.0	0.7	430
3.0	1.1	191

700mA : 2930 cd

LEDx4 (350mA) WW 30°



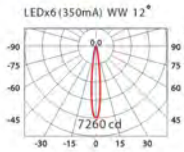
H(m)	D(m)	E(lx)
1.0	0.5	800
2.0	1.1	200
3.0	1.6	89

700mA : 1360 cd

光源：OSRAM LED
功率：LEDx6(350mA) / (700mA)
輸入電壓：AC 100-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LMVC8AI UNI(350mA)
LTVC18B-Z UNI(700mA)
垂直面雙向可30度調節

DA-506AD

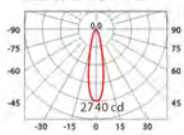
LEDx6 (350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	7260
2.0	0.4	1815
3.0	0.6	807

700mA : 12270 cd

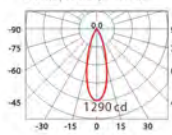
LEDx6 (350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	2740
2.0	0.7	685
3.0	1.1	304

700mA : 4640 cd

LEDx6 (350mA) WW 30°



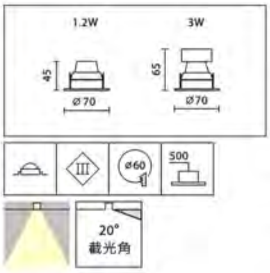
H(m)	D(m)	E(lx)
1.0	0.5	1290
2.0	1.1	323
3.0	1.6	143

700mA : 2170 cd

Recessed Ceiling Luminaires

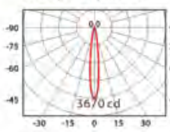
嵌入式燈DA-503系列

DA-503AN



光源：OSRAM LED
功率：LEDx3(350mA) / (700mA)
輸入電壓：AC 100-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LSVC3AI-Z UNI(350mA)
LBVC9BI UNI(700mA)

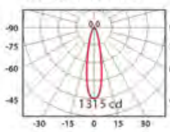
LEDx3 (350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	3670
2.0	0.4	918
3.0	0.6	408

700mA : 5960 cd

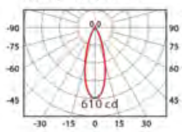
LEDx3 (350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	1315
2.0	0.7	329
3.0	1.1	146

700mA : 2230 cd

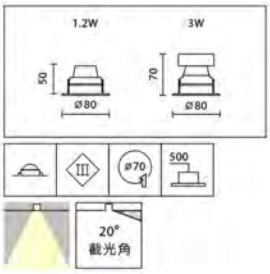
LEDx3 (350mA) WW 30°



H(m)	D(m)	E(lx)
1.0	0.5	610
2.0	1.1	153
3.0	1.6	68

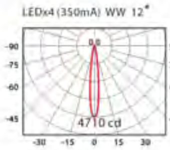
700mA : 1030 cd

DA-504AN



光源：OSRAM LED
功率：LEDx4(350mA) / (700mA)
輸入電壓：AC 100-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LFVC4AI-Z UNI(350mA)
LLVC12B UNI(700mA)

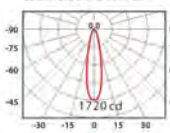
LEDx4 (350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	4710
2.0	0.4	1178
3.0	0.6	523

700mA : 8000 cd

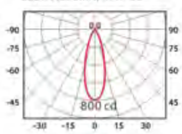
LEDx4 (350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	1720
2.0	0.7	430
3.0	1.1	191

700mA : 2930 cd

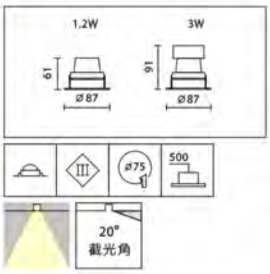
LEDx4 (350mA) WW 30°



H(m)	D(m)	E(lx)
1.0	0.5	800
2.0	1.1	200
3.0	1.6	89

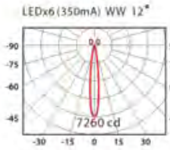
700mA : 1360 cd

DA-506AN



光源：OSRAM LED
功率：LEDx6(350mA) / (700mA)
輸入電壓：AC 100-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LMVC8AI UNI(350mA)
LTVC18B-Z UNI(700mA)

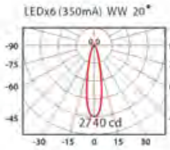
LEDx6 (350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	7260
2.0	0.4	1815
3.0	0.6	807

700mA : 12270 cd

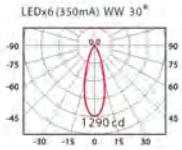
LEDx6 (350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	2740
2.0	0.7	685
3.0	1.1	304

700mA : 4640 cd

LEDx6 (350mA) WW 30°

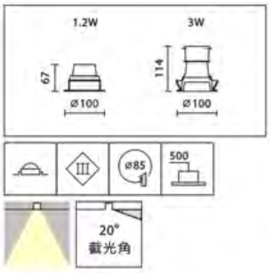


H(m)	D(m)	E(lx)
1.0	0.5	1290
2.0	1.1	323
3.0	1.6	143

700mA : 2170 cd

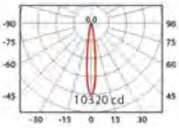
79

DA-509AN



光源：OSRAM LED
功率：LEDx9(350mA) / (700mA)
輸入電壓：AC 220-240V
LED 光色：■暖白 ■自然白 □冷白
角度：12°、20°、30°
顏色：□白色 ■黑色 ■銀灰
驅動器類型：外置
驅動器型號：LLVC12A UNI(350mA)
PHILIPS 25W 0.3-0.7A I 230V(700mA)

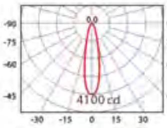
LEDx9 (350mA) WW 12°



700mA : 17900 cd

H(m)	D(m)	E(lx)
1.0	0.2	10320
2.0	0.4	2580
3.0	0.6	1147

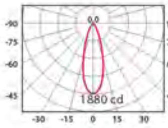
LEDx9 (350mA) WW 20°



700mA : 7100 cd

H(m)	D(m)	E(lx)
1.0	0.4	4100
2.0	0.7	1025
3.0	1.1	456

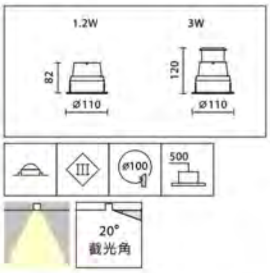
LEDx9 (350mA) WW 30°



700mA : 3330 cd

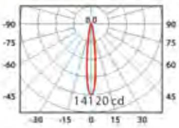
H(m)	D(m)	E(lx)
1.0	0.5	1880
2.0	1.1	470
3.0	1.6	209

DA-512AN



光源：OSRAM LED
功率：LEDx12(350mA) / (700mA)
輸入電壓：AC 220-240V
LED 光色：■暖白 ■自然白 □冷白
角度：12°、20°、30°
顏色：□白色 ■黑色 ■銀灰
驅動器類型：外置
驅動器型號：LTVC18A-Z UNI(350mA)
PHILIPS 50W SH 0.3-1A 62V I 230V(700mA)

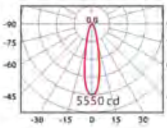
LEDx12 (350mA) WW 12°



700mA : 25040 cd

H(m)	D(m)	E(lx)
1.0	0.2	14120
2.0	0.4	3530
3.0	0.6	1569

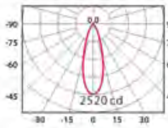
LEDx12 (350mA) WW 20°



700mA : 9460 cd

H(m)	D(m)	E(lx)
1.0	0.4	5550
2.0	0.7	1388
3.0	1.1	617

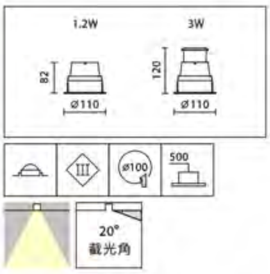
LEDx12 (350mA) WW 30°



700mA : 4390 cd

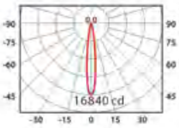
H(m)	D(m)	E(lx)
1.0	0.5	2520
2.0	1.1	630
3.0	1.6	280

DA-515AN



光源：OSRAM LED
功率：LEDx15(350mA) / (700mA)
輸入電壓：AC 220-240V
LED 光色：■暖白 ■自然白 □冷白
角度：12°、20°、30°
顏色：□白色 ■黑色 ■銀灰
驅動器類型：外置
驅動器型號：LTVC18A-Z UNI(350mA)
PHILIPS 50W SH 0.3-1A 62V I 230V(700mA)

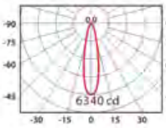
LEDx15 (350mA) WW 12°



700mA : 30710 cd

H(m)	D(m)	E(lx)
1.0	0.2	16840
2.0	0.4	4210
3.0	0.6	1871

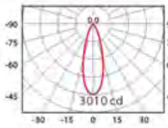
LEDx15 (350mA) WW 20°



700mA : 11100 cd

H(m)	D(m)	E(lx)
1.0	0.4	6340
2.0	0.7	1585
3.0	1.1	704

LEDx15 (350mA) WW 30°



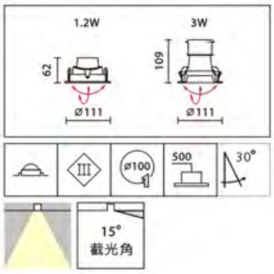
700mA : 5460 cd

H(m)	D(m)	E(lx)
1.0	0.5	3010
2.0	1.1	753
3.0	1.6	334

Recessed Ceiling Luminaires

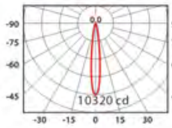
嵌入式燈DA-503系列

DA-509AD



光源：OSRAM LED
功率：LEDx9(350mA) / (700mA)
輸入電壓：AC 220-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LLVC12A UNI(350mA)
PHILIPS 25W 0.3-0.7A I 230V(700mA)
垂直面雙向可30度調節

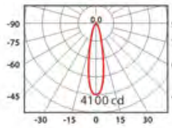
LEDx9(350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	10320
2.0	0.4	2580
3.0	0.6	1147

700mA : 17900 cd

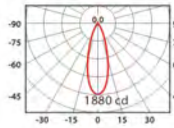
LEDx9(350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	4100
2.0	0.7	1025
3.0	1.1	456

700mA : 7100 cd

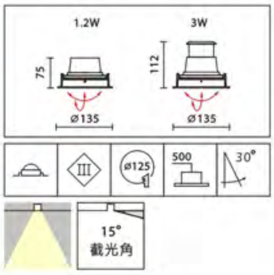
LEDx9(350mA) WW 30°



H(m)	D(m)	E(lx)
1.0	0.5	1880
2.0	1.1	470
3.0	1.6	209

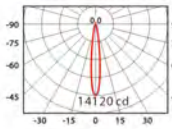
700mA : 3330 cd

DA-512AD



光源：OSRAM LED
功率：LEDx12(350mA) / (700mA)
輸入電壓：AC 220-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LTVC18A-Z UNI(350mA)
PHILIPS 50W SH 0.3-1A 62V I 230V(700mA)
垂直面雙向可30度調節

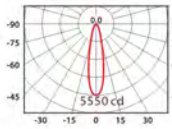
LEDx12(350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	14120
2.0	0.4	3530
3.0	0.6	1569

700mA : 25040 cd

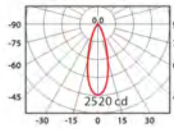
LEDx12(350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	5550
2.0	0.7	1388
3.0	1.1	617

700mA : 9460 cd

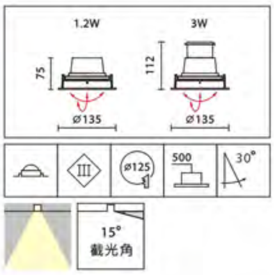
LEDx12(350mA) WW 30°



H(m)	D(m)	E(lx)
1.0	0.5	2520
2.0	1.1	630
3.0	1.6	280

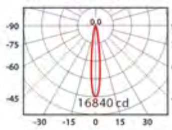
700mA : 4390 cd

DA-515AD



光源：OSRAM LED
功率：LEDx15(350mA) / (700mA)
輸入電壓：AC 220-240V
LED 光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：LTVC18A-Z UNI(350mA)
PHILIPS 50W SH 0.3-1A 62V I 230V(700mA)
垂直面雙向可30度調節

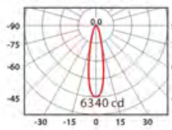
LEDx15(350mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	16840
2.0	0.4	4210
3.0	0.6	1871

700mA : 30710 cd

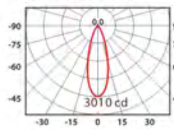
LEDx15(350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	6340
2.0	0.7	1585
3.0	1.1	704

700mA : 11100 cd

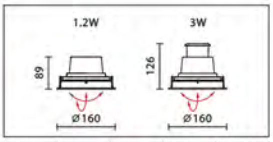
LEDx15(350mA) WW 30°

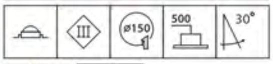


H(m)	D(m)	E(lx)
1.0	0.5	3010
2.0	1.1	753
3.0	1.6	334

700mA : 5460 cd

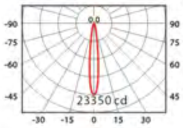
DA-520AD





光源：OSRAM LED
功率：LEDx20(350mA) / (700mA)
輸入電壓：AC 220-240V
LED光色：暖白 自然白 冷白
角度：12°、20°、30°
顏色：白色 黑色 銀灰
驅動器類型：外置
驅動器型號：PHILIPS 25W 0.3-0.7A I 230V(350mA)
PHILIPS 75W SH 0.3-1A 110V/230V(700mA)
垂直面雙向可30度調節

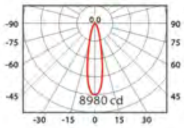
LEDx20(700mA) WW 12°



H(m)	D(m)	E(lx)
1.0	0.2	23350
2.0	0.4	5838
3.0	0.6	2594

700mA : 39690 cd

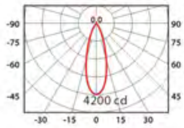
LEDx20(700mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	8980
2.0	0.7	2245
3.0	1.1	998

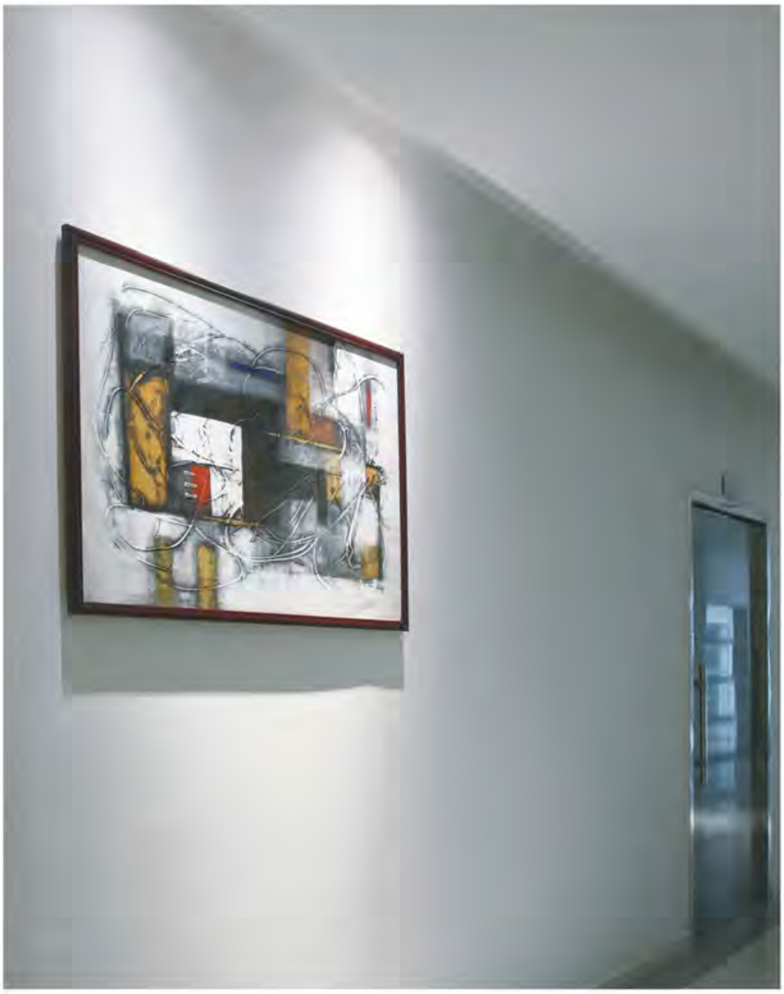
700mA : 15300 cd

LEDx20(700mA) WW 30°



H(m)	D(m)	E(lx)
1.0	0.5	4200
2.0	1.1	1050
3.0	1.6	467

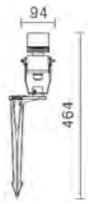
700mA : 7110 cd

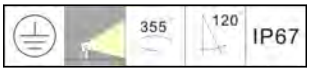


Tons:

FLOODLIGHTS 戶外投光燈系列

GA-123D





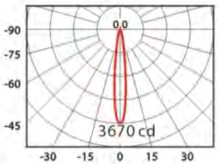
Product Features & Application areas 產品特點&適用場所

- 防護等級達到 IP67
- 優秀的光學設計,使得光形圓潤飽滿,質感出眾
- 專利的散熱設計結構,保證 LED 光源的超長壽命
- 採用國際品牌 LED 光源,高效節能
- 支架可水準方向轉動 355 度,燈頭可垂直擺動 120 度,滿足不同照明需求
- 人性化的防眩光設計為行人及車輛提供舒適的夜間照明
- 健康環保光線,光譜中不含紅、紫外線,為夜間照明提供節能環保的最佳選擇

適合用於庭院、園林、雕塑等戶外燈光工程

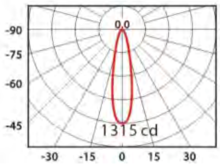
Photometic data 配光曲線圖

LEDx3 (350mA) WW 12°



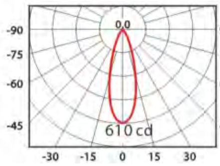
H(m)	D(m)	E(lx)
1.0	0.2	3670
2.0	0.4	918
3.0	0.6	408

LEDx3 (350mA) WW 20°



H(m)	D(m)	E(lx)
1.0	0.4	1315
2.0	0.7	329
3.0	1.1	146

LEDx3 (350mA) WW 30°



H(m)	D(m)	E(lx)
1.0	0.5	610
2.0	1.1	153
3.0	1.6	68

Product specifications 產品規格

光源(LightSource)	OSRAM OSLON LED	燈座(LampHolder)	/
瓦數(Watts)	1.2W*3 (350mA)	產品重量(Weight)	0.85kg
輸入電參數(AC Input)	100-240V 50HZ		
安定器/變壓器/驅動器(Ballast/Transformer/Driver)	益航：LDR004-110-A0		
反射罩角度(Reflector Angle)	12°、20°、30°		
色溫(Color Temperature)	冷白、自然白、暖白		
安規執行標準(Standards of Safety)	●EN 60598-1:2008+A11:2009 ●EN 60598-2-6:1994+A1:1997 ●EN 60598-2-7:1989+A2:1996+A13:1997		
線材 / 長度 / 連接器(Connecting)	H05NR-F1-3G 電纜線, 2M		
產品材質(Material)	Aluminum 鋁		
顏色 / 表面處理方式(Color)	戶外黑、銀灰色		
包裝方式(Packing)	342 號內盒包裝 · 1PCS/盒 · 15PCS/箱		
安裝方式(Installation)	Surface-mounted 明裝式		
儲存溫度 / 濕度(Storage Temperature Range)	溫度:-20℃ to +50℃/濕度: 85%		

Accessories 配件

版本：1.0
2013.10.07

PART 1 – GENERAL

1.1 DESCRIPTION
This specification includes:

A. Conduit
B. Outlets
C. Wiring Devices
D. Junction and pull boxes
E. Cable trays

1.2 APPLICABLE CODES AND STANDARDS

A. IEC - International Electrotechnical Commission
B. CNS - China National Standard
Standard 1302 Rigid Nonmetallic Conduit
Standard 2606 Electrical Rigid Metal Conduit
Standard 4970 Rigid Nonmetallic Outlet Box
Standard 6079 Rigid Metal Conduit Fittings
Standard 6086 Rigid Metal Outlet Box
Standard 6109 Rigid Nonmetallic Conduit Fittings
Cable Trays
C. TPC - Regulations

1.3 SUBMITTALS: Product Data

PART 2 - PRODUCTS

2.1 CONDUIT

A. Electrical Metallic Tubing (EMT):
Electrical metallic tubing shall be mild steel, electrical welded and galvanized. EMT shall be in accordance with CNS standard.
B. Nonmetallic Conduit
Nonmetallic conduit shall be in accordance with CNS 1302 Standard. Conduit fittings, elbows and cement shall be provided by the same manufacturer. All joints shall be leakproof and be installed in strict accordance with manufacturer's recommendations.
C. EMT Steel Fittings: Set screw connecting devices shall be used on all EMT conduit except where conduit is to be installed in poured concrete. All EMT connection in poured concrete shall be compression type. Pressure cast type fittings are not acceptable.
D. PVC Fittings: Connecting devices shall be cleaned, dried and glued to PVC conduit per manufacturer's inspections. Couplings shall be female socket type of correct size to match conduit.

2.2 OUTLETS

A. Single or Multiple Gang Outlet Boxes: Provide a 100mm square, 38 mm or deeper outlet box with single or two-gang plaster ring mounted vertically for a flush wall switch, receptacle, or telephone. Where three or more devices are at one location, use a multiple gang box with a suitable plaster ring. Install one device per gang unless otherwise shown.
B. Lighting Fixture Outlets: Wall bracket and ceiling-mounted lighting fixture outlets to be 100 mm octagon, 38 mm deep with a 10 mm fixture stud.

C. Surface Outlets: Surface outlets on exterior walls and in interior locations where exposed to moisture, and where specifically called for on the drawing shall be cast metal outlet boxes with conduit hubs matching device plates.

D. FLOOR BOXES: Floor boxes for receptacles, and other special outlets shall be provided if shown on the drawings. Floor boxes shall be flush mounted, cast metal adjustable, and watertight complete with gasket covers and bronze trim. Provide bronze carpet plate where appropriate.

2.3 WIRING DEVICES

A. Wall switches for control of lighting fixtures
1. Single-pole switch: 20 Ampere, 230 Volt.
2. Double-pole switch: 20 Ampere, 230 Volt.
3. Three-way switch: 20 Ampere, 230 Volt.
B. Receptacles
1. Single receptacle: 16A, 230 V, 3-wire, 2-pole, grounding type, with child protection.
2. Duplex receptacle: 16A, 230 V, 3-wire, 2-pole, grounding type, with child protection.

2.4 JUNCTION AND PULL BOXES

A. Junction boxes: Junction boxes having an internal volume of not over 0.0016m shall be as specified for outlet boxes, including grounding terminals, but not including other details applicable only to lighting fixture, switch, and receptacle outlet boxes, and shall have blank covers. Junction boxes having an internal volume of more than 0.002m shall be as hereinafter specified for pull boxes of corresponding sizes.

B. Pull Boxes: Pull boxes shall be made of galvanized steel, factory primed with zinc-chromate paint. Welded seams shall be continuous. Pull boxes shall be provided with grounding lugs welded to the box. Covers shall be fastened with screws and gasket as necessary. In addition, all outside surfaces of boxes and cover plates shall be given a factory finish coat of ANSI No.Z55.1 gray paint, except that finish may be omitted from outside surfaces of fully recessed boxes only. Boxes exposed to wet or rain conditions shall be cast waterproof type.

C. Fixtures: Each pull box shall be provided with sufficient clamps, grips, etc., to which cables shall be secured in a neat and orderly fashion permitting ready identification, so that no cable will have an unsupported length of more than 760mm.

2.5 CABLE TRAYS

A. General: Cable trays shall be ladder type trays with components, accessories and system interconnections as required.
B. Ratings
1. The cable tray, fittings, and connectors shall be designed for a working load of 75kg/m, with a load safety factor of 2.0 when tested in accordance with NEMA VE 1-3.01.
2. The design shall be based on a supported span length of 3.7m, NEMA class designation 12B.
3. Each rung shall be capable of supporting, without deformation, a load of 90kg placed at the midpoint of the rung.
4. The installation of a connector between two tray sections shall not decrease the strength of the tray.
C. Definitions: The definitions and manufacturing standards shall be in accordance with Parts 1 and 2 of NEMA VE 1.
D. Fittings
1. Fittings shall be designed and constructed exactly as the straight sections with respect to side rail and rung material, gauge, finish, and dimensions.
2. Unless otherwise shown, the inside radius of tray fittings shall be 300 mm.
3. Cable trays with covers shall be provided with straps or clamps for secure fastening of the covers.

PART 3 - EXECUTION

3.1 METHODS

A. General: Installation of materials shall be as specified herein.

3.2 CONDUIT INSTALLATION

A. General: Conceal conduit wherever possible unless otherwise shown or specified. Run all exposed conduit paralled with building walls using right-angle bends. Exposed diagonal runs of conduit will not be permitted unless specifically shown otherwise. Installation of electrical conduit shall conform to CNS Standard.
1. Size and routing of conduit shall be determined by Contractor. Conduit shall be installed without interference with other work. Metallic conduit and fittings shall be physically and electrically separated from reinforcing steel by the use of bitumastic paint or similar material.
2. The exact location of conduit runs shall be determined to suit field conditions.
3. Conduit shall run continuously between outlets and shall be provided with junction boxes for tap connections. Changes in direction shall be made with large radius bends or proper fittings.
4. Conduit size shall be determined from outside diameter of Contractor-furnished cable.
B. Supports
1. All supporting elements shall have adequate thread engagements. The amount of thread engaged and amount available for further adjustment shall be plainly in view. Sight holes shall be provided where necessary.
C. Flexible Connections: Provide flexible conduit connections for thermocouple assemblies, sensors and solenoids and connect raceway and cable as indicated.
D. Grounding Continuity: Metallic conduits and connections shall be electrically and mechanically continuous.
E. Nonmetallic Conduit Connections: Cut ends of plastic conduit shall be trimmed inside and outside to remove rough edges and shall be cleaned thoroughly. Joints in plastic conduit shall be made with manufacturer’s recommended sealant and shall be watertight. Each conduit run complete with bends, elbows, and other fittings shall be capable of passing freely a ball 6mm smaller in diameter than the inside diameter of the conduit. Between cable pull points, a conduit run shall not contain more than a total of three 90 degree bends, totaling 270 degrees, including bends at outlets and fittings.
F. Install bends on embedded conduit in accordance with the following tabulations:

size of Nominal mm(CNS)	minimum radius of factory bend mm	minimum radius of field bend mm
16,20&28	200	250
42	250	300
54	300	380
70	380	460
82	460	610
104	610	760

G. Hanger rods shall comply with the following schedule. Larger diameter rods may be necessary where the rod supports more than one conduit.

Conduit Diameter (mm CNS)	Rod Diameter (mm)
54 or less	10
70 to 104	12

H. Electrical Metallic Tubing (EMT)
1. Installation of EMT shall be in accordance with applicable instruction for exposed conduit unless otherwise specified.
2. Minimum size EMT shall be 15mm diameter.
3. EMT fittings shall be compression type.

3.3 OUTLET INSTALLATION

A. Outlets: outlets installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.
B. Outlet boxes: Install outlet boxes flush with the finished surface where outlets occur in finished walls or columns.
C. Supports: Outlet boxes shall be supported to masonry or concrete construction by expansion anchors and to steel beams by clamps, bolts, etc. Pull boxes shall be rigid under torsional and deflecting forces and, if necessary, shall be provided with angle iron frame for rigidity. Covers shall have a sufficient number of screws to ensure continuous contact with the box

3.4 JUNCTION AND PULL BOX INSTALLATION

Sheet metal boxes shall be adequately supported to maintain shape. Larger boxes shall be adequately formed or braced with structural steel welded into a rigid assembly to maintain alignment in shipment and installation.

3.5 CABLE TRAY INSTALLATION

A. General
1. Installation shall be in accordance with the manufacturer's written instructions.
2. Tray supports shall be designed and fabricated from steel or iron to rigidly support the trays under stress of cable installing and structure vibrations from equipment operation. Supports shall be constructed in accordance with details shown. Earthquake bracing shall be as required.
3. Expansion joints in the cable trays shall be installed at structure expansion joint crossings. Except where anchors are required, support elements shall be fabricated to permit free movement of raceways at crossings over structural expansion or contraction joints.
4. Each hanger shall be designed to permit adjustment after erection while supporting the load.1. Installation shall be in accordance with the manufacturer's written instructions.
5. Cable tray systems shall be coordinated with adjacent services and equipment to avoid interferences. Location of cable trays in accessible areas or directly underneath light fixtures will not be permitted.
B. Spacing of Supports: Supports for cable trays shall not be greater than 3.7m unless otherwise specified.
C. Attachment to Building Structures:Tray supports shall be attached to structural steel wherever possible.
D. Hanger Rods: Hanger rods shall be not less than 12mm diameter.
E. Trapeze Hangers:

1. A trapeze hanger with two or more hanger rods may be used for cable trays. Hanger rods shall not be less than 12mm in diameter.
2. Trapeze bars shall consist of special steel box channels with spring loaded nuts.

F. Tray Covers: Ladder type trays shall be provided with non-ventilated covers along their entire length. Covers shall be secured firmly with readily removable straps or clamps.

G. Grounding: Cable tray shall be grounded.

PART 1 – GENERAL

1.1 DESCRIPTION
This specification includes wires and cables used for power equipment, receptacle and lighting:

A. 16mm2 XLPE – LSFH (WD-YJY) / PVC
B. 10mm2 XLPE – LSFH (WD-YJY) / PVC
C. 6mm2 XLPE – LSFH (WD-YJY) / PVC
D. 4mm2 XLPE – LSFH (WD-YJY) / PVC
E. 2.5mm2 XLPE – LSFH (WD-YJY) / PVC

1.2 APPLICABLE CODES AND STANDARDS

A.	CNS 2655	C2047
B.	CNS 679	C2012
C.	IEC 60332	Tests on electric and optical fibre cables under fire condition
D.	IEC 61034	Measurement of smoke Density of Cables Burning under Defined Conditions
E.	IEC 60754	Test on Gases Evolved During Combustion of Materials from Cables

1.3 SUBMITTALS: Product Data

PART 2 - PRODUCTS

2.1
A. Multi core cable with copper conductor, XLPE insulated and LSHF material sheath cable are rated at 0.6/1KV and conform to IEC standard.
B. 2.5mm2, 4mm2, 6mm2, 10mm2, 16mm2 cable will be used for power, lighting and receptacle.

2.2
A. Single core cable with copper conductor, PVC insulated and PVC material sheath cable are rated at 0.6/1KV and confirm to IEC standard.
B. 2.5mm2, 4mm2, 6mm2, 10mm2, 16mm2 cable will be used for grounding.

PART 3 - EXECUTION

3.1 All installation shall be in accordance with specification and the manufacturer's written instructions.
3.2 Installation of wire and cable shall be accordance with plans and drawings.
3.3 Installation of Cable in Conduit
A. Wiring shall consist of insulated conductors installed in raceway. All conductors shall be continuous terminal to terminal.
B. Conduit wiring for lighting and receptacles shall be limited to three circuits per conduit.
C. The cables shall be unrolled from the drum in a manner to avoid kinking, undue tension, or crushing of the cores. The overall protective jacketing shall be maintained intact without scratches or abrasions.
D. Maximum pulling tension on cables with pulling eyes attached to the conductor or a basket grip shall not exceed manufacturer's published recommendations.

3.4 Installation of Cable in Trays

A. Installation shall be in accordance with the manufacturer’s written instructions.

B. Routing of cable in trays shall be as shown in the drawings.

C. Cables ampacities and spacing in cable trays shall be in accordance with TPC regulation.

D. Rollers shall be used at all bends and elbows to minimize pulling stresses.

E. Tray covers shall be installed as indicated after installation and inspection of cable is complete.

F. Cables shall be protected against injury or damage during storage, transit, and installation.

G. In vertical runs, the cables shall be fastened to the tray at intervals of not more than 3m.

PART 1 – GENERAL

1.1 DESCRIPTION
This section covers designing, furnishing, installing, and testing power distribution panelboards and accessories.

1.2 APPLICABLE CODES AND STANDARDS
A. CNS - China National Standard
C4172 General Distribution Panel
B. IEC – International Electrotechnical Commission
60947 Low-Voltage switchgear and controlgear
60439 Low-Voltage switchgear and controlgear assemblies

1.3 SUBMITTALS: Product Data

PART 2 - PRODUCTS

2.1 REQUIREMENTS
A. General: All panelboards shall be rated for the indicated short circuit currents.
B. Panelboards:
1. Panelboards shall be wall-mounted, consisting of circuit breakers, and other associated equipment as indicated.
C. Enclosures
1. The enclosure shall be fabricated with welded seams and corners, a folded edge flat frame around the front of the enclosure to provide a mounting surface for the front trim panel, and mounting plates or bosses to support the interior unit.
D. Circuit Breakers
1. Circuit breakers shall be molded case type manually operated, trip free, with thermal magnetic trip, in accordance with an interrupting capacity as shown.
2. The circuit breakers shall be capable of carrying 80 percent rated current continuously for panel application.
3. Circuit breaker arrangement shall be as shown.

PART 3 - EXECUTION

3.1 INSTALLATION
All installation shall be in accordance with specification and the manufacturer's written instructions.

3.2 FIELD TESTS
After the equipment has been installed, inspected, and placed in operating condition, it shall be field-tested. The field test shall demonstrate the equipment and components function in compliance with the specification over the entire range of operation.

NEO SOLAR POWER

D6P_B3A-WS
240W - 260W
Multi-Crystalline Photovoltaic Module

Positive power tolerance
0~+4.99 watt

Withstand strong wind/snow load up to 5400 Pa
Pass ASTM E330
Maximum wind speed: 197 km/h (safety factor 3)

Excellent low light performance
4% relative eff. reduction at low-irradiance (200W/m^2)

100% EL inline inspection
Better module reliability

Prolonged aging test
2000 hours damp heat test; 400 thermal cycles

Certified ammonia resistance
According to IEC 62716 Ed. 1

Compliance with RoHS and REACH

Reliability & Certification

Product guarantee: 5-year (10-year optional)
Performance warranty
- 25-year: minimum 80% power output
- 10-year: minimum 90% power output

IEC 61215 / IEC 61730, UL 1703, CE, MCS

⁎Please refer to NSP product warranty for details

NEO SOLAR POWER

Electrical Data

MODEL	D6P240B3A	D6P245B3A	D6P250B3A	D6P255B3A	D6P260B3A
Maximum Rating Power (Pmax)	240 W	245 W	250 W	255 W	260 W
Module Efficiency	14.7%	15.0%	15.3%	15.6%	15.9%
Open Circuit Voltage (Voc)	36.99 V	37.16 V	37.33 V	37.50 V	37.67 V
Maximum Power Voltage (Vpm)	29.76 V	30.05 V	30.34 V	30.64 V	30.93 V
Short Circuit Current (Isc)	8.54 A	8.61 A	8.69 A	8.76 A	8.83 A
Maximum Power Current (Ipm)	8.06 A	8.15 A	8.24 A	8.32 A	8.43 A

*Electrical data under Standard Test Conditions (STC): Cell Temperature of 25 °C, Irradiance 1000 W/m², AM 1.5
*Values w/o tolerance are typical numbers

Mechanical Data

Item	Specification
Dimension	1650 mm (L) x 990 mm (W) x 42 mm (D) / 65" (L) x 39" (W) x 1.65" (D)
Weight	18.3 kg / 40.3 lbs
Solar Cell	60 multicrystalline 6" silicon cells (156 mm x 156 mm)
Front Glass	Anti-reflective tempered solar glass, 3.2mm thickness
Cell Encapsulation	EVA (Ethylene-Vinyl-Acetate)
Back Cover	Composite film, white
Junction Box	IP 65 rated
Frame	Anodized aluminum frame, original or black

Operating Conditions

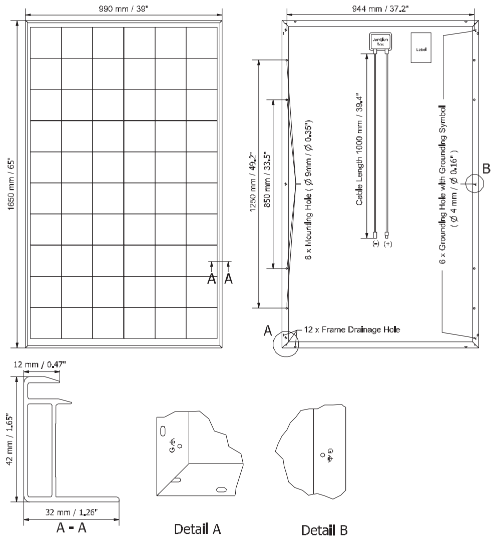
Item	Specification
Mechanical Load	5400 Pa (Certified by TUV Rheinland)
Maximum System Voltage	IEC: DC 1000 V / UL: DC 600 V
Series Fuse Rating	15 A
Operating Temperature	-40 to 85 °C

Temperature Characteristics

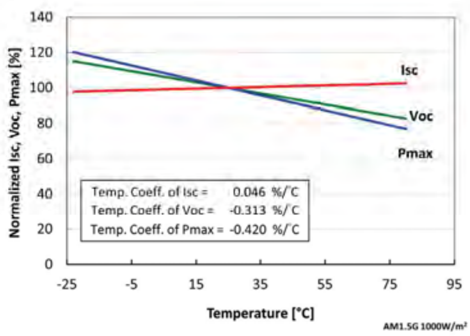
Item	Specification
Nominal Operating Cell Temperature	44.1 °C ± 2°C
Temperature Coefficient of Isc	0.046 % / °C
Temperature Coefficient of Voc	-0.313 % / °C
Temperature Coefficient of Pmax	-0.420 % / °C

* Normal Operating Cell Temperature (NOCT): Irradiance 800W/m², Ambient Temperature 20 °C, Wind Speed 1 m/s
* Please refer to NSP's Standard Module Installation Manual before using the product
* Reduction in efficiency from 1000 W/m² to 200 W/m² at 25 °C: 4% ± 2 %

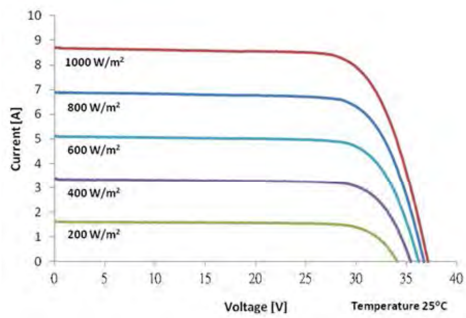
Front View & Back View



Dependence on Temperature



Dependence on Irradiance



Contact Us **www.nsp.com**

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Email: sales.module@nsp.com
Website: www.nsp.com

 Specifications are subject to change without notice. WSM-09-01-D6P_B3A-WS Ver.1.0

EC Declaration of Conformity

Producer:	Delta Energy Systems (Germany) GmbH	
Address:	Tscheulinstr. 21, 79331 Teningen, Germany	
Product description:	**Solar Inverter for Grid operation**	
Model:	**SOLIVIA2.0EUG4TR** (1)	**EOE45010459**
	SOLIVIA2.5EUG4TR (1)	**EOE45010288**
	SOLIVIA3.0EUG4TR (1)	**EOE46010287**
	SOLIVIA3.3EUG4TR (1)	**EOE46010252**
	SOLIVIA3.6EUG4TR (1)	**EOE46010316**
	SOLIVIA5.0EUG4TR (2)	**EOE46010253**

The product described above in the form as delivered is in conformity with the provisions of the following European Directives:

2004/108/EC Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility

Immunity	EN 61000-6-2 : 2005
Emission	EN 61000-6-3 : 2007 + A1 : 2011
Harmonics / Flicker	EN 61000-3-2 : 2006 + A1 : 2009 + A2 : 2009
	(1) EN 61000-3-3 : 2008
	(2) EN 61000-3-12 : 2005 + EN 61000-3-11 : 2000

2006/95/EC Council Directive on the approximation of the laws of the Member States related to electrical equipment designed for use within certain voltage limits

Safety	IEC 62109-1 : 2010
	EN 62109-1 : 2010
	IEC 62109-2 : 2011
	EN 62109-2 : 2012

Teningen, Oct 1st 2012

Klaus Gremmelspacher		Andreas Hoischen	
Head R&D LOB Solar	K. Gremmelspacher	Head of LOB Solar	Hoischen
Name, Function	Signature	Name, Function	Signature

This declaration certifies the conformity to the specified directives but contains no assurance of properties. The safety documentation accompanying the product shall be considered in detail..

SOLIVIA 5.0 TR

High efficiency solar inverters for the European market -
Perfect choice for a single or multi-family house

Versatile applications

- Usable with all commercially available solar modules (mono, poly, amorphous)
- Wide input voltage range
- Suitable for indoor and outdoor applications (IP65)

Maximum profitability

- Peak efficiency of 96 %
- Full output power up to 55 °C
- 10 years guarantee after online registration

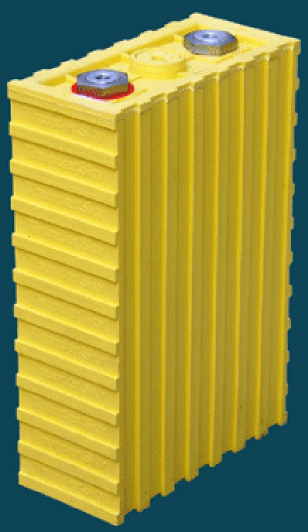
www.solar-inverter.com

Winston Battery

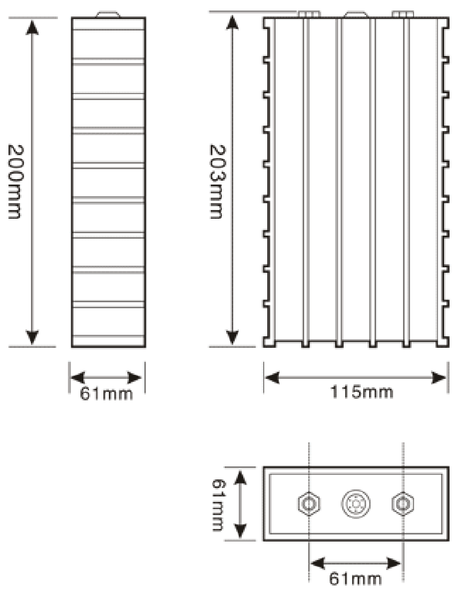
Address: Winston Industrial Park, Third Industrial Zone, Lisonglang Village, Gongming Town, Shenzhen, Guangdong P.R.C
Tel: +86-755-8602 6789 Fax: +86-755-8602 6678
Http: //www.winston-battery.com E-mail: winston@winston-battery.com

温斯頓牌稀土鋰釔動力電池性能説明
SPECIFICATION FOR WINSTON RARE EARTH LITHIUM YTTRIUM POWER BATTERY

單體電池尺寸 DIMENSIONS



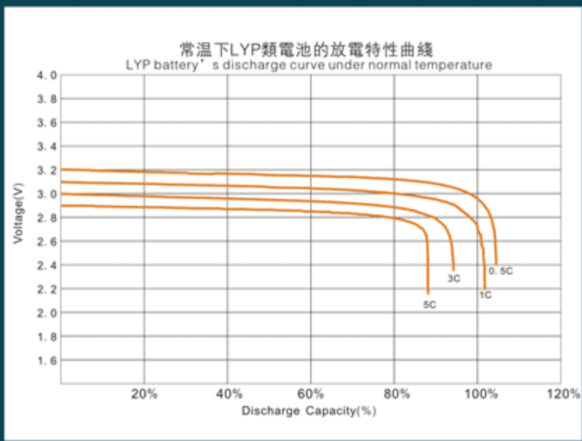
型号(MODEL)：WB–LYP60AHA

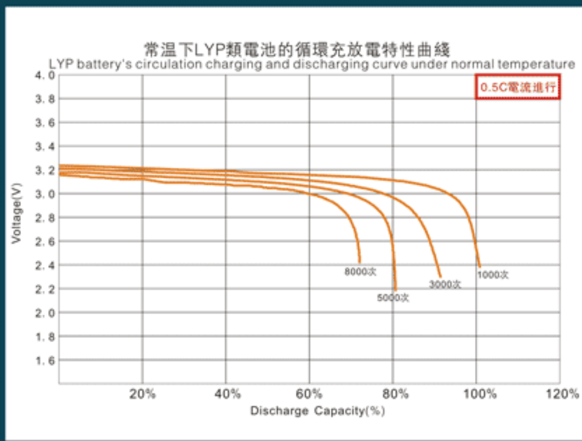


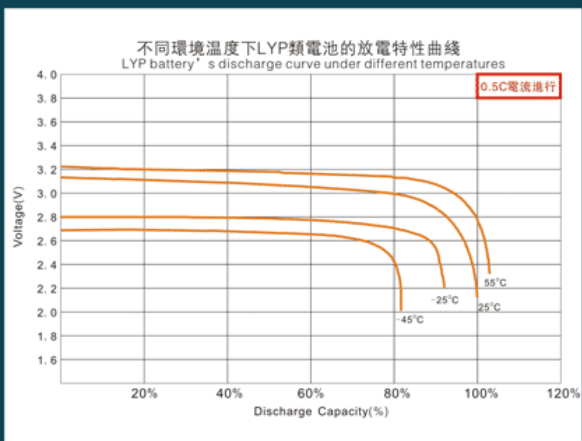
技術參數 SPECIFICATIONS

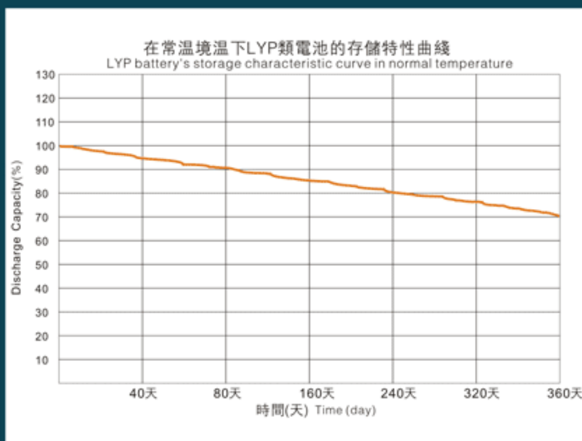
型號(MODEL)：WB–LYP60AHA		
標稱容量 Nominal Capacity	60Ah	
工作電壓 Operation Voltage	充電 (Charge)	4.0V
	放電 (Discharge)	2.8V
最大充電電流 Max Charge Current	≤3CA	
最大放電電流 Max Discharge Current	恒電流 (Constant Current)	≤3CA
	脉衝式 (Impulse Current)	≤20CA
標准充放電電流 Standard Charge/ Discharge Current	0.5CA	
循環壽命 Cycle Life	(80DOD%)	≥3000Times
	(70DOD%)	≥5000Times
殼體耐温性 Temperature Durability Of Case	≤200℃	
適應環境 Operating Temperature	充電 (Charge)	-45°C～85°C
	放電 (Discharge)	-45°C～85°C
自放電率(月) Self-discharge Rate	≤3% (Monthly)	
單體電池重量 Weight	2.3kg±50g	

WB-LYP60AHA型電池的充放電特性
WB-LYP60AHA CHARGE & DISCHARGE CHART









产品安全数据信息 MSDS
PRODUCT SAFETY DATA MSDS

产品名称：锂离子电池

PRODUCT NAME: LITHIUM-ION BATTERY

产品名称：锂离子电池
化学品用途：可反复充放电电池
厂商资料：

名称：温斯顿电池制造有限公司
地址：中国深圳宝安区公明镇李松蓢村第三工业区
电话： + 86 755 86026789　　传真：+86 755 86026678
网址：www.winston-battery.com 电邮：winston@winston-battery.com

紧急联络方式：+ 86 755 27165653 (24h)
化学品运输紧急应变中心：1-800-424-9300
技术服务邮箱：service@winston-battery.com
Product Name: Lithium-Ion Battery
Chemical Use :Battery
Manufacturer:

Name: Winston Battery Limited
Address: No.3 Industrial Zone,Lisonglang Village, Gongming Town, Bao'an Dist, Shenzhen, P.R.C
Tel:+86 755 86026789　　Fax:+86 755 86026678
Website：www.winston-battery.com Email: winston@winston-battery.com

Emergency Contact::+86 755 27165653(24h)
Chemical Transport Emergency Center : 1-800-424-9300
Technical Support email : service@winston-battery.com

产品信息 PRODUCT INFORMATION

a ）物质或化合物和供应商的标识 Substance/Compound And Supplier'S Logo；

1. 温斯顿锂离子电池 Winston Lithium-Ion Battery
2. 标识 **Logo**

b ）危险标识 Danger Sign：

c ）成分构成/成分信息COMPOSITION/INFORMATION ON INGREDIENTS：

电池型号：LYP/LP Product Model:LYP/LP			
成分 Ingredient	重量% Weight %	化学文摘号 Cas No.	备注 Notes
稀土钇 Rare Earth Y	40.5%	7440-65-5	--------------
碳酸锂 LI_2CO_3	16%	554-13-2	--------------
猛 Mn	4.4%	7439-96-5	--------------
钙 Ca	0.3%	7440-70-2	--------------
碳纤维 Graphite	5%	7782-42-5	--------------
钠 Na	1.5%	7440-23-5	--------------
碳 C	3.1%	7440-44-0	--------------
铁 Fe	3.4%	7439-89-6	--------------
聚氨基甲酸酯 PE	3.3%	9002-88-4	--------------
铜 Cu	10%	7440-50-8	--------------
铝 Al	6%	7429-90-5	--------------
钾 K	1.7%	7440-09-7	--------------
氟 F	3.3%	7782-41-4	--------------
锶 Sr	1.5%	7440-24-6	--------------

d ）急救措施FIRST AID MEASURES：

1. 万一电池破裂、冒烟、燃烧的情况下，首先应疏散危险区人员，并且提供最大的烟气通风口来排除烟雾气体；同时立即用水喷淋或将冒烟燃烧的电池浸泡在水中。
   In case of battery rupture, fume or fire, evacuate personnel from contaminated area and provide maximum ventilation to clean out fumes/gases. Meantime, spray the battery with water or put the smoking battery into basin at once.

2. 万一以下情况发生时，请立即就医：
   In case the following occur, seek medical attention immediately.

⑴ 与眼睛接触：用大量清水冲洗至少 15 分钟（保持眼帘打开）或立即到医院就医。
Eye contact: Flush with plenty of water (eyelids held open) for at least 15 minutes or go to the hospital for help immediately.

⑵ 与皮肤接触：脱掉所有受污染的衣物，用大量的清水清洗受污染皮肤，肥皂清洗至少15 分钟，请勿使用任何油类及软药膏。

Skin contact : Remove all contaminated clothing and flush affected areas with plenty of Water and soap for at least 15 minutes Do not apply greases or ointments.

⑶ 摄入：用大量的水进行稀释并且立即就医，误吞食电池部分物质，不会造成即时危险。在确保感染者没有使用催吐剂，确保粘液没有阻隔呼吸道时，建议到医院就医。

Ingestion: Dilute by giving plenty of water and get immediate medical attention, swallowed part of the substance of the battery will not cause immediate danger. Assure that the victim does not aspirate vomited material by use of positional drainage. Assure that mucus does not obstruct the airway. Seek for medical attention.

⑷ 吸入：立即将受害者移至新鲜空气处并给受污染区域通风；必要时通氧气或者人工呼吸。

Inhalation: Remove to fresh air and ventilate the contaminated area. Give oxygen or artificial respiration if needed.

e ）消防措施FIRE-FIGHTING MEASURES：

1. 灭火媒介：如果电池冒烟或燃烧，最好的解决方法是采用水喷淋电池或者把冒烟燃烧的电池迅速放入到水中。

   Extinguishing media: spray the battery with water or put the smoking /fire battery into water at once if the battery fume or fire.

2. 灭火器材：D 型灭火器，二氧化碳灭火器，干粉灭火器及泡沫灭火器。

   Extinguishing tools : Type D extinguishers , Co2, Dry chemical or Foam extinguishers.

f ）事故排除措施 ACCIDENT RELEASE MEASURES：

万一电池破裂或在滥用的情况下、冒烟、着火，应立即把电池浸入水中，或者用大量持续的水喷淋，或者在其冷却后放在特定的容器中，并根据当地的相关规定处理。

In case of battery rupture,or fume/fire under abuse, put the smoking /fire battery into water at once ,or soak under water or spray with copious amounts of water , place in approved container after cooling, and dispose in accordance with local regulations

g ）搬运和存储 HANDLING AND STORAGE：

1. 搬运：可采用叉车或卡板搬运，电池搬运时只能立放，要轻拿轻放，不能倒放或侧放和丢摔。

   Carriage: can use forklifts or pallets, stand up the battery gently when move. Do not upside down or on its side or throw.

2. 存储：把电池存放在凉爽通风的环境下（最佳温度为+25℃±5℃），和远离水源，热源及火源，电池放置需与墙壁保持适当距离；不要挤压、穿透电池，或者是使用导电物质促使

电池短路；不要直接加热或者焊接电池；不要把不同型号及品牌的电池混用；不要新旧电池混用；把电池置放在非导电托盘或者塑料托盘中。需要长期存放的电池，不能倒置储存，首先将电池充电至荷电 40-60％，以后需每月检查电池的开路电压，确定存放的同批电池的电压一致或相差在许可范围内，如发现电池电压低于 3.0V 时应该尽快补充充电。一般正常情况下电池每月自放电率≤3％，每半年应补充充电一次即可。

Storage: Store in a cool preferably condition (optimum temperature at +25℃±5℃) and ventilated area away from moisture, sources of heat, open flames. Keep adequate clearance between walls and batteries. Do not crush, pierce, short (+) and (-) battery terminals with conductive goods. Do not directly heat or solder batteries. Do not mix batteries of different types and brands. Do not mix new and used batteries; keep batteries in non-conductive or plastic trays. If need long term storage, do not store upside down, charge the batteries to 40-60% at first, and check the battery's open circuit voltage monthly is needed, make sure the voltage in the same batch to be consistent or difference within permitted extent. Charge the batteries immediately if the voltage of the batteries under 3.0V. The regular self-discharge rate is less than 3% every month. Charge the batteries once per half a year.

h ）接触控制/人身保护 CONTACT CONTROLS/PERSONAL PROTECTION:

1. 放在儿童不可触到的地方。
2. 电池泄漏或破裂时，避免皮肤直接接触。
3. 皮肤组织防护：正常使用下无需使用。在处置泄露电池时，使用氟胶手套和遮蔽罩。
4. 眼部防护：正常使用下无需使用。在处置泄露或者破裂电池时，穿防护衣和防护镜。
5. 呼吸防护：正常使用下无需使用。在电池破裂时，使用自给全脸呼吸设备。

1.Keep out of reach from children.
2.Avoid contact with skin when the battery leak or rupture.
3. Skin protection: Not necessary under normal use. Use rubber apron and protective working in case of handling of a ruptured battery.
4.Eye protection: Not necessary under normal use. Wear safety goggles or glasses with side shields if handling a leaking or ruptured battery.
5. Respiratory protection: Not necessary under normal use. In case of battery rupture, use self-contained full-face respiratory equipment.

i ）物理和化学特性 PHYSICAL AND CHEMICAL PROPERTIES:

1. 物理特性：锂离子可充电电池是密封式外壳，在正常使用和电池无损坏和密封完整的情况下温斯顿 LYP/LP 系列电池不会产生爆炸和起火的危险。只有在电池被滥用（如：机械能、热能、电能超标及受外来火源影响的情况下），导致电池安全阀的启动或者电池壳破裂，泄露出液体时，在潮湿或有水的情况下，电极物质可能发生反应或引发电池冒烟。为了预防电池由于内部过压及温度过高引发的危险，温斯顿电池设计了安全阀装置来确保电池壳不被损伤破裂。

   Physical characteristics : The lithium-ion rechargeable batteries are with sealed case, and under normal use and the seals remain intact, Winston LYP/LP series batteries are with no risk of explosion or fire .Only in case of abuse(i.e. over normal mechanical power、heat、electrical power and Under the influence of external sources of ignition),which leads to the activation of the safety valve or the rupture of the battery container, which cause the electrolyte leak, electrode materials reaction with moisture/water or battery vent. In case of excessive internal pressure ,Winston batteries design with a safety vent to protect the cell case from rupture.

2. 化学特性 Chemical Characteristics：

根据标准 67/548/EEC 指示的产品中含有危险物质的等级分类如下：
Classification of dangerous substances contained into the product as directive 67/548/EEC

物质 Substance		融化点 Melting Point	沸点 Boiling Point	分类 Classification			
CASNO	化学式 Chemical Formula			暴露极限 Exposure Limit	危险指示 Indication Of Danger	特殊风险（1） Special Risk(1)	安全指示（2） Safety Advice(2)
12190-79-3	LiFeYPO4	＞1000℃	N/A			R22 R43	S2 S22 S24 S26 S36 S37 S43 S45
EC：96-49-111 DMC：616-38-6 DEC:105-58-8 EA:141-78-6	有机溶液 （DC-DMC DEC-EA） Organic Solution	EC：38℃ DMC：4℃ DEC：-43℃ EA：-84℃	EC：24℃ DMC：90℃ DEC：127℃ EA：77℃	OSHA 中未规定 Unfound OSHA	易燃的 Inflammable	R21 R22 R41 R42 R43	S2 S24 S26 S36 S37 S45
21324-40-3	LiPF 6	N/A（分解于160℃） N/A (Decomposing in 160℃)	N/A	OSHA 中未规定 Unfound OSHA	刺激物/腐蚀 Stimulator Corrosion	R14 R21 R22 R41 R43	S2 S8 S22 S24 S26 S36 S37 S45

j ）稳定性和反应性STABILITY AND REACTIVITY：

1. 应避免的条件：温度高于 85℃或者焚烧电池。使变形、毁坏、挤压、分解、拉长或者把电池置于潮湿的环境。
2. 电解质中的 LiPF6 与水发生的化学反应将产生氟氧化物及二氧化碳。
3. 在燃烧中可能会形成氟化物（HF）与磷氧化物。

1. Conditions To Avoid : Heat above 85 ° C or incinerate. Deform, mutilate, crush, disassemble, elongate or exposure to humid condition.

2. Reaction of LiPF$_6$ with water to form Oxyfluoride and CO_2.
3. Formation of Hydrogen fluoride (HF) and phosphorous oxides during fire.

k ）毒理学信息 TOXICOLOGICAL INFORMATION：

温斯顿锂离子充电电池不含有毒物。
Winston lithium rechargeable battery does not contain toxic materials.

l ）生态信息ECOLOGICAL INFORMATION：

当正确使用至电池寿命终止时，可回收再造，温斯顿锂离子充电电池不会带来环境污染。
Under normal conditions of use till the end of the battery life,it can recycle and won’t bring any pollution to the environment.

m ）处理考虑DISPOSAL CONSIDERATIONS：

1. 根据可适用的规则处理，因各国法律而异。
2. 锂离子电池的电极必须保持绝缘并且最好在处理前用独立塑料包装袋包装。
3. 使用者不可焚烧电池，只能由权威的机构合理回收处理。

1. Dispose in accordance with applicable regulations, which vary from country to country.
2. Lithium-Ion batteries should have their terminals insulated and be preferably wrapped in individual plastic bags prior to disposal.
3. Do not dispose of the battery into fire except for authorized agency.

n ）运输信息TRANSPORT INFORMATION：

1. UN-NO.3480

ARD /RID

九类	二类包装	ARD/RID 标签	9
适当运输品名	锂离子电池，UN3480		
Class 9	Packing Group II	ADR/RID-Labels	9
Proper shipping name	Lithium-ion batteries, UN3480		

IMO

等级	二类包装	IMO-标签	9
适当运输品名	锂离子电池，UN3480		
Class	Packing Group II	IMO-Labels	9
Proper shipping name	Lithium-ion batteries, UN3480		

IATA-DGR

等级	二类包装	ICAO-标签	9
适当运输品名	锂离子电池，UN3480		
Class	Packing Group II	ICAO-Labels	9
Proper shipping name	Lithium-ion batteries, UN3480		

2. 温斯顿电池制造有限公司声明我们的产品符合联合国手册及测试标准下条理 38.3 的要求。
Winston Battery Ltd. declares that UN Manual of Tests and Criteria, Part III, sub-section 38.3 is met.

3. 在航空运输中，当他们能够满足 IATA 条款 UN3480 条款下 Ed. 54 规定的要求和 ICAO 包装要求 965 条款 II 的要求及每个包装不高于 35KG 的要求情况下，小容量的（单体≤20WH 或者电池组≤100WH）锂离子电池被认为是期望型产品。在通用的 IATA 规定下，标题货物可以像正常的货物一样运输。
In airfreight, small Lithium-ion batteries (cells≤20WH or packs≤100WH) are considered as "Expected Lithium-ion Batteries", when they meet the requirements of Ed. 54of IATA regulations (UN3480) and ICAO Packing Instruction 965 section II, specifying less than 35kg gross per package. Caption shipment can move as normal cargo under current IATA .

4. 在其他情况下（针对电池容量单体 > 20WH 或者电池组 > 100WH），锂离子电池被认为是九类产品. 必须符合 DGR 里适用的要求。（如 PI 965，Section IA 条款要求 ） 。
In other cases (mainly for large cells >20WH or packs > 100WH), they are considered as Class 9.They must meet the requirements of DGR (See Packing Instruction PI965 section IA for airfreight).

5. 在航海运输中，当电池满足 IMO 中 IMDG 危险产品的规定（UN3480）情况下，密封的锂离子电池被认为是不受限制-锂离子电池。
In the shipping by sea , sealed Lithium-ion batteries are considered as " Lithium-ion Batteries-Not Restricted" , when they meet the requirements of IMDG of IMO Dangerous Goods Regulations (UN3480).

6. 关于可充电锂离子电池的运输各种机构的相关规定，请参考 IATA，IMO，ADR/RID。
The transport of rechargeable lithium-ion batteries is regulated by various bodies, refer to: IATA, IMO, ADR/RID.

o ）管理信息 MANAGEMENT INFORMATION：

1. 温度范围 **Temperature range**

	持续Continuous	瞬间 Instant
储存Storage	+25℃±5℃	
放电 Discharge	-25℃/+75℃	-45℃/+85℃
充电 Charge	-25℃/+75℃	-45℃/+85℃

2. 比能：（备注： WH=标准电压*额定安时）KG=平均电池重量
Specific Energy: (Note: Wh = Normal voltage x Rated Ah) kg = Average battery weight)

3. 比脉冲功率：600W-1200W/KG，视电池尺寸不同。
Specific Pulse Power: 600w-1200w/kg Varies depending upon size

4. 机械阻力：如 IEC 标准相关规定

Mechanical Resistance : As defined in relevant IEC standard

p ）其他信息/免责声明OTHER INFORMATION/DISCLAIMER：

1. 此资料从其编译来源上被认为是可靠的，据我们所知及确信从我们编辑之日起是可靠并且准确的。但是，这儿需要指出的对于此材料的制造精准，可靠性和完整性不作出任何形式的陈述及表达和隐含的担保。

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1. This information has been compiled from sources considered to be dependable and is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either expressed or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein.

2. This information relates to the specific materials designated and may not be valid for such material used in combination with any other materials or in any process. It is the user's responsibility to satisfy himself as to the suitability and completeness of this information for his particular use.

3. Winston Battery Ltd. does not accept liability for any loss or damage that may occur whether direct, indirect, incidental or consequential, from the use of this information. Winston Battery Ltd. does not offer warranty against patent infringement. Additional information will be available by making a phone call on above designated purpose.

RenE-ES 6120
Battery Energy Storage System
Delta Energy Systems

Compact battery energy storage system is a complete solution for medium and small customer installations.
It collects electrical energy from the grid, when it is cost efficient and stores it in batteries. This energy can be then reused for local loads or sold back to the utility.
Installation is easy and does not require any changes to existing electrical installation. Just plug it in to your electrical socket!
The whole system is supervised by dedicated PLC controller, which gives the customer various possibilities of remote control, such as: system visualisation, change of state, load limitation, scheduled activities and alarms.

Main features

- Nominal power 3120VA, 230V AC
- Equipped with 6kWh batteries
- One point connection to the grid
- Easy installation without any need to interfere with existing installation (plug & play)
- Flexible operating modes for convenient power management.
- Compact and modular design enables easy expansion
- Possibility to equip with off-grid inverter and PV connection
- Remote management and access via RS-458 or Ethernet

Application:

Modern households, small industries

DELTA
Smarter. Greener. Together.

RenE-ES 6120
Battery Energy Storage System
Delta Energy Systems

Technical Specification (*)

1. General	
Nominal power	3120VA
AC voltage	230 V AC / 50Hz
Active elements	2 x Delta DPR2900B-48 12 x Delta DDP 260AB 1 x Battery LiIon 6kWh 1 x Controller PSC 1000N
Dimensions	600x600x1600 mm
Weight	140 kg
Standards	CE, IEC 62109, IEC 60950, VDE-AR-N 4105, EN61000-4-3-6, EN61000-6-3, EN61000-6-1, EN61000-3-2, EN 55022, UL 60950, CAN / CSA - C22.2

3. On-Grid Inverter	
Type	Delta Micro Inverter DDP 260 AB
AC voltage	230V AC
Nominal output frequency	47,5 - 51,5 Hz
Input voltage	20 - 59 V DC
Peak efficiency	>96%

4. Rectifier	
Type	2x Delta DPR2900B-48
Nominal power	2x2900 W
Input voltage	88 - 310 V AC
Output voltage	42 - 58 V DC

5. Battery	
Type	High density Lithium battery 30xWB-LY60AHA cells from Winston Battery
Nominal capacity	6kWh
Technology	LiFePO4
Voltage range	36,5 V – 56 V

Delta Energy Systems (Poland) Sp. z o.o.
Poleczki 23, 02-822 Warsaw, Poland
Phone: +48 22 335 2600, Fax: +48 22 335 2601
www.deltapowersolutions.com

DELTA
Smarter. Greener. Together.

SPECIFICATIONS
Heat Pipe Vacuum Tube Solar Collector
Heat pipe solar thermal collector can be started quickly even under cloudy day. When vacuum tube absorber energy from sun, heat pipe transfer energy from tubes to manifold immediately. 360° absorber vacuum tube make the most efficient and sustained use of the sun's energy all year round. The vacuum between two glass tubes prevents heat loss even at Frigid Zone. Manifold made of aluminum-alloy with perfect injected polyurethane insulation layer. Interior manifold is made of copper

Technical Parameter

- Solar Collector

Absorber :Heat pipe evacuated tube
Thermal Absorption : > 0.86%
Thermal Emissive : < 0.08%
Coating :AL/AL-ALN; CU/SS-ALN

- Evacuated Tube

Outer Diameter :0.58 mm
Length :1700 mm
Material :High Boron Silicon Glass 3.3
Thickness :1.6 mm

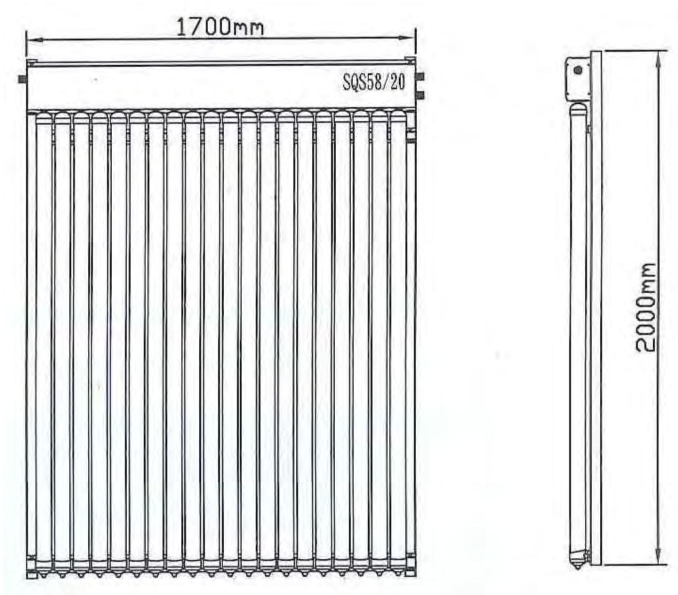
- Manifold

Material :Copper
Outer Covering :Aluminum alloy
Connection :3/4" (Inlet & Outlet)
Pressure Resistance :0.7 Mpa

- Frames

Material :Aluminum alloy
Antifreeze
Antifreeze liquid refers to local relevant standard

Dimensions



The new PadFone Infinity

Platform

Android 4.2 (Jelly Bean)

Color

Milky white / gray meteorite

Size

PadFone deformation phone
143.5 x 72.8 x 8.9 mm (length x width x height) **PadFone tablet docking station** 264.6 x 181.6 x 10.6 mm (L x W x H)

Weight

Phone:
145 g (with battery)

CPU

Qualcomm Snapdragon 800 2.2GHz

Memory

2 GB RAM

Data Storage Applications

50GB free cloud space used for 2 years (ASUS WebStorage)

Memory slots

Micro-SD card (up to 64 GB)

Link Technology

WLAN 802.11a/b/g/n/ac
Bluetooth V4.0 + EDR + HS + A2DP, NFC

Internet technical standards

UMTS / LTE / WCDMA
DC-HSPA + UL: 5.76 Mbps / DL: 42 Mbps
LTE UL: 50 Mbps / DL: 150 Mbps **3G:** UMTS: 850/900/1900/2100 **2G:** EDGE / GPRS / GSM: 850/900 / 1800/1900, **4G:** LTE: 800/1800/2600

Navigation

GPS, GLONASS & AGPS

Screen

PadFone deformation Mobile:
5-inch, 1920 x 1080/441 PPI, IPS panel with multi-touch **tablet PadFone base:** 10.1-inch, 1920 x 1200/224 PPI, IPS panel with multi-touch

Battery

PadFone deformation phone
2400 mAh built-in rechargeable lithium battery **PadFone tablet dock** 5000 mAh built-in rechargeable lithium battery

Standby time

410 hours (3G)

Talk time

19 hours (3G)

Network Camera

PadFone phone deformation
front lens auto focus, 2.0 megapixel, F2.0 aperture
lens autofocus back, 13 million pixels, LED flash, F2.0 aperture **PadFone tablet dock** front camera 1,000,000 pixels

Video features

Video playback:
up to 1080p MPEG4
H.264
H.263
3GP
Ogg
Audio Recording:
up to 1080p @ 30fps MPEG4, 720p @ 60fps
H.264
H.263 VGA @ 30fps
Ogg
3GP

Audio jack

3.5mm

Sound

MP3/3GP/AAC/AAC +

Ring

MP3

Browser

Google Browser

Message

SMS / MMS / Google Talk / Email

E-mail

Google Mail/Exchange/POP3/IMAP4/SMTP

Inductor

Gravity sensor / electronic compass / Gyroscope / Proximity Sensor / Ambient Light Sensor / Motion Sensor

Fitting

Transformer USB adapter
USB sync cable
3.5mm wired headset microphone

13.4 Fire Safety Table

Interior propagation spreading (Rules 51.3)

Type of material	Class	Location in Specifications in PD and PM
Covering (See Rule 51.3 Note 1)		
Bayer Makrolon	UL-94	PM 13.2.1 a
Ceiling (See Rule 51.3 Note 2)		
KD Wood Panel	Flame Retardant	
Walls (See Rule 51.3 Note 2)		
KD Wood Panel	Flame Retardant	
Flooring		
KD Floor Panel	CN7614	
Pipes and ducts (running through flooring, walls & ceilings)		
Stainless steel tube, galvanized sheet(ducting), EMT	A2-S1, d0	PM 5.3.4
Textile cover elements integrated into building		
N/A		
Thermal screen of thermal and acoustic insulation products	Fire resistance time	Location in Specifications in PD and PM
Glass Foam	Over 1 hour	PM 13.1.2

Evacuation of occupants

Evacuation element	Width (m)	Specifications in PD and PM
Doors and doorways		
Entrance Door Entrance doorway	1.14 1.45	PT-001
Hallways and ramps		
West side entrance ramp South side exist ramp	1.6 1.6	PT-001

Fire protection systems

	Quantity and Efficiency	Specifications in PD and PM
Portable fire extinguisher(s) inside the house	2;21A, 113B, C	FP-002, 003
Portable fire extinguisher(s) outside the house	1;21A, 113B, C	FP-002

Fire resistance of the structure

Fire resistance of the structure	Specifications in PD and PM
R30	PM 13.1.2 i

13.5 Safety in Use Table

1. **Safety against falls**

Floor class slipperiness

Type of floors	Where (Location in the project)	Floor classification - Specifications in PD and PM
Dry interior area: Surface's slope less than 5%	Kitchen, Living Room, Bedroom	AR-021
Dry interior area: Surface's slope equal or greater than 5%. Stairs included	Tea Terrace, Mezzanine	AR-021, 022
Humid interior area: Surface's slope less than 5%	Bathroom	AR-021
Humid interior area: Surface's slope equal or greater than 5%. Stairs included	Exterior Ramp	AR-002
Exterior areas	Deck	AR-021

Differences in the floor level, holes and opening (limit the risks of falling)

Where (in the project) and difference in floor level, holes and opening that represent a risk of falling	Type of protective barriers	Height of protective barriers where the difference in the floor level are more than 400mm - Specifications in PD and PM
Slope	Guardrail	1.0 M (AR-101)
Deck	Guardrail	1.0M (AR-101)

Restricted Areas stairs

	Value	Specifications in PD and PM
Width of the tread	1.26 M	AR-371
Height of the riser	0.17 M	AR-371
Depth of the tread	0.28 M	AR-371
Height of handrails	1.1 M	AR-371

Public Areas staircases

	Value	Specifications in PD and PM
Width of the tread	N/A	N/A
Length of the tread	N/A	N/A
Height of the riser	N/A	N/A
Depth of the tread	N/A	N/A
Height of handrails	N/A	N/A

Ramps

	Value	Specifications in PD and PM
% slope value	5%	AR-002
Length of ramp	15.095M 16.61 M	AR-021
Width of ramp	1.6 M	AR-021
Height of handrails	1.0 M	AR-101
Size of the resting landings	1.875 M x 3.4 M 1.6 M x 6.48 M	AR-021

2. Safety for avoiding trapping and impact risk

Impact due to fixed elements (House Tours area)

	Minimum Value	Specifications in PD and PM
Clearance height in house	2.418 M	AR-201
Height of the doors threshold	2.415 M	AR-311
Height of fixed elements projecting from facades		
Projection of fixed elements in the walls that do not which do not start from the ground		

Impact due to opening elements (public tours areas)

	Value (circular freespace)	Specifications in PD and PM
Sweep of the doors on the sides of the hallway	1.5 M	PT-001

Impact due to fragile elements and not very perceptible elements.

Location in the project	Type of glazing (safety)	Specifications in PD and PM

Trapping

	Value (distance)	Specifications in PD and PM
Distance of manual sliding door to the nearest fixed element		

3. Safety against the risk of inadequate lighting

	Where- min. illumination level	Specifications in PD and PM
Light fittings for exterior areas		PD: EL-401,
Light fittings for interior areas	200 Lux	PD: EL-402, PM:5.2.3

14. STRUCTURAL CALCULATIONS

Structural Calculation Report

(Rev. B)

吳子良

潤弘精密工程事業股份有限公司
吳子良
技執字第001943號
結構工程技師

吳子良

1. Introduction

This report explain the structural calculations for the Orchid House. This building will be located at NCTU in Hsinchu city, Taiwan. The building size is 12.6m x 9m x 6.8m (Length x Width x Height) in approximation. Single footing is adopted in the foundation design. Ordinary Moment Resistant Framing System (OMRF) is chosen in the building. The load types considered in structural system design include DL(dead load)、LL(live load) and EL(earthquake load). The wind load in this project is not considered because it is smaller than LL for roof and EL for lateral load. The design and analysis of structural system are completed by software “CSI-SAP2000 v14.2”.

2. Codes and Standards

The design codes used in this report include:

(a) Taiwan Building Technical Regulations, 2013
(b) Taiwanese Design and Technique Specifications of Steel Structures for Buildings (Allowable Stress Design), 2010
(c) Taiwanese Design and Construction Specifications of Wood Construction for Buildings(Allowable Stress Design), 2011
(d) Taiwan Seismic Design Specifications and Commentary of Buildings, 2011
(e) Chinese National Standards (CNS)

3. Materials

The structural system is intended to use two major material types: steel for structural member, wood for floor deck.

(a) Steel: SS400 or ASTM-A36
(b) Wood: CNS 14630 (TYPE IV)

4. Loads

(a) Dead Loads (DL)

The dead loads include the weight of the structural members and the other permanently loads (Such as ceiling, insulation and facilities, etc.) applied on the structure.

Structural Weight: calculated by structural analysis software (SAP2000) automatically.

Roof: 100kgf/m^2 (include Solar Glass Panel and Ceiling)

Top and Ground Floor: 100kgf/m^2 (include Wood Deck, Insulation Ceiling and Partition)

Exterior Wall: 100kgf/m(line load on exterior girders)

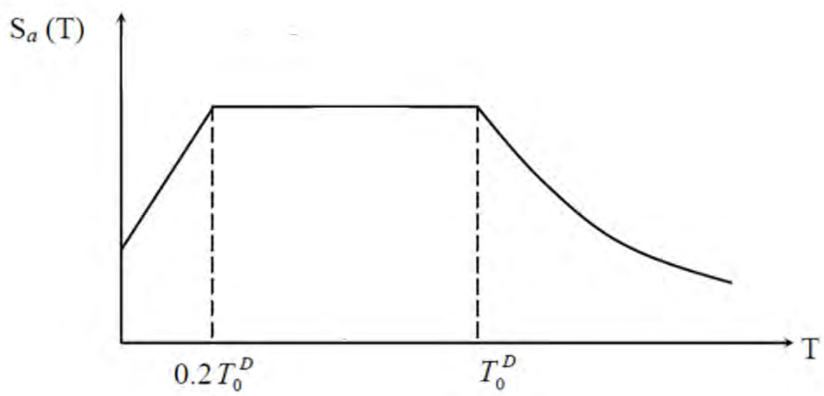
(b) Live Load (LL)

Roof: 100kgf/m^2 (as maintenance load)

Top and Ground Floor: 200kgf/m^2 (for residential usage)

(c) Earthquake Load (EL)

Owing to Taiwan located at Pacific seismic belt, seismic design for building should be considered. The typical response earthquake acerbation curve is as follows:



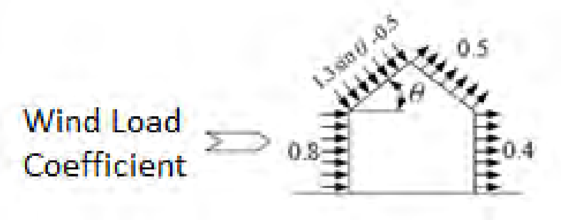
In this report, the structural period for the building located in Hsinchu is 0.358sec and the T_0^D is 0.7sec. Based on the Taiwan Seismic Design Specifications and Commentary of Buildings, the lateral load by earthquake will be

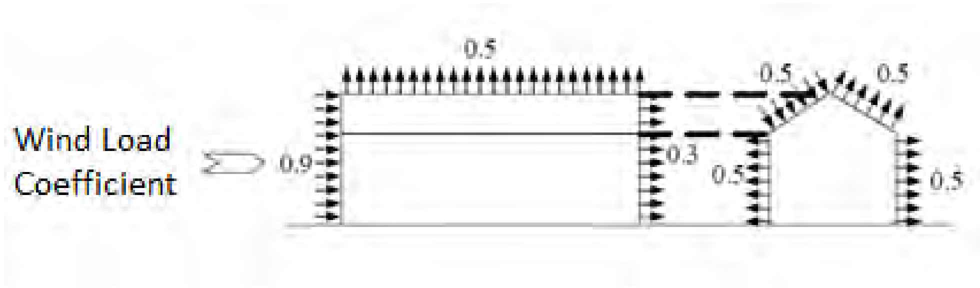
(EL)x = 0.247DL for X-dir

(EL)y = 0.247DL for Y-dir

(d) Wind Load (WL)

For this structure, the basic wind pressure is 110kgf/m^2 and the applied wind load coefficients are listed as follows:





The lateral wind load applied on the structural system is smaller than that caused by earthquake. For the roof, it is also less than the live load. Therefore, it is not the controlling load case in the structural design.

5. Comfort Criteria

Deflection:

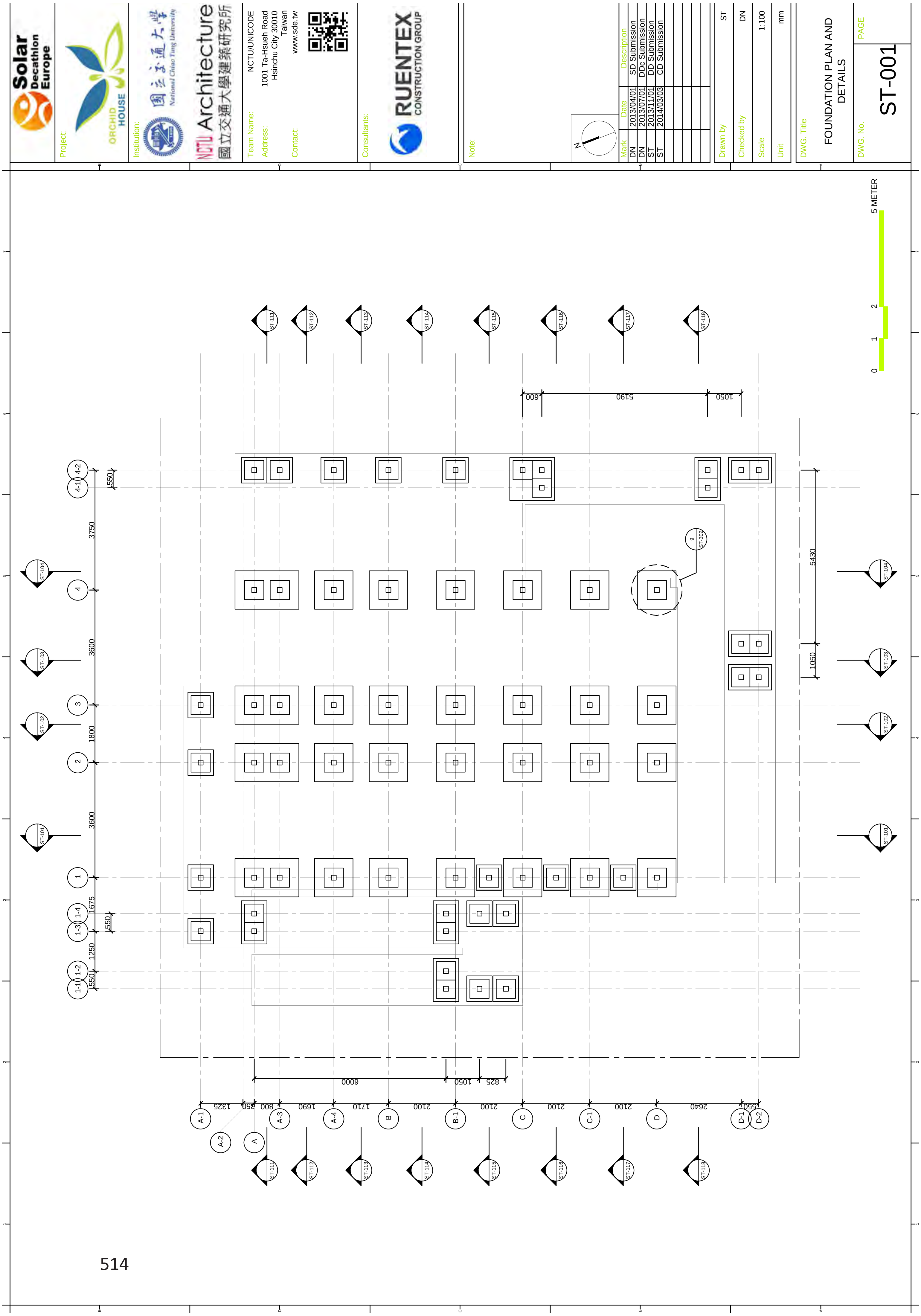
(a) Vertical Deflection of steel girder/beam: L/240 (for DL+LL); L/360 (for LL)
(b) Vertical Deflection of wood beam: L/240 (for DL+LL); L/360 (for LL)
(c) Horizontal Drift of top of the structure: H/200 (for EL)

6. Load Combination

ID	Combination
101	DL+LL
201	DL+0.75(LL+0.8Ex)
202	DL+0.75(LL-0.8Ex)
203	0.7DL+0.8Ex
204	0.7DL-0.8Ex
301	DL+0.75(LL+0.8Ey)
302	DL+0.75(LL-0.8Ey)
303	0.7DL+0.8Ey
304	0.7DL-0.8Ey

7. Structural Layout

The Structural plan and elevation layout are listed as follows.


Solar Decathlon Europe
Project:
ORCHID HOUSE
Institution:
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NCTU Architecture
國立交通大學建築研究所
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Consultants:
RUENTEX CONSTRUCTION GROUP
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Mark | Date | Description
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ST | 2013/11/01 | DD Submission
ST | 2014/03/03 | CD Submission
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Scale 1:100
Unit mm
DWG. Title FOUNDATION PLAN AND DETAILS
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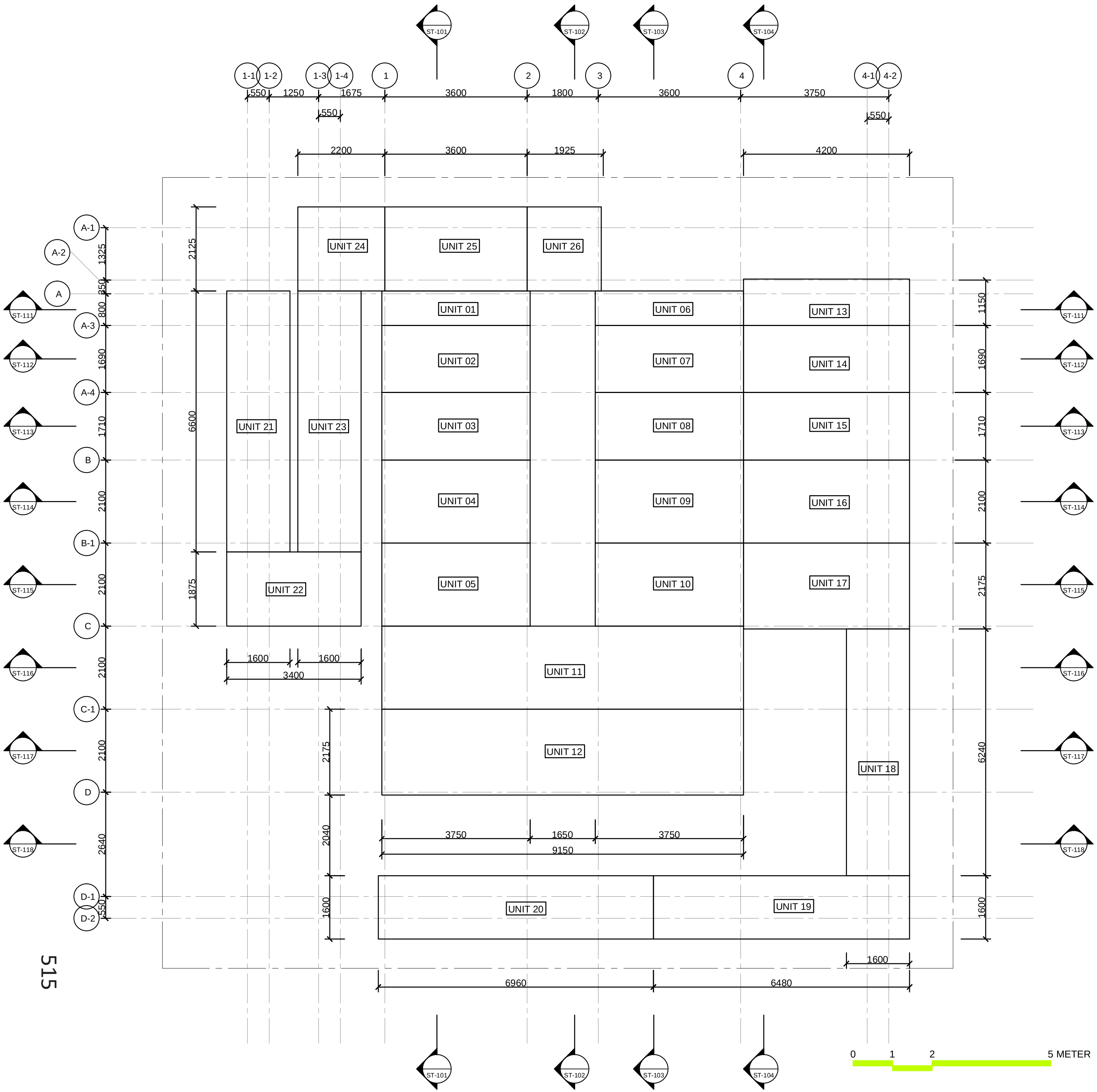
5 METER



UNIT No.	Size (L x W x D)
UNIT 01	3750 x 875 x 150
UNIT 02	3750 x 1690 x 150
UNIT 03	3750 x 1710 x 150
UNIT 04	3750 x 2100 x 150
UNIT 05	3750 x 2100 x 150
UNIT 06	3750 x 875 x 150
UNIT 07	3750 x 1690 x150
UNIT 08	3750 x 1710 x 150
UNIT 09	3750 x 2100 x 150
UNIT 10	3750 x 2100 x 150
UNIT 11	9150 x 2100 x 150
UNIT 12	9150 x 2175 x 150
UNIT 13	4200 x 1150 x 150
UNIT 14	4200 x 1690 x 150
UNIT 15	4200 x 1710 x 150
UNIT 16	4200 x 2100 x 150
UNIT 17	4200 x 2175 x 150
UNIT 18	6240 x 1600 x 150
UNIT 19	6480 x 1600 x 150
UNIT 20	6960 x 1600 x 150
UNIT 21	6600 x 1600 x 150
UNIT 22	3400 x 1875 x 150
UNIT 23	6600 x 1600 x 150
UNIT 24	2200 x 2125 x 150
UNIT 25	3600 x 2125 x 150
UNIT 26	2125 x 1925 x 150

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DWG. Title: STRUCTURAL FLOOR UNITS

DWG. No.: ST-002

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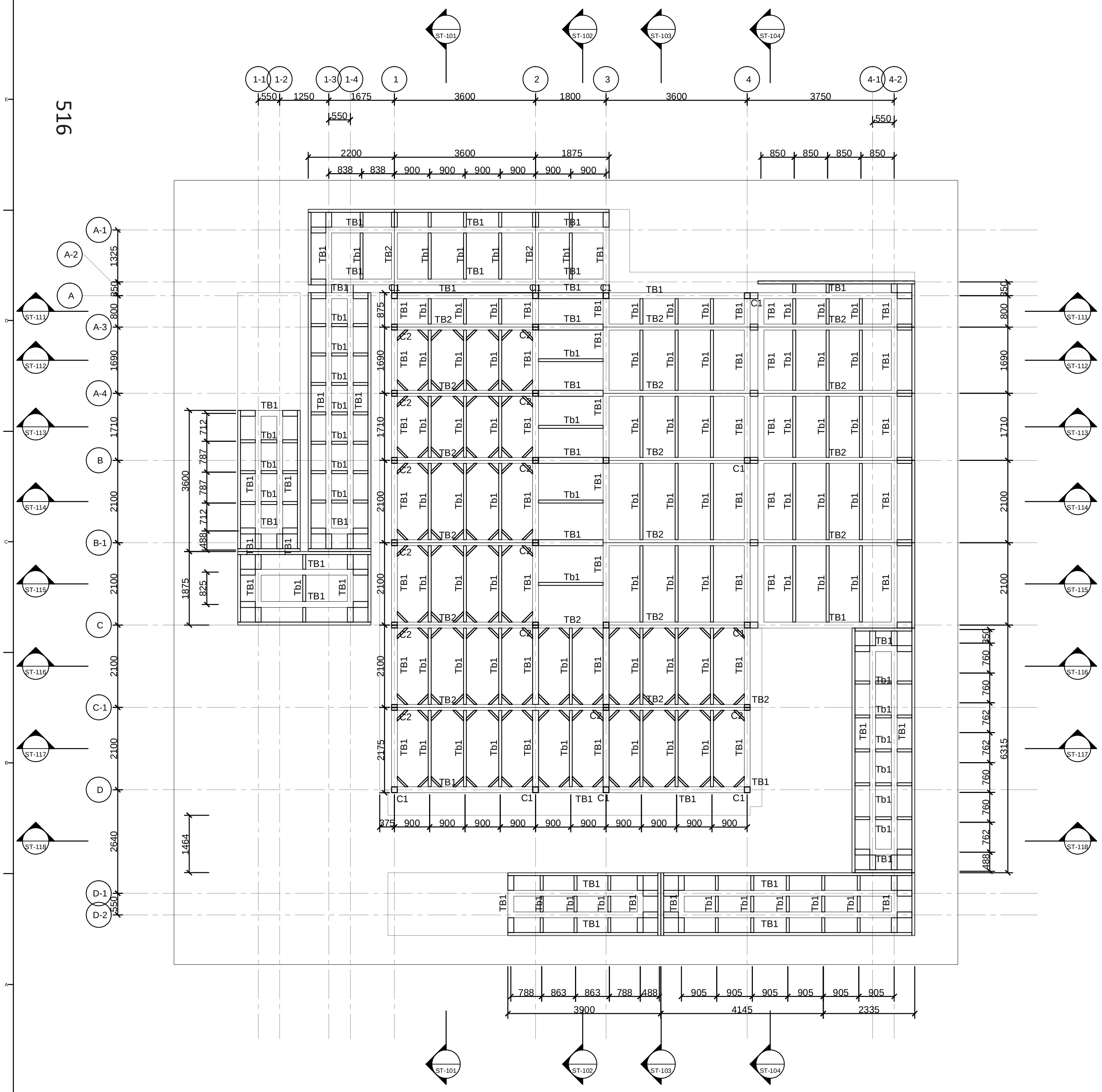
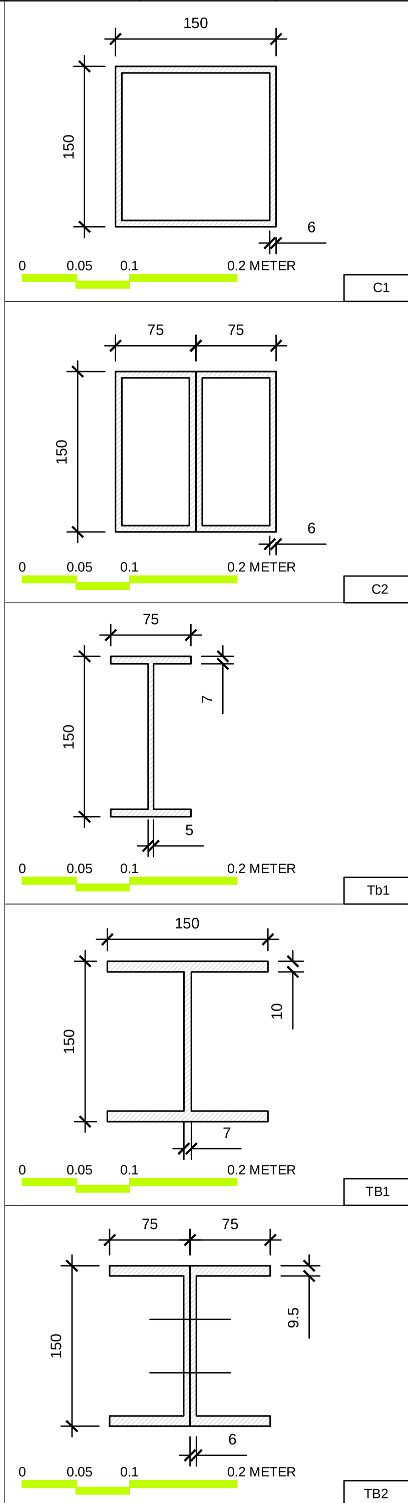
516





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DWG. Title: STRUCTURAL GROUND LEVEL PLAN

DWG. No.: ST-011

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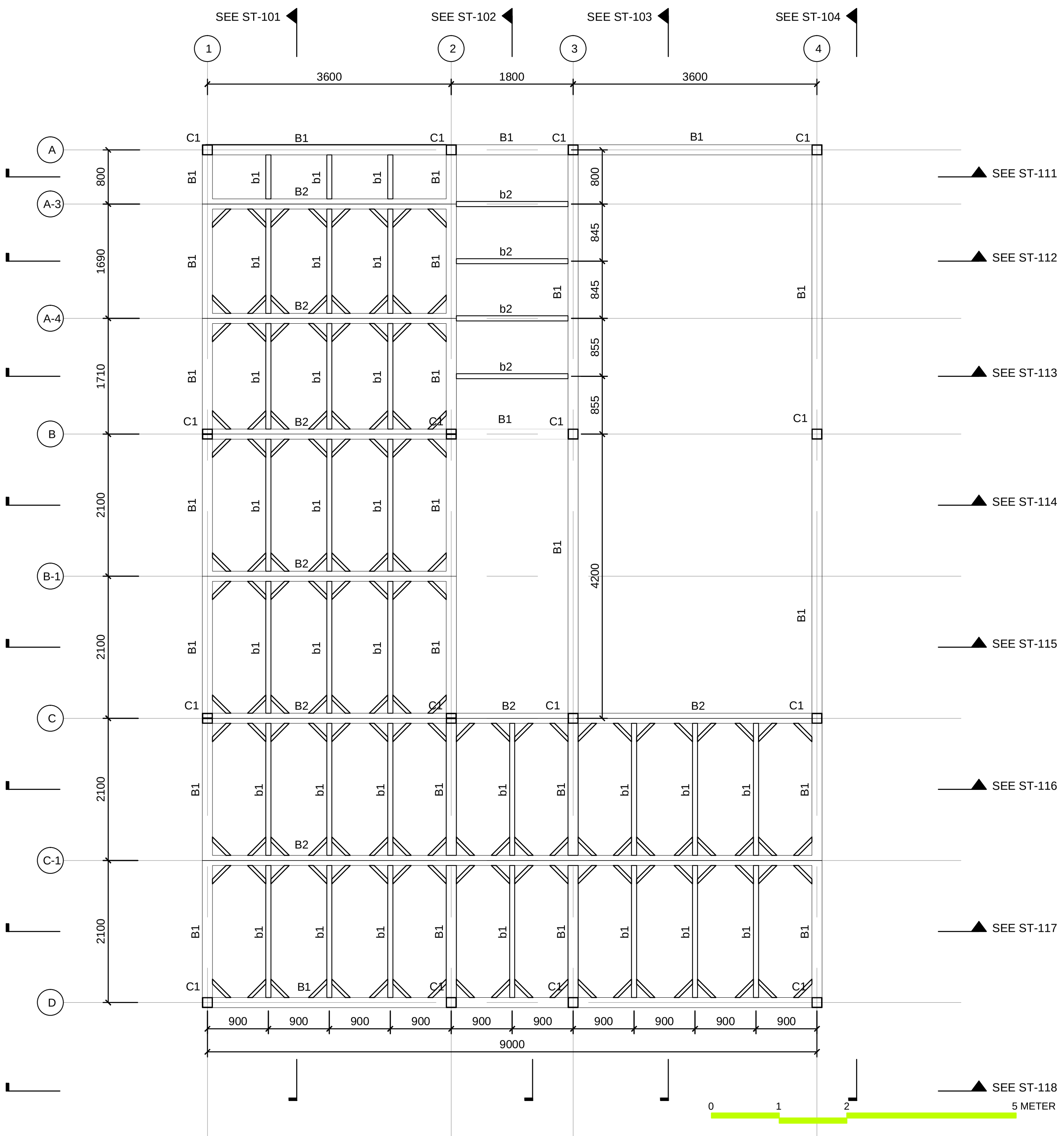

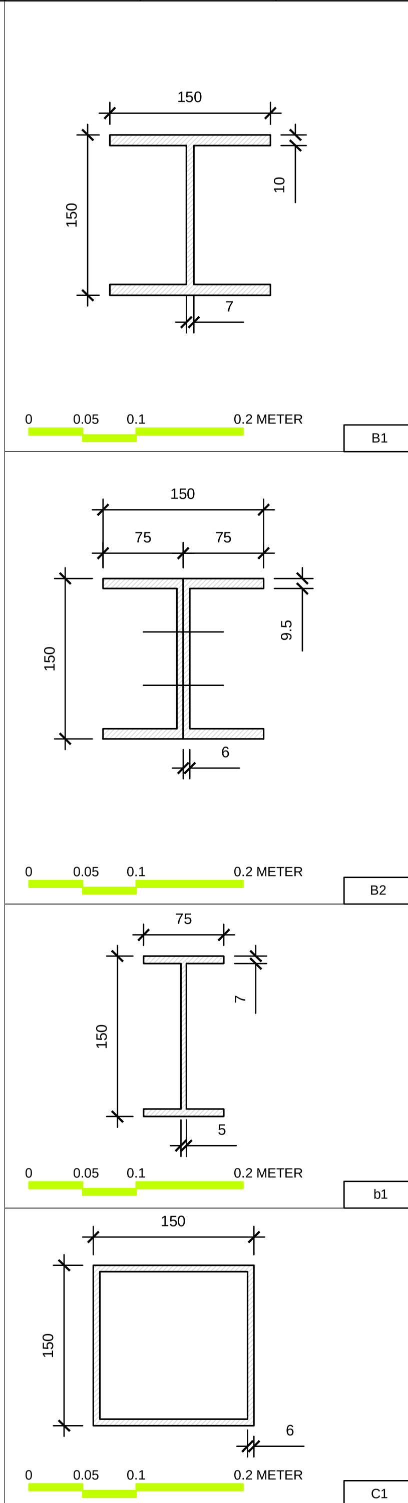

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Scale	1:60
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STRUCTURAL PLAN MEZZANINE LEVEL

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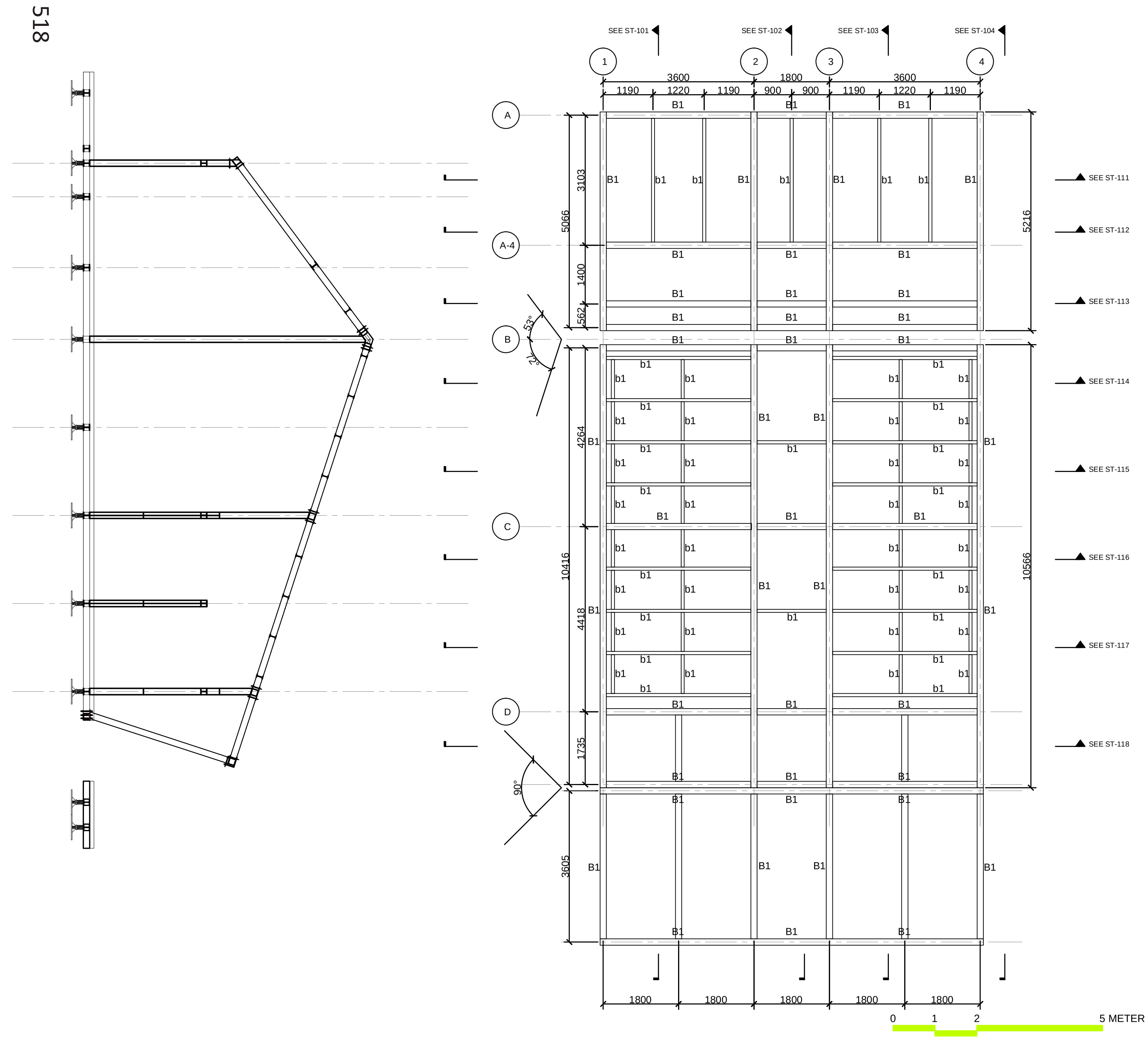

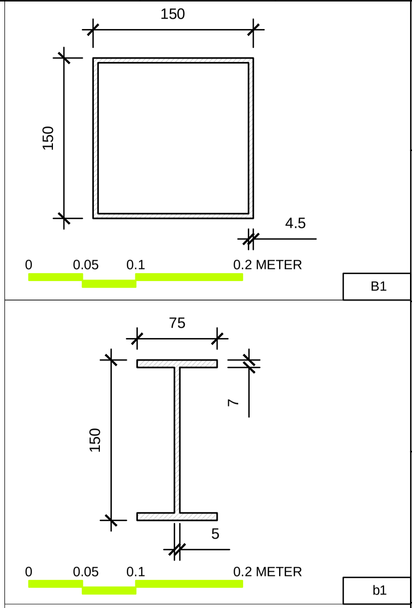

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ST	2014/03/03	CD Submission

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DWG. Title: STRUCTURAL ROOF PLAN

DWG. No.: ST-021

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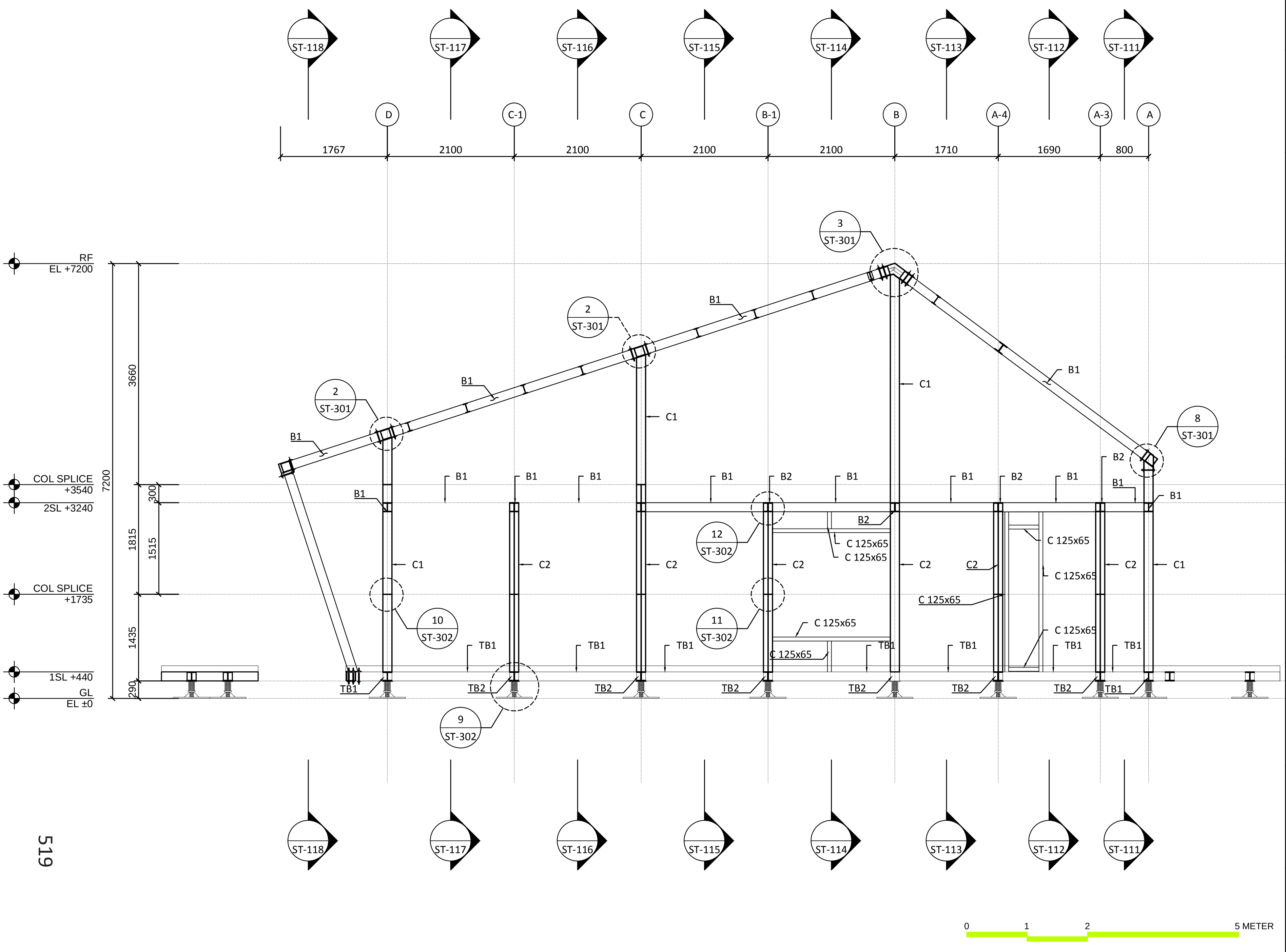

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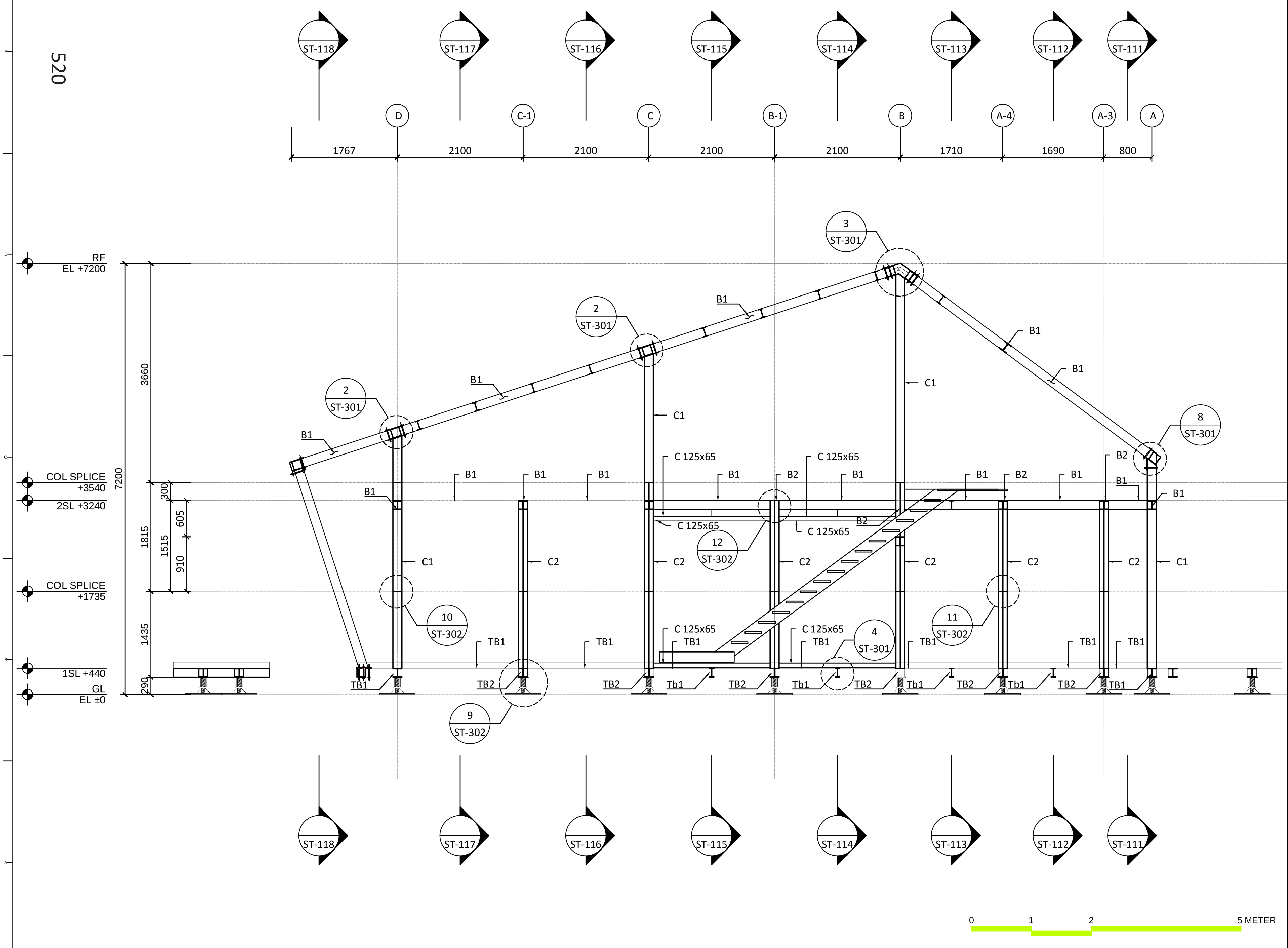

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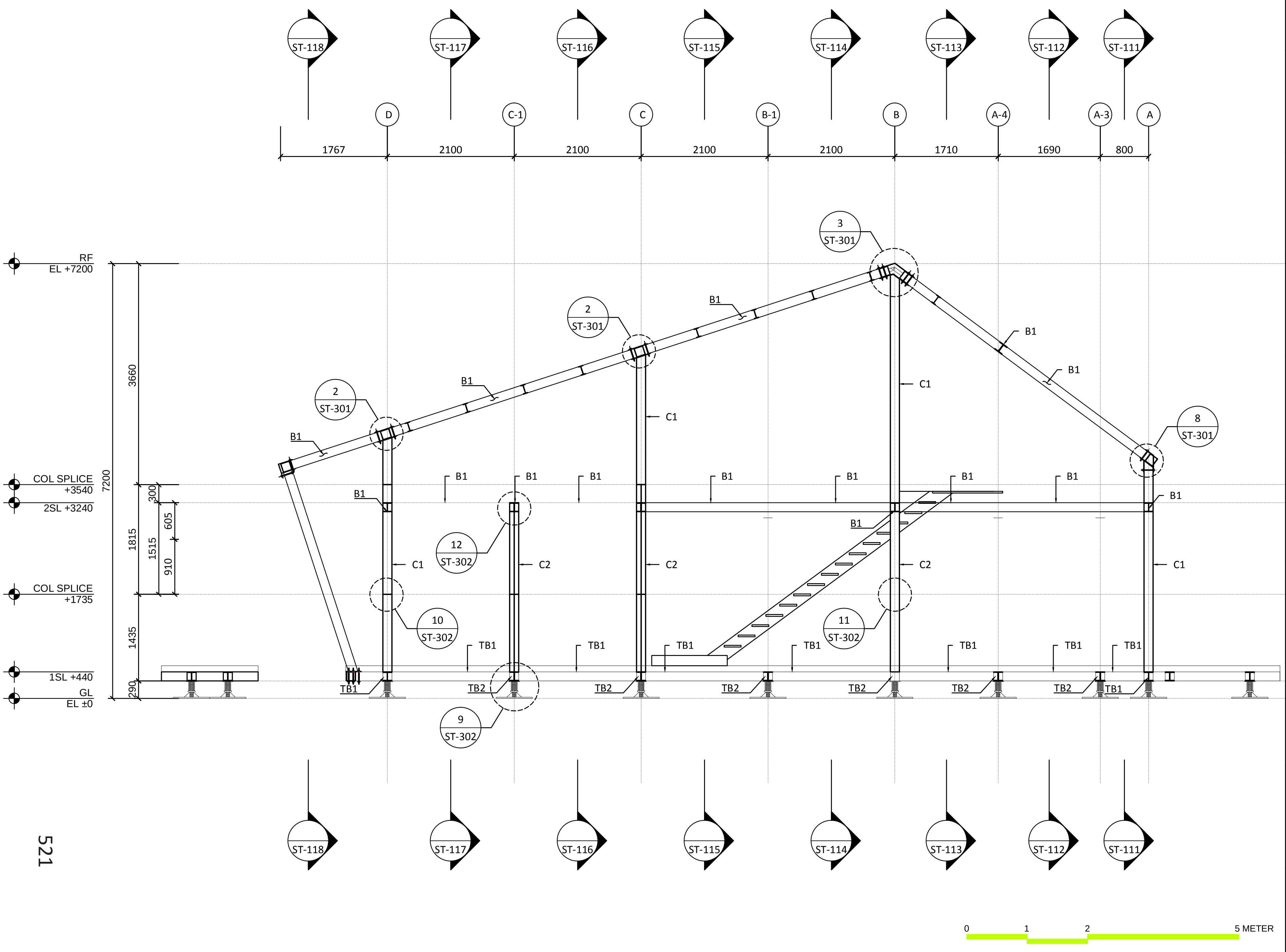

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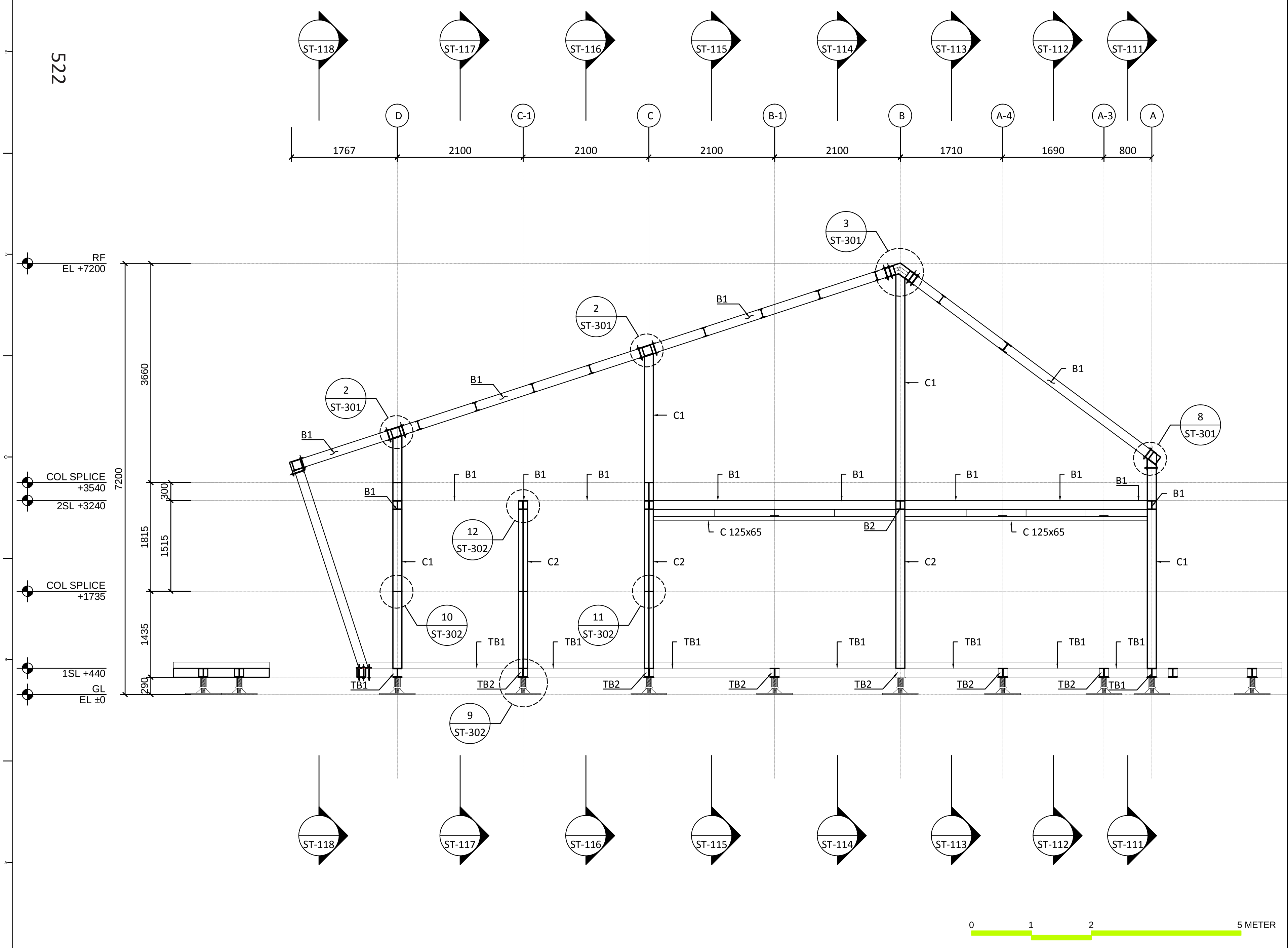

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ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

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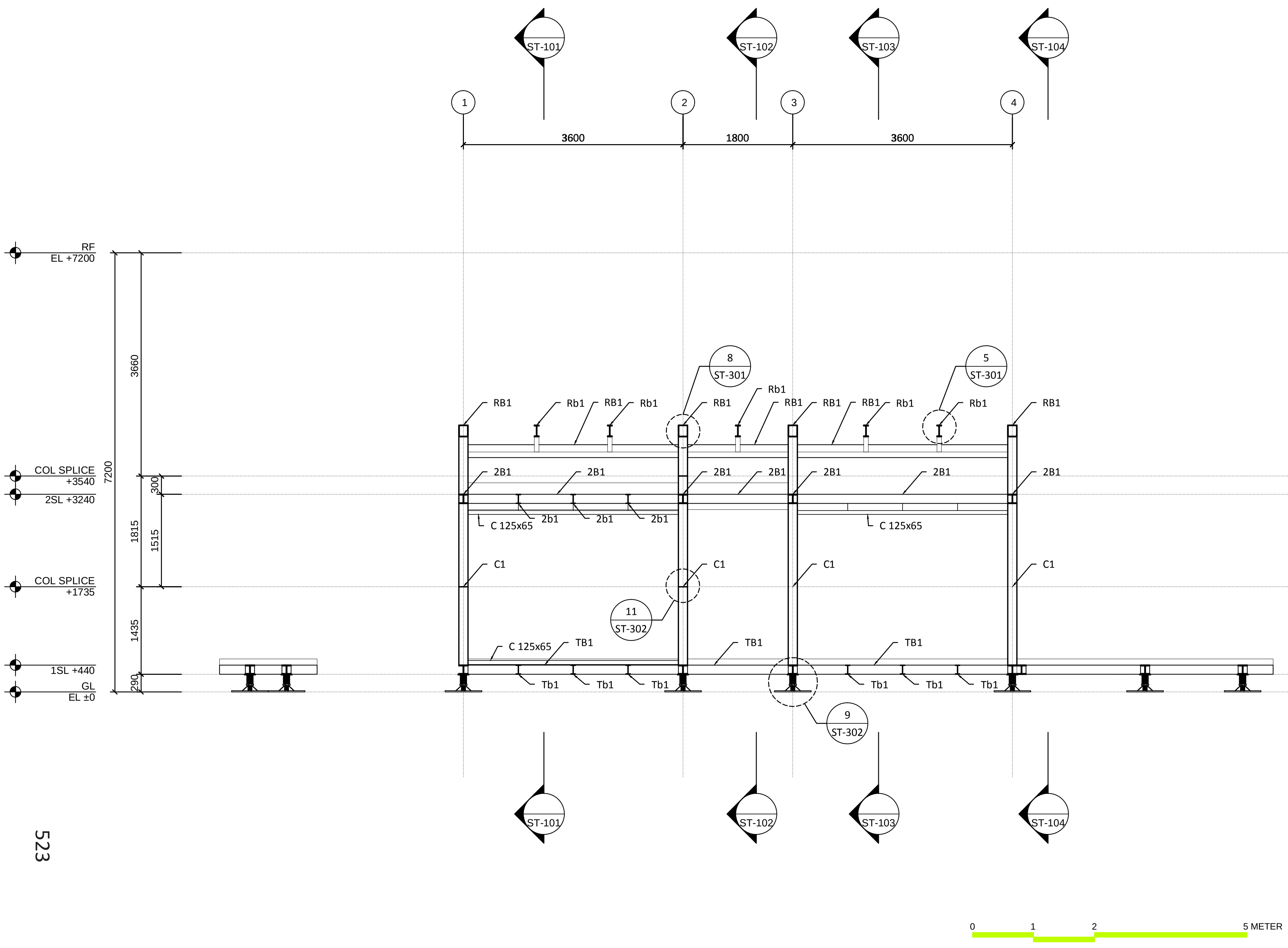

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Team Name: NCTU/UNICODE

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Contact: www.sde.tw

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Note:

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DN	2013/07/01	DDc Submission
ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

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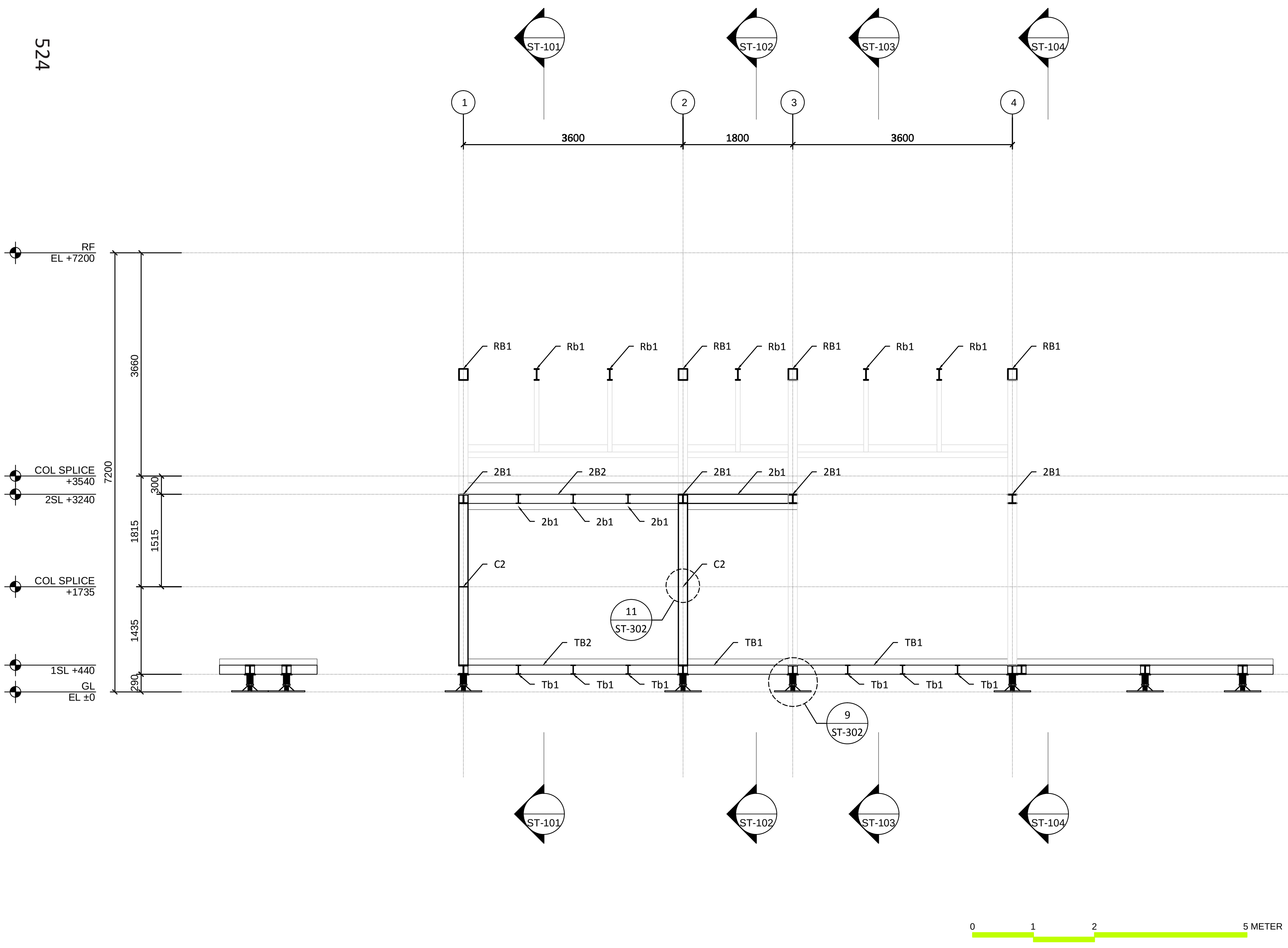
DWG. Title: STRUCTURAL TRANSVERSAL SECTIONS FRAME A

DWG. No.: ST-111

PAGE

524



Solar Decathlon Europe

Project: ORCHID HOUSE

Institution: 國立交通大學 National Chiao Tung University

NCTU Architecture 國立交通大學建築研究所

Team Name: NCTU/UNICODE

Address: 1001 Ta-Hsueh Road, Hsinchu City 30010, Taiwan

Contact: www.sde.tw

Consultants: RUENTEX CONSTRUCTION GROUP

Note:

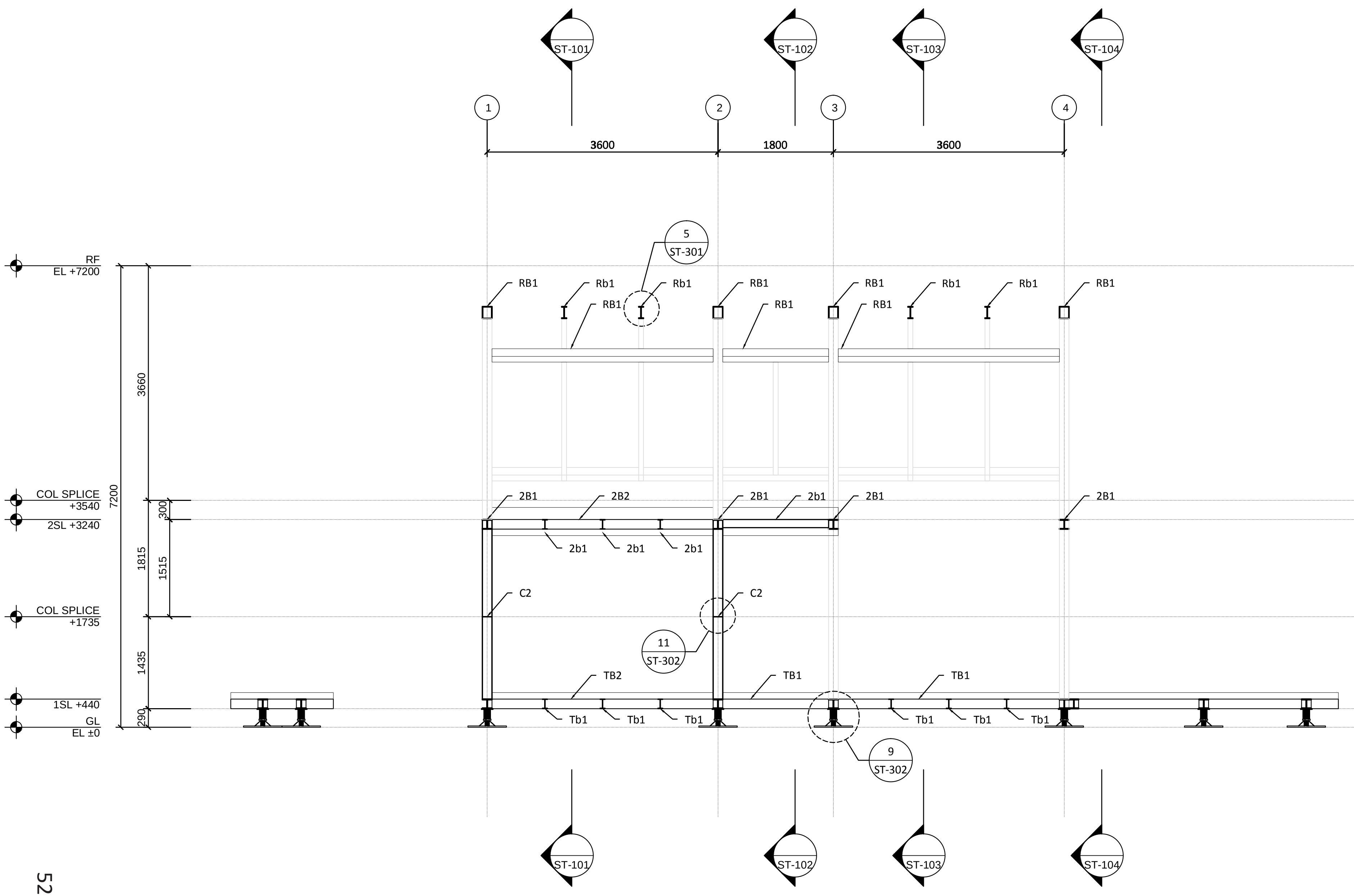
Mark	Date	Description
DN	2013/04/01	SD Submission
DN	2013/07/01	DDc Submission
ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

Drawn by	ST
Checked by	DN
Scale	1:60
Unit	mm

DWG. Title: STRUCTURAL TRANSVERSAL SECTIONS FRAME A-3

DWG. No.: ST-112

PAGE



Solar Decathlon Europe

Project: ORCHID HOUSE

Institution: 國立交通大學 National Chiao Tung University

NCTU Architecture 國立交通大學建築研究所

Team Name: NCTU/UNICODE

Address: 1001 Ta-Hsueh Road Hsinchu City 30010 Taiwan

Contact: www.sde.tw

Consultants: RUENTEX CONSTRUCTION GROUP

Note:

Mark	Date	Description
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DN	2013/07/01	DDc Submission
ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

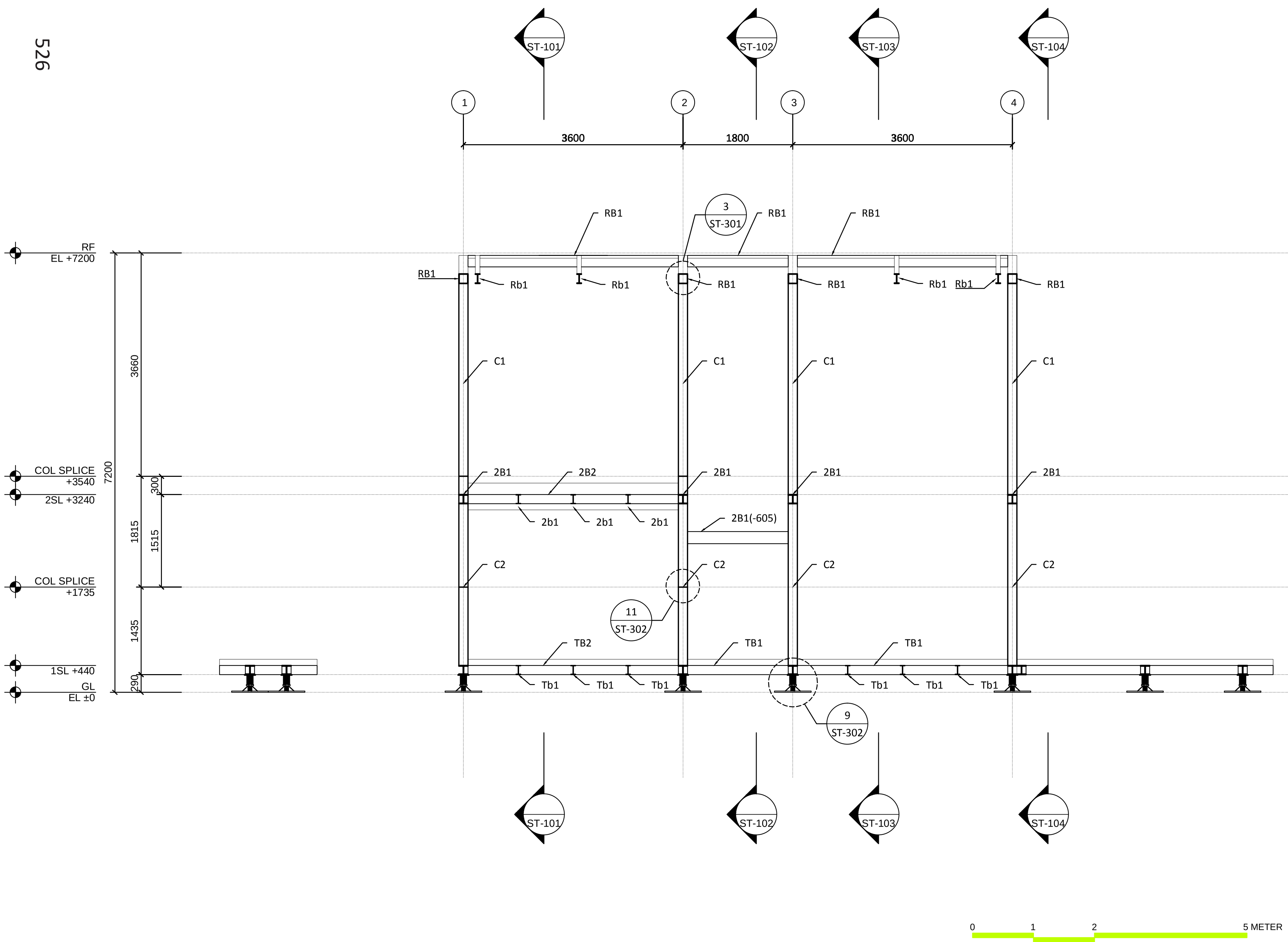
Drawn by	ST
Checked by	DN
Scale	1:60
Unit	mm

DWG. Title: STRUCTURAL TRANSVERSAL SECTIONS FRAME A-4

DWG. No.: ST-113

PAGE

526



Solar Decathlon Europe

Project: ORCHID HOUSE

Institution: 國立交通大學 National Chiao Tung University

NCTU Architecture 國立交通大學建築研究所

Team Name: NCTU/UNICODE

Address: 1001 Ta-Hsueh Road, Hsinchu City 30010, Taiwan

Contact: www.sde.tw

Consultants: RUENTEX CONSTRUCTION GROUP

Note:

Mark	Date	Description
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DN	2013/07/01	DDc Submission
ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

Drawn by: ST

Checked by: DN

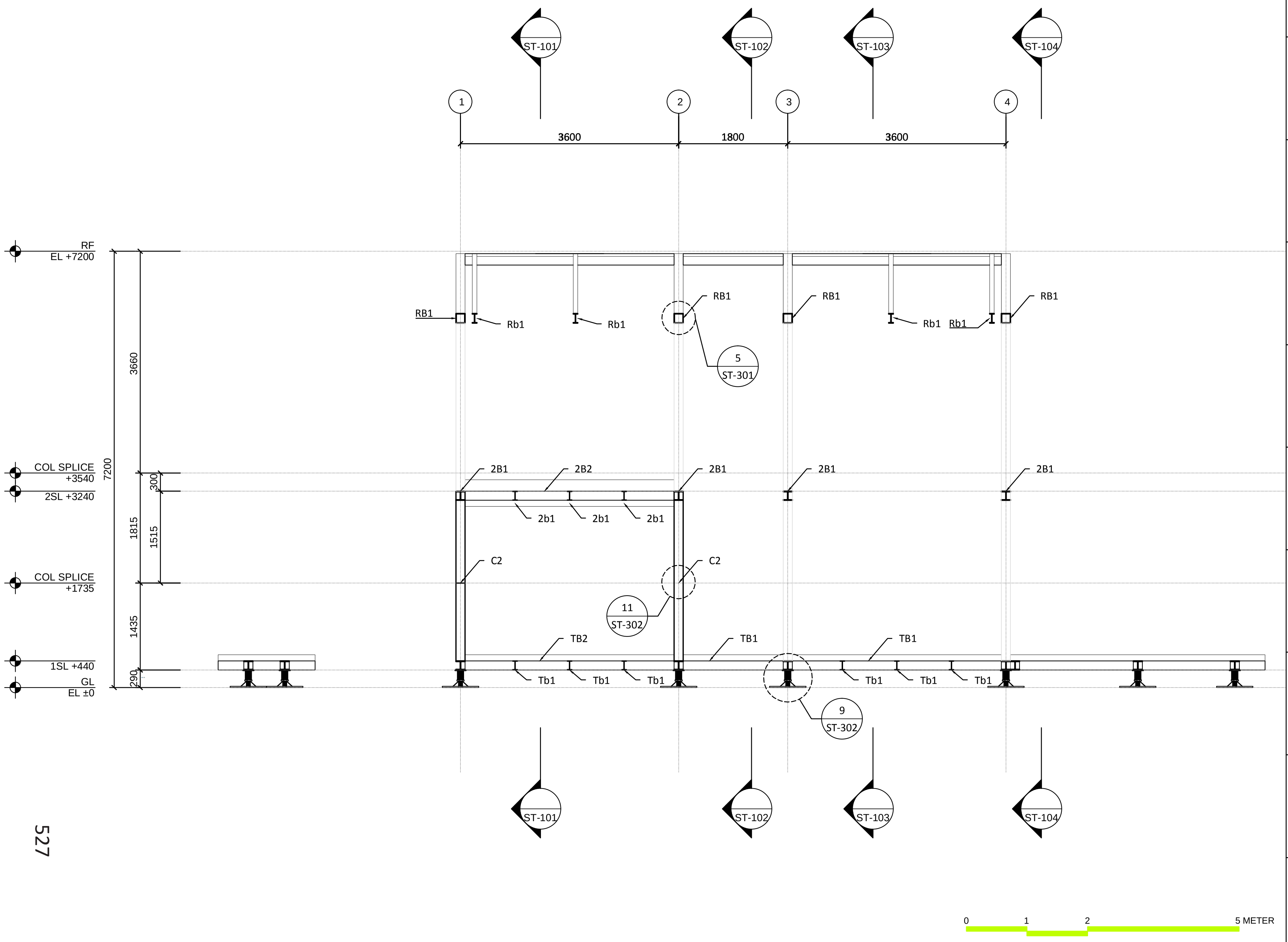
Scale: 1:60

Unit: mm

DWG. Title: STRUCTURAL TRANSVERSAL SECTIONS FRAME B

DWG. No.: ST-114

PAGE



Solar Decathlon Europe

Project: ORCHID HOUSE

Institution: 國立交通大學 National Chiao Tung University

NCTU Architecture 國立交通大學建築研究所

Team Name:	NCTU/UNICODE
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Contact:	www.sde.tw

Consultants: RUENTEX CONSTRUCTION GROUP

Note:

Mark	Date	Description
DN	2013/04/01	SD Submission
DN	2013/07/01	DDc Submission
ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

Drawn by	ST
Checked by	DN
Scale	1:60
Unit	mm

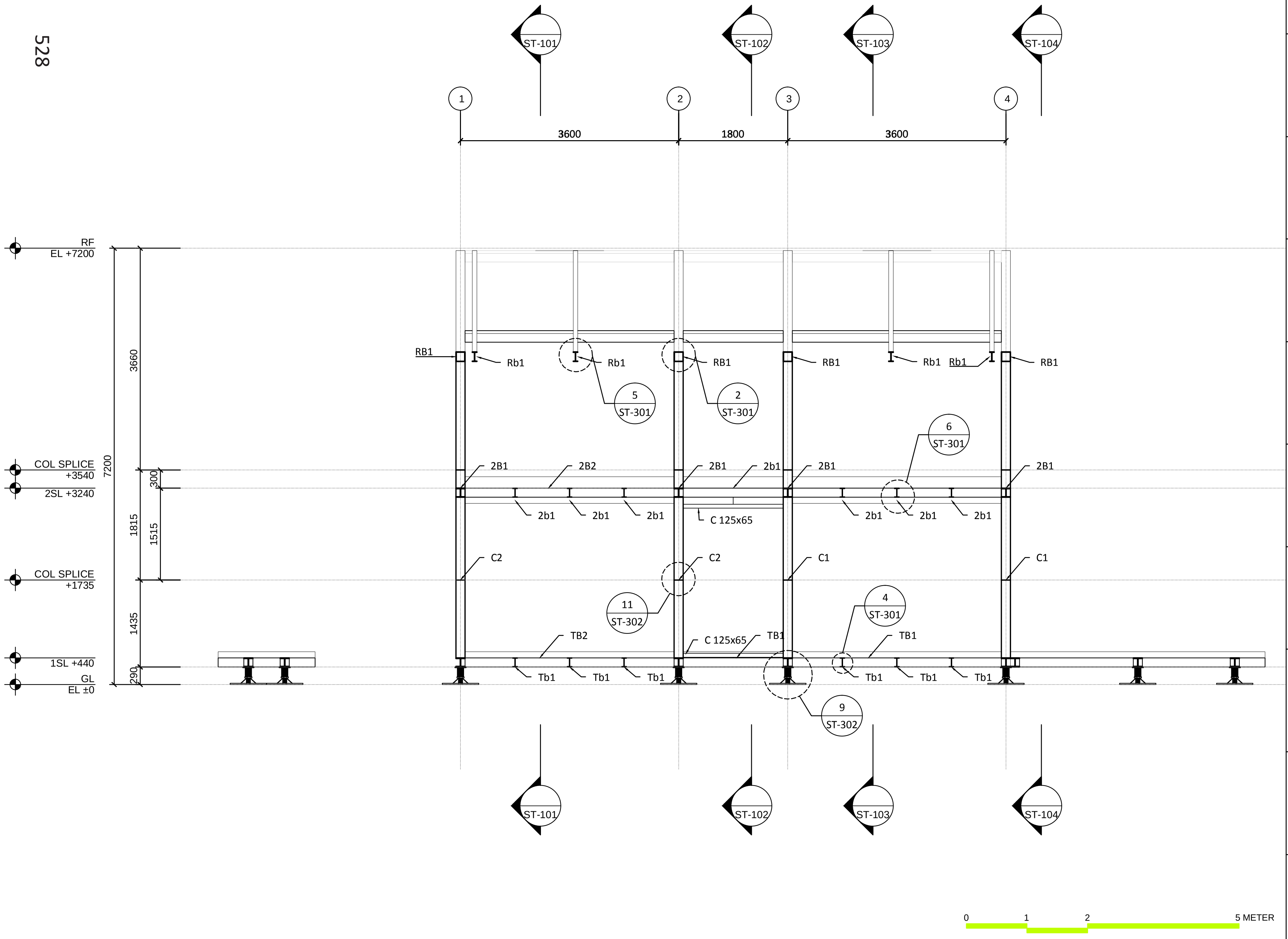
DWG. Title: STRUCTURAL TRANSVERSAL SECTIONS FRAME B-1

DWG. No.: ST-115

PAGE

527

528



Project: ORCHID HOUSE

Institution: 国立交通大學 National Chiao Tung University

NCTU Architecture 國立交通大學建築研究所

Team Name: NCTU/UNICODE

Address: 1001 Ta-Hsueh Road, Hsinchu City 30010, Taiwan

Contact: www.sde.tw

Consultants: RUENTEX CONSTRUCTION GROUP

Note:

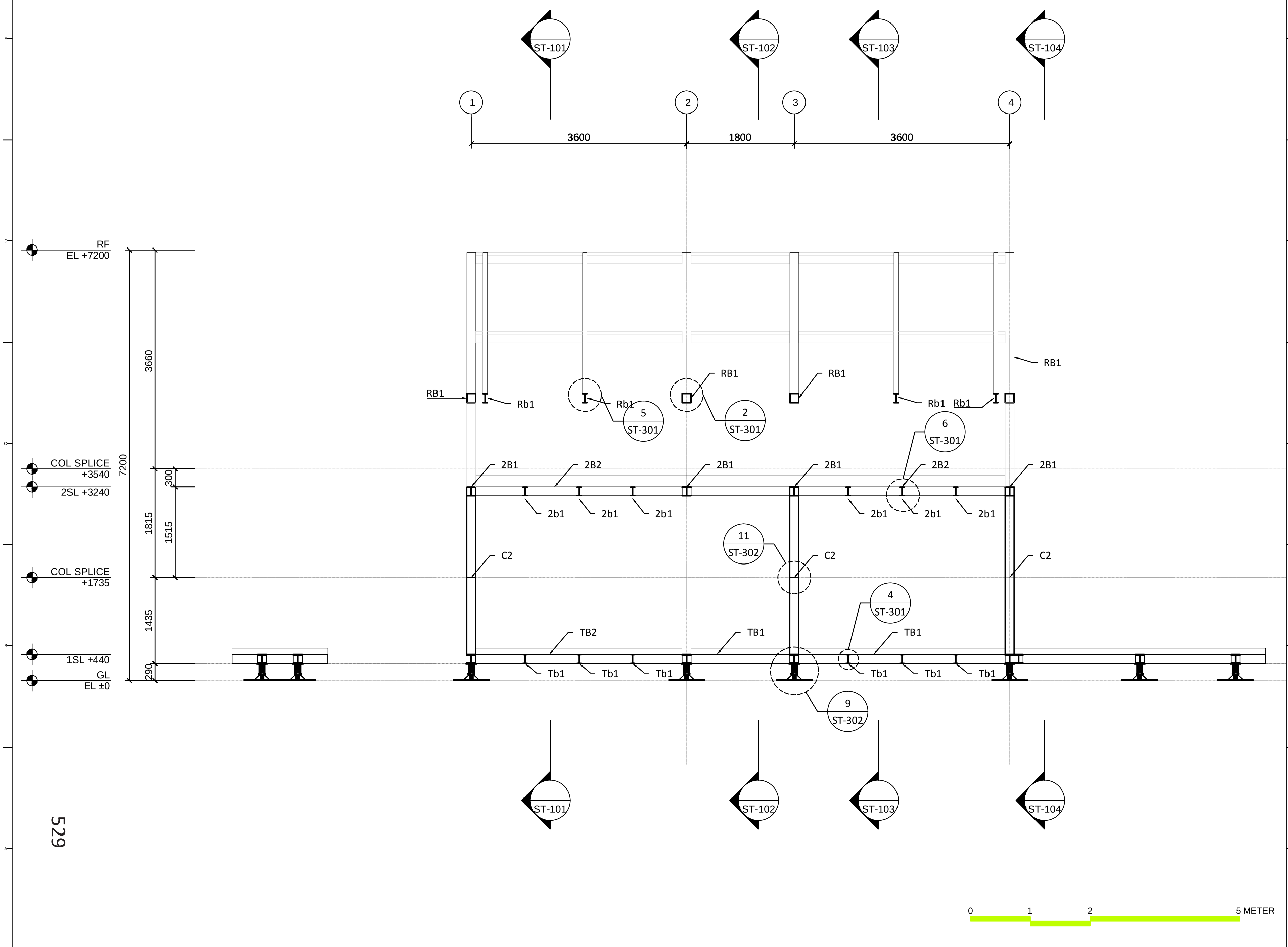
Mark	Date	Description
DN	2013/04/01	SD Submission
DN	2013/07/01	DDc Submission
ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

Drawn by	ST
Checked by	DN
Scale	1:60
Unit	mm

DWG. Title: STRUCTURAL TRANSVERSAL SECTIONS FRAME C

DWG. No.: ST-116

PAGE



Solar Decathlon Europe

Project:

ORCHID HOUSE

Institution:

國立交通大學
National Chiao Tung University

NCTU Architecture
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Hsinchu City 30010
Taiwan

Contact: www.sde.tw

Consultants:

RUENTEX CONSTRUCTION GROUP

Note:

Mark	Date	Description
DN	2013/04/01	SD Submission
DN	2013/07/01	DDc Submission
ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

Drawn by: ST

Checked by: DN

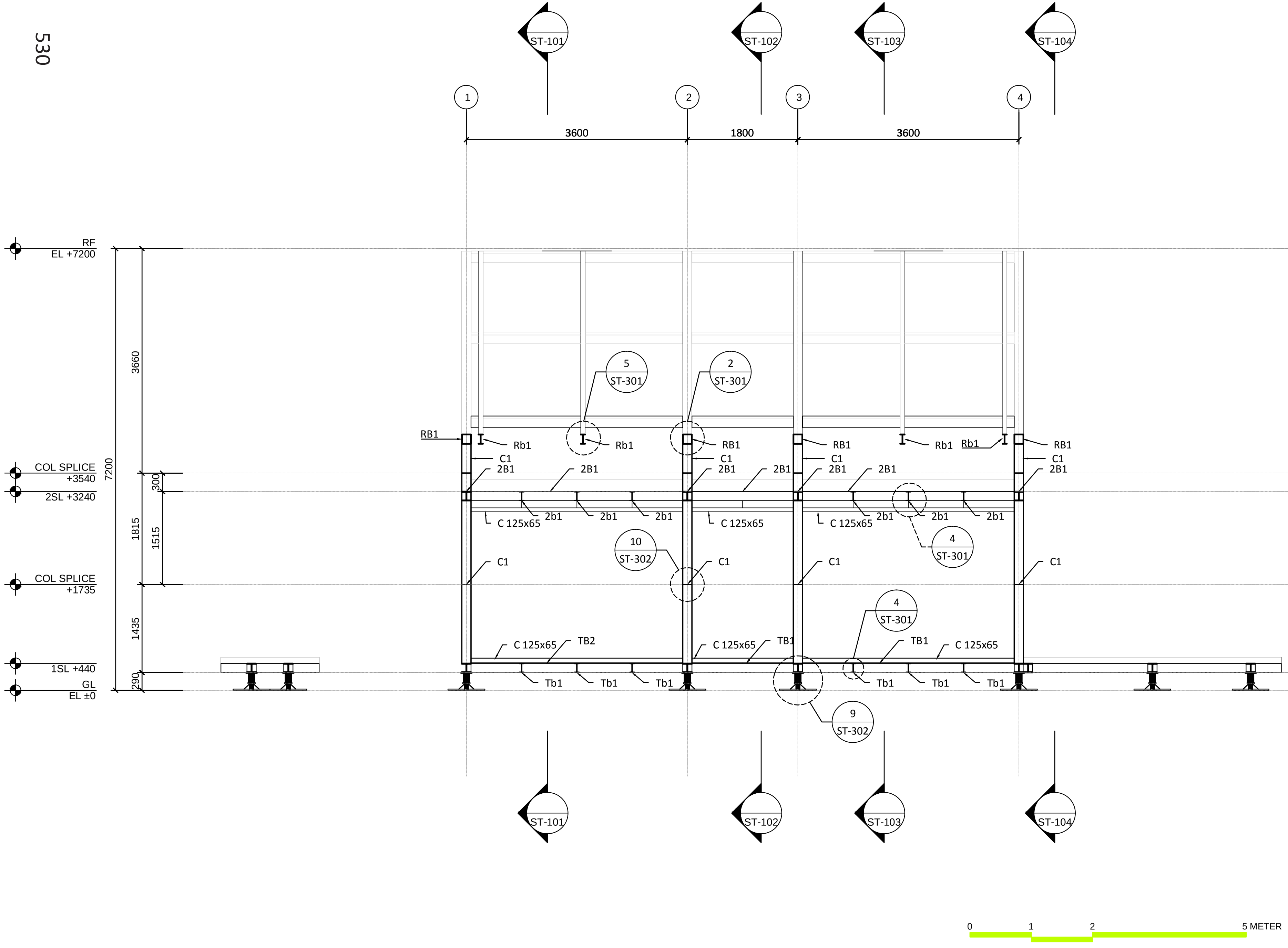
Scale: 1:60

Unit: mm

DWG. Title: STRUCTURAL TRANSVERSAL SECTIONS FRAME C-1

DWG. No.: ST-117

PAGE



Solar Decathlon Europe

Project: ORCHID HOUSE

Institution: 國立交通大學 National Chiao Tung University

NCTU Architecture 國立交通大學建築研究所

Team Name:	NCTU/UNICODE
Address:	1001 Ta-Hsueh Road Hsinchu City 30010 Taiwan
Contact:	www.sde.tw

Consultants: RUENTEX CONSTRUCTION GROUP

Note:

Mark	Date	Description
DN	2013/04/01	SD Submission
DN	2013/07/01	DDc Submission
ST	2013/11/01	DD Submission
ST	2014/03/03	CD Submission

Drawn by	ST
Checked by	DN
Scale	1:60
Unit	mm

DWG. Title: STRUCTURAL TRANSVERSAL SECTIONS FRAME D

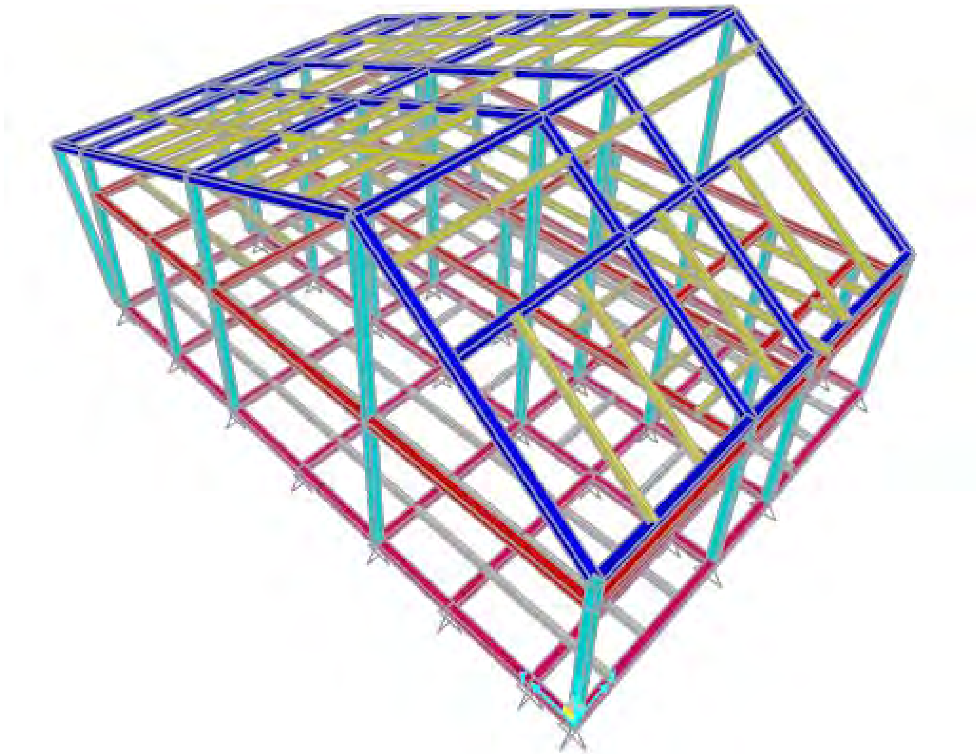
DWG. No.: ST-118

PAGE

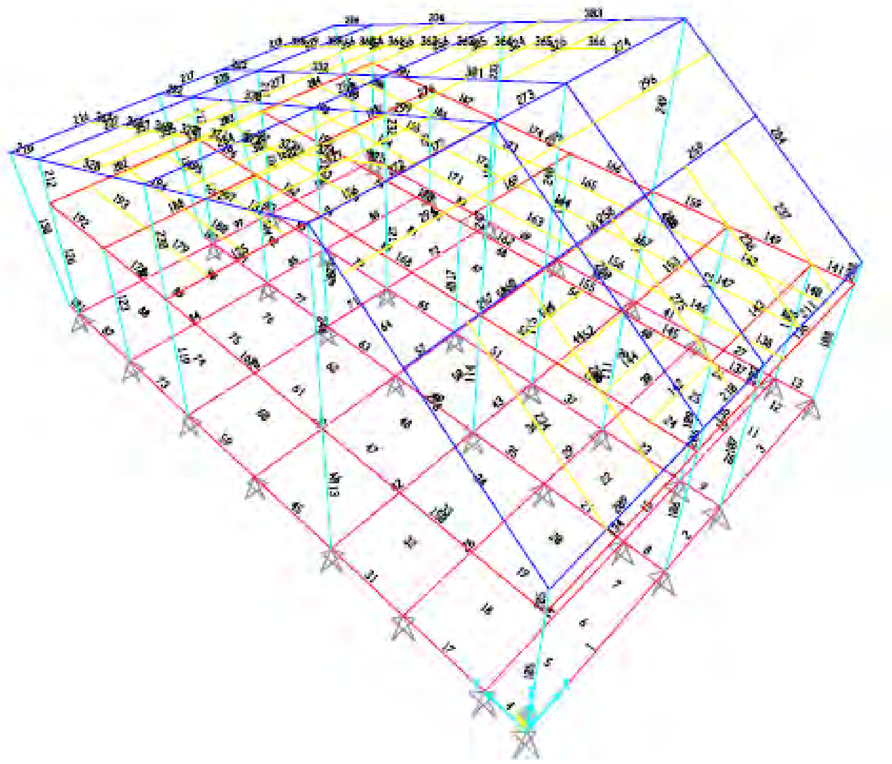
8. Structural Model

The structural model is shown as follows:

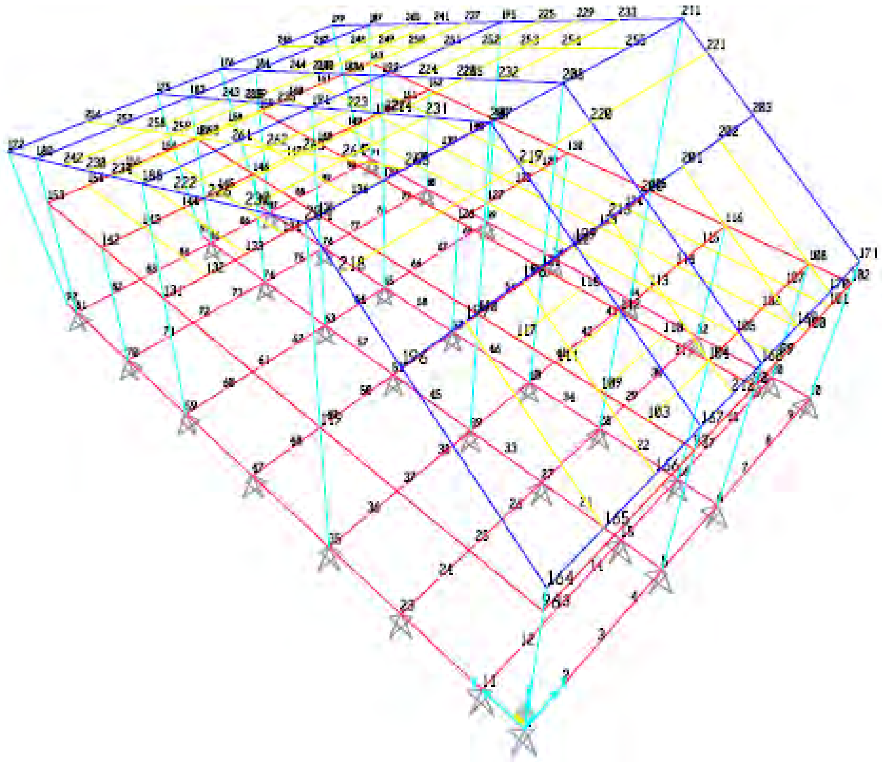
(a) 3D Model



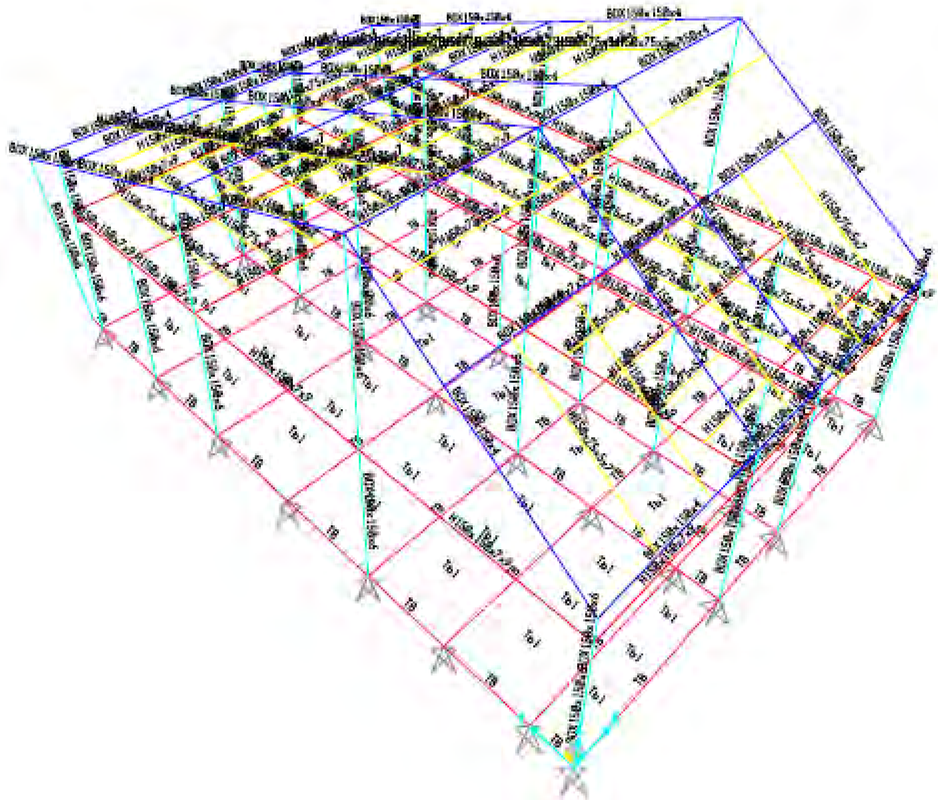
(b) Member ID



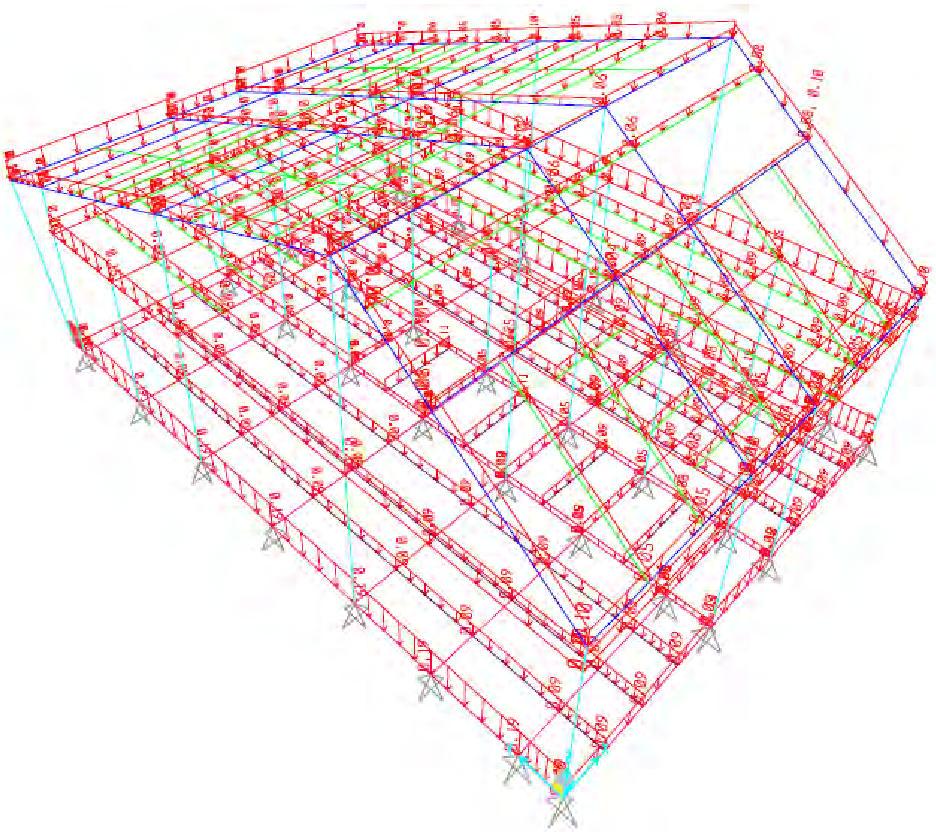
(c) Joint ID



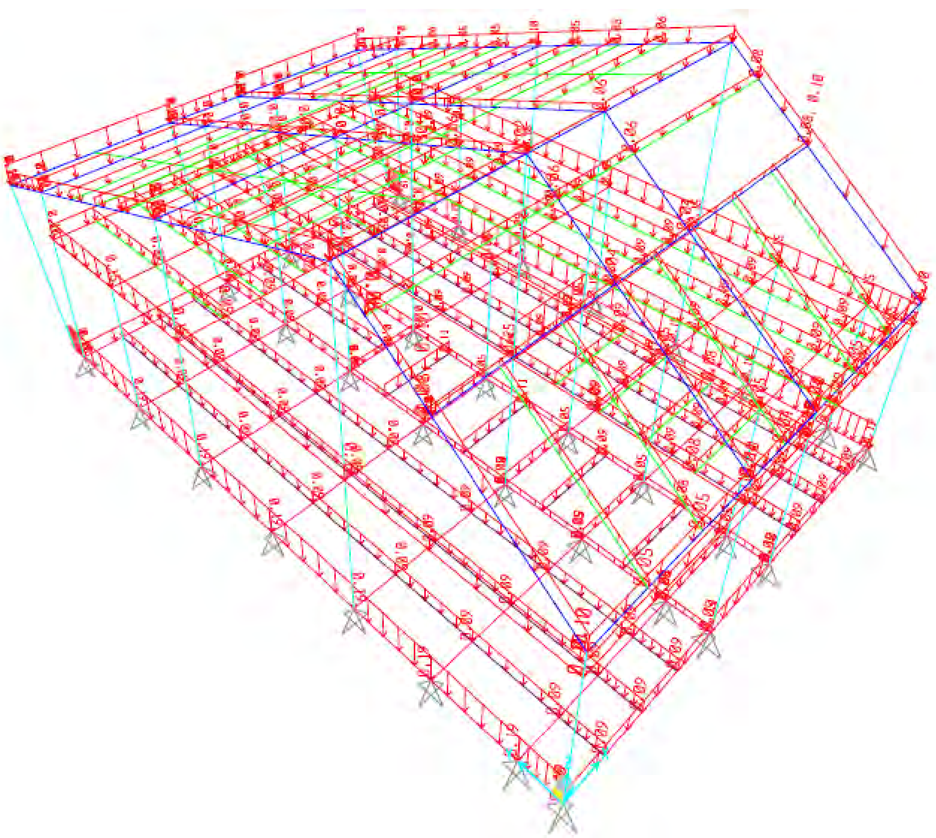
(d) Assigned Section



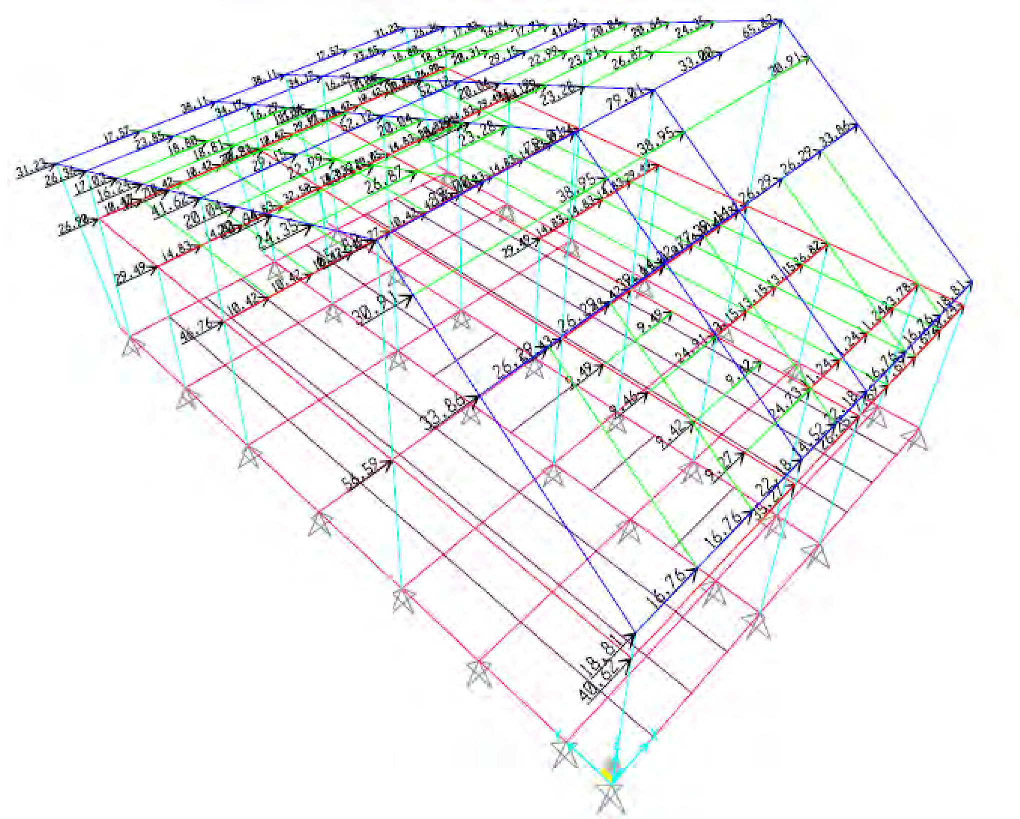
(e) Dead Load



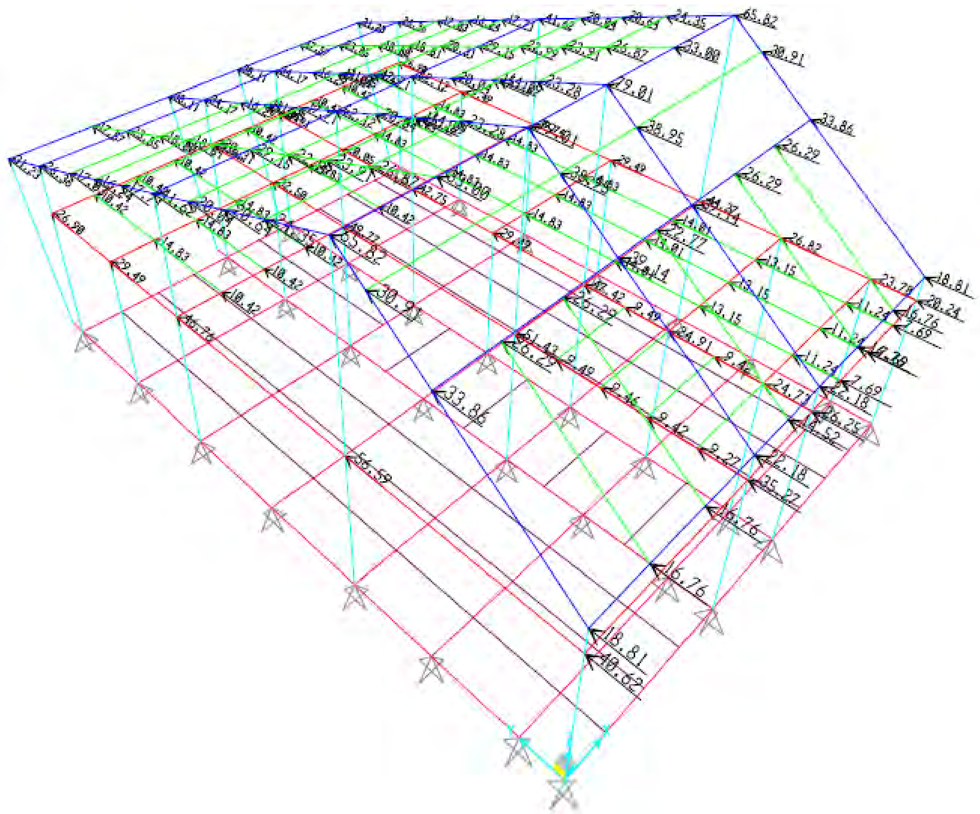
(f) Live Load



(g) Earthquake Load



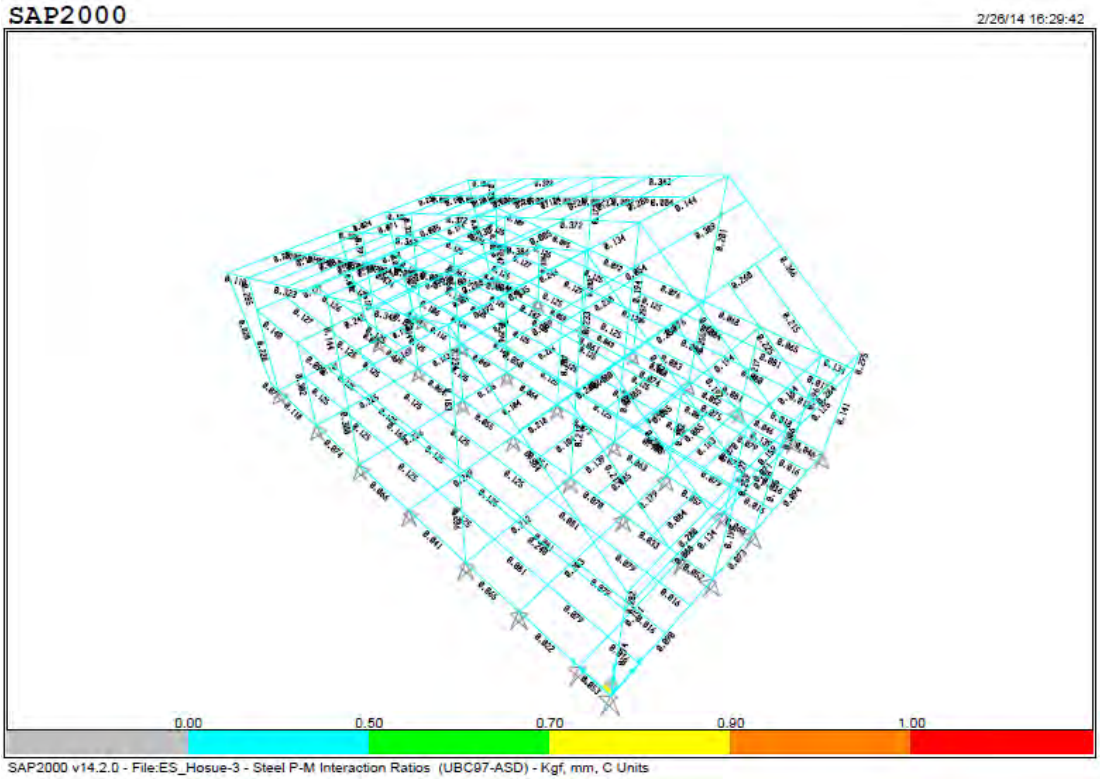
(X-dir)



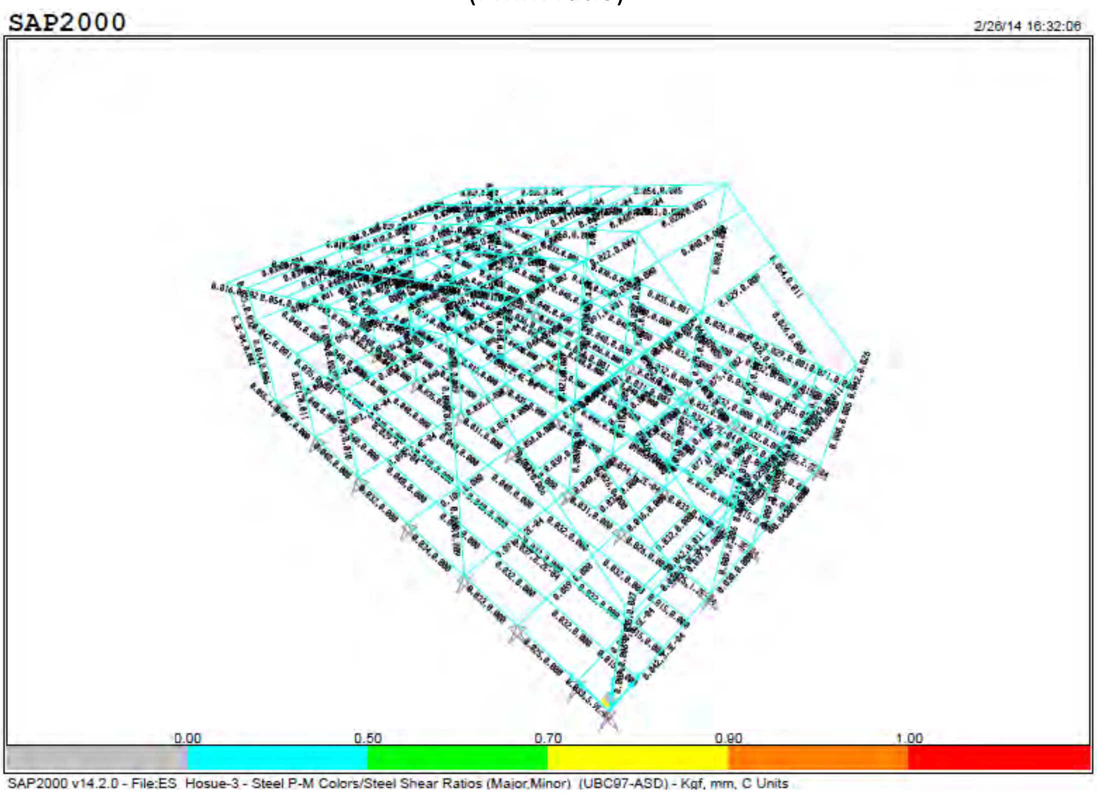
(Y-dir)

9. Structural Memebr Design

The structural member design and check are shown in the following figure. Dtail calculations for column, girder and beam are listed in 9.(1)~9.(5)。



(PMM ratio)



(Shear Ratio)

(1) Steel Column (Box-150x150x6)

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignTyp	Status	Ratio	RatioTyp	Combo
105	BOX150x150x6	Column	No Messages	17.4%	PMM	202
106	BOX150x150x6	Column	No Messages	19.9%	PMM	201
107	BOX150x150x6	Column	No Messages	15.5%	PMM	202
108	BOX150x150x6	Column	No Messages	14.1%	PMM	201
113	BOX150x150x6	Column	No Messages	28.6%	PMM	301
114	BOX150x150x6	Column	No Messages	21.2%	PMM	301
115	BOX150x150x6	Column	No Messages	26.9%	PMM	301
116	BOX150x150x6	Column	No Messages	25.5%	PMM	301
119	BOX150x150x6	Column	No Messages	30.0%	PMM	301
120	BOX150x150x6	Column	No Messages	23.4%	PMM	201
121	BOX150x150x6	Column	No Messages	29.4%	PMM	202
122	BOX150x150x6	Column	No Messages	28.3%	PMM	201
126	BOX150x150x6	Column	No Messages	22.8%	PMM	202
127	BOX150x150x6	Column	No Messages	19.5%	PMM	201
128	BOX150x150x6	Column	No Messages	27.6%	PMM	202
129	BOX150x150x6	Column	No Messages	20.8%	PMM	201
205	BOX150x150x6	Column	No Messages	28.2%	PMM	101
206	BOX150x150x6	Column	No Messages	25.9%	PMM	101
207	BOX150x150x6	Column	No Messages	30.6%	PMM	101
208	BOX150x150x6	Column	No Messages	29.5%	PMM	101
246	BOX150x150x6	Column	No Messages	18.3%	PMM	202
247	BOX150x150x6	Column	No Messages	23.3%	PMM	202
248	BOX150x150x6	Column	No Messages	19.4%	PMM	202
249	BOX150x150x6	Column	No Messages	20.1%	PMM	201
212	BOX150x150x6	Column	No Messages	28.5%	PMM	101
213	BOX150x150x6	Column	No Messages	29.1%	PMM	101
214	BOX150x150x6	Column	No Messages	33.7%	PMM	101
215	BOX150x150x6	Column	No Messages	27.6%	PMM	101
230	BOX150x150x6	Column	No Messages	14.4%	PMM	202
231	BOX150x150x6	Column	No Messages	15.6%	PMM	201
232	BOX150x150x6	Column	No Messages	24.7%	PMM	202
233	BOX150x150x6	Column	No Messages	17.2%	PMM	201
109	BOX150x150x6	Column	No Messages	22.7%	PMM	301
110	BOX150x150x6	Column	No Messages	19.6%	PMM	301
111	BOX150x150x6	Column	No Messages	25.2%	PMM	301
112	BOX150x150x6	Column	No Messages	21.7%	PMM	301
117	BOX150x150x6	Column	No Messages	28.7%	PMM	301
118	BOX150x150x6	Column	No Messages	25.7%	PMM	201
123	BOX150x150x6	Column	No Messages	30.2%	PMM	301
124	BOX150x150x6	Column	No Messages	21.4%	PMM	301
125	BOX150x150x6	Column	No Messages	33.6%	PMM	101

Calculation Detail

```
UBC97-ASD STEEL SECTION CHECK
Combo  : 101
Units  : Kgf, mm, C



Frame  : 125             Design Sect: BOX150x150x6
X Mid  : 9000.000        Design Type: Column
Y Mid  : 10500.000       Frame Type : Ordinary Moment Resisting Frame
Z Mid  : 1475.000        Sect Class : Compact
Length : 2950.000        Major Axis : 0.000 degrees counterclockwise from local 3
Loc    : 2950.000        RLLF       : 1.000

Area   : 3456.000        SMajor : 159528.960      rMajor : 58.839         AVMajor: 1800.000
IMajor : 11964672.000    SMinor : 159528.960      rMinor : 58.839         AVMinor: 1800.000
IMinor : 11964672.000    ZMajor : 186732.000      E      : 20400.000
Ixy    : 0.000           ZMinor : 186732.000      Fy     : 25.000

STRESS CHECK FORCES & MOMENTS
    Location              P         M33         M22          V2          V3           T
    2950.000      -1689.211 -712482.406  -59393.384     424.875      39.342    -418.103

PMM DEMAND/CAPACITY RATIO
    Governing         Total           P      MMajor      MMinor       Ratio      Status
    Equation          Ratio       Ratio       Ratio       Ratio       Limit       Check
     (H1-3)           0.336  =    0.043  +    0.271  +    0.023       0.950          OK

AXIAL FORCE DESIGN
                          P          fa          Fa          Ft
                      Force      Stress   Allowable   Allowable
    Axial         -1689.211       0.489      11.491      15.000

MOMENT DESIGN
                          M          fb          Fb          Fe       Cm        K        L       Cb
                     Moment      Stress   Allowable   Allowable   Factor   Factor   Factor   Factor
    Major Moment -712482.406      4.466      16.500      21.861    0.850    1.383    1.000    2.300
    Minor Moment  -59393.384      0.372      16.500      34.825    0.850    1.095    1.000

SHEAR DESIGN
                          V          fv          Fv      Stress      Status           T
                      Force      Stress   Allowable       Ratio       Check     Torsion
    Major Shear     424.875       0.236      10.000       0.024          OK       0.000
    Minor Shear      39.342       0.022      10.000       0.002          OK       0.000
```

(2) Steel Girders & Beams

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignTyp	Status	Ratio	RatioTyp	Combo
134	H150x150x7x9	Beam	No Messages	8.8%	PMM	201
135	H150x150x7x9	Beam	No Messages	7.1%	PMM	201
136	H150x150x7x9	Beam	No Messages	12.5%	PMM	202
160	H150x150x7x9	Beam	No Messages	18.0%	PMM	201
161	H150x150x7x9	Beam	No Messages	23.0%	PMM	202
175	H150x150x7x9	Beam	No Messages	16.9%	PMM	201
177	H150x150x7x9	Beam	No Messages	24.6%	PMM	202
202	H150x150x7x9	Beam	No Messages	17.7%	PMM	201
204	H150x150x7x9	Beam	No Messages	17.4%	PMM	201
150	H150x150x7x9	Beam	See WarnMsg	24.0%	PMM	301
167	H150x150x7x9	Beam	No Messages	16.5%	PMM	301
151	H150x150x7x9	Beam	No Messages	16.8%	PMM	301
168	H150x150x7x9	Beam	No Messages	5.8%	PMM	101
190	H150x150x7x9	Beam	No Messages	36.1%	PMM	101
143	H150x150x7x9	Beam	No Messages	14.4%	PMM	101
153	H150x150x7x9	Beam	No Messages	19.4%	PMM	101
169	H150x150x7x9	Beam	No Messages	23.8%	PMM	101
188	H150x150x7x9	Beam	No Messages	24.2%	PMM	201
191	H150x150x7x9	Beam	No Messages	25.8%	PMM	101
159	H150x150x7x9	Beam	No Messages	6.8%	PMM	301
166	H150x150x7x9	Beam	No Messages	7.6%	PMM	301
174	H150x150x7x9	Beam	No Messages	7.2%	PMM	201
187	H150x150x7x9	Beam	No Messages	9.5%	PMM	301
201	H150x150x7x9	Beam	No Messages	10.9%	PMM	301
141	H150x150x7x9	Beam	No Messages	13.4%	PMM	301
149	H150x150x7x9	Beam	No Messages	6.5%	PMM	301
178	H150x150x7x9	Beam	No Messages	9.0%	PMM	301
192	H150x150x7x9	Beam	No Messages	14.0%	PMM	301
182	H150x150x7x9	Beam	No Messages	10.6%	PMM	301
196	H150x150x7x9	Beam	No Messages	13.4%	PMM	301
137	H150x150x7x9	Beam	No Messages	13.9%	PMM	301
145	H150x150x7x9	Beam	No Messages	7.5%	PMM	301
155	H150x150x7x9	Beam	No Messages	7.4%	PMM	202
162	H150x150x7x9	Beam	No Messages	6.1%	PMM	301
170	H150x150x7x9	Beam	No Messages	14.7%	PMM	202

Calculation Detail

```
UBC97-ASD STEEL SECTION CHECK
Combo   : 101
Units   : Kgf, mm, C



Frame  : 190               Design Sect: H150x150x7x9
X Mid  : 5400.000          Design Type: Beam
Y Mid  : 10500.000         Frame Type : Ordinary Moment Resisting Frame
Z Mid  : 2950.000          Sect Class : Compact
Length : 4200.000          Major Axis : 0.000 degrees counterclockwise from local 3
Loc    : 2100.000          RLLF       : 1.000

Area   : 3624.000          SMajor : 197060.640      rMajor : 63.861          AVMajor: 1050.000
IMajor : 14779548.000      SMinor : 67550.307       rMinor : 37.390          AVMinor: 2250.000
IMinor : 5066273.000       ZMajor : 220842.000      E      : 20400.000
Ixy    : 0.000             ZMinor : 102867.000      Fy     : 25.000


STRESS CHECK FORCES & MOMENTS
    Location                  P        M33         M22          V2          V3           T
    2100.000            810.312  936616.358   36940.072    -362.178     -32.755     481.673

PMM DEMAND/CAPACITY RATIO
    Governing             Total           P      MMajor      MMinor       Ratio      Status
    Equation              Ratio       Ratio       Ratio       Ratio       Limit       Check
    (H2-1)                0.361  =    0.015   +   0.317   +   0.029       0.950          OK

AXIAL FORCE DESIGN
                              P          fa          Fa          Ft
                          Force      Stress   Allowable   Allowable
    Axial               810.312       0.224      11.740      15.000

MOMENT DESIGN
                              M          fb          Fb          Fe        Cm         K         L        Cb
                         Moment      Stress   Allowable   Allowable    Factor    Factor    Factor    Factor
    Major Moment     936616.358       4.753      15.000      24.286     1.000     1.000     1.000     1.000
    Minor Moment      36940.072       0.547      18.750      33.300     1.000     1.000     0.500

SHEAR DESIGN
                              V          fv          Fv      Stress      Status           T
                          Force      Stress   Allowable       Ratio       Check     Torsion
    Major Shear         362.178       0.345      10.000       0.034          OK       0.000
    Minor Shear          32.755       0.015      10.000       0.001          OK       0.000
```

Frame	DesignSect	DesignTyp	Status	Ratio	RatioTyp	Combo
176	H150x75x5x7	Beam	No Messages	19.2%	PMM	201
203	H150x75x5x7	Beam	No Messages	16.2%	PMM	202
152	H150x75x5x7	Beam	No Messages	8.5%	PMM	101
189	H150x75x5x7	Beam	No Messages	43.5%	PMM	101
138	H150x75x5x7	Beam	No Messages	1.8%	PMM	101
139	H150x75x5x7	Beam	No Messages	1.7%	PMM	101
140	H150x75x5x7	Beam	No Messages	1.7%	PMM	101
146	H150x75x5x7	Beam	No Messages	8.1%	PMM	101
147	H150x75x5x7	Beam	No Messages	8.0%	PMM	101
148	H150x75x5x7	Beam	No Messages	8.1%	PMM	101
156	H150x75x5x7	Beam	No Messages	8.3%	PMM	101
157	H150x75x5x7	Beam	No Messages	8.2%	PMM	101
158	H150x75x5x7	Beam	No Messages	8.4%	PMM	101
163	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
164	H150x75x5x7	Beam	No Messages	12.7%	PMM	101
165	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
171	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
172	H150x75x5x7	Beam	No Messages	12.7%	PMM	101
173	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
184	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
185	H150x75x5x7	Beam	No Messages	12.7%	PMM	101
186	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
198	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
199	H150x75x5x7	Beam	No Messages	12.6%	PMM	101
200	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
179	H150x75x5x7	Beam	No Messages	12.8%	PMM	101
180	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
181	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
193	H150x75x5x7	Beam	No Messages	12.7%	PMM	101
194	H150x75x5x7	Beam	No Messages	12.6%	PMM	101
195	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
197	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
183	H150x75x5x7	Beam	No Messages	12.5%	PMM	101
154	H150x75x5x7	Beam	No Messages	8.5%	PMM	101
144	H150x75x5x7	Beam	No Messages	8.5%	PMM	101
142	H150x75x5x7	Beam	No Messages	7.0%	PMM	101
234	H150x75x5x7	Brace	No Messages	21.7%	PMM	101
235	H150x75x5x7	Brace	No Messages	22.5%	PMM	101
236	H150x75x5x7	Brace	No Messages	22.5%	PMM	101
237	H150x75x5x7	Brace	No Messages	21.5%	PMM	101
275	H150x75x5x7	Brace	No Messages	19.2%	PMM	101
276	H150x75x5x7	Beam	No Messages	0.5%	PMM	201
277	H150x75x5x7	Beam	No Messages	0.5%	PMM	101
294	H150x75x5x7	Beam	See WarnMsg	38.9%	PMM	101
295	H150x75x5x7	Beam	No Messages	5.4%	PMM	101
296	H150x75x5x7	Beam	See WarnMsg	38.9%	PMM	101

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignTyp	Status	Ratio	RatioTyp	Combo
305	H150x75x5x7	Beam	No Messages	24.7%	PMM	101
307	H150x75x5x7	Beam	No Messages	24.7%	PMM	101
324	H150x75x5x7	Beam	No Messages	23.7%	PMM	101
325	H150x75x5x7	Beam	No Messages	23.7%	PMM	101
326	H150x75x5x7	Beam	No Messages	28.8%	PMM	101
327	H150x75x5x7	Beam	No Messages	28.8%	PMM	101
336	H150x75x5x7	Beam	No Messages	24.5%	PMM	101
337	H150x75x5x7	Beam	No Messages	24.5%	PMM	101
354	H150x75x5x7	Beam	No Messages	23.6%	PMM	101
355	H150x75x5x7	Beam	No Messages	23.5%	PMM	101
356	H150x75x5x7	Beam	No Messages	28.1%	PMM	101
357	H150x75x5x7	Beam	No Messages	28.1%	PMM	101
358	H150x75x5x7	Brace	No Messages	0.7%	PMM	101
359	H150x75x5x7	Brace	No Messages	0.5%	PMM	201
360	H150x75x5x7	Brace	No Messages	0.4%	PMM	201
361	H150x75x5x7	Brace	No Messages	0.4%	PMM	201
362	H150x75x5x7	Brace	No Messages	0.4%	PMM	201
363	H150x75x5x7	Brace	No Messages	0.3%	PMM	301
364	H150x75x5x7	Brace	No Messages	0.2%	PMM	202
365	H150x75x5x7	Brace	No Messages	0.2%	PMM	301
366	H150x75x5x7	Brace	No Messages	0.4%	PMM	301
367	H150x75x5x7	Brace	No Messages	0.7%	PMM	101
368	H150x75x5x7	Brace	No Messages	0.4%	PMM	304
369	H150x75x5x7	Brace	No Messages	0.3%	PMM	202
370	H150x75x5x7	Brace	No Messages	0.4%	PMM	101
371	H150x75x5x7	Brace	No Messages	0.4%	PMM	101
372	H150x75x5x7	Brace	No Messages	0.3%	PMM	301
373	H150x75x5x7	Brace	No Messages	0.2%	PMM	301
374	H150x75x5x7	Brace	No Messages	0.1%	PMM	301
375	H150x75x5x7	Brace	No Messages	0.4%	PMM	301

Calculation Detail

```
UBC97-ASD STEEL SECTION CHECK
Combo   : 101
Units   : Kgf, mm, C



Frame  : 190             Design Sect: H150x150x7x9
X Mid  : 5400.000        Design Type: Beam
Y Mid  : 10500.000       Frame Type : Ordinary Moment Resisting Frame
Z Mid  : 2950.000        Sect Class : Compact
Length : 4200.000        Major Axis : 0.000 degrees counterclockwise from local 3
Loc    : 2100.000        RLLF       : 1.000

Area   : 3624.000        SMajor : 197060.640     rMajor : 63.861          AVMajor: 1050.000
IMajor : 14779548.000    SMinor : 67550.307      rMinor : 37.390          AVMinor: 2250.000
IMinor : 5066273.000     ZMajor : 220842.000     E      : 20400.000
Ixy    : 0.000           ZMinor : 102867.000     Fy     : 25.000

STRESS CHECK FORCES & MOMENTS
    Location                P         M33         M22          V2          V3           T
    2100.000          810.312  936616.358   36940.072    -362.178     -32.755     481.673

PMM DEMAND/CAPACITY RATIO
    Governing           Total           P      MMajor      MMinor       Ratio      Status
    Equation            Ratio       Ratio       Ratio       Ratio       Limit       Check
    (H2-1)              0.361  =    0.015  +    0.317  +    0.029       0.950          OK

AXIAL FORCE DESIGN
                            P          fa          Fa          Ft
                        Force      Stress   Allowable   Allowable
    Axial             810.312       0.224      11.740      15.000

MOMENT DESIGN
                            M          fb          Fb          Fe       Cm       K       L      Cb
                       Moment      Stress   Allowable   Allowable   Factor  Factor  Factor  Factor
    Major Moment   936616.358       4.753      15.000      24.286    1.000   1.000   1.000   1.000
    Minor Moment    36940.072       0.547      18.750      33.300    1.000   1.000   0.500

SHEAR DESIGN
                            V          fv          Fv      Stress      Status           T
                        Force      Stress   Allowable       Ratio       Check     Torsion
    Major Shear       362.178       0.345      10.000       0.034          OK       0.000
    Minor Shear        32.755       0.015      10.000       0.001          OK       0.000
```

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignType	Status	Ratio	RatioType	Combo
209	BOX150x150x4	Beam	No Messages	28.0%	PMM	201
210	BOX150x150x4	Beam	No Messages	15.9%	PMM	202
211	BOX150x150x4	Beam	No Messages	28.4%	PMM	202
272	BOX150x150x4	Beam	No Messages	13.5%	PMM	202
273	BOX150x150x4	Beam	No Messages	13.4%	PMM	202
274	BOX150x150x4	Beam	No Messages	14.4%	PMM	201
227	BOX150x150x4	Beam	No Messages	18.2%	PMM	201
228	BOX150x150x4	Beam	No Messages	7.1%	PMM	203
229	BOX150x150x4	Beam	No Messages	19.0%	PMM	202
254	BOX150x150x4	Beam	No Messages	16.4%	PMM	201
255	BOX150x150x4	Beam	No Messages	13.0%	PMM	203
256	BOX150x150x4	Beam	No Messages	17.4%	PMM	201
130	BOX150x150x6	Brace	No Messages	2.8%	PMM	202
219	BOX150x150x4	Brace	No Messages	11.0%	PMM	301
131	BOX150x150x6	Brace	No Messages	3.2%	PMM	304
222	BOX150x150x4	Brace	No Messages	10.9%	PMM	301
132	BOX150x150x6	Brace	No Messages	3.8%	PMM	202
223	BOX150x150x4	Brace	No Messages	10.5%	PMM	101
133	BOX150x150x6	Brace	No Messages	2.8%	PMM	201
226	BOX150x150x4	Brace	No Messages	10.6%	PMM	202
257	BOX150x150x4	Beam	No Messages	26.0%	PMM	101
258	BOX150x150x4	Beam	No Messages	7.6%	PMM	101
259	BOX150x150x4	Beam	No Messages	26.0%	PMM	101
216	BOX150x150x4	Beam	No Messages	23.5%	PMM	101
217	BOX150x150x4	Beam	No Messages	2.4%	PMM	101
218	BOX150x150x4	Beam	No Messages	23.6%	PMM	101
278	BOX150x150x4	Brace	No Messages	38.4%	PMM	101
280	BOX150x150x4	Brace	No Messages	43.3%	PMM	101
282	BOX150x150x4	Brace	No Messages	42.7%	PMM	101
284	BOX150x150x4	Brace	No Messages	36.6%	PMM	101
297	BOX150x150x4	Brace	No Messages	34.8%	PMM	101
299	BOX150x150x4	Brace	No Messages	38.6%	PMM	101
301	BOX150x150x4	Brace	No Messages	37.2%	PMM	101
303	BOX150x150x4	Brace	No Messages	34.3%	PMM	101
328	BOX150x150x4	Brace	No Messages	32.3%	PMM	101
330	BOX150x150x4	Brace	No Messages	36.2%	PMM	101
332	BOX150x150x4	Brace	No Messages	37.2%	PMM	101
334	BOX150x150x4	Brace	No Messages	32.2%	PMM	101

Calculation Detail

```
UBC97-ASD STEEL SECTION CHECK
Combo  : 101
Units  : Kgf, mm, C



Frame  : 282               Design Sect: BOX150x150x4
X Mid  : 5400.000          Design Type: Brace
Y Mid  : 2100.000          Frame Type : Ordinary Moment Resisting Frame
Z Mid  : 5105.000          Sect Class : Compact
Length : 5347.532          Major Axis : 0.000 degrees counterclockwise from local 3
Loc    : 5347.532          RLLF       : 1.000

Area   : 2619.000          SMajor : 123328.710      rMajor : 59.429         AVMajor: 1350.000
IMajor : 9249653.250       SMinor : 123328.710      rMinor : 59.429         AVMinor: 1350.000
IMinor : 9249653.250       ZMajor : 142944.750      E      : 20400.000
Ixy    : 0.000             ZMinor : 142944.750      Fy     : 25.000

STRESS CHECK FORCES & MOMENTS
    Location                P         M33         M22          V2          V3           T
    5347.532         -102.060 -778414.907   82918.384     818.709    -114.363    2143.519

PMM DEMAND/CAPACITY RATIO
    Governing           Total           P      MMajor      MMinor       Ratio      Status
    Equation            Ratio       Ratio       Ratio       Ratio       Limit       Check
    (H1-3)              0.427  =    0.004  +    0.383  +    0.041       0.950          OK

AXIAL FORCE DESIGN
                            P          fa          Fa          Ft
                        Force      Stress   Allowable   Allowable
    Axial            -102.060       0.039       9.913      15.000

MOMENT DESIGN
                            M          fb          Fb          Fe       Cm       K       L      Cb
                       Moment      Stress   Allowable   Allowable   Factor  Factor  Factor  Factor
    Major Moment -778414.907       6.312      16.500      12.974    0.850   1.000   1.000   1.000
    Minor Moment   82918.384       0.672      16.500      36.912    0.850   1.000   0.593

SHEAR DESIGN
                            V          fv          Fv      Stress      Status           T
                        Force      Stress   Allowable       Ratio       Check     Torsion
    Major Shear       818.709       0.606      10.000       0.061          OK       0.000
    Minor Shear       114.363       0.085      10.000       0.008          OK       0.000
```

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignType	Status	Ratio	RatioType	Combo
101	TB	Beam	No Messages	7.1%	PMM	301
102	TB	Beam	No Messages	7.8%	PMM	301
103	TB	Beam	No Messages	6.4%	PMM	301
104	TB	Beam	No Messages	6.7%	PMM	301
1	TB	Beam	No Messages	9.0%	PMM	201
2	TB	Beam	No Messages	7.3%	PMM	202
3	TB	Beam	No Messages	9.4%	PMM	202
16	TB	Beam	No Messages	13.6%	PMM	101
14	TB	Beam	No Messages	15.1%	PMM	101
15	TB	Beam	No Messages	13.4%	PMM	101
28	TB	Beam	No Messages	20.3%	PMM	101
29	TB	Beam	No Messages	17.9%	PMM	101
30	TB	Beam	No Messages	18.3%	PMM	101
42	TB	Beam	No Messages	21.2%	PMM	101
43	TB	Beam	No Messages	13.9%	PMM	202
44	TB	Beam	No Messages	20.6%	PMM	101
56	TB	Beam	No Messages	24.9%	PMM	101
57	TB	Beam	No Messages	21.8%	PMM	101
58	TB	Beam	No Messages	22.5%	PMM	101
70	TB	Beam	No Messages	22.6%	PMM	101
71	TB	Beam	No Messages	13.6%	PMM	202
72	TB	Beam	No Messages	22.6%	PMM	101
84	TB	Beam	No Messages	22.5%	PMM	101
85	TB	Beam	No Messages	16.3%	PMM	101
86	TB	Beam	No Messages	22.7%	PMM	101
98	TB	Beam	No Messages	14.7%	PMM	201
99	TB	Beam	No Messages	11.0%	PMM	202
100	TB	Beam	No Messages	15.4%	PMM	202
4	TB	Beam	No Messages	5.3%	PMM	304
31	TB	Beam	No Messages	6.5%	PMM	301
45	TB	Beam	No Messages	4.1%	PMM	304
59	TB	Beam	No Messages	6.6%	PMM	301
73	TB	Beam	No Messages	7.4%	PMM	301
87	TB	Beam	No Messages	11.8%	PMM	301
8	TB	Beam	No Messages	5.2%	PMM	304
21	TB	Beam	No Messages	3.3%	PMM	101
35	TB	Beam	No Messages	7.0%	PMM	301
49	TB	Beam	No Messages	5.1%	PMM	101
63	TB	Beam	No Messages	5.5%	PMM	301
77	TB	Beam	No Messages	6.4%	PMM	301
91	TB	Beam	No Messages	11.5%	PMM	301
9	TB	Beam	No Messages	6.0%	PMM	303
23	TB	Beam	No Messages	5.7%	PMM	301
37	TB	Beam	No Messages	6.3%	PMM	301
51	TB	Beam	No Messages	7.3%	PMM	301
65	TB	Beam	No Messages	6.4%	PMM	301

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignTyp	Status	Ratio	RatioTyp	Combo
79	TB	Beam	No Messages	4.9%	PMM	101
93	TB	Beam	No Messages	11.6%	PMM	301
13	TB	Beam	No Messages	4.6%	PMM	303
27	TB	Beam	No Messages	4.6%	PMM	301
41	TB	Beam	No Messages	5.2%	PMM	301
55	TB	Beam	No Messages	6.4%	PMM	301
69	TB	Beam	No Messages	6.3%	PMM	301
83	TB	Beam	No Messages	5.9%	PMM	301
97	TB	Beam	No Messages	9.6%	PMM	301

Calculation Detail

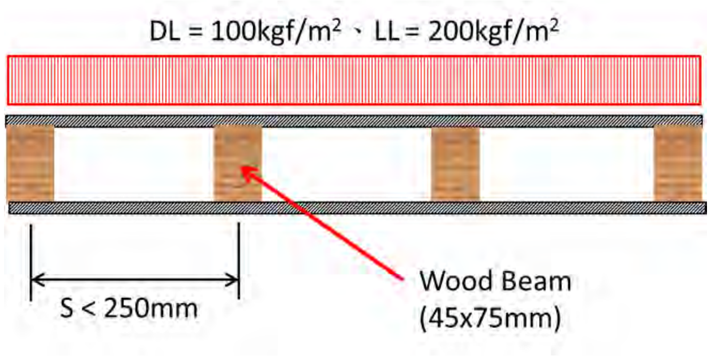
```
UBC97-ASD STEEL SECTION CHECK
Combo  : 101
Units  : Kgf, mm, C



Frame  : 72               Design Sect: TB
X Mid  : 7200.000         Design Type: Beam
Y Mid  : 8400.000         Frame Type : Ordinary Moment Resisting Frame
Z Mid  : 0.000            Sect Class : Compact
Length : 3600.000         Major Axis : 0.000 degrees counterclockwise from local 3
Loc    : 1800.000         RLLF       : 1.000

Area   : 3624.000         SMajor : 197060.640      rMajor : 63.861         AVMajor: 1050.000
IMajor : 14779548.000     SMinor : 67550.307       rMinor : 37.390         AVMinor: 2250.000
IMinor : 5066273.000      ZMajor : 220842.000      E      : 20400.000
Ixy    : 0.000            ZMinor : 102867.000      Fy     : 25.000

STRESS CHECK FORCES & MOMENTS
    Location                P          M33         M22          V2          V3           T
    1800.000            0.000   734095.161     -44.218     233.036      -0.427     -12.208

PMM DEMAND/CAPACITY RATIO
    Governing           Total           P      MMajor      MMinor       Ratio      Status
    Equation            Ratio       Ratio       Ratio       Ratio       Limit       Check
    (BENDING)           0.226   =   0.000   +   0.226   +   0.000       0.950          OK

AXIAL FORCE DESIGN
                            P          fa          Fa          Ft
                        Force      Stress   Allowable   Allowable
    Axial               0.000       0.000      12.366      15.000

MOMENT DESIGN
                            M          fb          Fb          Fe         Cm          K           L         Cb
                       Moment      Stress   Allowable   Allowable     Factor     Factor      Factor     Factor
    Major Moment   734095.161       3.725      16.500      33.056      1.000      1.000       1.000      1.000
    Minor Moment      -44.218  6.546E-04      18.750     181.300      1.000      1.000       0.250

SHEAR DESIGN
                            V          fv          Fv      Stress      Status           T
                        Force      Stress   Allowable       Ratio       Check     Torsion
    Major Shear       233.036       0.222      10.000       0.022          OK       0.000
    Minor Shear         0.427   1.899E-04      10.000   1.899E-05          OK       0.000
```

TABLE: Steel Design 1 - Summary Data - UBC97-ASD						
Frame	DesignSect	DesignTyp	Status	Ratio	RatioTyp	Combo
5	Tb1	Beam	No Messages	1.6%	PMM	101
6	Tb1	Beam	No Messages	1.6%	PMM	101
7	Tb1	Beam	No Messages	1.6%	PMM	101
18	Tb1	Beam	No Messages	7.9%	PMM	101
19	Tb1	Beam	No Messages	7.9%	PMM	101
20	Tb1	Beam	No Messages	7.9%	PMM	101
32	Tb1	Beam	No Messages	8.1%	PMM	101
33	Tb1	Beam	No Messages	8.1%	PMM	101
34	Tb1	Beam	No Messages	8.1%	PMM	101
46	Tb1	Beam	No Messages	12.5%	PMM	101
47	Tb1	Beam	No Messages	12.5%	PMM	101
48	Tb1	Beam	No Messages	12.5%	PMM	101
60	Tb1	Beam	No Messages	12.5%	PMM	101
61	Tb1	Beam	No Messages	12.5%	PMM	101
62	Tb1	Beam	No Messages	12.5%	PMM	101
74	Tb1	Beam	No Messages	12.5%	PMM	101
75	Tb1	Beam	No Messages	12.5%	PMM	101
76	Tb1	Beam	No Messages	12.5%	PMM	101
88	Tb1	Beam	No Messages	12.5%	PMM	101
89	Tb1	Beam	No Messages	12.5%	PMM	101
90	Tb1	Beam	No Messages	12.5%	PMM	101
10	Tb1	Beam	No Messages	1.6%	PMM	101
11	Tb1	Beam	No Messages	1.6%	PMM	101
12	Tb1	Beam	No Messages	1.6%	PMM	101
24	Tb1	Beam	No Messages	7.9%	PMM	101
25	Tb1	Beam	No Messages	7.9%	PMM	101
26	Tb1	Beam	No Messages	7.9%	PMM	101
38	Tb1	Beam	No Messages	8.1%	PMM	101
39	Tb1	Beam	No Messages	8.1%	PMM	101
40	Tb1	Beam	No Messages	8.1%	PMM	101
52	Tb1	Beam	No Messages	12.5%	PMM	101
53	Tb1	Beam	No Messages	12.5%	PMM	101
54	Tb1	Beam	No Messages	12.5%	PMM	101
66	Tb1	Beam	No Messages	12.5%	PMM	101
67	Tb1	Beam	No Messages	12.5%	PMM	101
68	Tb1	Beam	No Messages	12.5%	PMM	101
80	Tb1	Beam	No Messages	12.5%	PMM	101
81	Tb1	Beam	No Messages	12.5%	PMM	101
82	Tb1	Beam	No Messages	12.5%	PMM	101
94	Tb1	Beam	No Messages	12.5%	PMM	101
95	Tb1	Beam	No Messages	12.5%	PMM	101
96	Tb1	Beam	No Messages	12.5%	PMM	101
64	Tb1	Beam	No Messages	10.4%	PMM	101
50	Tb1	Beam	No Messages	10.4%	PMM	101
36	Tb1	Beam	No Messages	8.5%	PMM	101
22	Tb1	Beam	No Messages	8.4%	PMM	101
92	Tb1	Beam	No Messages	12.5%	PMM	101
78	Tb1	Beam	No Messages	12.5%	PMM	101

Calculation Detail

```
UBC97-ASD STEEL SECTION CHECK
Combo   : 101
Units   : Kgf, mm, C



Frame   : 46                Design Sect: Tb1
X Mid   : 900.000           Design Type: Beam
Y Mid   : 5250.000          Frame Type : Ordinary Moment Resisting Frame
Z Mid   : 0.000             Sect Class : Compact
Length  : 2100.000          Major Axis : 0.000 degrees counterclockwise from local 3
Loc     : 840.000           RLLF       : 1.000

Area    : 1730.000          SMajor : 85603.422       rMajor : 60.919          AVMajor: 750.000
IMajor  : 6420256.667       SMinor : 13162.778       rMinor : 16.891          AVMinor: 875.000
IMinor  : 493604.167        ZMajor : 98195.000       E      : 20400.000
Ixy     : 0.000             ZMinor : 20537.500       Fy     : 25.000


STRESS CHECK FORCES & MOMENTS
    Location                P          M33          M22          V2          V3           T
    840.000             0.976   150069.929        0.000     -59.552       0.000       0.000

PMM DEMAND/CAPACITY RATIO
    Governing           Total            P       MMajor       MMinor       Ratio      Status
    Equation            Ratio        Ratio        Ratio        Ratio       Limit       Check
    (BENDING)           0.125   =    0.000   +    0.125   +    0.000       0.950          OK

AXIAL FORCE DESIGN
                            P           fa           Fa           Ft
                        Force       Stress    Allowable    Allowable
    Axial               0.976    5.643E-04        6.786       15.000

MOMENT DESIGN
                            M           fb           Fb           Fe        Cm        K        L       Cb
                       Moment       Stress    Allowable    Allowable    Factor   Factor   Factor   Factor
    Major Moment   150069.929        1.753       14.061       88.400     1.000    1.000    1.000    1.000
    Minor Moment        0.000        0.000       18.750        6.796     1.000    1.000    1.000

SHEAR DESIGN
                            V           fv           Fv       Stress      Status           T
                        Force       Stress    Allowable        Ratio       Check     Torsion
    Major Shear        59.552        0.079       10.000        0.008          OK       0.000
    Minor Shear         0.000        0.000       10.000        0.000          OK       0.000
```

(3) Wood Deck Beam



Wood Deck Section

Calculation Detail

The maximum span is L_{max} = 105cm
and
uniform line load on wood beam is w = (DL+LL)xS= 75kgf/m

$\therefore$ $M_{max} = wL^2_{max} / 8$ = 10.34 kgf-m = 1034 kgf-cm

Section Modulus, Sx, of Wood Beam is 42.1875cm^3.
The compressive and tension stress of wood beam are

fc = ft = Mmax/Sx = 24.51 kgf/cm^2

The allowable compressive and tension stress of wood beam are

$_Lfc$ = 60kgf/cm^2 ; $_Lft$ = 45kgf/cm^2.

Because both fc and ft are less than the allowable stresses, the design result is satisfactory.

Any type of wood deck which satify the minimum depth 75mm and maximum spacing 250mm in the above-mentioned calculation can be adopted in this building.

(4) Bolt Connection Check

The connection between Gider H150x150x7x9 and Column Box-150x150x6 is moment connection. The penetration weld is adopted in factory. So, the connection strength is enough.

The bolt connection completed in site for box column splice and girder connection is check as follow:

The maximum PMM ratio (shown in 9.(1)) for column is 0.337 Therefore, it the bolt connection force can be determined by capacity design concepet, that is

$$P_{t,col} = (0.6F_y) \times b_f \times t_f \times PMM\_ratio = 0.6x2.5x15x0.6x0.337 = 4.55 \text{ tf}$$

As for Girder H150x150x7x9 & TB, its maximum PMM ratio (shown in 9.(2)) is 0.361. So, the bolt connection force can be obtained as follows:

$$P_{t,girder} = (0.6F_y) \times b_f \times t_f \times PMM\_ratio = 0.6x2.5x15x0.9x0.361 = 7.31 \text{ tf}$$

As for Girder Box150x150x4 & Box150x150x6, its maximum PMM ratio (shown in 9.(2)) is 0.433. So, the bolt connection force can be obtained as follows:

$$P_{t,girder} = (0.6F_y) \times b_f \times t_f \times PMM\_ratio = 0.6x2.5x15x0.6x0.433 = 5.85 \text{ tf}$$

F10T M16 bolt (bearing type) is used in the connection design, its allowable shear force is 3.8tf. Base on the above forces, Pt,col and Pt,Girder, two bolts are needed for each flange of box column/girder.

………

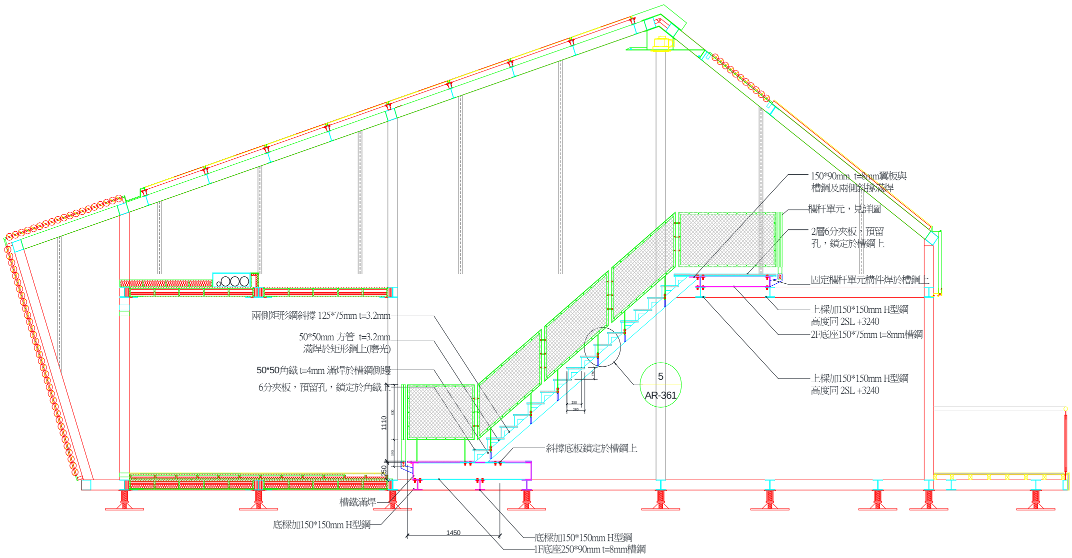
For beam H150x75x5x7 & Tb1, its connection to girder is shear connection. The shear ratio of beam is less than 0.25. Use capacity design concept, the connection force can be determined as

$$V_{BM} = (0.4F_y) \times (2 \times d_w \times t_w) \times Shear\_ratio = 0.4x2.5x15x0.5x0.25 = 1.875 \text{ tf}$$

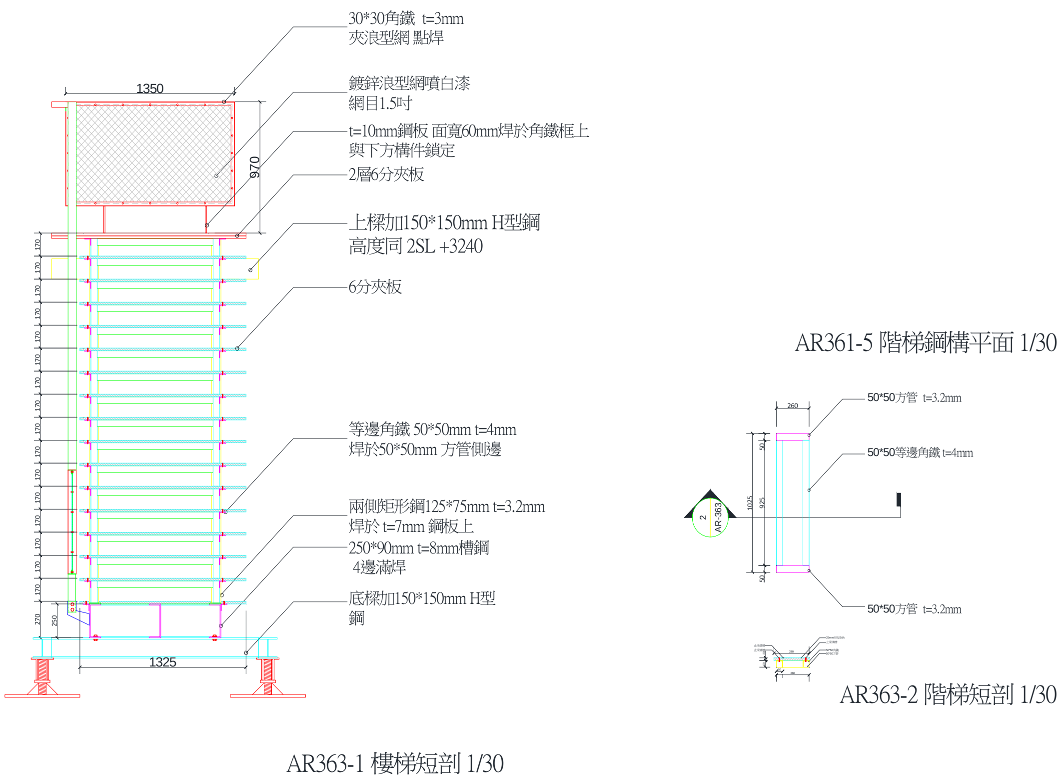
F10T M16 bolt (bearing type) is adopted in the shear connection design, its allowable shear force is 3.8tf. Base on the force, V_{BM}, one bolt is needed for web of box beam.

10. Stair Design

The stair-design in this building is completed in the following calculation. The stair drawing as follows:



Elev. View_1



Elev. View_2

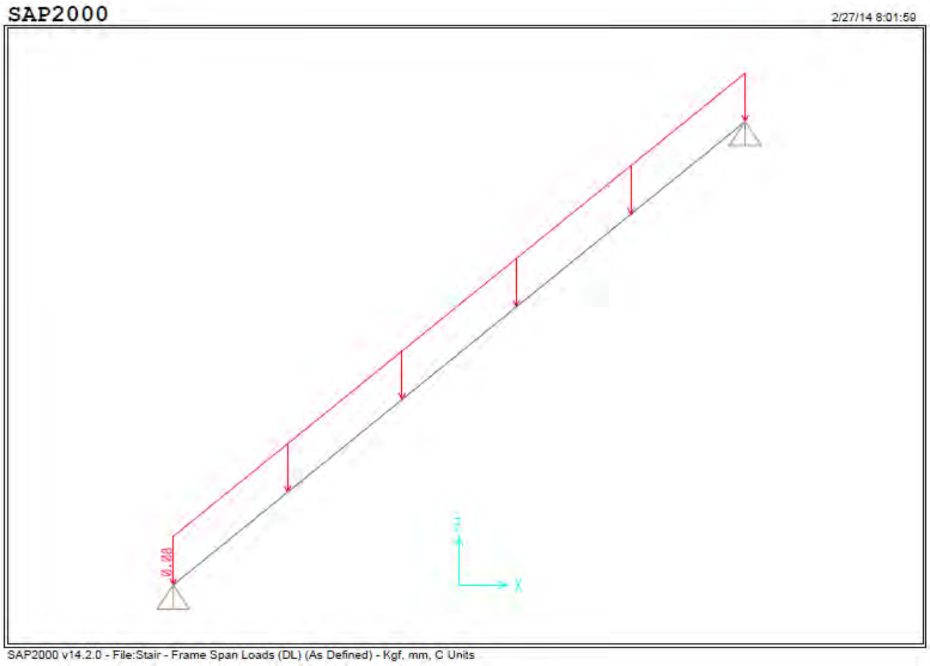
Design Loading

(1) DL: 150 kgf/m^2

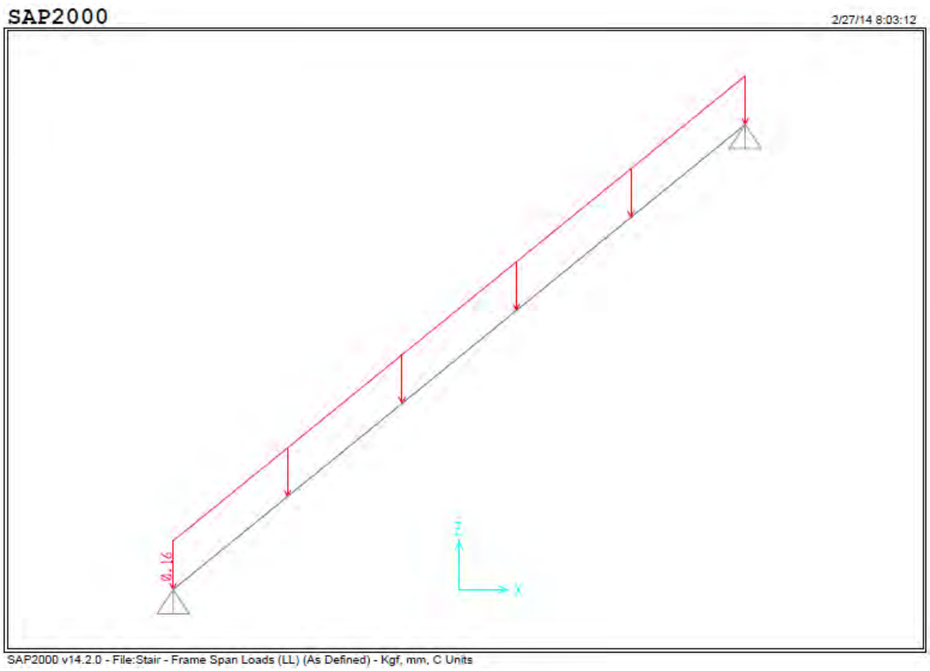
(2) LL: 300 kgf/m^2

Analysis Model

(DL Case)



(LL Case)



Design Result

```
AISC-ASD89 STEEL SECTION CHECK
Combo   : COMB2
Units   : Kgf, mm, C



Frame   : 1                  Design Sect: Box125x75x3
X Mid   : 0.000              Design Type: Brace
Y Mid   : 0.000              Frame Type : Braced Frame
Z Mid   : 1347.500           Sect Class : Compact
Length  : 4280.029           Major Axis : 0.000 degrees counterclockwise from local 3
Loc     : 1902.235           RLLF       : 1.000

Area    : 1239.040           SMajor : 42725.716     rMajor : 46.424          AVMajor: 800.000
IMajor  : 2670357.257        SMinor : 32104.162     rMinor : 31.171          AVMinor: 480.000
IMinor  : 1203906.057        ZMajor : 51737.536     E      : 20400.000
Ixy     : 0.000              ZMinor : 36249.536     Fy     : 25.000

STRESS CHECK FORCES & MOMENTS
    Location                P         M33          M22          V2           V3           T
    1902.235          -36.350  426554.193        0.000      -44.848        0.000        0.000

PMM DEMAND/CAPACITY RATIO
    Governing           Total           P       MMajor       MMinor        Ratio       Status
    Equation            Ratio       Ratio        Ratio        Ratio        Limit        Check
    (H1-3)              0.608   =   0.003   +    0.605   +    0.000        0.950           OK

AXIAL FORCE DESIGN
                            P          fa           Fa           Ft
                        Force      Stress    Allowable    Allowable
    Axial             -36.350       0.029        9.731       15.000

MOMENT DESIGN
                            M          fb           Fb           Fe       Cm        K        L       Cb
                       Moment      Stress    Allowable    Allowable   Factor   Factor   Factor   Factor
    Major Moment   426554.193       9.984       16.500       12.359    1.000    1.000    1.000    1.000
    Minor Moment        0.000       0.000       16.500     1426.386    1.000    1.000    0.063

SHEAR DESIGN
                            V          fv           Fv       Stress       Status            T
                        Force      Stress    Allowable        Ratio        Check      Torsion
    Major Shear        44.848       0.056       10.000        0.006           OK        0.000
    Minor Shear         0.000       0.000       10.000        0.000           OK        0.000
```

11. Footing Design

The reactions of single footing are obtained by SAP2000 analysis results. The following list shows the reactions for footing design and soil bearing check.

TABLE: Joint Reactions								
Joint	OutputCase	CaseType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm
1	101	Combination	105.87	37.87	2379.82	0	0	0
1	201	Combination	38.63	33.96	2122.53	0	0	0
1	202	Combination	156.54	39.82	2333.76	0	0	0
1	203	Combination	-27.71	19.85	1100.37	0	0	0
1	204	Combination	129.52	27.67	1382	0	0	0
1	301	Combination	100.52	-28.28	1850.53	0	0	0
1	302	Combination	156.54	39.82	2333.76	0	0	0
1	303	Combination	54.82	-63.13	737.69	0	0	0
1	304	Combination	46.99	110.65	1744.68	0	0	0
5	101	Combination	-34.46	93.99	3445.95	0	0	0
5	201	Combination	-132.97	78.4	2917.99	0	0	0
5	202	Combination	66.96	80	3262.45	0	0	0
5	203	Combination	-153.34	23.3	1186.5	0	0	0
5	204	Combination	113.24	25.45	1645.78	0	0	0
5	301	Combination	-26.14	15	2717.66	0	0	0
5	302	Combination	66.96	80	3262.45	0	0	0
5	303	Combination	-10.9	-61.23	919.39	0	0	0
5	304	Combination	-29.2	109.98	1912.88	0	0	0
6	101	Combination	63.36	-20.07	2653.56	0	0	0
6	201	Combination	-39.9	-20.69	2531	0	0	0
6	202	Combination	156.95	-18.03	2224.32	0	0	0
6	203	Combination	-100.41	-13.84	1289.43	0	0	0
6	204	Combination	162.06	-10.29	880.53	0	0	0
6	301	Combination	65.55	-96.36	1480.64	0	0	0
6	302	Combination	156.95	-18.03	2224.32	0	0	0
6	303	Combination	40.19	-114.73	-111.06	0	0	0
6	304	Combination	21.46	90.6	2281.02	0	0	0
10	101	Combination	-96.77	-2.97	1955	0	0	0
10	201	Combination	-151.07	-1.71	1910.27	0	0	0
10	202	Combination	-27.13	-4.33	1681.06	0	0	0
10	203	Combination	-128.9	-0.47	1075.15	0	0	0
10	204	Combination	36.37	-3.96	769.54	0	0	0
10	301	Combination	-80.9	-62.82	1083.24	0	0	0
10	302	Combination	-27.13	-4.33	1681.06	0	0	0
10	303	Combination	-35.33	-81.95	-27.55	0	0	0
10	304	Combination	-57.2	77.52	1872.25	0	0	0
11	101	Combination	-8.04	1.79	900.74	0	0	0
11	201	Combination	-13.73	3.33	802.77	0	0	0
11	202	Combination	0.27	-0.32	798.88	0	0	0
11	203	Combination	-11.29	2.89	353.35	0	0	0
11	204	Combination	7.37	-1.98	348.17	0	0	0
11	301	Combination	-6.02	1.35	1001.39	0	0	0
11	302	Combination	0.27	-0.32	798.88	0	0	0
11	303	Combination	-1.02	0.26	618.18	0	0	0
11	304	Combination	-2.9	0.66	83.34	0	0	0

TABLE: Joint Reactions								
Joint	OutputCase	CaseType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm
15	101	Combination	0.52	0.39	1405.98	0	0	0
15	201	Combination	0.67	0.005933	1172.09	0	0	0
15	202	Combination	-0.16	0.55	1246.43	0	0	0
15	203	Combination	0.18	-0.41	383.81	0	0	0
15	204	Combination	-0.94	0.31	482.93	0	0	0
15	301	Combination	-1.78	-0.4	1405.94	0	0	0
15	302	Combination	-0.16	0.55	1246.43	0	0	0
15	303	Combination	-3.1	-0.95	695.6	0	0	0
15	304	Combination	2.34	0.85	171.13	0	0	0
16	101	Combination	201.53	-36.89	2626.27	0	0	0
16	201	Combination	89.93	-36.63	2228.16	0	0	0
16	202	Combination	253.5	-34.33	2343.11	0	0	0
16	203	Combination	-51.44	-23.4	807.99	0	0	0
16	204	Combination	166.65	-20.35	961.25	0	0	0
16	301	Combination	172.29	-149.27	2791.92	0	0	0
16	302	Combination	253.5	-34.33	2343.11	0	0	0
16	303	Combination	58.37	-173.6	1559.67	0	0	0
16	304	Combination	56.83	129.85	209.57	0	0	0
20	101	Combination	-199.54	-27.73	2341.14	0	0	0
20	201	Combination	-238.62	-25.67	2188.41	0	0	0
20	202	Combination	-101.84	-26.03	1991.11	0	0	0
20	203	Combination	-148.81	-13.89	1066.47	0	0	0
20	204	Combination	33.56	-14.37	803.4	0	0	0
20	301	Combination	-172.11	-115.53	2480.91	0	0	0
20	302	Combination	-101.84	-26.03	1991.11	0	0	0
20	303	Combination	-60.13	-133.71	1456.46	0	0	0
20	304	Combination	-55.12	105.44	413.41	0	0	0
23	101	Combination	-0.09013	0.05922	1104.54	0	0	0
23	201	Combination	1.13	0.99	980.46	0	0	0
23	202	Combination	-1.26	-0.86	975.61	0	0	0
23	203	Combination	1.6	1.29	422.19	0	0	0
23	204	Combination	-1.58	-1.18	415.74	0	0	0
23	301	Combination	0.06356	0.13	886.95	0	0	0
23	302	Combination	-1.26	-0.86	975.61	0	0	0
23	303	Combination	0.18	0.14	297.52	0	0	0
23	304	Combination	-0.16	-0.02943	540.41	0	0	0
27	101	Combination	0.0636	0.4	1921.71	0	0	0
27	201	Combination	0.23	-0.5	1590.48	0	0	0
27	202	Combination	-0.11	1.11	1676.43	0	0	0
27	203	Combination	0.26	-1.06	480.78	0	0	0
27	204	Combination	-0.2	1.09	595.37	0	0	0
27	301	Combination	0.18	-0.17	1545.47	0	0	0
27	302	Combination	-0.11	1.11	1676.43	0	0	0
27	303	Combination	0.19	-0.63	420.76	0	0	0
27	304	Combination	-0.14	0.65	655.39	0	0	0
28	101	Combination	275.38	-38.24	3007.88	0	0	0
28	201	Combination	146.1	-36.17	2502.49	0	0	0
28	202	Combination	322.09	-35.64	2640.15	0	0	0
28	203	Combination	-40.15	-20.57	791.39	0	0	0
28	204	Combination	194.51	-19.86	974.93	0	0	0
28	301	Combination	235.52	-143.49	2562.05	0	0	0
28	302	Combination	322.09	-35.64	2640.15	0	0	0
28	303	Combination	79.08	-163.66	870.8	0	0	0
28	304	Combination	75.28	123.23	895.52	0	0	0

TABLE: Joint Reactions								
Joint	OutputCase	CaseType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm
32	101	Combination	-266.86	-28.79	2565.76	0	0	0
32	201	Combination	-299.16	-23.87	2382.4	0	0	0
32	202	Combination	-154.28	-29.48	2147.98	0	0	0
32	203	Combination	-171.01	-10.48	1110.72	0	0	0
32	204	Combination	22.17	-17.96	798.15	0	0	0
32	301	Combination	-225.64	-111.29	2256.16	0	0	0
32	302	Combination	-154.28	-29.48	2147.98	0	0	0
32	303	Combination	-72.98	-127.05	942.4	0	0	0
32	304	Combination	-75.86	98.61	966.47	0	0	0
35	101	Combination	77.54	-42.51	3633.14	0	0	0
35	201	Combination	24.62	-41.5	3180.11	0	0	0
35	202	Combination	107.27	-38.2	3432.82	0	0	0
35	203	Combination	-33.28	-24.5	1460.05	0	0	0
35	204	Combination	76.91	-20.1	1796.99	0	0	0
35	301	Combination	66.66	-144.58	3544.62	0	0	0
35	302	Combination	107.27	-38.2	3432.82	0	0	0
35	303	Combination	22.76	-161.95	1946.06	0	0	0
35	304	Combination	20.87	117.34	1310.98	0	0	0
39	101	Combination	-57.34	-88.18	4943.2	0	0	0
39	201	Combination	-147.17	-78.5	3782.14	0	0	0
39	202	Combination	49.2	-77.65	4735.15	0	0	0
39	203	Combination	-147.66	-34	908.15	0	0	0
39	204	Combination	114.18	-32.88	2178.82	0	0	0
39	301	Combination	-49.16	-179.56	4494.15	0	0	0
39	302	Combination	49.2	-77.65	4735.15	0	0	0
39	303	Combination	-16.97	-168.74	1857.49	0	0	0
39	304	Combination	-16.5	101.87	1229.48	0	0	0
40	101	Combination	188.72	-35.46	5722.95	0	0	0
40	201	Combination	39.83	-32.96	5279.25	0	0	0
40	202	Combination	280.88	-33.69	4549.35	0	0	0
40	203	Combination	-108.01	-18.36	2228.44	0	0	0
40	204	Combination	213.38	-19.33	1255.24	0	0	0
40	301	Combination	160.05	-137.34	5209.84	0	0	0
40	302	Combination	280.88	-33.69	4549.35	0	0	0
40	303	Combination	52.28	-157.53	2135.9	0	0	0
40	304	Combination	53.1	119.84	1347.78	0	0	0
44	101	Combination	-232.12	-18.2	4394.87	0	0	0
44	201	Combination	-255.43	-15.99	4139.59	0	0	0
44	202	Combination	-138.67	-18	3680.68	0	0	0
44	203	Combination	-142.13	-8.03	2025.09	0	0	0
44	204	Combination	13.56	-10.72	1413.21	0	0	0
44	301	Combination	-197.49	-98.79	4143.06	0	0	0
44	302	Combination	-138.67	-18	3680.68	0	0	0
44	303	Combination	-64.87	-118.43	2029.71	0	0	0
44	304	Combination	-63.7	99.68	1408.58	0	0	0

TABLE: Joint Reactions								
Joint	OutputCase	CaseType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm
47	101	Combination	-0.43	-0.36	1404.2	0	0	0
47	201	Combination	-1.5	0.31	1246.95	0	0	0
47	202	Combination	0.76	-0.89	1241.01	0	0	0
47	203	Combination	-1.65	0.76	538.27	0	0	0
47	204	Combination	1.37	-0.85	530.35	0	0	0
47	301	Combination	-0.55	-0.23	1248.32	0	0	0
47	302	Combination	0.76	-0.89	1241.01	0	0	0
47	303	Combination	-0.37	0.02832	540.1	0	0	0
47	304	Combination	0.09353	-0.11	528.51	0	0	0
51	101	Combination	-0.007587	-0.29	2433.06	0	0	0
51	201	Combination	-0.09396	-0.9	2019.52	0	0	0
51	202	Combination	0.07422	0.34	2114.88	0	0	0
51	203	Combination	-0.12	-1	615.15	0	0	0
51	204	Combination	0.1	0.65	742.3	0	0	0
51	301	Combination	-0.0874	-0.76	2071.08	0	0	0
51	302	Combination	0.07422	0.34	2114.88	0	0	0
51	303	Combination	-0.12	-0.81	683.9	0	0	0
51	304	Combination	0.09167	0.46	673.55	0	0	0
52	101	Combination	337.58	-59.05	2907	0	0	0
52	201	Combination	186.03	-54.57	2411.41	0	0	0
52	202	Combination	386.7	-52.68	2564.89	0	0	0
52	203	Combination	-40.87	-27.39	759.8	0	0	0
52	204	Combination	226.69	-24.88	964.44	0	0	0
52	301	Combination	285.9	-158.97	2470.39	0	0	0
52	302	Combination	386.7	-52.68	2564.89	0	0	0
52	303	Combination	92.3	-166.59	838.44	0	0	0
52	304	Combination	93.52	114.32	885.8	0	0	0
56	101	Combination	-326.45	-30.89	3179.28	0	0	0
56	201	Combination	-359.13	-27.43	2935.48	0	0	0
56	202	Combination	-194.73	-29.84	2671.26	0	0	0
56	203	Combination	-199.44	-13.71	1349.1	0	0	0
56	204	Combination	19.76	-16.92	996.81	0	0	0
56	301	Combination	-277.22	-110.75	2800.86	0	0	0
56	302	Combination	-194.73	-29.84	2671.26	0	0	0
56	303	Combination	-90.23	-124.8	1169.6	0	0	0
56	304	Combination	-89.45	94.17	1176.31	0	0	0
59	101	Combination	242.58	-54.98	4552.45	0	0	0
59	201	Combination	123.48	-50.08	3868.99	0	0	0
59	202	Combination	288.24	-55.31	4289.93	0	0	0
59	203	Combination	-42.84	-28.61	1581.72	0	0	0
59	204	Combination	176.84	-35.58	2142.97	0	0	0
59	301	Combination	205.57	-157.14	3917.96	0	0	0
59	302	Combination	288.24	-55.31	4289.93	0	0	0
59	303	Combination	66.61	-171.36	1647.01	0	0	0
59	304	Combination	67.4	107.16	2077.68	0	0	0
63	101	Combination	-125.32	-22.29	5007.19	0	0	0
63	201	Combination	-235.39	-24.61	4125.81	0	0	0
63	202	Combination	22.96	-21.63	4493.58	0	0	0
63	203	Combination	-206.47	-19.9	1306.86	0	0	0
63	204	Combination	138	-15.93	1797.22	0	0	0
63	301	Combination	-106.76	-125.39	4152.86	0	0	0
63	302	Combination	22.96	-21.63	4493.58	0	0	0
63	303	Combination	-34.95	-154.28	1342.92	0	0	0
63	304	Combination	-33.51	118.45	1761.15	0	0	0

TABLE: Joint Reactions								
Joint	OutputCase	CaseType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm
65	101	Combination	223.16	48.27	6475.09	0	0	0
65	201	Combination	59.75	38.1	5728.91	0	0	0
65	202	Combination	317.93	38	5376.29	0	0	0
65	203	Combination	-111.99	5.23	2184.68	0	0	0
65	204	Combination	232.25	5.1	1714.52	0	0	0
65	301	Combination	188.33	-56.09	5616.22	0	0	0
65	302	Combination	317.93	38	5376.29	0	0	0
65	303	Combination	59.44	-120.35	2034.42	0	0	0
65	304	Combination	60.82	130.68	1864.78	0	0	0
69	101	Combination	-253.66	-29.75	4981.48	0	0	0
69	201	Combination	-297.51	-26.81	4627.29	0	0	0
69	202	Combination	-132.43	-27.92	4208.42	0	0	0
69	203	Combination	-179.28	-13.41	2188.15	0	0	0
69	204	Combination	40.82	-14.89	1629.65	0	0	0
69	301	Combination	-215.52	-106.3	4387.16	0	0	0
69	302	Combination	-132.43	-27.92	4208.42	0	0	0
69	303	Combination	-69.96	-119.39	1867.97	0	0	0
69	304	Combination	-68.5	91.09	1949.83	0	0	0
70	101	Combination	347.02	-64.93	3015.93	0	0	0
70	201	Combination	211.14	-57.63	2519.6	0	0	0
70	202	Combination	377.44	-62.46	2782.33	0	0	0
70	203	Combination	-15.58	-28.53	914.1	0	0	0
70	204	Combination	206.15	-34.98	1264.41	0	0	0
70	301	Combination	293.71	-184.09	2582.19	0	0	0
70	302	Combination	377.44	-62.46	2782.33	0	0	0
70	303	Combination	94.5	-197.15	997.55	0	0	0
70	304	Combination	96.06	133.64	1180.96	0	0	0
74	101	Combination	-122.64	-52.95	4087.95	0	0	0
74	201	Combination	-218.29	-50.78	3557.64	0	0	0
74	202	Combination	10.06	-48.43	3396.46	0	0	0
74	203	Combination	-186.2	-29.25	1258.48	0	0	0
74	204	Combination	118.26	-26.12	1043.57	0	0	0
74	301	Combination	-107.44	-170.93	3402.49	0	0	0
74	302	Combination	10.06	-48.43	3396.46	0	0	0
74	303	Combination	-38.41	-189.45	1051.63	0	0	0
74	304	Combination	-29.53	134.08	1250.43	0	0	0
76	101	Combination	0.8	0.29	1851.64	0	0	0
76	201	Combination	1.81	0.98	1563.43	0	0	0
76	202	Combination	-0.4	-0.43	1569.95	0	0	0
76	203	Combination	1.77	1.1	493.92	0	0	0
76	204	Combination	-1.19	-0.78	502.62	0	0	0
76	301	Combination	0.97	0.68	1527.97	0	0	0
76	302	Combination	-0.4	-0.43	1569.95	0	0	0
76	303	Combination	0.65	0.7	446.65	0	0	0
76	304	Combination	-0.06695	-0.39	549.89	0	0	0
80	101	Combination	-423.26	-39.87	3328.46	0	0	0
80	201	Combination	-421.81	-39.08	2984.69	0	0	0
80	202	Combination	-296.43	-34.33	2861.97	0	0	0
80	203	Combination	-200.29	-22.21	1277.36	0	0	0
80	204	Combination	-33.12	-15.88	1113.74	0	0	0
80	301	Combination	-357.85	-123.23	2858.14	0	0	0
80	302	Combination	-296.43	-34.33	2861.97	0	0	0
80	303	Combination	-115	-134.41	1108.63	0	0	0
80	304	Combination	-118.41	96.32	1282.48	0	0	0

TABLE: Joint Reactions								
Joint	OutputCase	CaseType	F1	F2	F3	M1	M2	M3
Text	Text	Text	Kgf	Kgf	Kgf	Kgf-mm	Kgf-mm	Kgf-mm
81	101	Combination	188.28	118.26	4398.78	0	0	0
81	201	Combination	74.45	106.03	3835.41	0	0	0
81	202	Combination	257.96	117.92	4154.09	0	0	0
81	203	Combination	-52.35	57.26	1735.4	0	0	0
81	204	Combination	192.34	73.12	2160.3	0	0	0
81	301	Combination	162.2	19.82	4249.47	0	0	0
81	302	Combination	257.96	117.92	4154.09	0	0	0
81	303	Combination	64.65	-57.69	2287.47	0	0	0
81	304	Combination	75.34	188.07	1608.23	0	0	0
85	101	Combination	-82.86	178.89	5284.11	0	0	0
85	201	Combination	-205.95	164.29	4515.84	0	0	0
85	202	Combination	55.99	170.77	4830.78	0	0	0
85	203	Combination	-210.58	89.08	1778.69	0	0	0
85	204	Combination	138.67	97.73	2198.61	0	0	0
85	301	Combination	-80.63	78.11	4917.86	0	0	0
85	302	Combination	55.99	170.77	4830.78	0	0	0
85	303	Combination	-43.48	-25.82	2314.71	0	0	0
85	304	Combination	-28.43	212.63	1662.59	0	0	0
87	101	Combination	132.29	77.18	5946.94	0	0	0
87	201	Combination	-15.19	83.45	5383.88	0	0	0
87	202	Combination	247.57	80.39	5078.13	0	0	0
87	203	Combination	-127.65	69.33	2362.05	0	0	0
87	204	Combination	222.7	65.25	1954.39	0	0	0
87	301	Combination	110.8	13.14	5348.31	0	0	0
87	302	Combination	247.57	80.39	5078.13	0	0	0
87	303	Combination	40.33	-24.42	2314.64	0	0	0
87	304	Combination	54.71	159.01	2001.8	0	0	0
91	101	Combination	-154.83	137.02	4277.53	0	0	0
91	201	Combination	-230.34	136.22	4041.9	0	0	0
91	202	Combination	-46.45	121.59	3723.64	0	0	0
91	203	Combination	-184.97	82.94	2101.12	0	0	0
91	204	Combination	60.22	63.43	1676.76	0	0	0
91	301	Combination	-143.02	68.08	4071.1	0	0	0
91	302	Combination	-46.45	121.59	3723.64	0	0	0
91	303	Combination	-68.53	-7.91	2140.04	0	0	0
91	304	Combination	-56.21	154.28	1637.84	0	0	0

In the previous list, the maximum vertical force is 6475kgf and uplift force is 111kgf. The uplift force does not include the footing base. After considering the footing weight (near 70kgf), the uplift force is reduced to 41kgf. It is too small and can be ignored. Therefore, we only consider the maximum compressive force 6475kgf for footing design.

(A) Axial Capacity Check

The M40 screw bar is 300mm long and its both ends (100mm in length) are constrained in a series of stiffness plates. Therefore, its axial allowable compressive load is $0.6F_y \times A_b$ = 18.85tf. It is quite enough to resist the above-mentioned force, 6429kgf.

(B) Soil bearing check

The allowable soil bearing stress is $4tf/m^2$ for short term loading in site. Therefore, the footing plate size 60x60cm is not enough, so sandbox in size of 120x120cm will adopted under the footing plate with 12cm THK. Then the soil bearing, $6.429/((1.2+0.12*2)x(1.2+0.12*2))= 3.1\ tf/m^2$, is less than the allowable soil bearing stress.