PROJECT MANUAL

Deliverable #3
November 1st, 2013

NCTUNICODE

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National Chiao Tung University

Solar Decathlon Europe

ORCHID HOUSE

SUMMARY OF CHANGES

ITEM	STATUS	DATE
COVER SHEET	UPDATED	NOV 1, 2013
SUMMARY OF CHANGES	UPDATED	NOV 1, 2013
TABLE OF CONTENTS	UPDATED	NOV 1, 2013
RULES AND BUILDING CODE COMPLIANCE CHECKLIST	UPDATED	NOV 1, 2013
CONTEST SUPPORT DOCUMENTS	UPDATED	NOV 1, 2013
Urban Design, Transportation and Affordability Report	UPDATED	NOV 1, 2013
Architecture Design Narrative	UPDATED	NOV 1, 2013
Engineering and Construction Design Narrative	UPDATED	NOV 1, 2013
Energy Efficiency Design Narrative	UPDATED	NOV 1, 2013
Innovation Report	UPDATED	NOV 1, 2013
Sustainability Report	UPDATED	NOV 1, 2013
Communications Plan	UPDATED	NOV 1, 2013
DINNER PARTY MENU	UPDATED	NOV 1, 2013
CONTEST WEEK TASKS’ PLANNING	UPDATED	NOV 1, 2013
COST ESTIMATE AND PROJECT FINANCIAL SUMMARY	UPDATED	NOV 1, 2013
SITE OPERATION REPORT	UPDATED	NOV 1, 2013
HEALTH & SAFETY PLAN	UPDATED	NOV 1, 2013
DETAILED WATER BUDGET	UPDATED	NOV 1, 2013
ELECTRIC AND PV DESIGN SYSTEMS INFORMATION	UPDATED	NOV 1, 2013
CONSTRUCTION SPECIFICATIONS	UPDATED	NOV 1, 2013
STRUCTURAL CALCULATIONS	UPDATED	NOV 1, 2013

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RULES 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 27
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	N/A
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
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
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	N/A
6.1 Electrical and Photovoltaic Design Approval	Electrical and Photovoltaic drawings and calculations signed and stamped by a qualified licensed professional	N/A
6.1 Codes Design Compliance	List of the country of origin codes complied, properly signed by the faculty advisor	N/A
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: Page 265
7.4 Batteries	Drawing(s) showing the location(s) and quantity of stand-alone, PV-powered devices and corresponding specifications	PD: EL-401
7.4 Batteries	Drawing(s) showing the location(s) and quantity of hard-wired battery banks components and corresponding specifications	PD: AR-051 PR: Page 289
7.6 Thermal Energy Storage	Drawing(s) showing the location of thermal energy storage components and corresponding specifications	PD: ME-001
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	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)	N/A
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).	N/A

8.5 Grey water reuse	Specifications for grey water reuse systems	N/A
8.6 Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	N/A
8.8 Thermal Mass	Drawing(s) showing the locations of water-based thermal mass systems and corresponding specifications	PD: AR-051, AR-114
8.9 Grey Water Heat Recovery	Specifications for grey water heat recovery systems.	N/A
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	N/A
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: Page 170
11.3 Teams' sponsors & Supporting Institutions	Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage	PM: Page 170
11.4 Team Uniforms	Drawing(s) showing the artwork, content and design of the team uniform	PM: Page 171
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
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
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: Page 265, 279
36.5 Photovoltaic systems design	Inverters' certificates	PM: Page 291, 292
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: Page 142, 144
36.5 Photovoltaic systems design	The corresponding table "design summary" must be filled out	PM: Page 250
51.3 Fire Safety	Specifications for Fire Reaction of Constructive elements, extinguishers and fire resistance of the house's structure.	N/A
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	N/A
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	N/A
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: Page 293

51.7 Electrical and PV Systems	Complete the "Electrical System Design PV Chart and Checklist" Rule 48.	PM: Page 251
51.7 Electrical and PV Systems	Specifications of the wiring, channels, panels and protections of the electrical installation	PM: Page 279
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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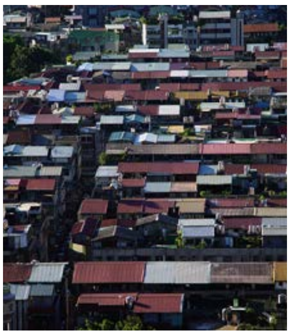
URBAN DESIGN, TRANSPORTATION AND AFFORDABILITY REPORT

1.0 Urban Design Strategy

Taiwan is a small, developed island country located on the Tropic of Cancer and mainly mountainous. Most of the 22 million people of Taiwan live along the coast and as a result, urban areas such as the capital city, Taipei, have extremely high population densities. With 9,753 people per square kilometer, ranking top 10 in the world.

Taipei is facing increasing population and over saturated traffic, and the infrastructure which was implemented 20 years ago, is no longer valid. Cars and motorcycle take over most of the street, leaving no place of the pedestrians and bike riders. To improve the city of Taipei, NCTU/UNICODE have designed an urban regeneration plan, with extensive research about the city's growth, the market, the infrastructure, and potential users. In year 2002 the Taiwanese government have begun with the "old building renewal plan" by promoting the redesign of old buildings, with the €250,000 support from the city. However, it has not yet been effective due to the strict rules during qualification check. Also, the surfacing treatment does not solve the basic problems of old utilities and equipment.



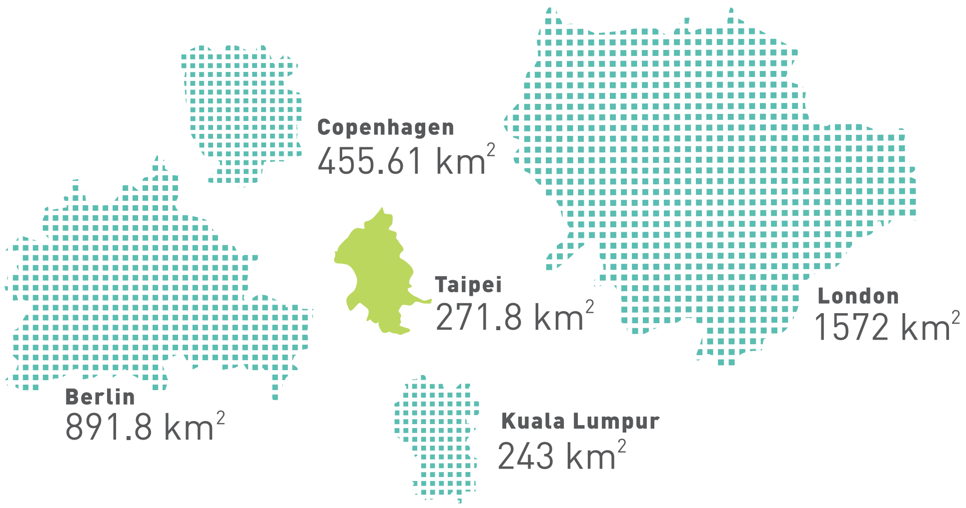


Figure 1.0.1: Comparison of capital areas in major cities in the world

This is also a great opportunity to reconsider the possible development of our solar house to a new type of Taiwanese social housing system. At the present moment, Taiwan's social housing situation is in sore need of improvement. Because much of Taiwan's land is not easily developed, most of the 23.31 million people of Taiwan live close to the coasts rather than in the mountains, which take up around two thirds of the island's land mass. With such high population density – in Taipei, the capitol of Taiwan, population density in separate districts range from 4,600 to 27,600 – the solution the Taiwanese people use is to build upwards. Many families have row houses three to four stories tall that take up very little horizontal space. The other most common form of housing is the duplex apartment that also extends vertically to maximize the number of families that can inhabit the apartment. Despite the solutions to conserve space, there are still a number of people who require but cannot afford better homes. The social housing system is partly to blame, as it only takes up 0.8% of the total houses in Taiwan, com¬pared to 6.06% in Japan, 6.2% in the USA, and 9.7% in Korea.

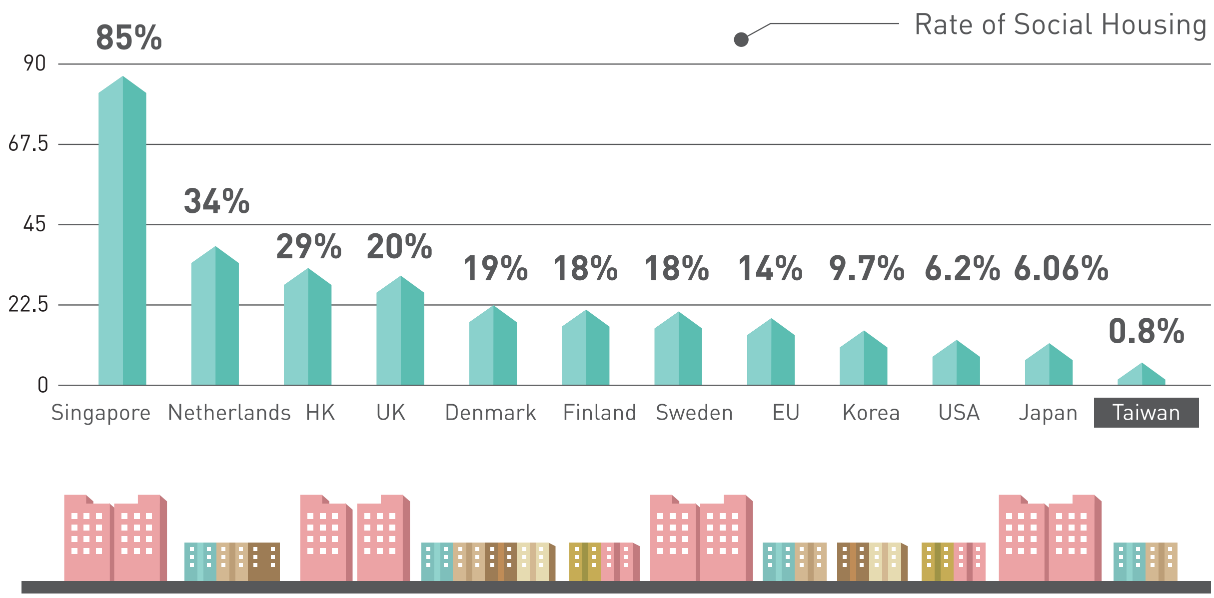


Figure 1.0.2: Comparison of social housing percentage in the world

Our goal is to revamp the social housing system of Taiwan and integrate more eco-friendly buildings in the process. As one of the aspects of environmental architecture is to disturb the surroundings as little as possible, one of the things we hope to accomplish is to create a design that causes minimal disturbance and even contributes aesthetically to its surroundings. Our solution is to build on top of existing buildings – specifically, the row houses and duplex apartments that are extremely common in Taipei.

Besides additional living space, some people also use the rooftop extensions to grow plants. This inspired us to design a house that allows living, socializing, and plant cultivation. We used the orchid plant, which flourishes in the tropical forests of Taiwan, as a model to find the perfect balance of sunlight and rainwater for our house.

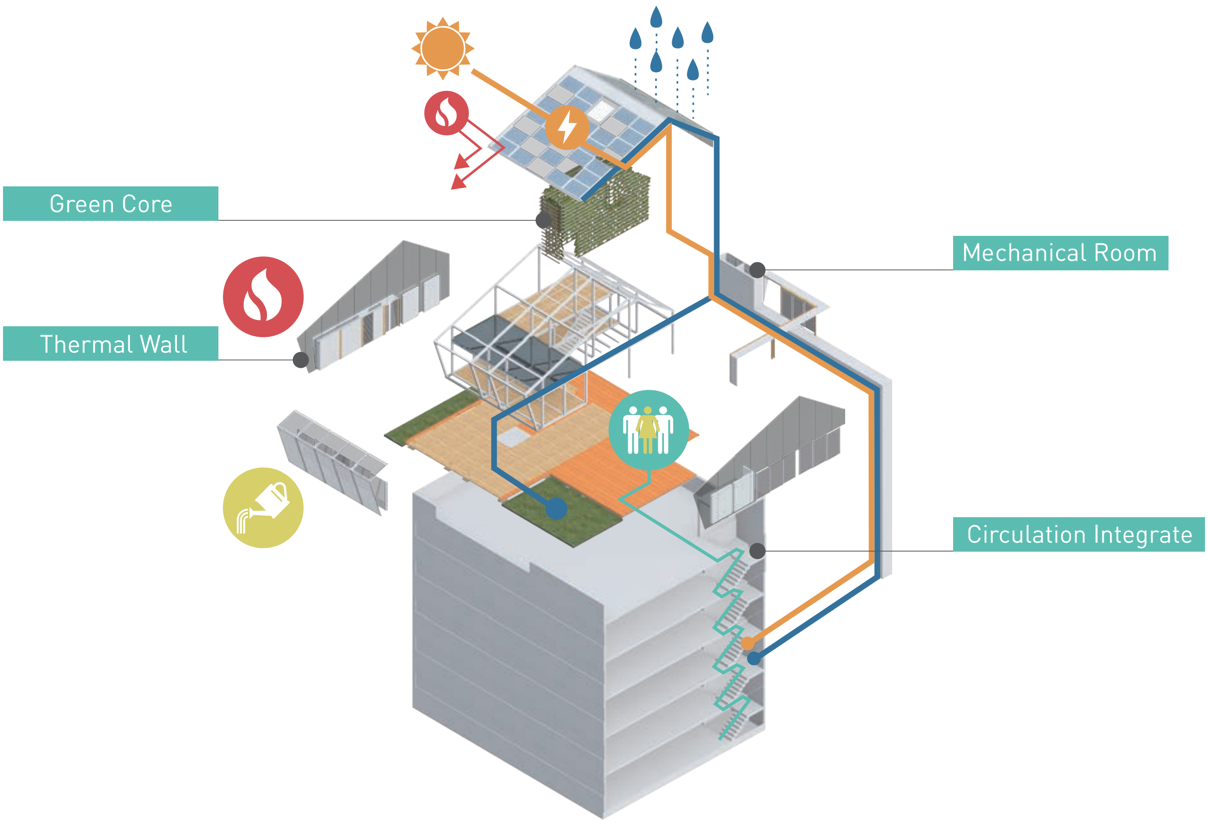


Figure 1.0.3 Rooftop application

Rather than taking down the 30-year-old existing apartment and make more high-rise buildings to accommodate the population density, we believe there is a chance to change the urban condition while keeping the existing city fabric. First, we want to implement the Orchid House, which collect sun energy, recycle rain water integrate existing structural on the rooftop. The benefits from above is then shared by the residents underneath, while the extra electricity goes back the city grid, making more profit for the residents. Next, each Orchid House becomes a "house keeper", which is an information center with sensor stations. It gathers data concerning the city, such as air quality and light pollution, and these "house keeper" can then turn into a "city keeper", and link the information nation-wide. Also, the new EV charging station will be installed on the ground level for each unit.

On top of increasing the social housing unit, the influence on the existing city fabric is immense. With the new and improved system, the old building "reborn" into new building types, with additional vertical circulation and maintenance system. During the process of urban regeneration, residents can have the Orchid House as a sustainable alternative. Instead of developers taking down people's homes to build new towers, we want to preserve the beautiful culture of its original neighborhood. This way, the citizens will also be keen to change, for the better.

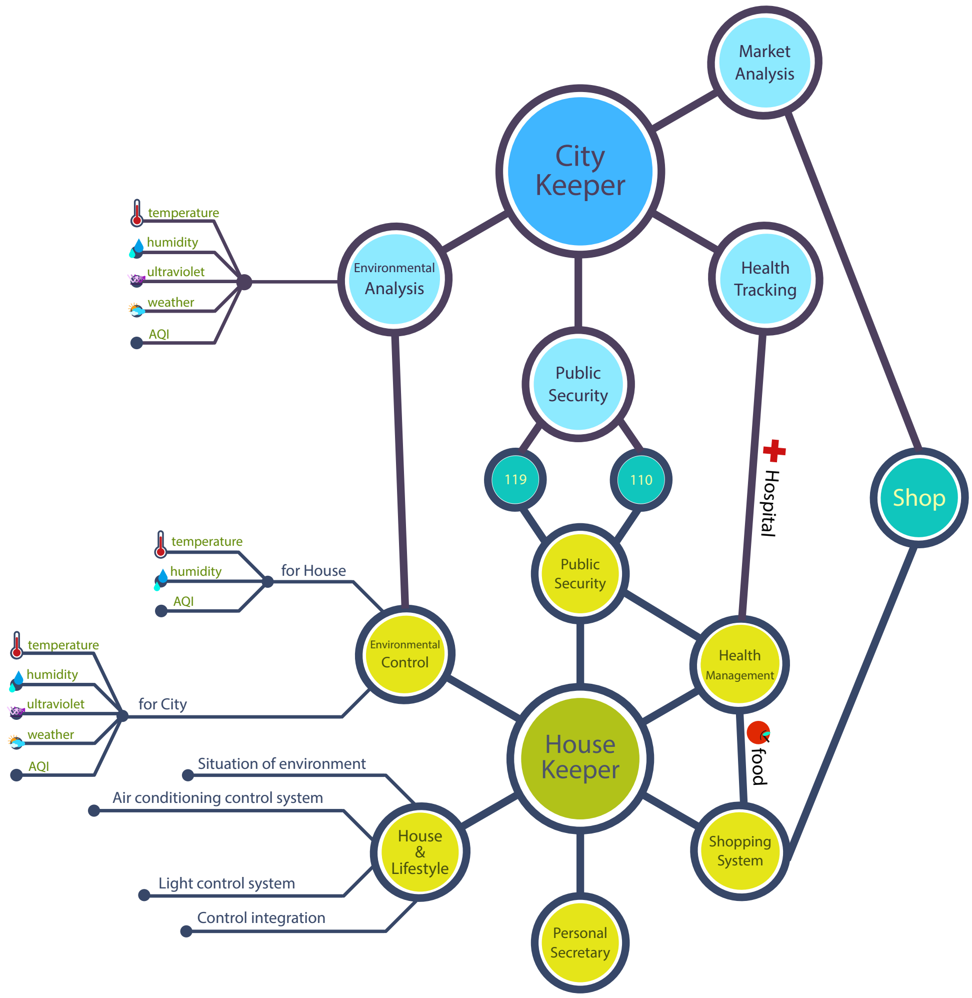


Diagram 1.0.4: House keeper and City keeper system diagram

2.0 Market Viability

2.1 Market

Tenant

The Orchid House is an affordable solution for young professionals, whom seeks more opportunity in the capital city, without much funding to begin with. The average annual housing price of Taipei is €6,184 per m², and an average 2 people family live in a unit around 50m2. Therefore, each house is about €300,000 in the current market. Orchid house provides a new solu¬tion to the overly expensive housing market. In order to have a better understanding of our potential users and create an affordable housing module, it is important to initiate a market study that covers the average family income per household and average housing price in Taiwan.

Economical Aspects

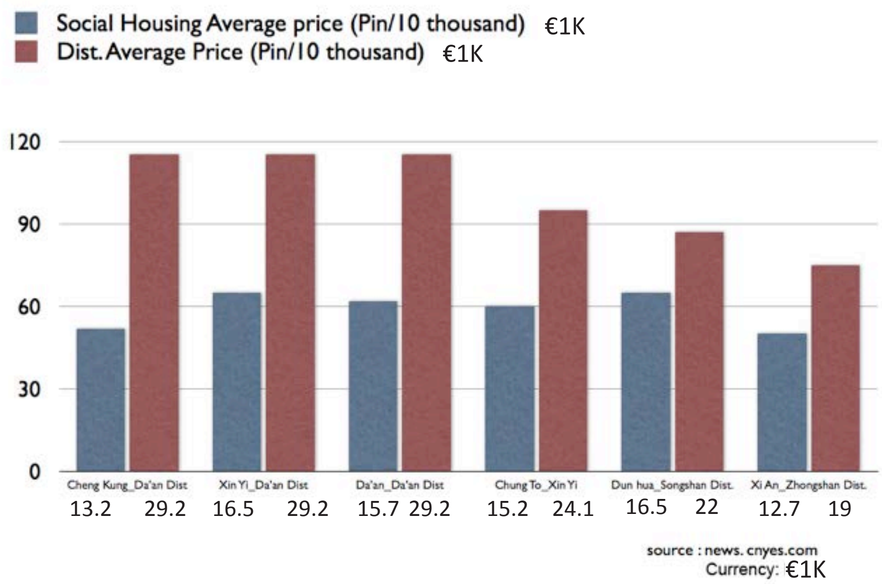


Figure 2.1.1: Comparison of Social Housing and Average Housing in different districts in Taipei city per pin (Unit:€1K)

Age

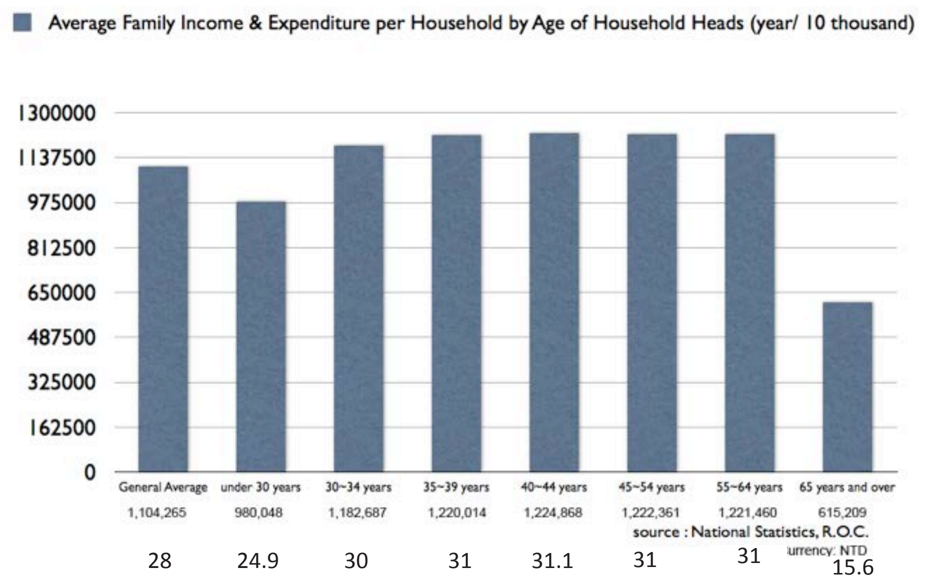


Figure 2.1.2: Average family annual income per household by age of household head (Unit:€1K)

Location

Taiwanese have dealt with the lack of space by expanding upward, rather than spreading horizontally. Therefore, these rooftops are the opportunity to spur urban regeneration. Our goal is to propose a smarter solution for future Taiwan. Orchid House will provide a sustainable solution in terms of reducing heat island effect and storm water, on top of harvesting energy and water. In the diagram below, we chose the row houses and duplex apartments, which consists of 50% of all buildings and have usable rooftops. By focusing on these 2 types of roof¬tops, we plan to generate a considerable amount of energy and rainwater with sustainable technologies.

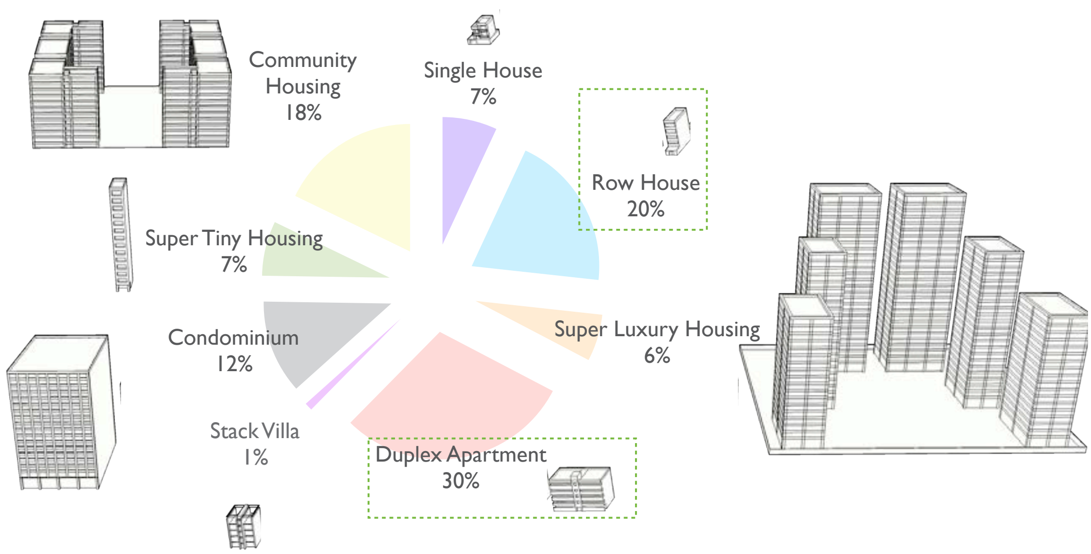


Figure 2.1.3 8 types according to the construction

2.2 Target Market

The Orchid House is designed for a working couple to live and work in the house. Since the real estate value in Taipei is extremely high, renting the Orchid House becomes an alternative option which younger generation prefers. It also reduce the commuting expensive in a high density area. The intension of our team is to design a single dwelling prototype, which can be easily developed into a large scale of collective public housing.
Under this condition, our target market identification is as the following:

• Geographical market: high density cities, Taipei
• Housing Configuration: one living room, one kitchen/dining, one bedroom, additional working space on the mezzanine
• Occupant: 2 adults. If having children, can consider the duplex configuration
• Household annual income: €30,000-€50,000

2.3 Appealing Characteristics

The Orchid House a new housing prototype, which turns the illegal additions on the rooftop into a usable living area, and gives back public space back to the tenants. All material and construction technique are carefully calculated so it can fit on the rooftop without adding too much deadload, and most of the components are made locally to reduce the carbon footprint during transportation. The innovative system of house keeper creates a smart living network, which is convenient and energy saving for modern living. The smart living system improves our living quality, use less energy, and it collects data through out the city.

Figure 2.3.1: Automated smart living system

The green core in the center of the unit serves as a buffer zone to moderate indoor and outdoor air, reducing the heating and cooling loads. With potted Orchids and other vegetations, we want to offer the tenant a vertical green space, as what the Taiwanese rooftops use to be.

Figure 2.3.2: Green core planting design concept

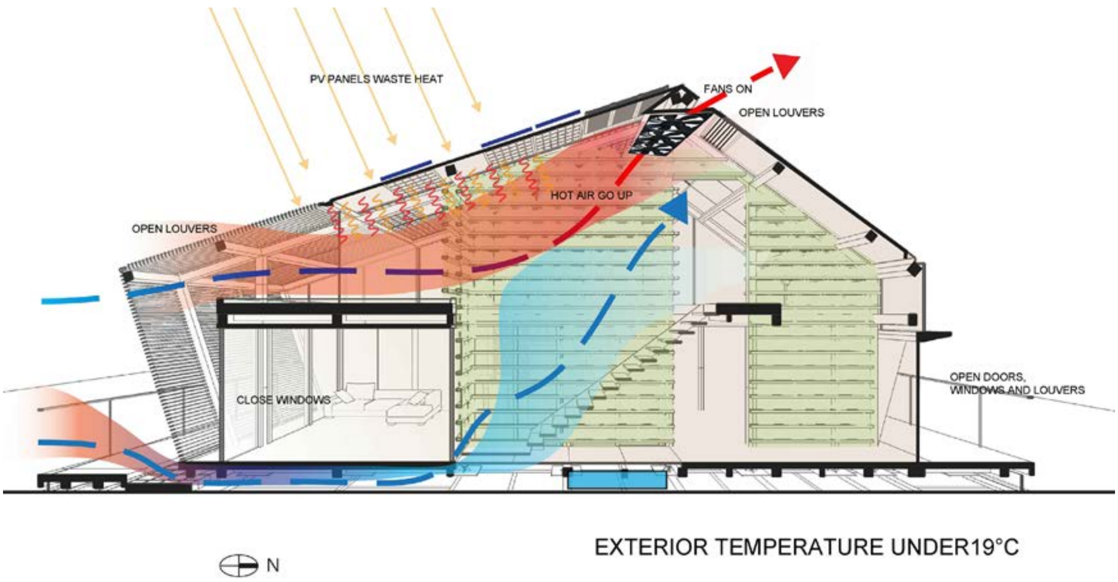


Diagram 2.3.3: Air flow within the semi-public area

Several architectural strategies also forms the building characteristics, including:

- Mezzanine – increase usable area
- Asian-inspired porch – allows natural ventilation and lighting
- Green core - architectural feature which serves both functionally and aesthetically

Since the unit design is flexible and can orient due to the sun, we can expect a non-uniform rooftop design across the city, and it will redefine the city's skyline. The water recycling system will help greatly on storm water run-off, and reduce the burden on city's sewage system. Therefore, the government can save large amount of money on flood control.

Figure 2.3.4: Future projection of urban regeneration

3.0 Individual or Collective housing building characteristics

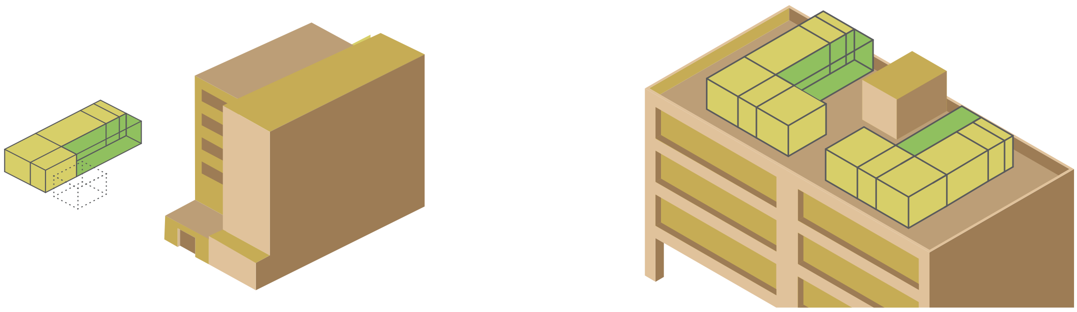


Diagram 3.0.1 Housing Configurations I shape row house vs L shape duplex aparment

In the city which has already over saturated population, we need to make space from existing conditions. These rooftops that we are targeting serves as a platform to create new from the old, and it will extend the life cycle of existing building to another 30 years.

On the narrow row houses, we will detach the protruding arm of the L-shaped house and transform it into an I shape. On the other hand, when applied to the larger duplex-apartment buildings, we will mirror the L house-module to make a C shape. The rectangular area within the C can be space for an extension of the building's elevator or it can act as a socializing space for all the occupants of the building.

The Orchid House in Taipei can have different variations, depending on the targeted tenant. Translucent PV panels can be integrated into the building façade to increase the power generation. More importantly, water tanks are incorporated under the solar house while the existing machines stored in the mechanical space, making the city's skyline much more pleasant. Our proposal is to preserve the city's image and keep people's memory to their homes, rather than destroying it to make new buildings.

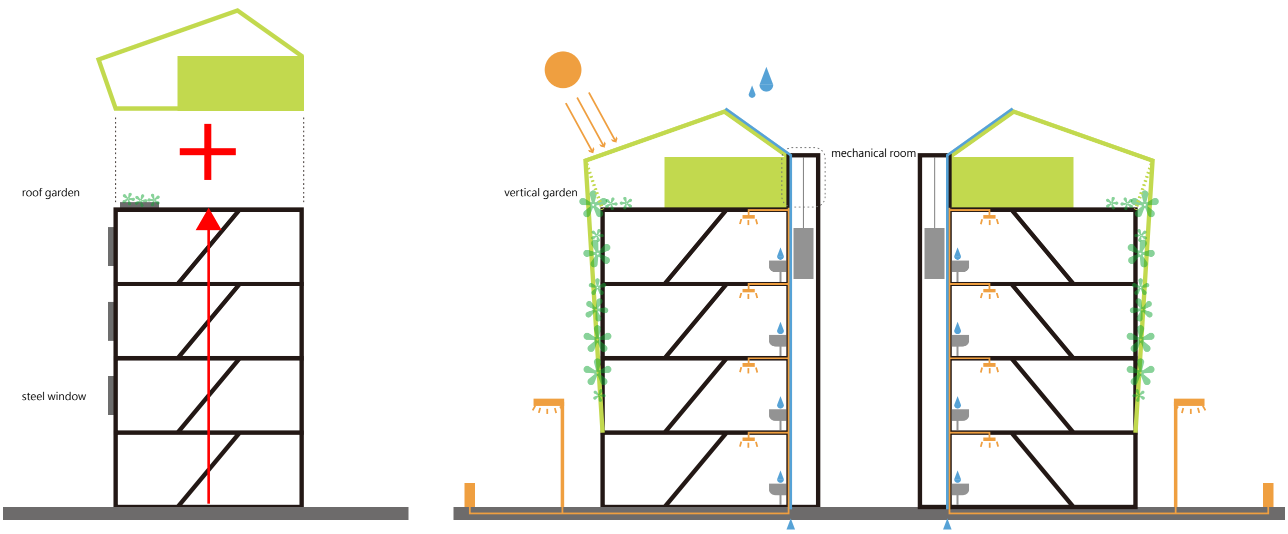
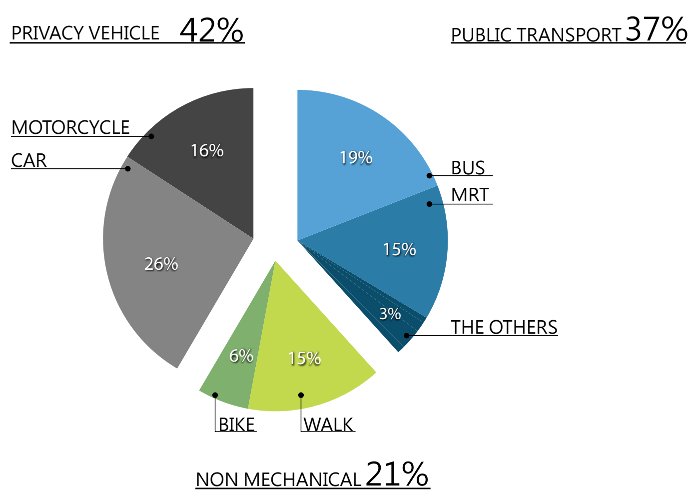


Diagram 3.0.2 Urban regeneration concept: revitalize existing structures

4.0 Transportation and Mobility Strategies

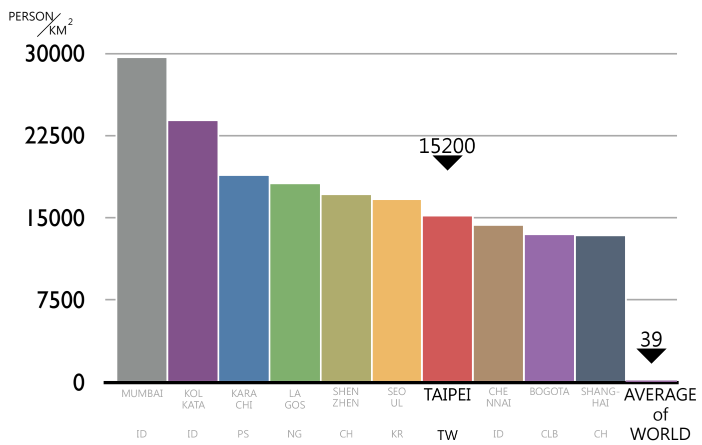
The increasing population density have resulted in the congestion in traffic. It is also a national issue, when single occupancy vehicle simply does not work. Taipei city government have provided the following public transportation systems such as:
Metro Rail Transit
Inter-city bus
UBike: public rental bicycle

TAIPEI TRAFFIC



TAIPEI DENSITY of POPULATION

NO.7 in the world



Although these infrastructure were implemented, it is still not enough to ease the traffic congestion. Taipei public transportation is takes up around 37.7% of all transportation systems. However, it is only 1/3 compare to Hong Kong, which is nearly 92%. By increase social housing units in the city, more people will live closer to work, and the commute time will be greatly reduced. Since using cars is unavoidable, we also want to make sure that green energy can help ease the usage of gasoline. With the Orchid House, we will introduce the EV charger, which promote using renewable energy rather than gasoline. Electric cars have a key advantage of regenerative braking and suspension, and it has the ability to recover energy during braking and store it in the battery. We expect each building can have 3 EV charger, which will reduce the total car CO2 emission in the city to 1/10.

Delta EV Charging station

Delta Charging Network Management System (CNMS)

Delta Charging Network Management System (CNMS):
Delta's CNMS is a smart and centralized management of electric vehicle charging network for multiple system integration capabilities and scalability.

This EV Charging Solutions contribute to a faster development of EV charging infrastructure and accelerate the adoption of EVs. The aim is, "To provide innovative, clean and energy-efficient solutions for a better tomorrow."

Source from: Delta Electric
http://www.deltaww.com/Solutions/CategoryListT1.aspx?CID=03&SID=4&hl=en-US&Name=EV%20Charging%20Solutions

5.0 Affordability

Social Housing Application
After extensive research and data gathering regarding to the rooftops, the 4-5 story apartments add up to be nearly half of the entire roof surface in Taipei. By making the Orchid House into social housing, we believe that our solar house can help mend the social housing system in a number of ways in addition to making the buildings of Taiwan more environmentally friendly without causing a large disturbance in the pre-existing structures. The projection shows that our social housing units can increase to around 12%. These rental units are much more affordable than typical units, and the rents will be shared by the residents in the building.

In consideration to the local context, our strategy to make the Orchid house affordable, is to divide the cost into 3 sectors:

- 30% from government. By having the country support partially, it will enhance the policy affect, and equalize the extreme real estate in Taiwan.
- 30% from resident. Several added benefit of owning Orchid House including having a better living environment and money saving in terms of energy and water, can further promote the idea sustain able living.
- 40% from ESCO. ESCO is a commercial or non-profit business providing a broad range of comprehen sive energy solutions including designs and implementation of energy savings projects. Using ESCO as a platform, the result is a better performing building along with all the public relations and marketing benefits of green buildings

With this division, each sector's financial responsibility is a lot less, thus both public and private sectors will be more willing to support the program. The implementation of renewable energy technologies and high efficiency systems throughout the house, results in the best return on the resident's initial investment. Our initial calculations shows that the return each month to the resident is about 200 euros, which is more than 10% of typical monthly salary of a working couple.

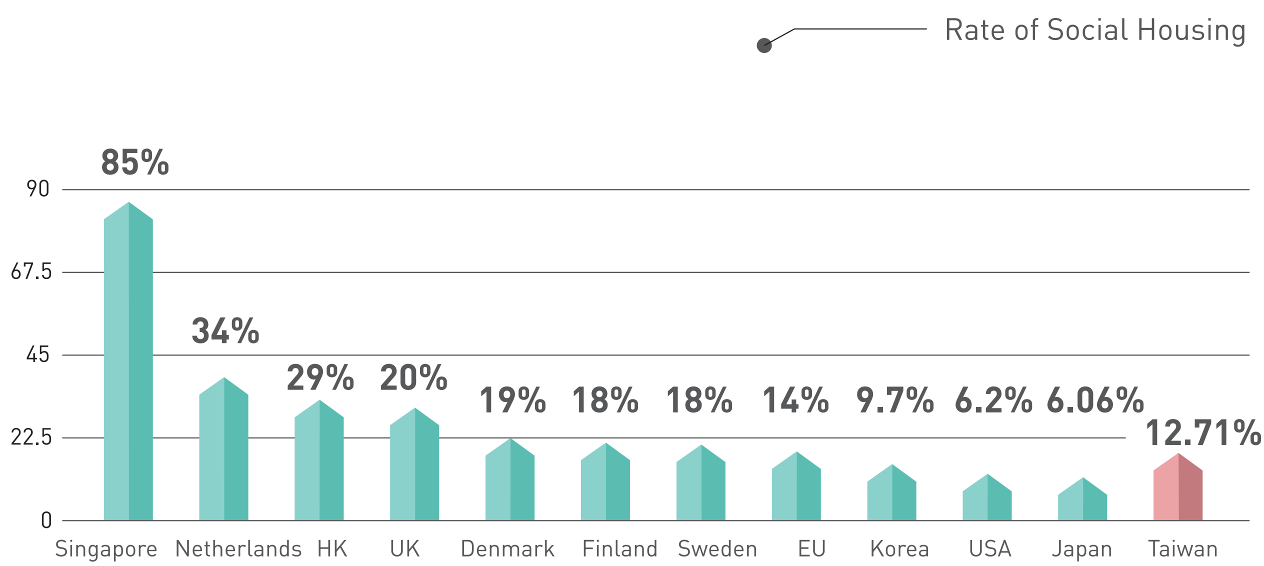


Figure 5.0.1 Rate of social housing comparison between countries

To reduce the cost of making, the manufacturing process of our house can be modularized and industrialized, which will reduce the work load of the construction workers and shorten the required construction time, ultimately resulting in a lower construction budget. The house will incorporate a water-filtering system as well as a thermal water system for the cooling and heating of units. The house will also be self-sustaining with electricity through the use of building integrated photovoltaic panels. A report that includes the data from Solar Decathlon Europe 2014 will be submitted as a proposal to the Ministry of the Interior of Taiwan after the completion of the project.

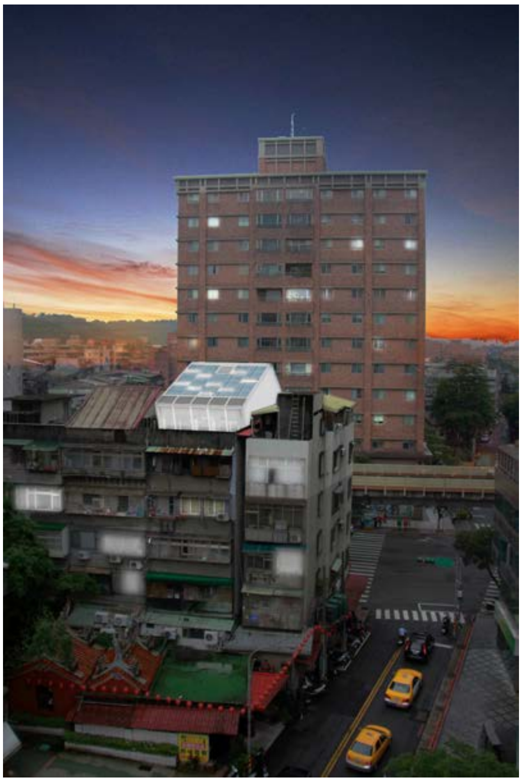


Figure 5.0.2 Rainwater collection and energy generation per year

1.0 Background

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.

Figure 1.0.1 Painting of orchid by Chang-shuo Wu

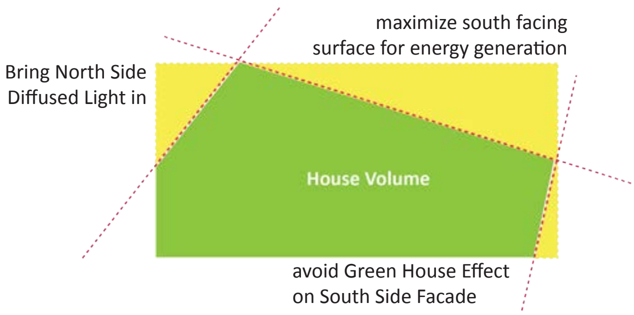
Figure 1.0.2 South West View at La Cité du Soleil®

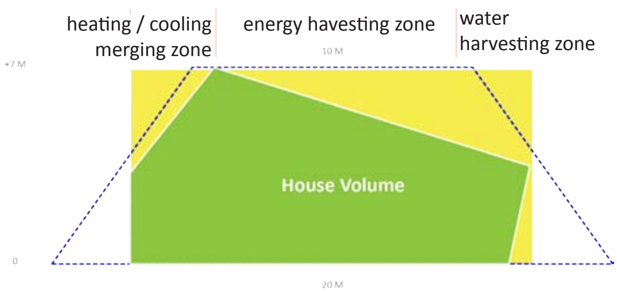
1.1 Massing Development

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 (52.92 m^2), surrounded by a larger envelope (133 m^2).





We have designed the house so that both sunlight and water are utilized to ensure optimal living conditions and minimal waste. Our house harnesses natural light not only to generate electric energy through the photovoltaic panels integrated on the roof, but also to regulate the internal temperatures of the house through a thermal mass wall. We also maximize water efficacy by using greenhouse cooling and drip irrigation systems. Lastly, the functions of sunlight and water intersect to provide heated water that can be used domestically as well as to regulate indoor temperatures when it is cold outside. The implementation of such systems will provide great benefit at little cost, as the lightweight structure of the house will allow for efficient construction and low budgets.

Figure 1.1.1 Orchid House Overview

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.

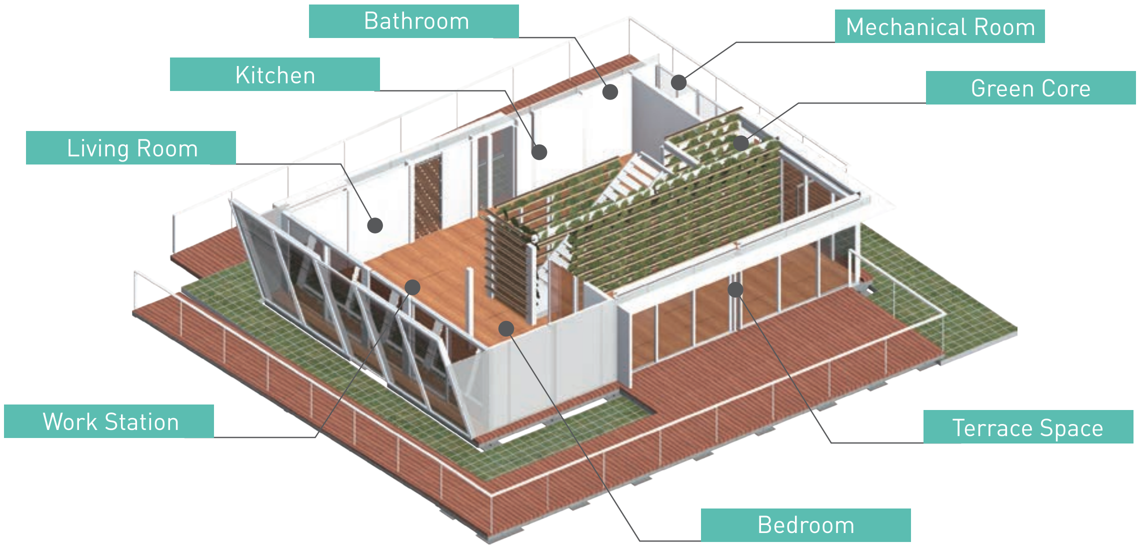
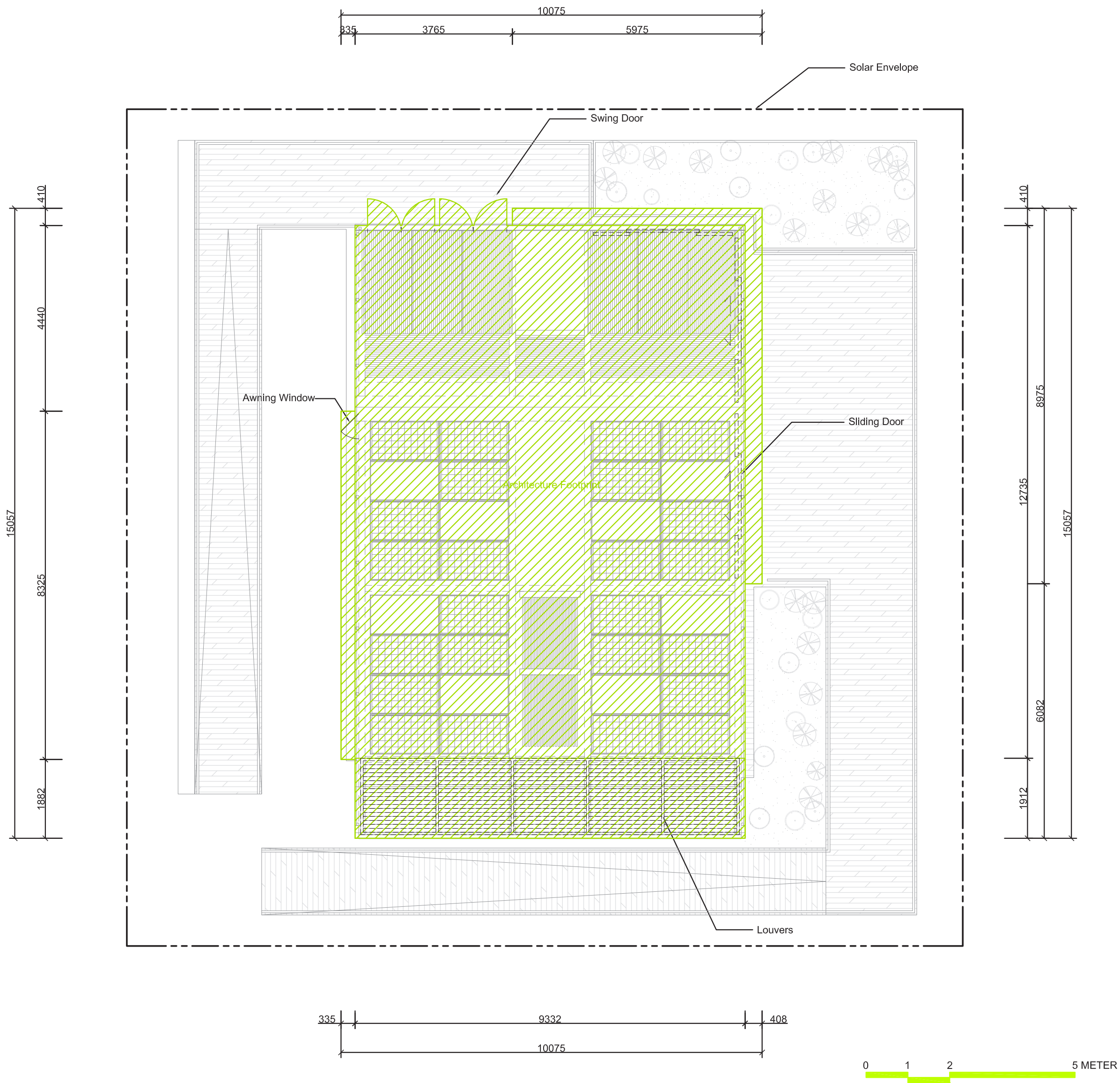


Figure 1.2.1 Orchid House Programming

Figure 1.2.2 Green Core View

2.0 Reconfigurable Features

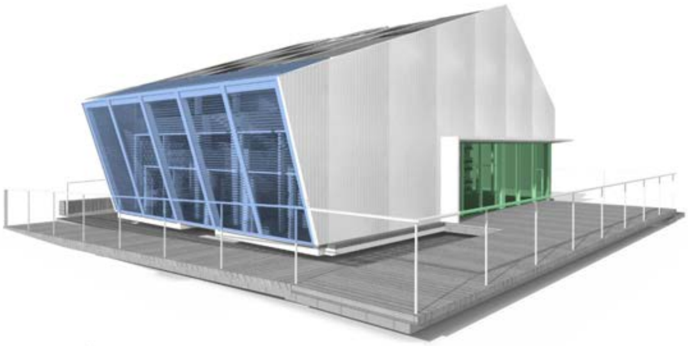
The façade of Orchid House is mostly covered by translucent Bayer Makrolon 40mm material to bring diffused natural light into the interior space. However, there are some portion of façade to be reconfigured with the passive design strategy .

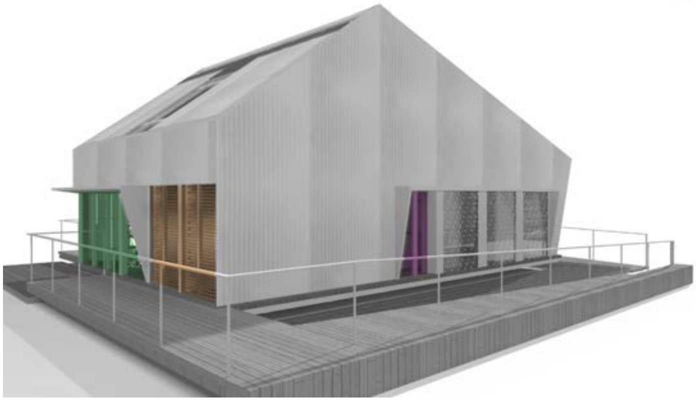


Footprint Calculation

House: 120.4 M^2
Canopy: 8.7 M^2
Louvers: 17.8 M^2

Total: 146.9 M^2

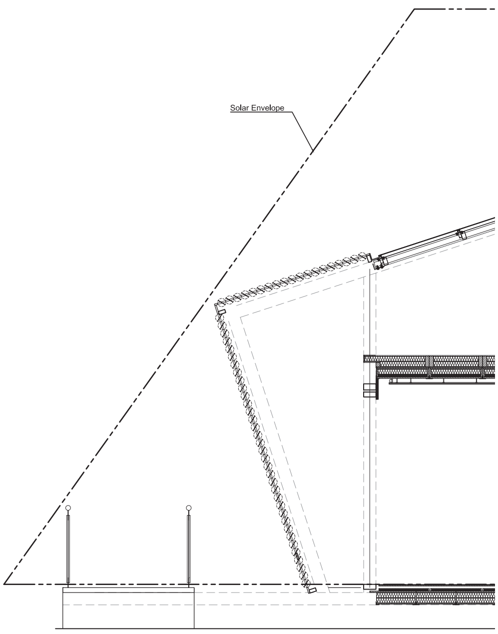




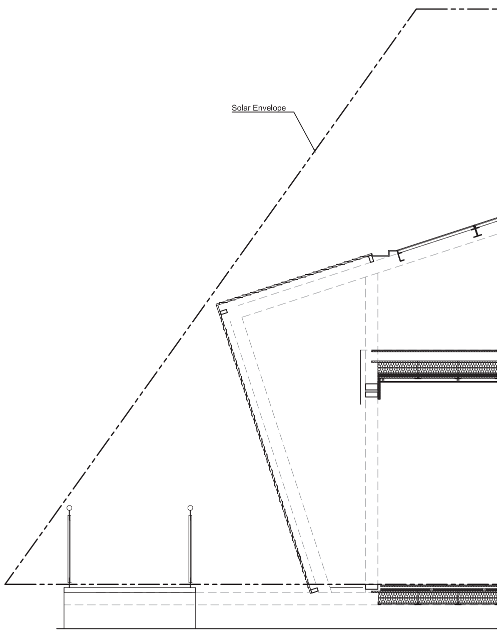
Louvers
Sliding Door
Swing Door
Awning Window

2.2 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

2.3 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.

Figure 2.3.1 Tea Terrace View

Figure 2.3.2 East Side View

3.0 Lighting Design Narratives

3.1 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.

Figure 3.1.1 View from the mezzanine level

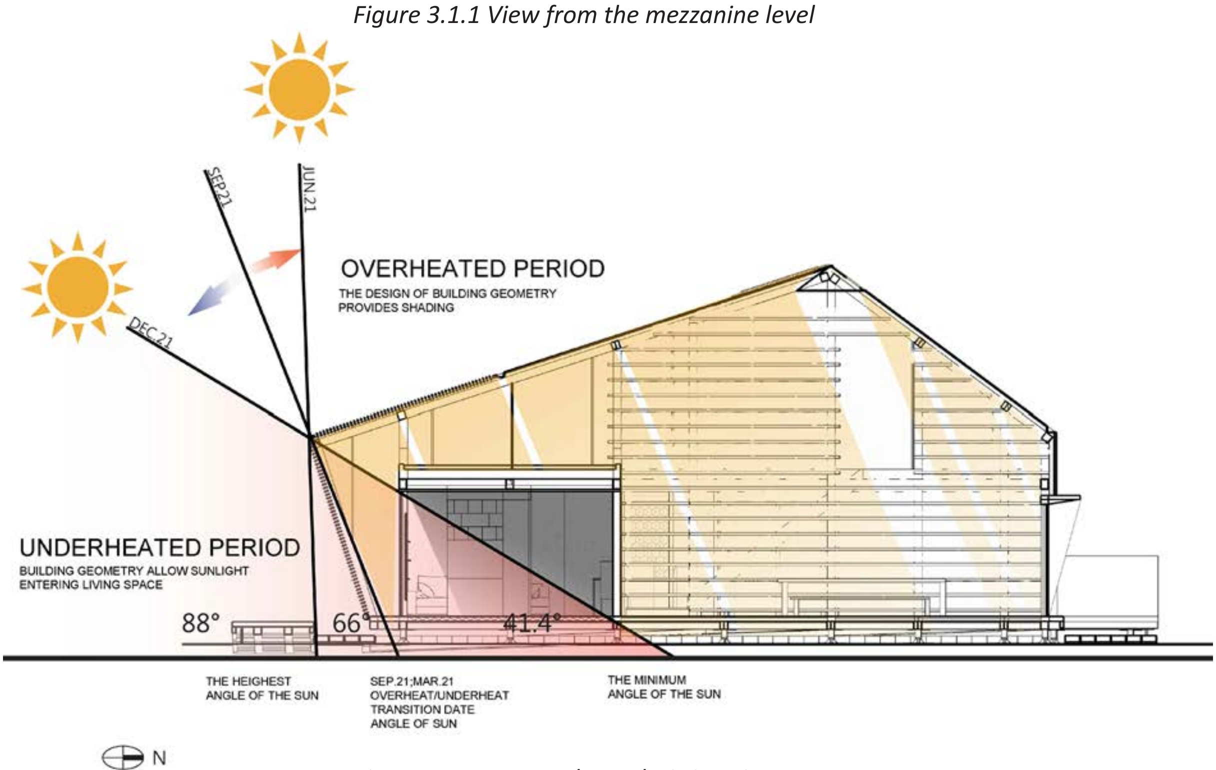


Figure 3.1.2 Sun angle analysis in Taiwan

3.2 Artificial lighting

3.2.1 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.

3.2.2 Lighting Controls for Energy Saving

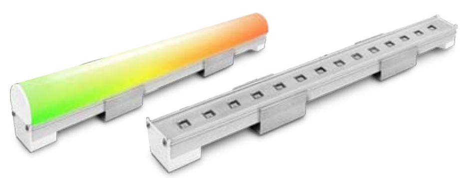
- There are two ways to reduce lighting energy use through controls:
- Turn lights off when not need
- Reduce lighting power to minimum need

3.2.3 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

3.2.4 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

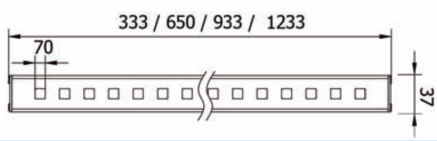
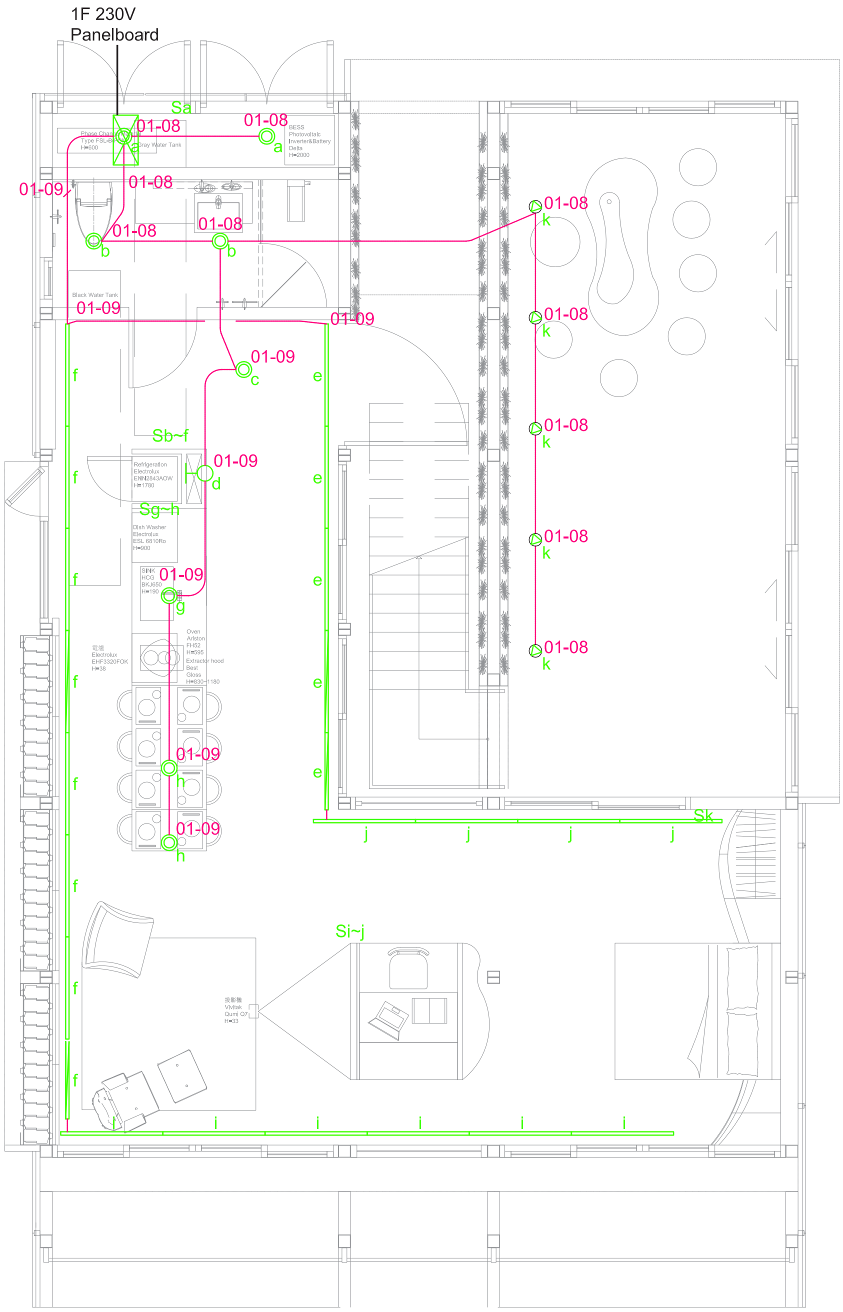


Figure 3.2.4.1 Delat Electronics LED Strip Light



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

Figure 3.2.4.2 Lighting Plan

1.0 Structural Design

1.1 Introduction

The Orchid House's engineering design features an integrated set of systems which is highly efficient, yet keeps the house comfortable. Similar to an orchid's natural eco-system, the engineering systems work in a coherent way to increase the efficiency or 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.

1.2 Joint System

The joint system is composed with the Ordinary Moment Resisting Frame method, which is lower ductility for strong seismic resistance. The Ordinary Moment Resisting Frame also allows easy fabrication and short construction time at the same time pass the high regulation for seismic proofing in Taiwan. Due to the low ductility of the Ordinary Moment Resisting Frame, the Orchid House requires no structural bracing, which easily distracts the continuity of space as well as adding the construction complexity.

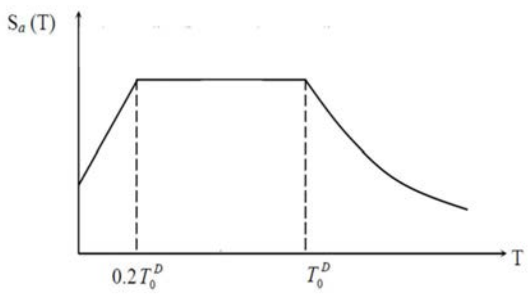


Figure 1.2.1 Earthquake Load in Taiwan

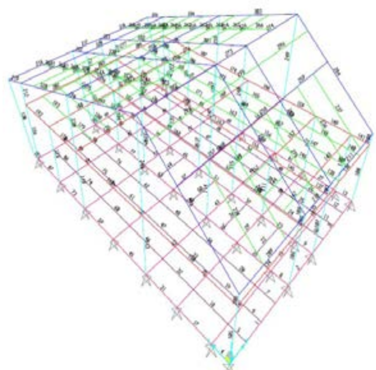


Figure 1.2.2 Structural Diagram

1.3 Prefabrication

All of structural components are prefabricated at the factory near Taipei City and transported to the construction site, which also allows no on-site welding joints as well as no landfill trash while building up the structure. Most of the connection will be joined by bolts and nuts, which can be done without any special equipment and skill to construct the structure. The modules are designed to be transported with track and standard container shipping. This prefabricated methods are also applied when the Orchid House is placed on existing building rooftop in Taipei City for reducing construction cost and time.

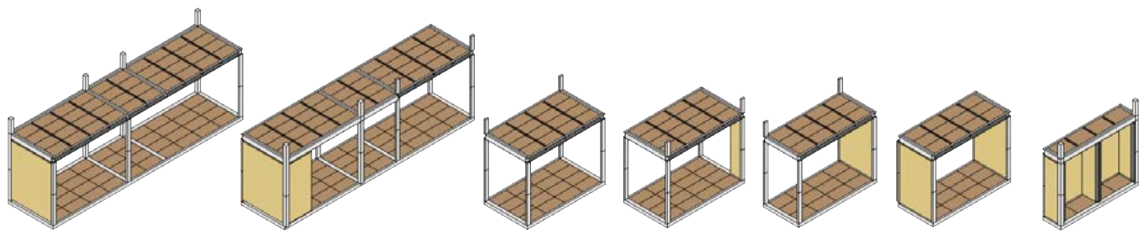


Figure 1.3.1 Modules

1.4 Foundation

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.

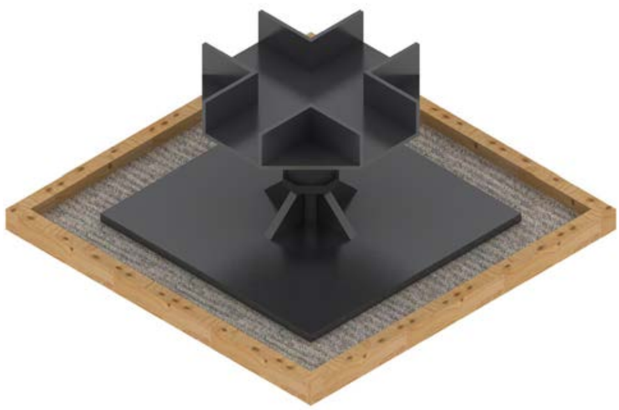


Figure 1.4.1 Adjustable Footing

1.5 QR code management

The QR code will be used for all the structural components marked in the factory while they are fabricated for the construction management. The QR code does not require any expensive and special device for reading, yet usual mobile device, such as 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

2.0 Constructive Design Narrative

2.1 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 reduces mechanical load. The material selection for the Orchid House is mainly concentrated on the products manufactured in Taiwan with sustainability production process, especially for the structure, architectural finishes, façade material, and the furniture installed in interior space.

2.2 Façade

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

Figure 2.2.1 Makrolon® Sheet

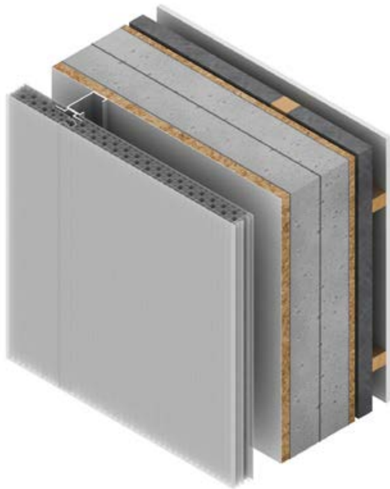


Figure 2.2.2 Orchid House Facade System

2.3 Window Frame

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

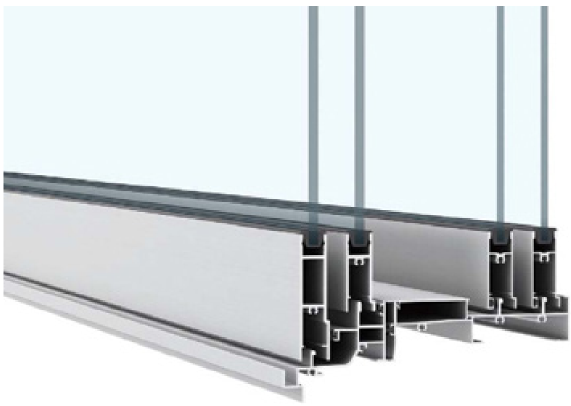


Figure 2.3.1 YKK AP Frame Detail

2.4 Wood Finishes

Most of the Orchid House interior wood finish material is 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 made their product to be recyclable and sustainable. UAPR Premium Collection Products especially utilize Nano technology coating to eliminate defection of wood surface and last much longer than typical wood flooring, yet emits low VOC.

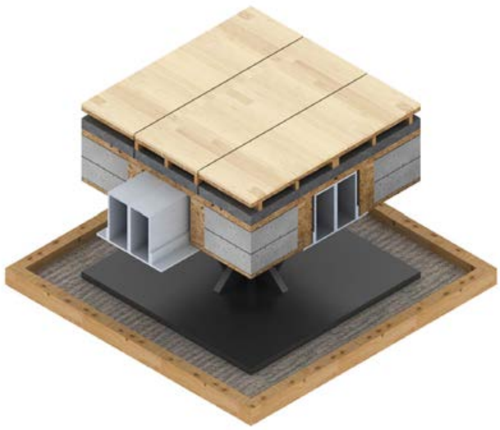


Figure 2.4.1 Orchid House Flooring System

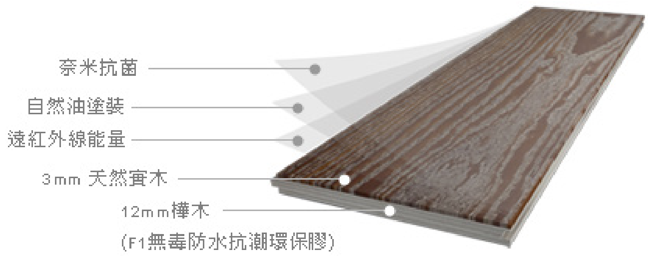


Figure 2.4.2 UA Floor Diagram

2.5 Wood Deck

The Orchid House east side outdoor deck as well as the west and south side slope will be covered by Wood Plastic Composite (WPC) provided by HaunSu Tech Corporation. WPC panel is composed by 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

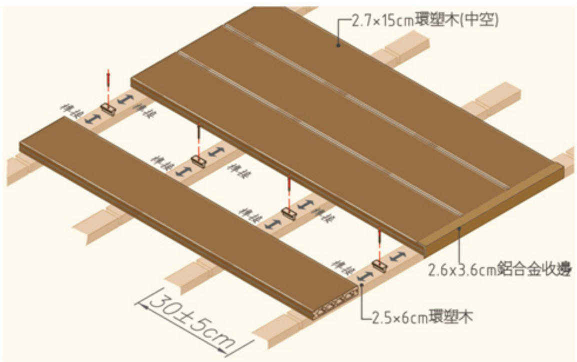


Figure 2.5.2 WPC Panel Installation

2.6 Thermal Mass

The POLLI-BRICK™ is chosen for the Orchid House thermal mass solution. The POLLI-BRICK™ is the 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.

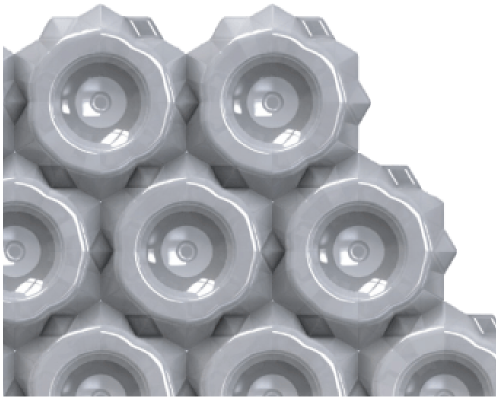


Figure 2.6.1 POLLI-BRICK™

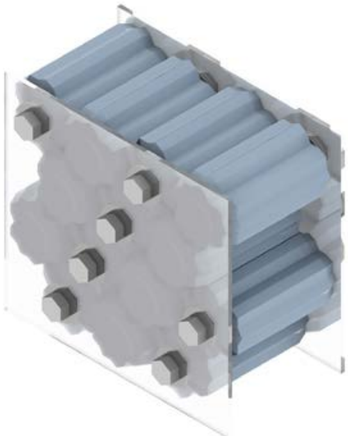


Figure 2.6.2 Orchid House Thermal Mass

2.7 Insulation Glass Foam

For the acoustic performance solution, the insulation material chosen for the Orchid House a very unique recycled glass foam, which comply to STC ≧ 42dB (ASTM E413). This insulation material will be installed on the inside of wall, above the ceiling, as well as underneath to flooring to reduce the reverberation and improve acoustic performance.

Figure 2.7.1 Glass Foam Insulation

Figure 2.7.2 Orchid House Partition Wall

2.8 Furniture

While choosing the interior furniture, we select mostly fabric covered pieces to reduce reverberation by absorbing the sound. These pieces of furniture are manufactured in Taiwan with local resources and create warm modern Taiwanese life style with environmental friendly concern.

3.0 Systems Design: Plumbing, Electrical, Photovoltaic and Control Systems

Closely integrated with the architecture of the house, the engineering systems are outlined as below:

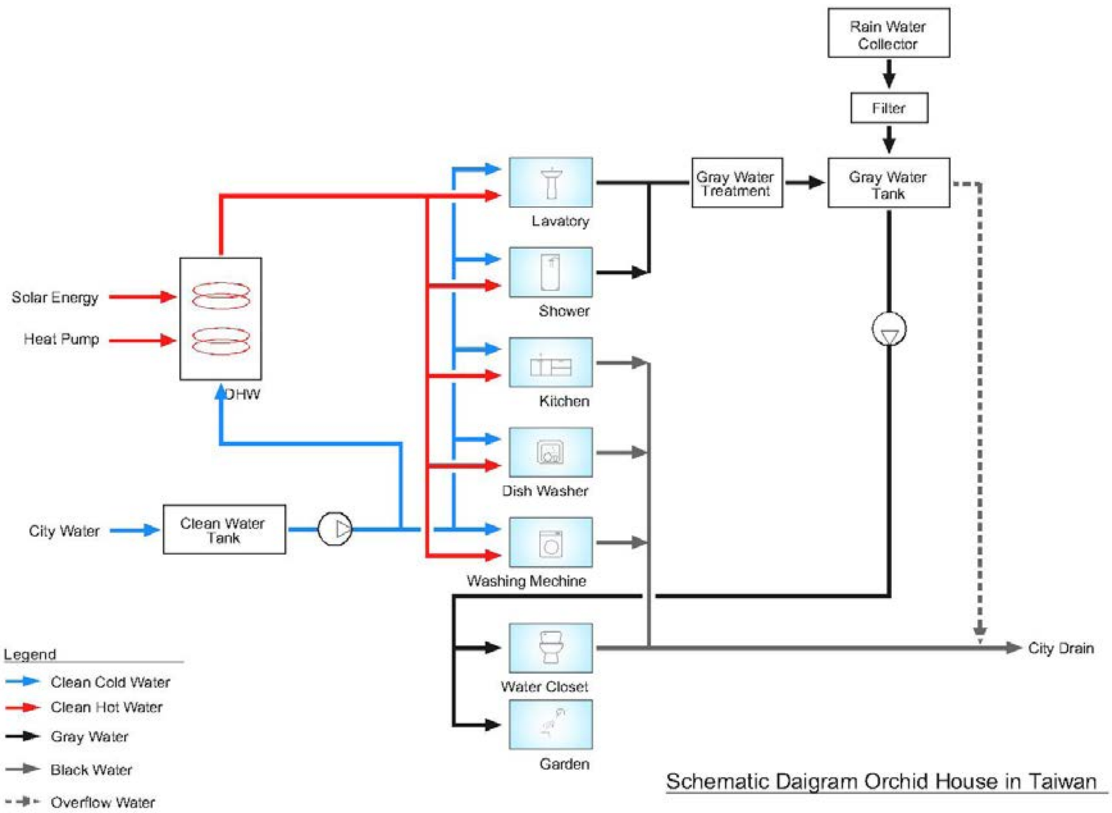
3.1 Plumbing System

General Description

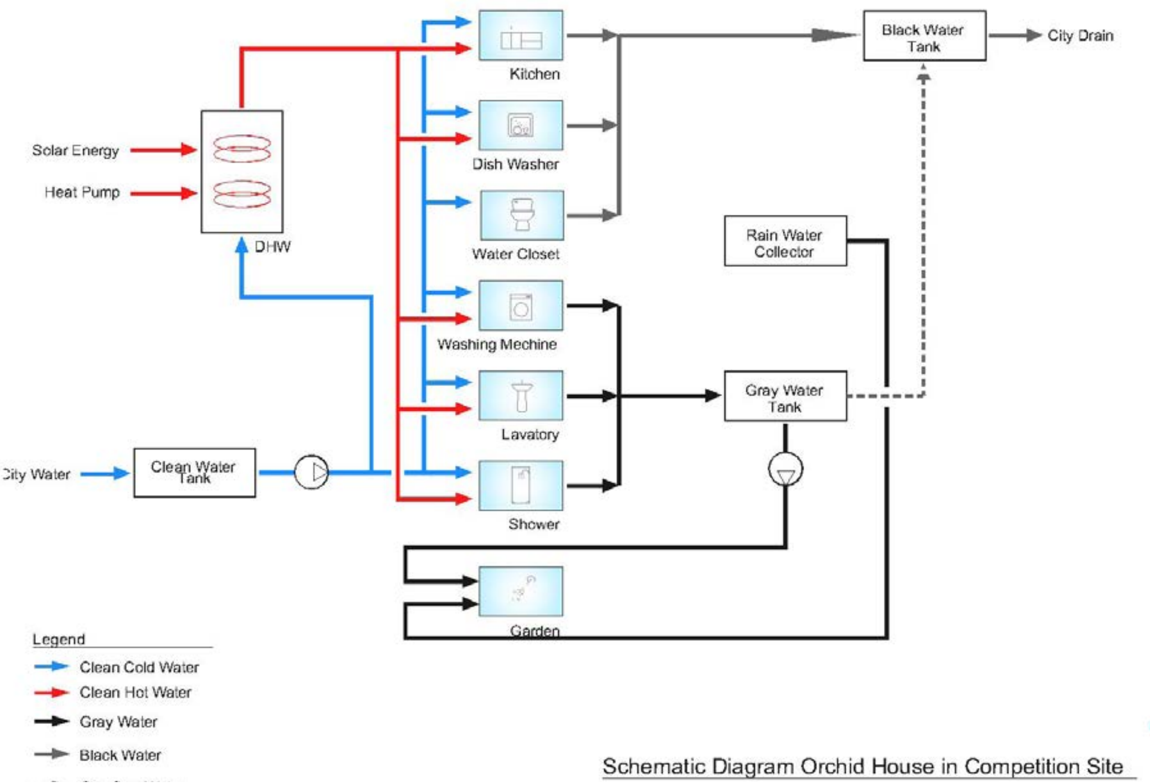
- The plumbing system consists of cold water supply (city water) system, domestic hot water (DHW) system, gray water system, drainage system and rainwater havesting system.
- The plumbing system design must not only meet the basic requirements of hygiene, but also achieve the other goals of water conservation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

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 Daigram Orchid House in Taiwan



Schematic Diagram Orchid House in Competition Site

Detailed Description of the Plumbing Systems

- Cold Water Supply System

i. Orchid House EN FRANCE

The cold water is delivered by the Solar Decathlon Organization Europe to the cold water tank under neath the floor. The cold water supplier use points by a pressure boosting unit. The use points include the plumbing fixtures, dishwashing, cloth washing and gray water makeup.

ii. Orchid House Taiwan

The cold water supply is interconnected with the building's city water supply system.

iii. Cold Water Needs

Use	Unit Consumer	Cycles / Day	Need in Litres
Water Closet	Person		
Full		2	2 × 6 = 12.0
Half		10	10 × 3 = 30.0
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 × 9.8 = 9.8
Cloth Washing	Family	1	1 × 100 = 100.0
Gardening	Family	1	-
Total			**395.8**

iv. Major Equipment

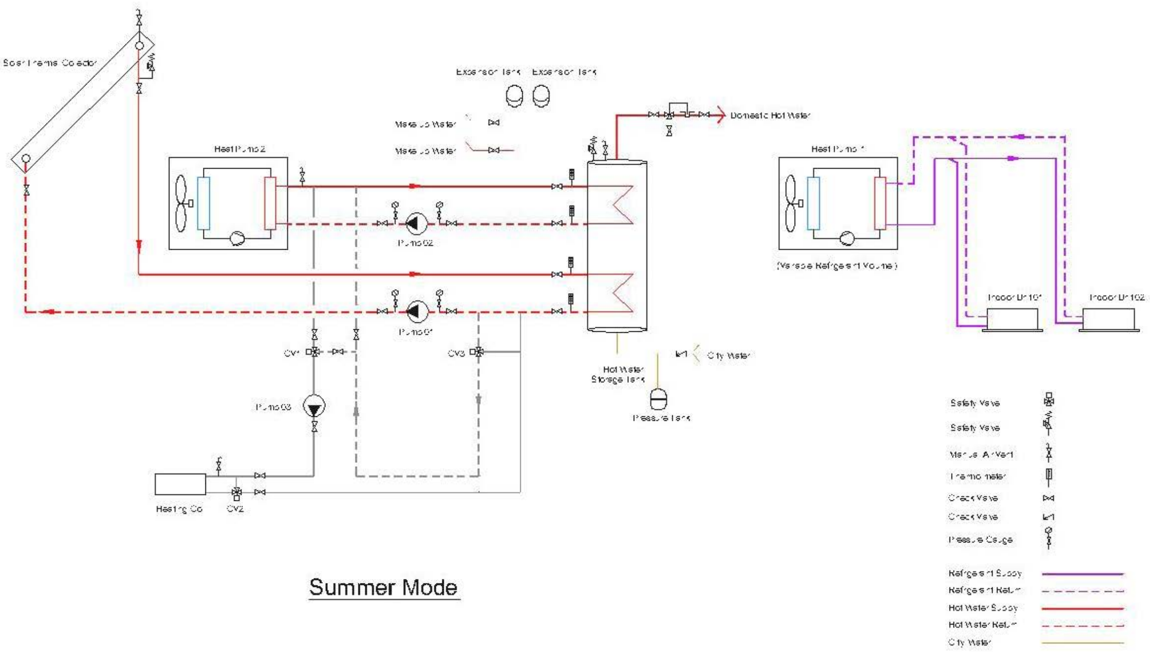
- A rectangular shape of cold water tank is molded of FRP with the storage capacity of 1000 L × 2.
- Pressure boosting unit is a stainless steel pump equipped with a buffer tank to maintain a constant pressure supply. The flow is 30 lpm with the booster pressure set at 1.5 kg/cm2.

- 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 temperature regulator controls the hot water temperature by mixing the hot water coming from the hot water storage tank with the cold water to 55°C. The DHW is supplied to shower head, hand sink, kitchen sink, dishwashing and cloth washing.

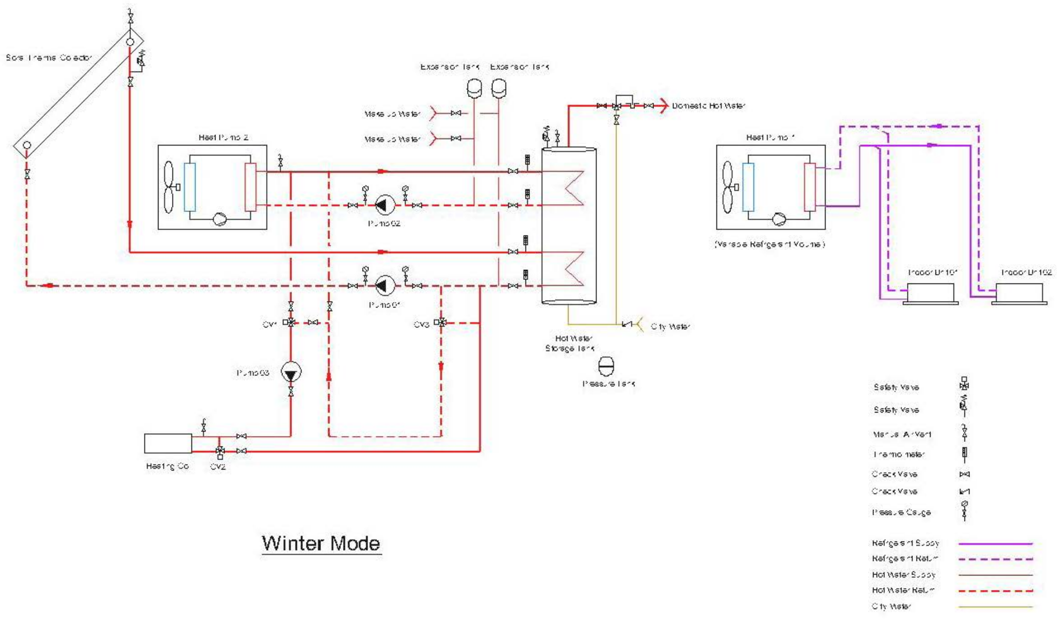
ii. Hot Water Needs

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	9.8	1	9.8 (50°C)
Cloth Washing	100.0	1	100 (45°C)



Summer Mode

Cooling Mode Schematic Drawings



Heating Mode Schematic Drawings

- Gray Water System

i. Gray water system collects the wastewater water from shower, hand sink, and cloth washing machine in the gray water tank underneath the floor.

ii. The case in France prohibits the reuse of gray water other than gardening. But in Taiwan, the gray water is reused for both the toilet (water closet) and gardening after the filtering process.

iii. The pressure boosting unit supplies the gray water to the use point – the automatic gardening system. The automatic gardening system connects to two water sources – gray water and rain water harvesting system. The two sources are selected manually.

iv. Major Equipment
  - The cold water tank is molded of FRP in one piece of rectangular shape with the storage ca pacity of 1000 L.
  - The pressure boosting unit is a stainless pump equipped with a buffer tank to maintain a con stant supply pressure. The flow is 15 lpm with the booster pressure at 1 kg/cm2.

- Drainage System

i. Orchid House EN FRANCE
Drainage system collects the wastewater from water closet, kitchen sink and dishwashing machine in the black water tank underneath the floor. The black water also receives the over flow from the neighboring gray water tank.

ii. Orchid House Taiwan
The waste water system in Taiwan collects from water closet, kitchen sink, dish washing machine and the overflow of gray water tank, and then drains by gravity to the building’s central drainage system.

iii. The black water tank is molded of FRP in one piece in rectangular shape with the storage capacity of 1000 L × 2.

・ Rainwater Harvesting System

i. The catchment area of rainwater is the roof, and the rainwater is stored in the roof tank. The rainwater feeds by gravity to the gardening system.

3.2 Electrical System Design

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

・ Design characteristics for residential appliance and equipment circuits

Description	Load (W)	Volts (V)	Wire	Circuit Breaker	Number of outlet	Notes
Refrigeration	150	220	3-2.5 mm^2	16A	1	
Oven	2250	220	3-2.5 mm^2	16A	1	
Diswasher	2200	220	3-2.5 mm^2	16A	1	
Cooking	1600	220	3-6 mm^2	25A	1	
Clothes Washer	1450	220	3-2.5 mm^2	16A	1	
Clothes Dryer	1850	220	3-2.5 mm^2	16A	1	
Extractor Hood	260	220	3-2.5 mm^2	16A	1	
Domastic Water Pump	373	220	3-2.5 mm^2	16A	—	Equipment will be direct connected
Gray water pump	200	220	3-2.5 mm^2	16A	—	Equipment will be direct connected
Bathroom & Tea Terrace Receptacle	—	220	3-2.5 mm^2	16A	6	
Living Room & Workstation Receptacle	—	220	3-2.5 mm^2	16A	2	TV and Computer
Pump 01	435	220	3-2.5 mm^2	16A	—	Equipment will be direct connected
Pump 01	435	220	3-2.5 mm^2	16A	—	Equipment will be direct connected
Pump 01	435	220	3-2.5 mm^2	16A	—	Equipment will be direct connected
VRV	2760	220	3-6 mm^2	16A	—	Equipment will be direct connected
HRV & PCM	100	220	3-2.5 mm^2	16A	—	Equipment will be direct connected
Heat Pump	2100	220	3-4 mm^2	16A	—	Equipment will be direct connected

・ 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	150	220	0.7	3-2.5mm²	7.410	18	0.18	0.08
1st panel board	Oven	2250	220	10.2	3-2.5mm²	7.410	21	3.18	1.45
1st panel board	Dishwasher	2200	220	10.0	3-2.5mm²	7.410	19	2.82	1.28
1st panel board	Cooking	1600	220	7.3	3-6.0mm²	3.080	21	0.94	0.43
1st panel board	Clothes Washer	150	220	0.7	3-2.5mm²	7.410	22	0.13	0.06
1st panel board	Clothes Dryer	900	220	4.1	3-2.5mm²	7.410	24	1.46	0.66
1st panel board	Hood	150	220	0.7	3-2.5mm²	7.410	30	0.30	0.14
1st panel board	Lighting	200	220	4.1	3-2.5mm²	7.410	30	0.4	0.18
1st panel board	Lighting	300	220	4.1	3-2.5mm²	7.410	30	0.61	0.28
1st panel board	Lighting	200	220	4.1	3-2.5mm²	7.410	40	0.54	0.24
1st panel board	2nd Panel board	4500	220	20.5	3-6.0mm²	3.080	10	1.26	0.57
1st panel board	Automation	150	220	0.7	3-2.5mm²	7.410	10	0.10	0.05
1st panel board	Domestic water pump	373	220	1.7	3-2.5mm²	7.410	10	0.25	0.11
1st panel board	Gray water pump	200	220	0.9	3-2.5mm²	7.410	20	0.27	0.12
1st panel board	General receptacle	900	220	4.1	3-2.5mm²	7.410	30	1.82	0.83
1st panel board	General receptacle	900	220	4.1	3-2.5mm²	7.410	30	1.82	0.83
1st panel board	PUMP 01	435	220	2.0	3-2.5mm²	7.410	10	0.30	0.13
1st panel board	PUMP 02	435	220	2.0	3-2.5mm²	7.410	10	0.30	0.13
1st panel board	PUMP 03	435	220	2.0	3-2.5mm²	7.410	10	0.30	0.13
2nd panel board	VRV	2760	220	12.5	3-6.0mm²	3.080	26	2.01	0.91
2nd panel board	HRV & PCM	100	220	0.5	3-2.5mm²	7.410	15	0.10	0.05
2nd panel board	Heat Pump	2100	220	9.5	3-4.0mm²	4.610	26	2.29	1.04
2nd panel board	General receptacle	900	220	4.1	3-2.5mm²	7.410	30	1.82	0.83
2nd panel board	Water wall Pump	373	220	1.7	3-2.5mm²	7.410	26	0.37	0.17
2nd panel board	Circulation Fan	40	220	0.2	3-2.5mm²	7.410	24	0.06	0.03

- Grounding system

i. 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.

ii. he exposed conductive parts are connected to ground by direct electrical connection. Residual Current Devices (RCDs) are installed on the main and each branch.

iii. 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).

4.0 Electrical Energy Balance Simulation

4.1 *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 limitation, also not to generate waste during power generation process.

ii. Solar module life can last 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.

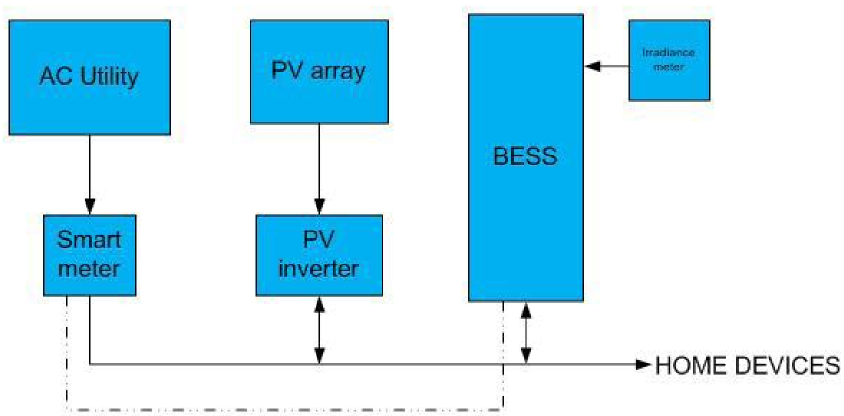
4.2 *List of the electric loads*

List of the Electrical Loads

Item	Product Name	Manufacturer / Model Name	Specification	Max. Power (W)
Appliances	Refrigerator/ Freezing	Electrolux ENN2843AOW	R: 210 L F: 58 L	150
	Clothes Washer	Thomson TX-1199	Max. Water Temp.up to 60℃	1450
	Clothes Dryer	Bosch WTC82101TC		1850
	Cooking	HCG RF102	2 heating plates	1600
	Oven	Best OV-365	58 L	2150
	Extractor Hood	Best Gloss	630 m3/h	260
	Dishwashing	Electrolux ESL6810RO	8 place settings Max. Water Temp.：70℃	2200
Devices	TV	Vivitek Qumi-Q7 HD	800 lm / 3D	100
	Notebook	ASUS Transformer AiO P1801	18.4 inch	180
Lighting	Kitchen / Lighting	Delta DRPT-509AD	LED 1.2Wx9	54
	Living Room / Lighting	Delta BFDA-W	LED 12W	120
	Workstation & Bedroom / Lighting	Delta BFDA-W	LED 12W	120
	Bathroom / Lighting	Delta DRPT-509AD	LED 1.2Wx9	21.6

4.3 Photovoltaic (and other electric solar) system description

The photovoltaic system consists of 24 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.



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
iiii. 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. The BESS can operate in several modes:

i. Standby mode (keeping default SOC of the battery)
ii. Energy absorbing mode (charging the battery) at the power defined by system controller (depending on home power consumption and photovoltaic output power)
iii. Energy dispatching mode at the power defined by the system controller

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.

Battery bank chosen in the BESS system is 8 units of 12 V 60 Ah battery to form a total 5,760 Wh battery storage capacity.

4.4 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. One has to define the plane orientation (with the possibility of tracking planes or shed mounting), and to choose the specific system components. One 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.

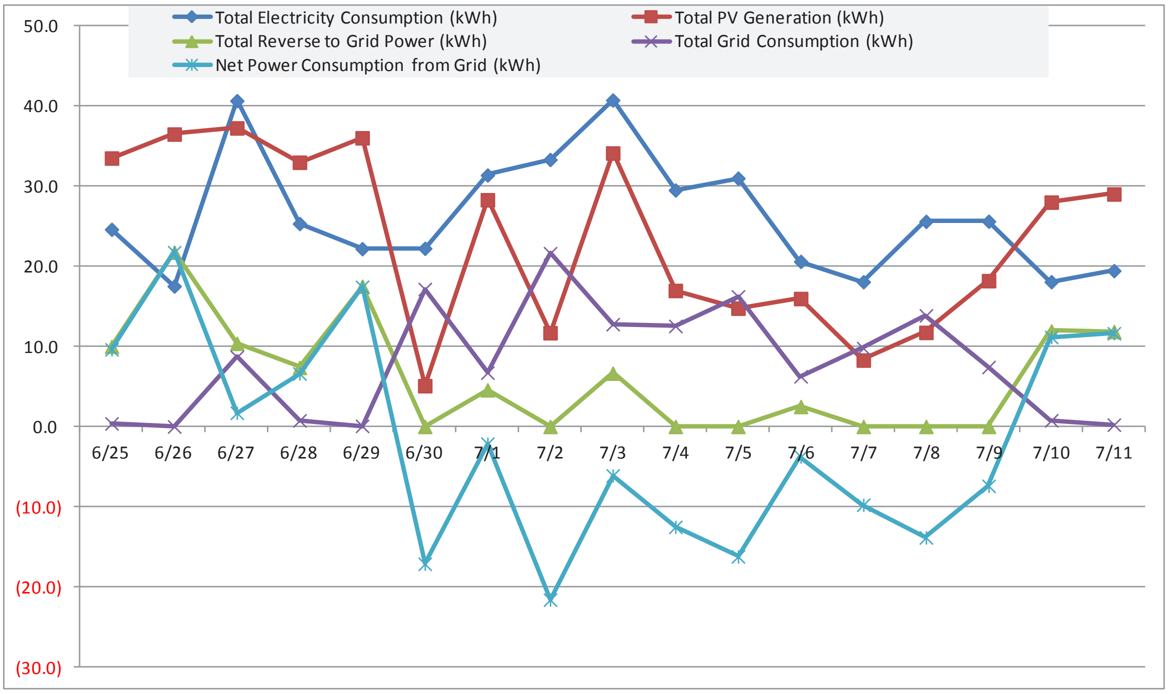
The simulation calculates the distribution of energies throughout the year. Main results are:

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 (location and orientation).

4.5 *The electrical energy balance analysis*

The electrical energy balance analysis consists of an annual, monthly and contest week estimates of the electricity demand by the electric loads, the electricity generated by the photovoltaic installation and the electricity extracted.

		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



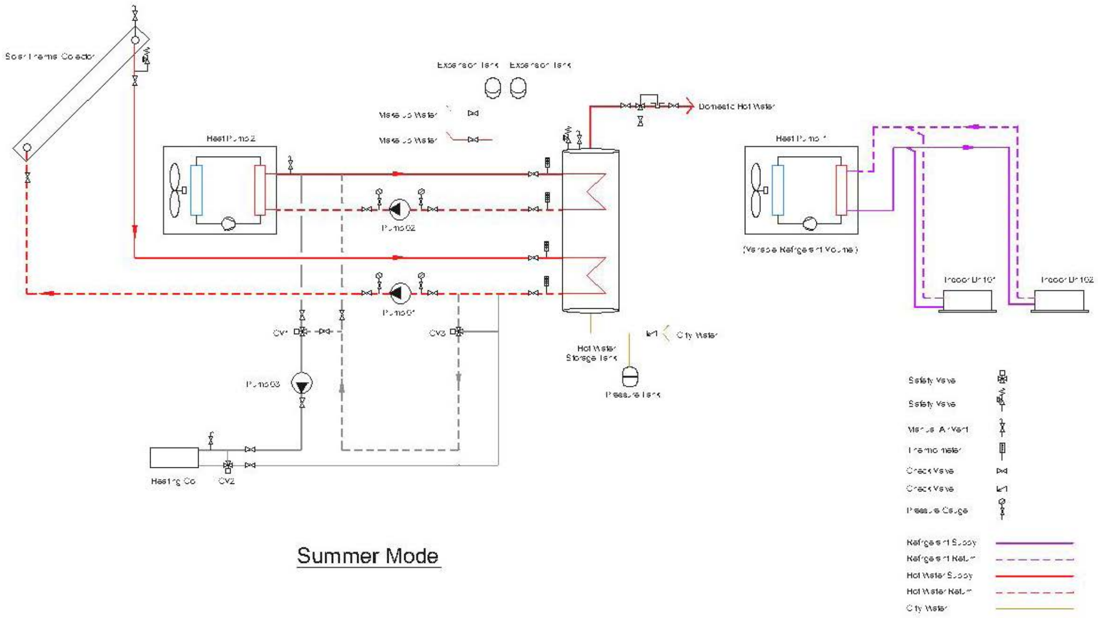
4.6 An Energy Payback Time analysis

An Energy Payback Time analysis as well as the CO2 reduction associates to a standard year of use must be ncluded

5.0 Solar Thermal Design

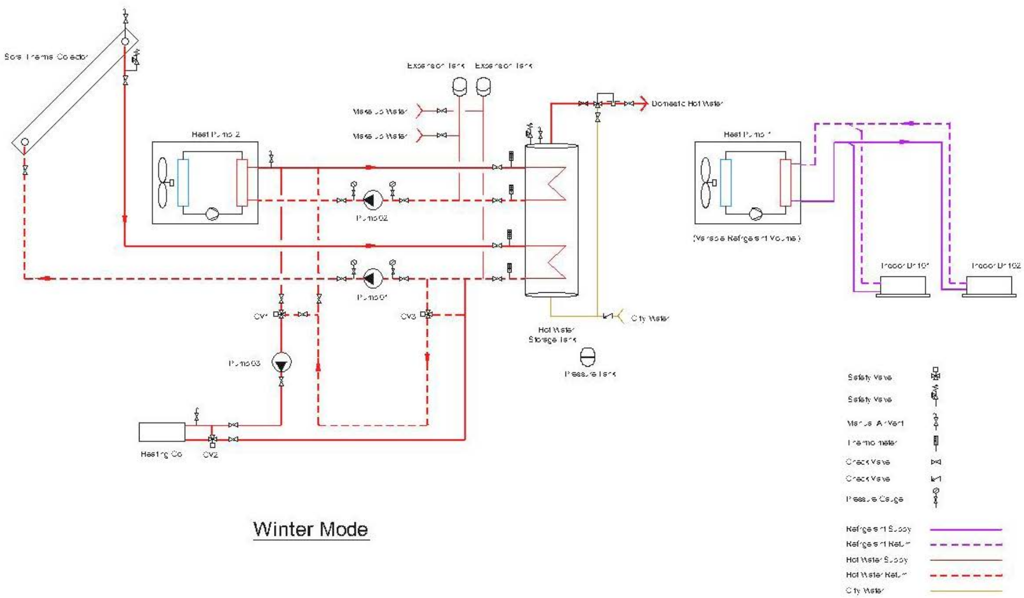
5.1 General Description

・ The solar thermal system is to recover the heat from the 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. However, solar thermal energy cannot satisfy the thermal demands year-round independently. Therefore, an auxiliary heat generator – air-to-water heat pump – is included.



Summer Mode

Cooling Mode Schematic Drawings



Winter Mode

Heating Mode Schematic Drawings

5.1 Design Criteria

- The solar thermal system is part of overall energy plan including the passive solar system, active solar system, HVAC system, and other high performance strategies.
- The solar thermal energy takes precedence over the heat pump to heat the water for both the domestic hot water and space heating. During the overcast days and winter, the solar thermal energy can also be used as pre-heating.
- Nevertheless, the back-up heat pump can still be able to cover all the demands from domestic hot water and space heating independently of solar heating.
- Considering the protection against possible legionellosis, the hot water temperature can achieve 60°C occasionally.

5.2 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
Hand Sink	12	9 (35°C)	108
Kitchen Sink	2	18 (55°C)	36
Dishwashing	1	9.8 (50°C)	9.8
Cloth Washer	1	100 (45°C)	100
Total			353.8

The thermal energy required to heat the domestic hot water is 40.1 Mege joules per day.

- Total thermal energy need – Daily Profile

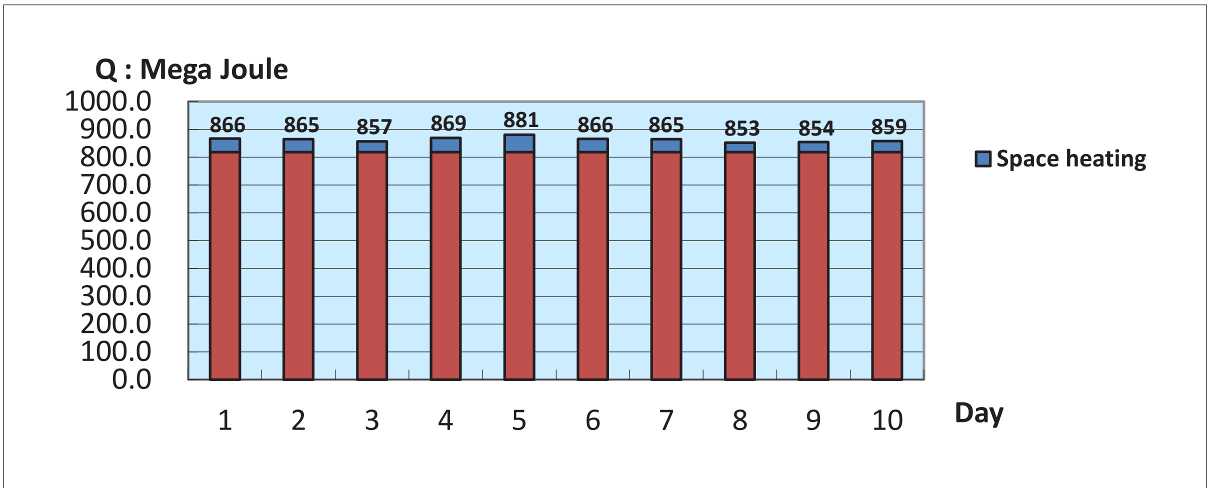


Figure ?

The domestic hot water system need is calculated as shown above.
The space heating need is estimated based on the heating load calculation.

5.3 Major Equipment

- Solar Collectors

i.	Type	:	Evacuated Tube
ii.	Characteristics		
•	Quantity	:	2
•	Absorber shape	:	Cylindrical
•	Gross Collector area	:	2.61 m2
•	Efficiency constant @ G = 8000 w/m2	:	η0 = 0.734 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

5.4 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.

5.5 Effectiveness of the Insulation

- Solar water supply and return piping :
  EPDM rubber insulating material of 15mm thickness with UV protective jacket.
- Hot water storage tank :
  100mm thick flexible polyurethane foam.
- Domestic hot water piping :
  15mm thick polyurethane foam.

5.6 Control System

- Hot water storage tank loading

i. When the temperature at the lower area of the tank (T1) is 9°C less than the temperature at the collector (T2), the pump (P1) is switched on. If the temperature difference falls below 4°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 and its circulation pump (P2) are switched on.

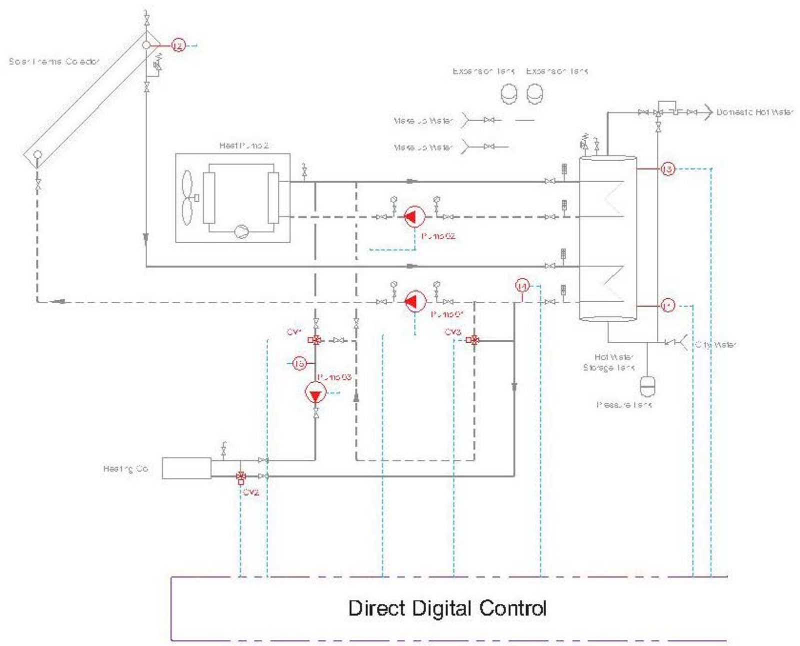
- Space heating process

i. When the space heating process is actuated, the circulation pump (P3) operates. When the solar energy is sufficient for heating and DHW, the control valve (CV3) is switched to take the energy from the solar thermal system.

ii. When the solar energy is insufficient, the heat pump (P2) operates and the control valve (CV1) is modulating to maintain the constant water supply temperature, and control valve (CV3) is switched to bypass the solar thermal system.

iii. When the solar energy can only provide partial demands of space heating, the control valve (CV3) is positioned like the case i and control valve (CV1) is modulating like case ii in a way to utilize the solar energy as the preheating.

iv. The room temperature sensor (T6) switches on/off the control valve (CV2) to control the room temperature within the designated range.



Control

5.7 Cost of the Installation

- *The total cost for the solar thermal system is at about USD. The itemized estimation is as follows.*

Item	*Description*	*Cost (USD)*
1	*Solar collectors*	*To be updated next deliverables*
2	*Heat pump*	*To be updated next deliverables*
3	*Hot water storage tank*	*To be updated next deliverables*
4	*Pump stations*	*To be updated next deliverables*
5	*Control*	*To be updated next deliverables*
6	*Piping material*	*To be updated next deliverables*
7	*Labor*	*To be updated next deliverables*
	Total	*To be updated next deliverables*

6.0 Building Integrated Solar Active Systems

6.1 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.

6.2 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.

6.3 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.

6.4 Additional properties

Modules of the photovoltaic system is a big part of the southern side of 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.

6.5 Maintenance

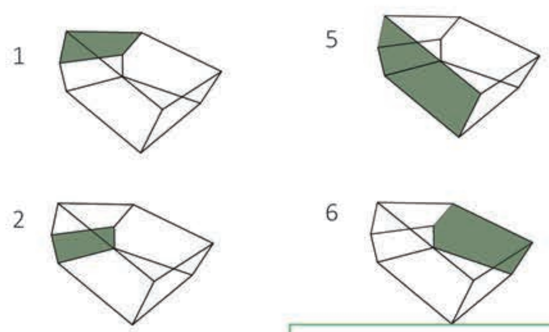
Structural maintenance (mostly inspection) of the photovoltaic system is required periodically like all other building materials. As module can withstand wind or snow load up to 5,400 Pa and the roof is tilt, there is no specific maintenance work has to be performed after snowing. Electrical maintenance is also to be performed periodically, mostly is for inspection. Battery to be replaced after a certain years when house owner finds that the charging efficiency is low.

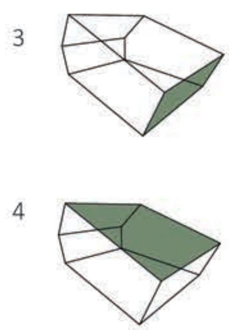
ENERGY EFFICIENCY DESIGN NARRATIVE

1.0 Technical Project Summary

1.1 Project Dimensions

Surface Area



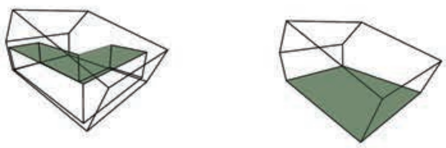


Caculation

Surface	Area
1	45.64
2	30.65
3	32.22
4	94.41
5	75.94
6	75.94
Total	354.80

square meters

Net Floor Area



Caculation

Net Floor Area	
2F	55.90
1F	108.55
Total	164.45

square meters

Project Dimensions	
Gross area	149.9 square meters
Gross Volume	584.81 cubic meters
Surface area	354.80square meters
Net floor area	164.45 square meters
Conditioned Volume	141.00 cubic meters

Table 1.1.1 Project Dimensions

1.2 House Envelope

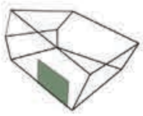
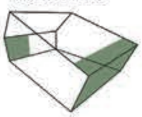
	Insulation Type	Thickness (mm)	Thermal Conductivity (W / m*K)	Thermal Transmittance (W/m2k)	Thermal Resistance (m2k/W)	AREA (m2)
1F Floor 	Interior Air film			6.6667	0.1500	
	UA Floor :R1621	15	0.1300	8.6667	0.1154	
	Plywood	18	0.1300	7.2222	0.1385	
	AIR	24	0.024	1.0000	1.0000	
	VIP	30	0.0070	0.2333	4.2857	
	Plywood(12+18)	30	0.1300	4.3333	0.2308	
	Glass Foam	130	0.0711	0.546923077	1.8284	
	Plywood	12	0.1300	10.8333	0.0923	
	Exterior Air Film			6.6667	0.1500	
TOTAL:		259		0.1251	7.9910	108.55
2F Floor 	Interior Air film			6.6667	0.1500	
	UA Floor :R1621	25	0.1300	5.2000	0.1923	
	AIR	65	0.024	0.3692	2.7083	
	Waterproof Plastics	5	0.03	6	0.1667	
	Plywood	18	0.13	7.222222222	0.1385	
	Glass Foam	130	0.0711	0.546923077	1.8284	
	Plywood(12+12)	24	0.13	5.416666667	0.1846	
	AIR	4	0.024	6.0000	0.1667	
	VIP	30	0.0070	0.2333	4.2857	
	Glass Foam	65	0.0711	1.093846154	0.9142	
	Plywood	18	0.13	7.222222222	0.1385	
	Plywood	6	0.13	21.66666667	0.0462	
	AIR	79	0.024	0.3038	3.2917	
	Plywood	12	0.13	10.83333333	0.0923	
	Plywood	9	0.13	14.44444444	0.0692	
	Interior Air film			6.6667	0.1500	
TOTAL:		490		0.0688	14.5232	55.90
THERMAL WALL 	Exterior Air Film			20.0000	0.0500	
	Polycarbonate	10	0.0280	2.8000	0.3571	
	Air	40	0.0240	0.6000	1.6667	
	PET/POLLI-Bricks	3	0.5100	170.0000	0.0059	
	Water	379	0.5800	1.5303	0.6534	
	PET/POLLI-Bricks	3	0.5100	170.0000	0.0059	
	Air	40	0.0240	0.6000	1.6667	
	Polycarbonate	10	0.0280	2.8000	0.3571	
	Air	40	0.0240	0.6000	1.6667	
	Plywood	40	0.1300	3.2500	0.3077	
	Interior Air film			8.3333	0.1200	
TOTAL:		565		0.1458	6.8572	13.75
GLASS LOUVERS 	Exterior Air Film			20.0000	0.0500	
	Glass louvers	5	1.0500	210.0000	0.0048	
	Interior Air film			8.3333	0.1200	
TOTAL:		5		5.7221	0.1748	60.58
1F WALL (East+West) 	Exterior Air Film			20	0.05	
	Polycarbonate	40	0.0440	1.1000	0.9091	
	Air	75	0.0240	0.3200	3.1250	
	Plywood	18	0.1300	7.2222	0.1385	
	Glass Foam	132	0.0711	0.5386	1.8565	
	Plywood	18	0.1300	7.2222	0.1385	
	VIP	30	0.0070	0.2333	4.2857	
	Plywood	12	0.1300	10.8333	0.0923	
	Air	24	0.0240	1.0000	1.0000	
	Plywood	10	0.1300	13.0000	0.0769	
	Rubber	2	0.1300	65.0000	0.0154	
	Calcium silicate	6	0.05	8.3333	0.1200	
	Interior Air film			6.6667	0.1500	
TOTAL:		367		0.0836	11.9579	29.40

Table 1.2.1 House envelope surfaces

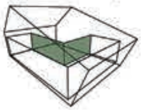
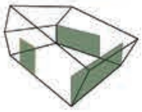
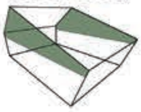
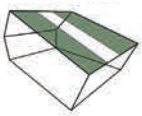
	Insulation Type	Thickness (mm)	Thermal Conductivity (W / m*K)	Thermal Transmittance (W/m2k)	Thermal Resistance (m2k/W)	AREA (m2)
1F WALL (INTERIOR) 	Exterior Air Film			20	0.05	
	Plywood	18	0.1300	7.2222	0.1385	
	Glass Foam	132	0.0711	0.5386	1.8565	
	Plywood	18	0.1300	7.2222	0.1385	
	VIP	30	0.0070	0.2333	4.2857	
	Plywood	12	0.1300	10.8333	0.0923	
	Air	24	0.0240	1.0000	1.0000	
	Plywood	10	0.1300	13.0000	0.0769	
	Rubber	2	0.1300	65.0000	0.0154	
	Calcium silicate	6	0.05	8.3333	0.1200	
	Interior Air film			6.6667	0.1500	
TOTAL:		252		0.1262	7.9238	34.46
PLYCARBONATE WINDOW 	Polycarbonate	16	0.0448	2.8000	0.3571	
TOTAL:		16		2.8000	0.3571	77.27
2F WALL (East+West) 	Exterior Air Film			20	0.05	
	Polycarbonate	40	0.0440	1.1000	0.9091	
	Air	75	0.0240	0.3200	3.1250	
	Plywood	18	0.1300	7.2222	0.1385	
	Glass Foam	132	0.0711	0.5386	1.8565	
	Plywood	18	0.1300	7.2222	0.1385	
	VIP	30	0.0070	0.2333	4.2857	
	Plywood	12	0.1300	10.8333	0.0923	
	Air	24	0.0240	1.0000	1.0000	
	Plywood	10	0.1300	13.0000	0.0769	
	Rubber	2	0.1300	65.0000	0.0154	
	Calcium silicate	6	0.05	8.3333	0.1200	
	Interior Air film			6.6667	0.1500	
TOTAL:		367		0.0836	11.9579	76.22
PLYCARBONATE ROOF 	Polycarbonate	6	0.0168	2.8	0.357142857	
TOTAL:		6		2.8	0.3571	61.21
PV PANEL 	PV Panel	5.2	1.05	201.9230769	0.004952381	
TOTAL:		5.2		201.9230	0.004	78.84

Table 1.2.2 House envelope surfaces

1.3 HVAC Systems

Name	**Dual Coil Storage Tank**
Service	Domestic Hot Water
Total Capacity	300 L
Tank Diameter	450 mm
Tank Height	2000 mm
DHW Outlet Size	20ф
Standby Heat Loss	2.1 Kwh/24h
Size of Solar Indirect Coil	1.2 m^2

Name	**Pump Station 1**
Service	Solar Thermal Collector Circuit
Pump Flow	0.7 cmh
Pump Head	7.5 m
Electrical Power Supply	230 V
Frequency	50
Power Consumption	235 W
Pipe Connection Size	25ф

Name	**Heating Only Heat Pump**
Service	Domestic Hot Water and Heating
Type	Air-to-Water Heat Pump
Nominal Capacity	4 KW
COP	4.1
EER	4.7
Electrical Power Supply	230 V
Frequency	50 HZ
Power Consumption	1.2 KW
Liquid Pipe Size	6.4 ф
Gas Pipe Size	9.5 ф
Refrigerant	R-410A

Name	**Solar Thermal Collector**
Service	Domestic Hot Water and Heating
Type	Evacuated Tube
Quantity	2
Gross Collector Area	2.61 m^2
Net Aperture Area	1.71 m^2
Max. Operating Temperature	99°C
Stagnation Temperature	375°C
Max. Operating Pressure	6 Bar
Nominal Flow Rate	237 L/hr
Efficiency η_0	73 %
Effective Heat Transfer Coefficient	
K_1	1.553 w/m^2
K_2	0.0022 w/m^2
Thermal Capacity	4.1 ckj (m^2 · K)

1 / 2

Name	Outdoor Unit of Cooling/Heating Heat Pump
Service	HVAC Cooling and Heating
Type	Heat Pump
Cooling Capacity	11.2 KW
Heating Capacity	12.5 KW
COP	Cooling = 3.8 Heating = 3.82
EER	Cooling = 4.4 Heating = 4.4
Electrical Power Supply	230 V
Frequency	50 HZ
Power Consumption	KW Cooling = 2.95 Heating = 3.27
Refrigerant	R-410A

Test condition for outdoor unit:

1. Cooling Condition : Indoor Temperature 27°C DB / 19°C WB
   Outdoor Temperature 35°C DB
2. Heating Condition : Indoor Temperature 20°C DB
   Outdoor Temperature 7°C DB / 6°C WB

Name	Indoor Unit of Heat Pump
Service	Room Heating and Cooling
Type	Wall Mounted
Quantity	2
Cooling Capacity	3.7 KW
Heating Capacity	4 KW
Fan Flow	9 ~ 5.5 m^3/min
Air Filter	Washable Resin Net

Name	Heat Reclaim Ventilator
Service	Room Active Ventilation
Temperature Exchange Efficiency	79%
Enthalpy Exchange Efficiency	
Cooling	66%
Heating	72%
Fan Air Flow Rate	150 m^3/h
Electrical Power Supply	230 V
Frequency	50 HZ
Power Consumption	30 W × 2

Test condition for exchange efficiency:

Condition	Indoor		Outdoor	
	°Cdb	rh%	°Cdb	rh%
Cooling	27	50	35	60
Heating	20	40	7	70

1 / 1

1.4 Domestic Hot Water

Name	Dual Coil Storage Tank
Service	Domestic Hot Water
Total Capacity	300 L
Tank Diameter	450 mm
Tank Height	2000 mm
DHW Outlet Size	20ϕ
Standby Heat Loss	2.1 Kwh/24h
Size of Solar Indirect Coil	1.2 m^2

Name	Pump Station 1
Service	Solar Thermal Collector Circuit
Pump Flow	0.7 cmh
Pump Head	7.5 m
Electrical Power Supply	230 V
Frequency	50
Power Consumption	235 W
Pipe Connection Size	25ϕ

Name	Solar Thermal Collector
Service	Domestic Hot Water and Heating
Type	Evacuated Tube
Quantity	2
Gross Collector Area	2.61 m^2
Net Aperture Area	1.71 m^2
Max. Operating Temperature	99°C
Stagnation Temperature	375°C
Max. Operating Pressure	6 Bar
Nominal Flow Rate	237 L/hr
Efficiency η_0	73 %
Effective Heat Transfer Coefficient	
K_1	1.553 w/m^2
K_2	0.0022 w/m^2
Thermal Capacity	4.1 ckj (m^2 · K)

1 / 1

1.5 Electrical Energy production

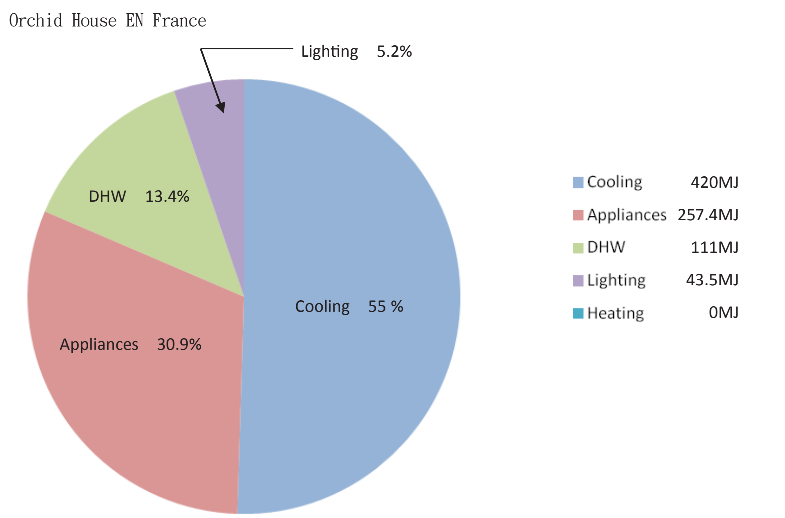
i. PV Modules (Type)
PV module type is multi-crystalline module with Aluminum frame.

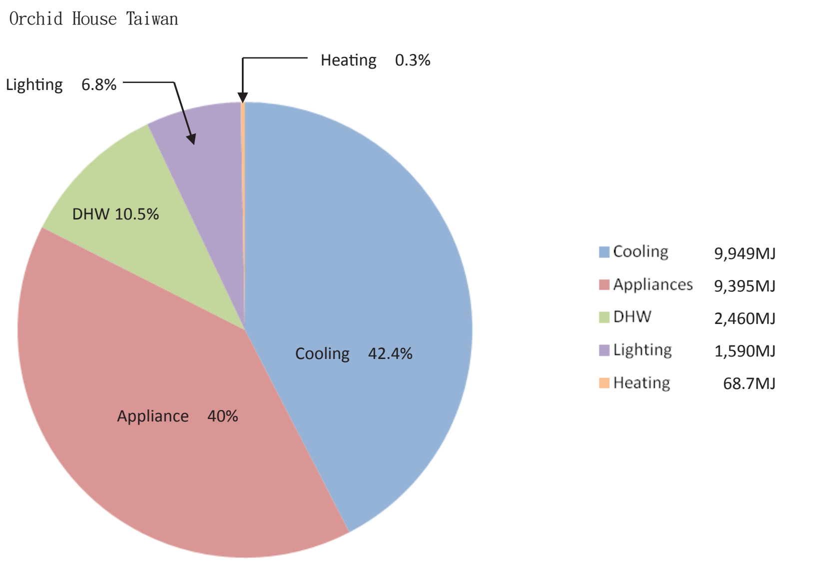
ii. PV panels area (m2)
Single module includes Aluminum frame is 1.6335 m2. The whole system consists of 24 modules and the total module area is 39.204 m2.

iii. Installed PV power (kWp)
Single module peak power is 250 Wp. Total 24 modules produce peak power of 6,000 Wp.

iiii. Estimated energy production (kWh/year)
Simulation of yearly energy production is 6,960 kWh/year, in Taiwan.

1.6 Energy Consumption

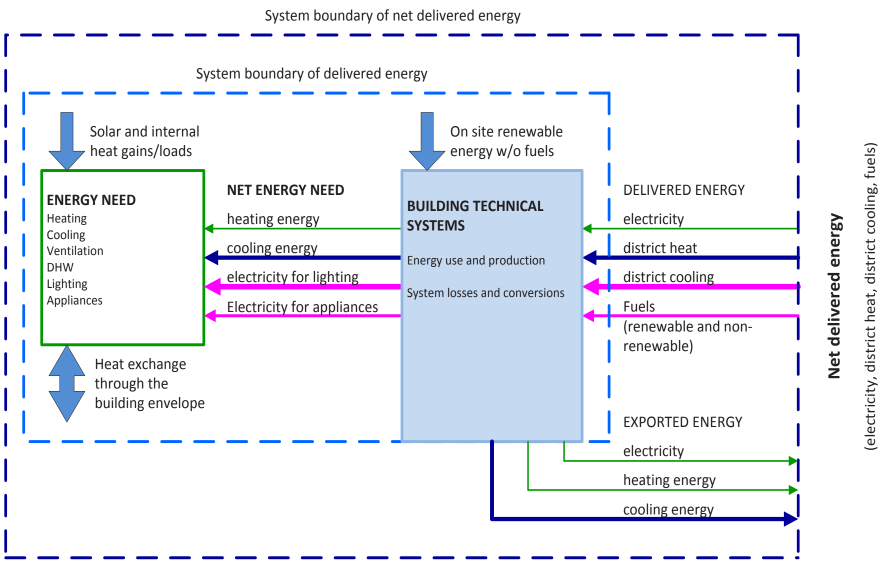




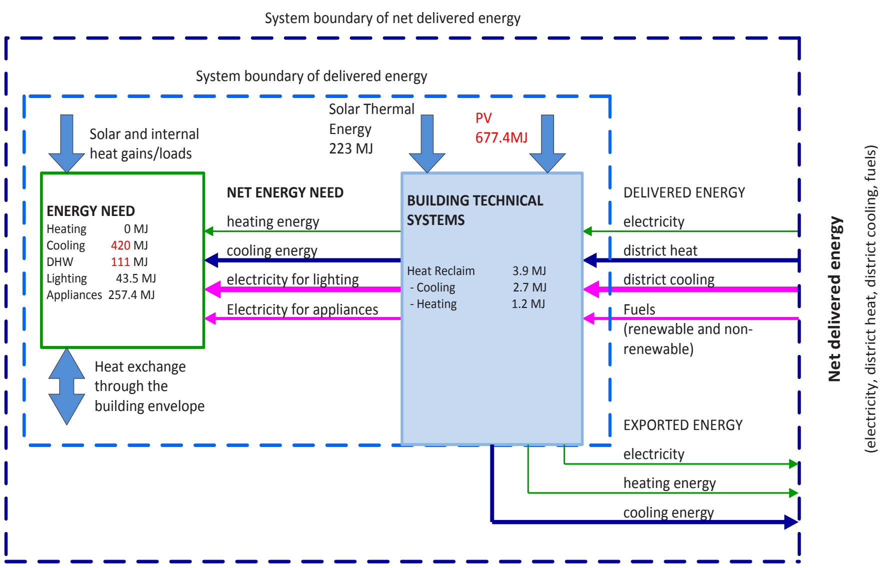
1.7 *Energy Balance*

1.7.1 Energy Balance

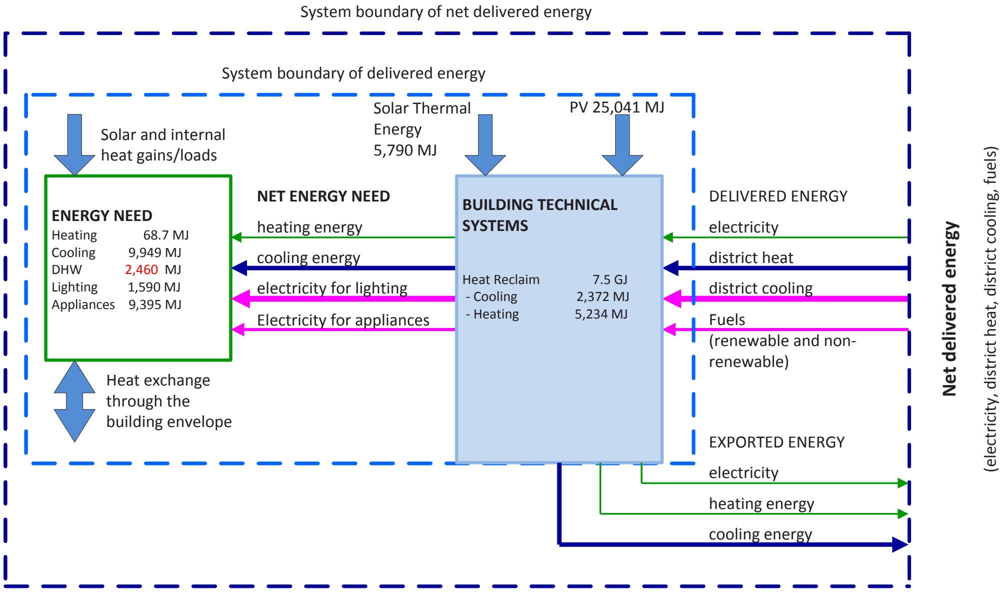
According to EPBD recast – Directive 2010/31/EU of the European parliament and the Council of 19 May 2010 on the energy performance of buildings (recast) – the Member States shall ensure that by 31 December 2020, all new buildings are nearly zero energy building. In the directive 'nearly-energy building' means a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby. The following figure proposed by REHVA Task Fore is to show the energy boundary of net delivered energy and how it forms from energy need, energy use of technical building systems, on-site renewable energy production, delivered energy and exported energy.



- Energy Balance for Orchid House EN France – 10 days

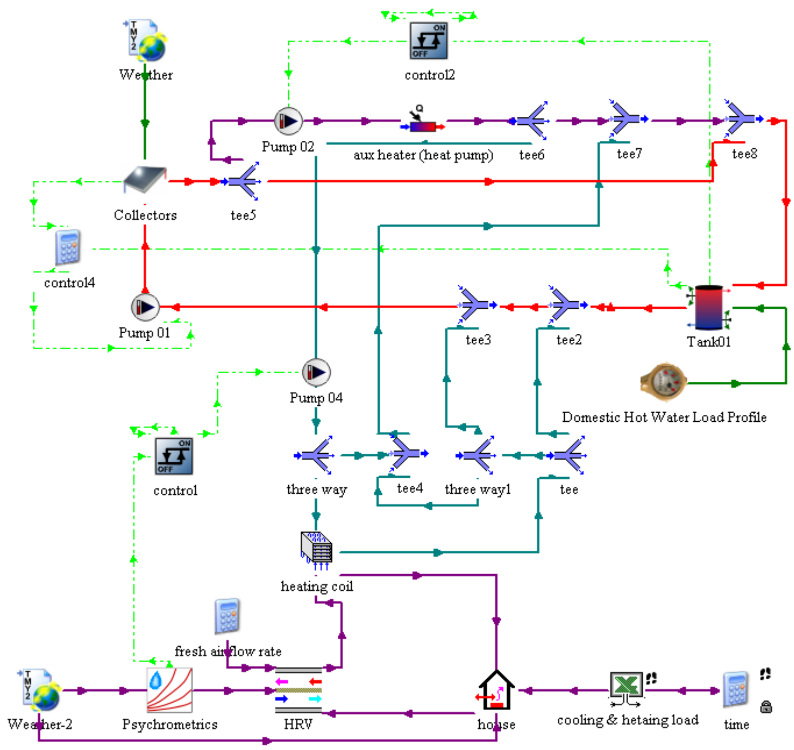


- Energy Balance for Orchid House Taiwan – 1 Year



1.7.2 TRNSYS Simulation Program

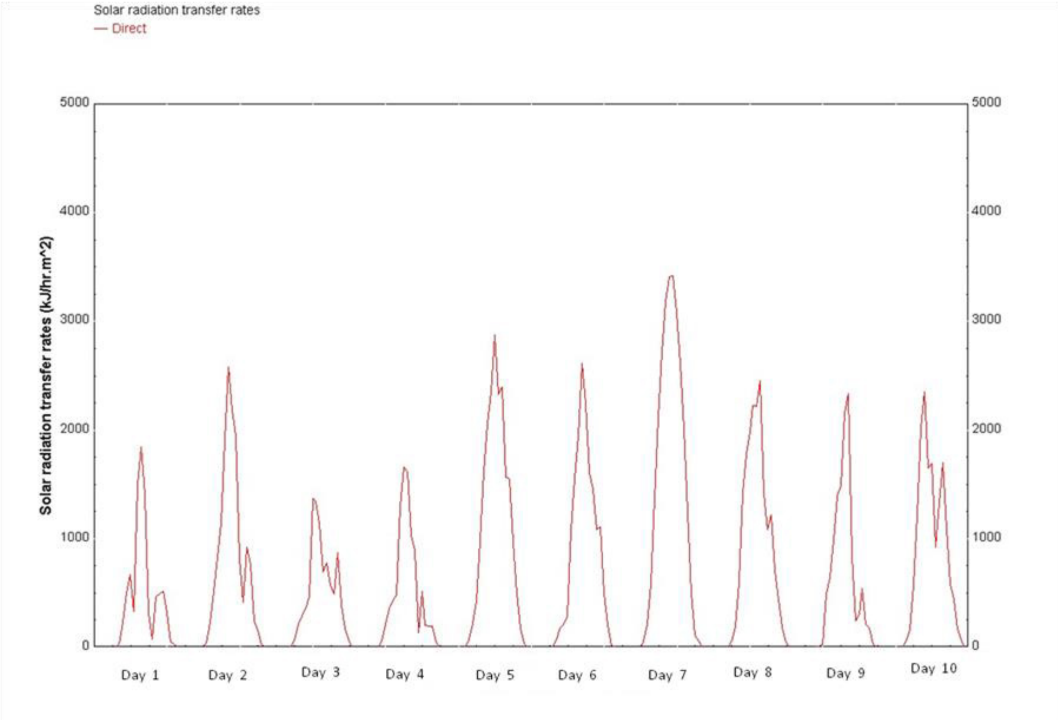
TRNSYS is an acronym for "transient Simulation", which is quasi-steady simulation model. The program consists of many subroutines that model subsystem components. The mathematical models for the subsystem components are given in terms of their ordinary differential or algebraic equation. These components can be interconnected in a certain manner, solve differential equations, and facilitate information output.



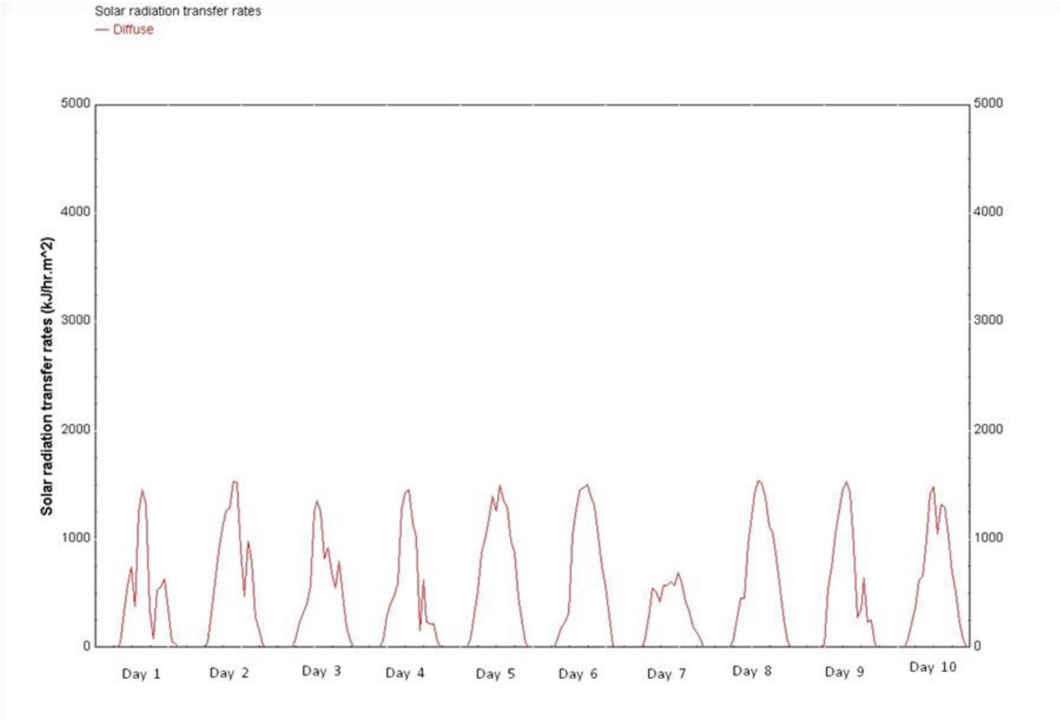
Trnsys Overall Flow Diagram

- Energy Balance for Orchid House EN France – 10 days

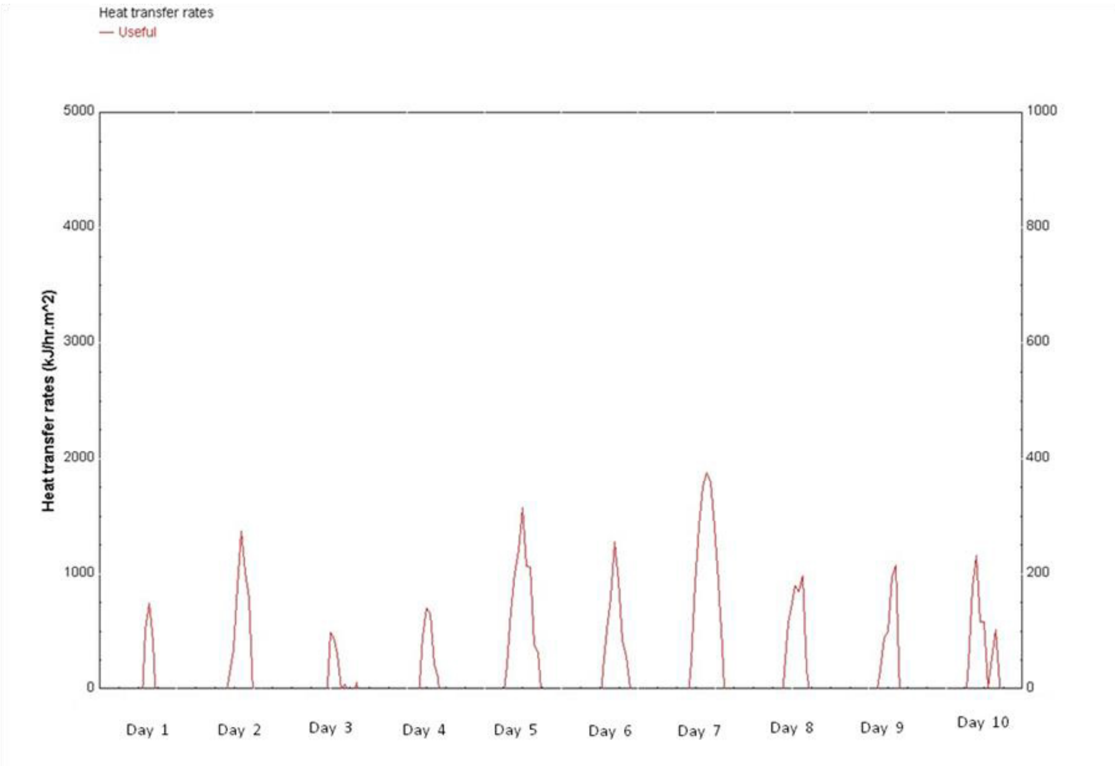
(1). Solar Thermal Energy

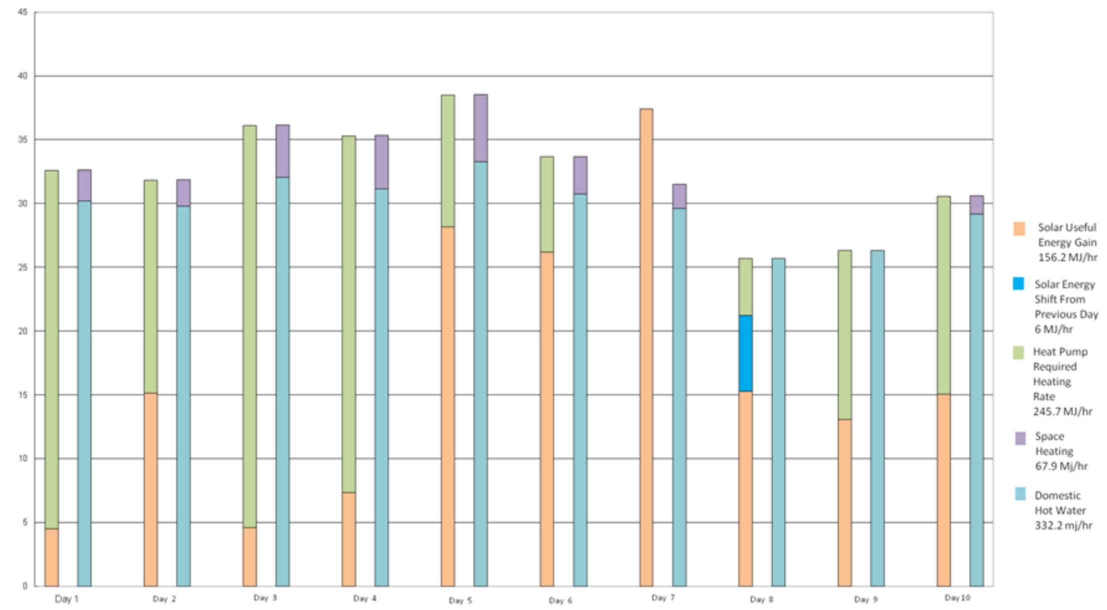


Direct Solar Radiation Transfer Rate - France

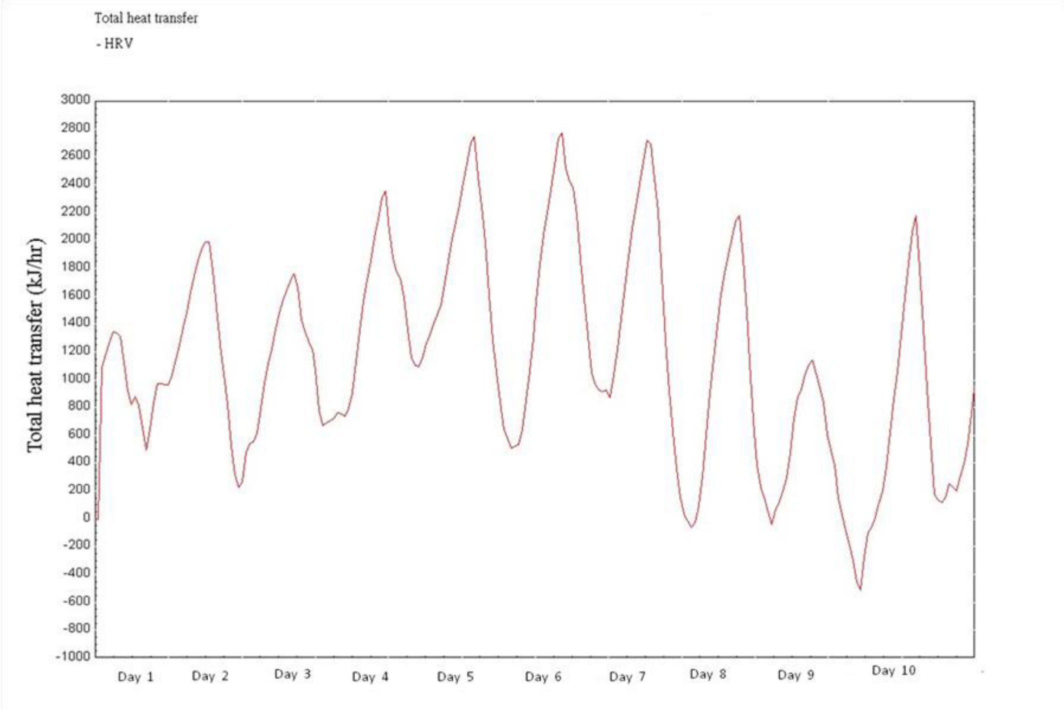


Diffuse Solar Radiation Transfer Rate - France

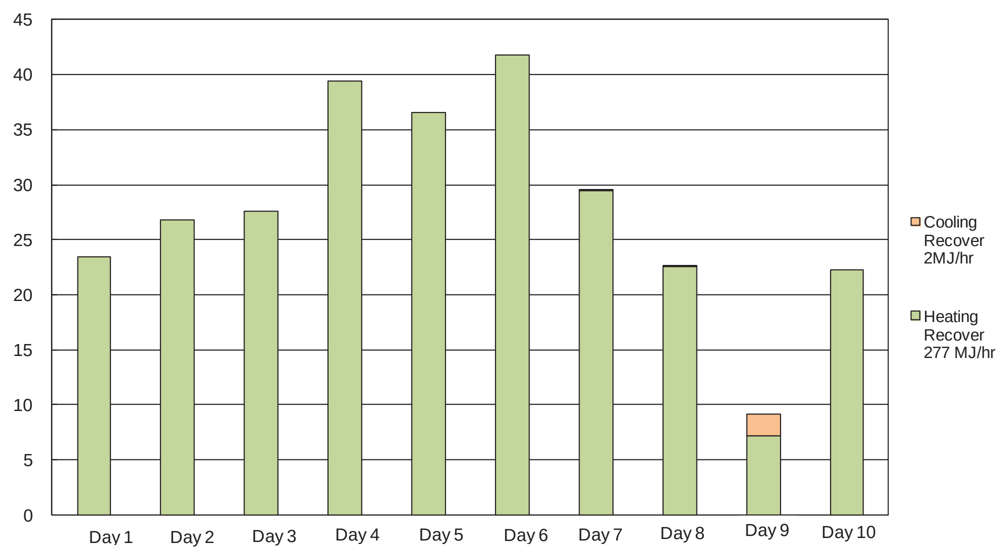




Useful Heat Transfer Rate - France

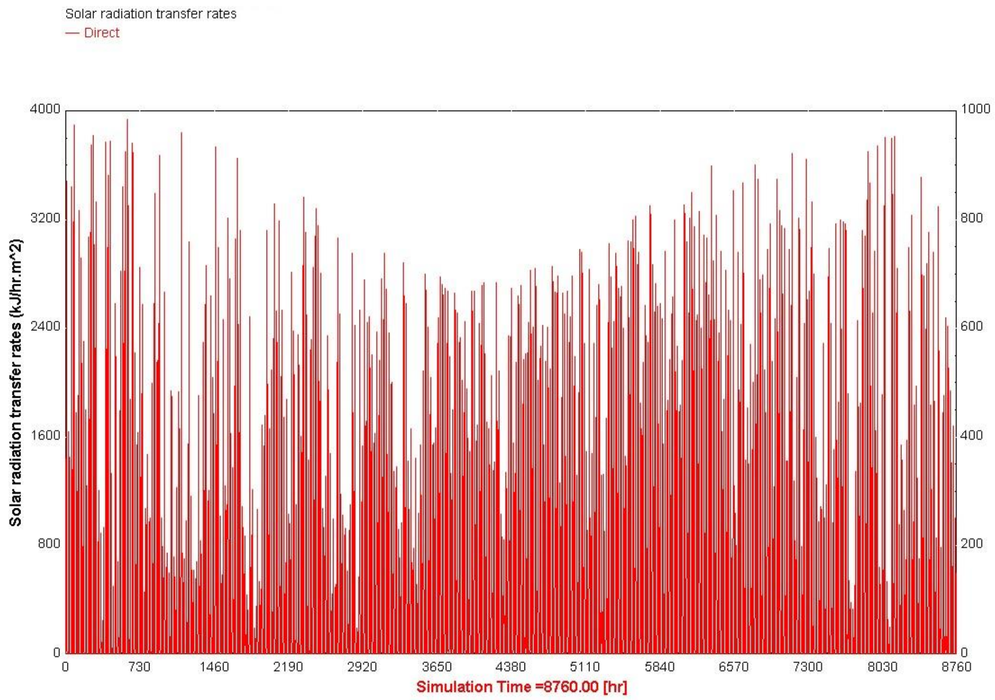


(2). Heat Reclaimed by HRV

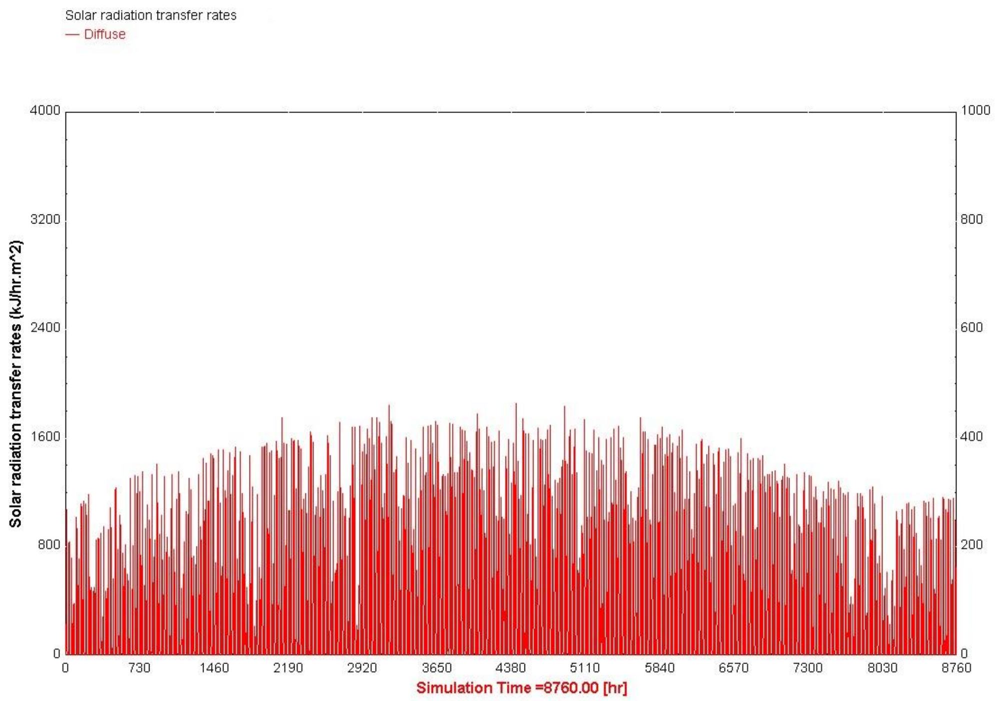


Energy Recovered by HRV - France

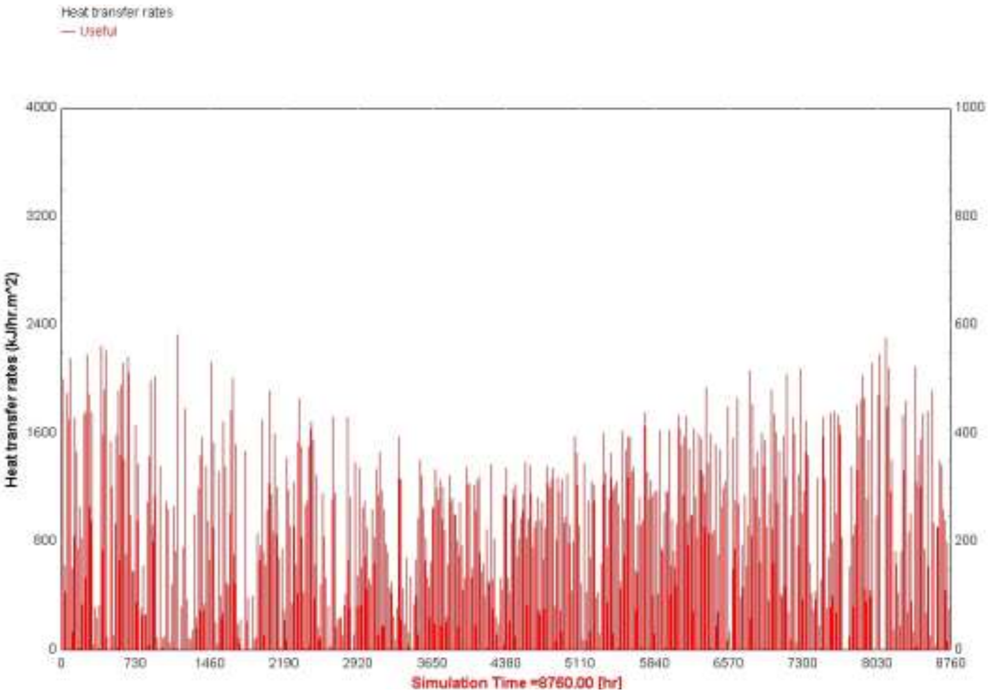
- Energy Balance for Orchid House Taiwan – 1 Year
  (1). Solar Thermal Energy



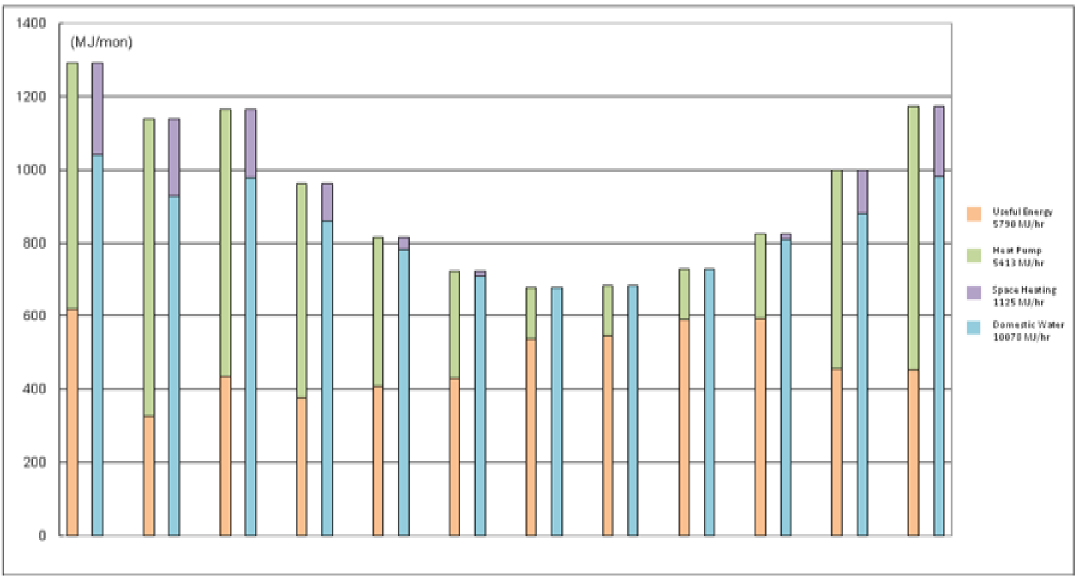
Direct Solar Radiation Transfer Rate - Taipei



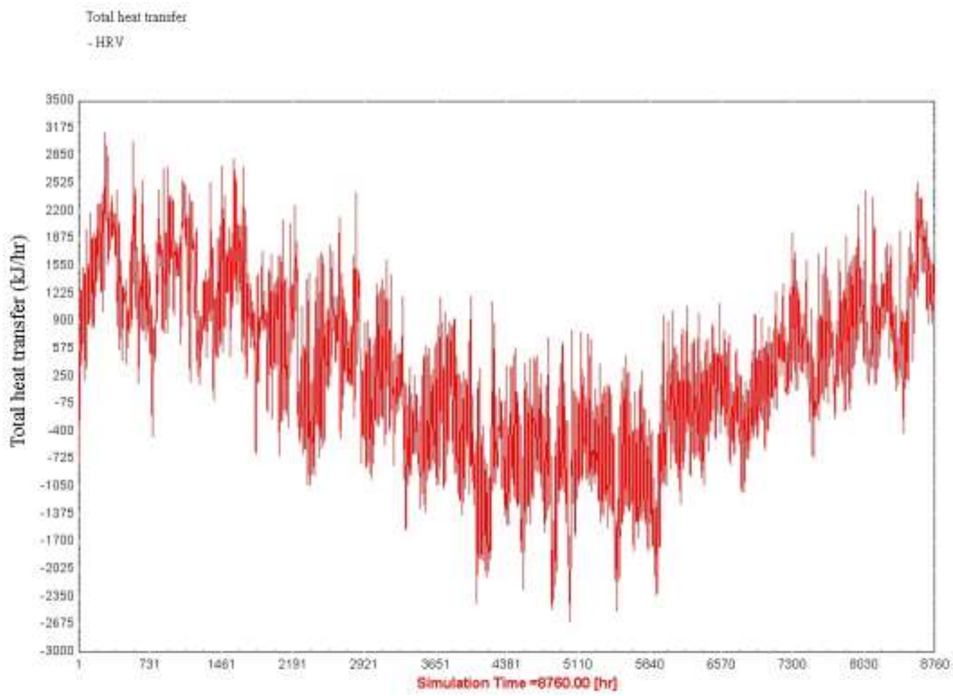
Diffuse Solar Radiation Transfer Rate - Taipei



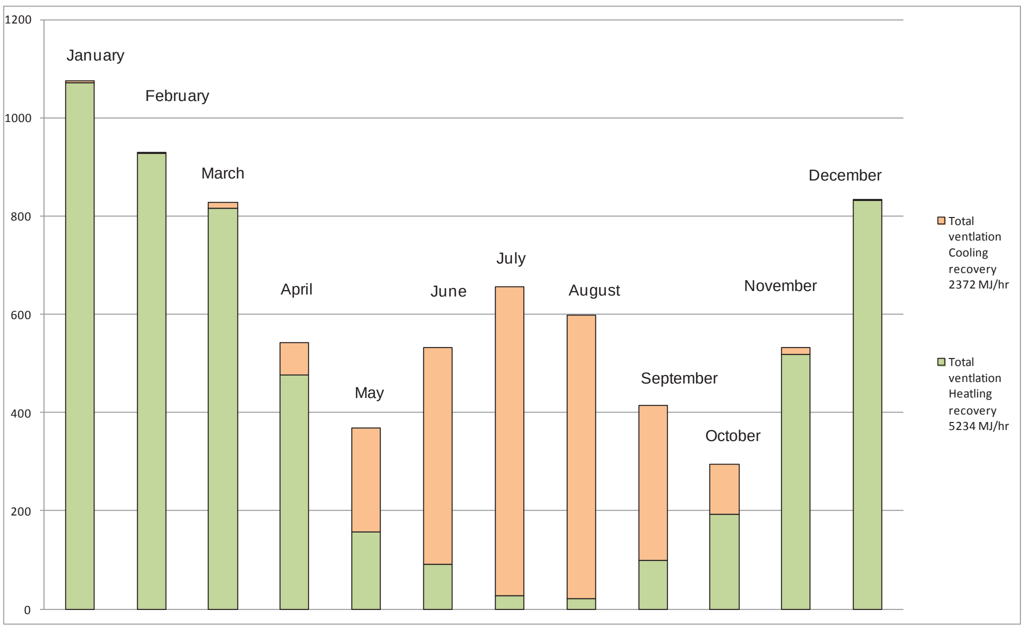
Useful Heat Transfer Rate - Taipei



Energy Solar Thermal Energy Balance - Taipei



(2). Heat Reclaimed by HRV



Energy Recovered by HRV - Taipei

1.8 List of Singular and Innovative materials and Systems

Equipment and Materials

- Phase change materials (PCM) unit
- Heat reclaim ventilator with automatic control
- Heat pump with the feature of nighttime quiet operation function

System

- Advanced House Automation System (BAS)
- Solar thermal system for both DHW and space heating
- Hot water storage tank of DHW system stores high temperature water
- Integrated Battery Energy Storage System (BESS).

2.0 Appliances Report

Product Name	Manufacturer	Model Name	Specifications	Size (W/D/H) cm	Energy label	Power
Refrigeration / Freezing	Electrolux	ENN2843AOW	R: 210 L F: 58 L	54/55/178	A+	150 W
Oven	Best	OV-365	58 L	60/52.4/60		2150 W
Dishwasher	Electrolux	ESL6810RO	8 place settings Max. Water Temp. ：70℃	60/55/90	A+++	2200W/9.8L
Cooking	HCG	RF102	2 heating plates	29/51		1600 W
Washer	THOMSON	TX-1199	Max. Water Temp.up to 60℃	45/60/90		1450 W
Dryer	BOSCH	WTC82101TC		59.9/63.5/84.2		1850 W
TV	Vivitek	Qumi-Q7 HD	800 lm / 3D	16/10.92/3.3		Normal100 W Standby 6W
Notebook	ASUS	Transformer AiO P1801	18.4 inch	46.6/16.2/37.6		180 W
Extractor hood	Best	Gloss	630 m3/h	45.5/43.5		260 W

3.0 Comprehensive Energy Analysis and Discussion Report

3.1 Section I - Projected Performances of Final Housing Unit Design: Minimum Requirements

3.1.1 Introduction
Our objective is to have both sunlight and water work together to ensure optimal living conditions and minimal waste for the occupants of the Orchid House. The Orchid House harnesses natural light not only to generate electric energy through the photovoltaic panels integrated on the roof, but also to regulate the internal temperatures through the thermal mass wall. The Orchid House also maximizes water efficacy through its water wall greenhouse cooling and drip irrigation systems. Lastly, sunlight and water interact in the Orchid House to provide heated water that can be used domestically as well as to radiate warmth when run under the panels of the floor.

In order to maximize energy efficiency, NCTU/UNICODE sets numerous parameters to test the home systems. Our modeling process is summarized as follows:

- Use building information modeling to create a baseline model of the house to study the relationship between the envelope and the measureable area
- Predict internal gains within the structure to design HVAC system and additional cooling device
- Predict annual electricity demand
- Predict house performance in competition week

3.1.2 Tools
NCTU/UNICODE team has used multiple computer tools to generate models and run studies, including:

Autodesk Revit
We are proud to have Autodesk's sponsorship to work on the solar house. It allows users to design a building and its components in 3D, annotate the model with 2D drafting elements and access building information directly from the building models database.

Rhinoceros
Rhino specializes in free-form non-uniform rational B-spline (NURBS) modeling. With this modeling tool, we have the freedom to design through a computer sketch format, to create a useful data and housing image.

Ecotect
Ecotect specializes in whole-building energy analysis, thermal performance, water usage and cost evaluation, solar radiation and daylighting.

3.1.3 Climate Data and Weather Analysis
Taiwan is an island located in South East Asia on the Pacific Rim. The latitude of Taiwan is 23.5 degree north, right on the Tropic of Cancer. Taipei city is at the north tip of the island and 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. We get prevailing southwest winds in summer and northeast winds in winter on this island.

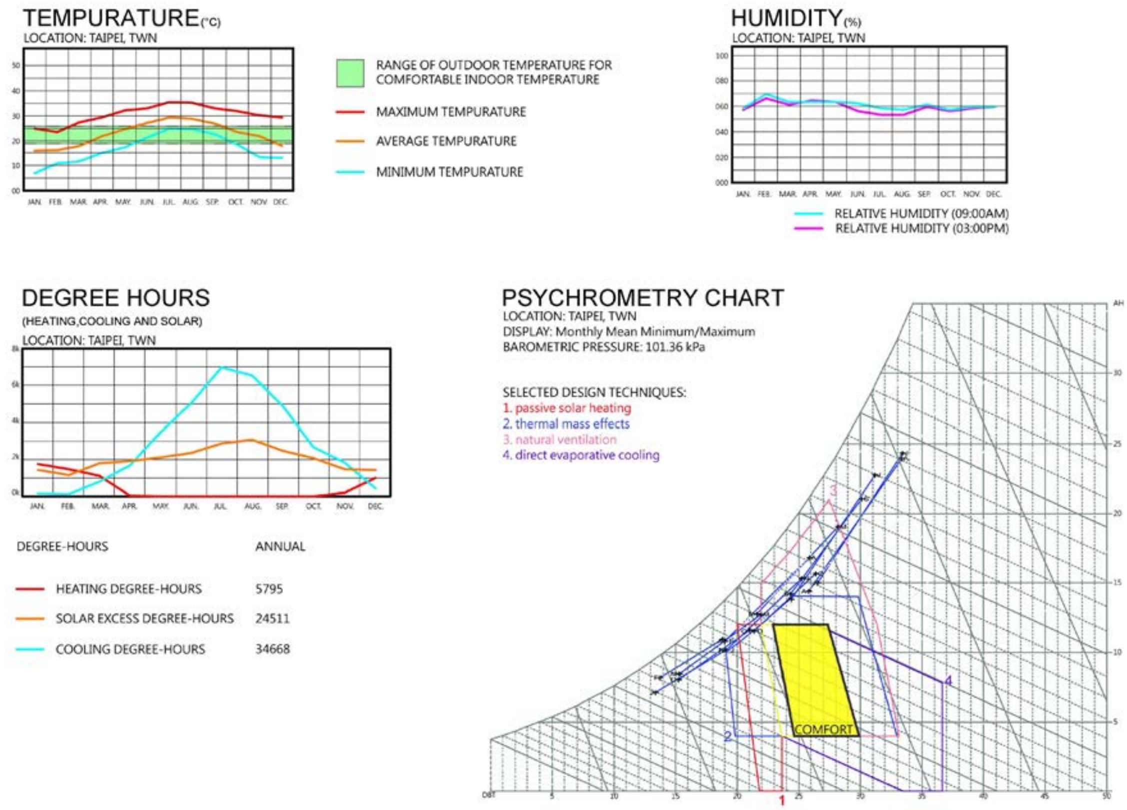


Figure 3.1.3.1 Basic Climate Condition of Taipei

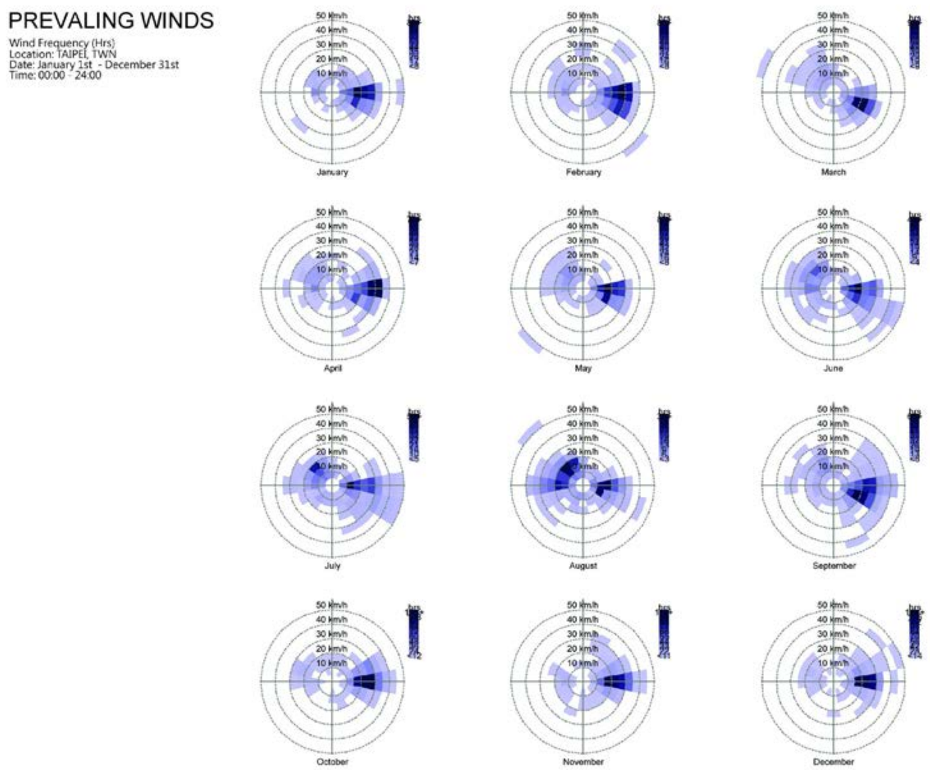


Figure 3.1.3.2 Surface Wind Rose Plot of Taipei

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 is freezing and summer is comfortable. The prevailing winds blow from the west all year round.

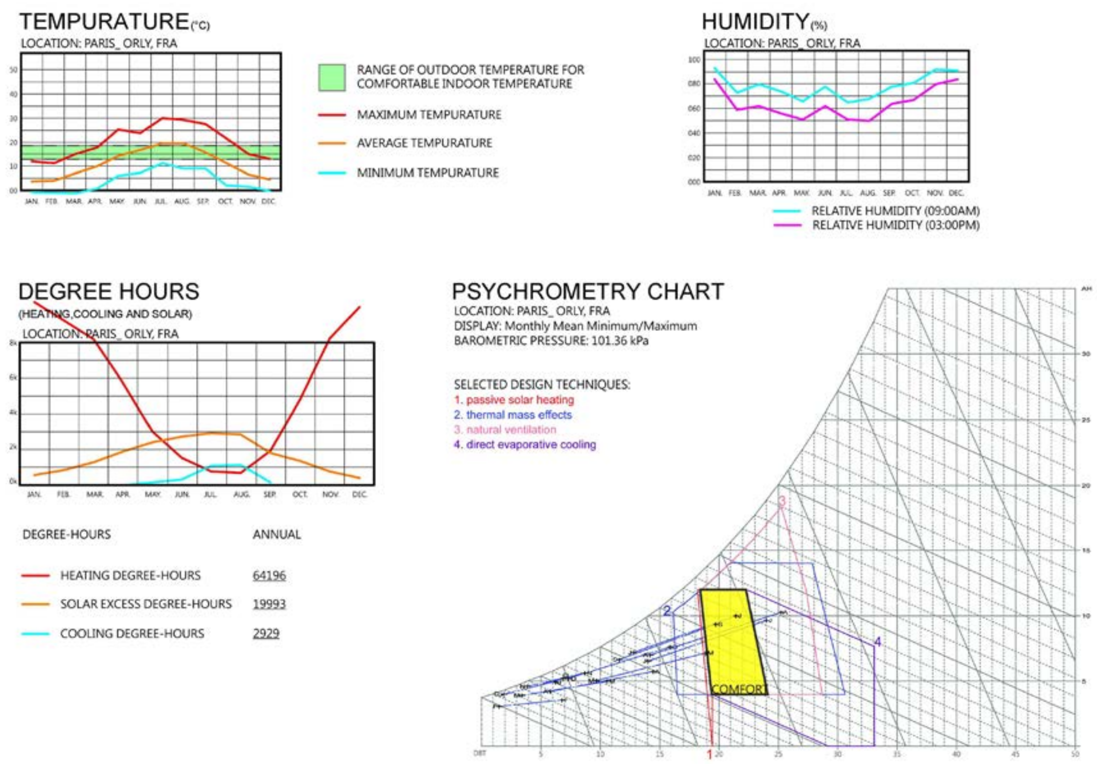


Figure 3.1.3.3 Basic Climate Condition of Versailles

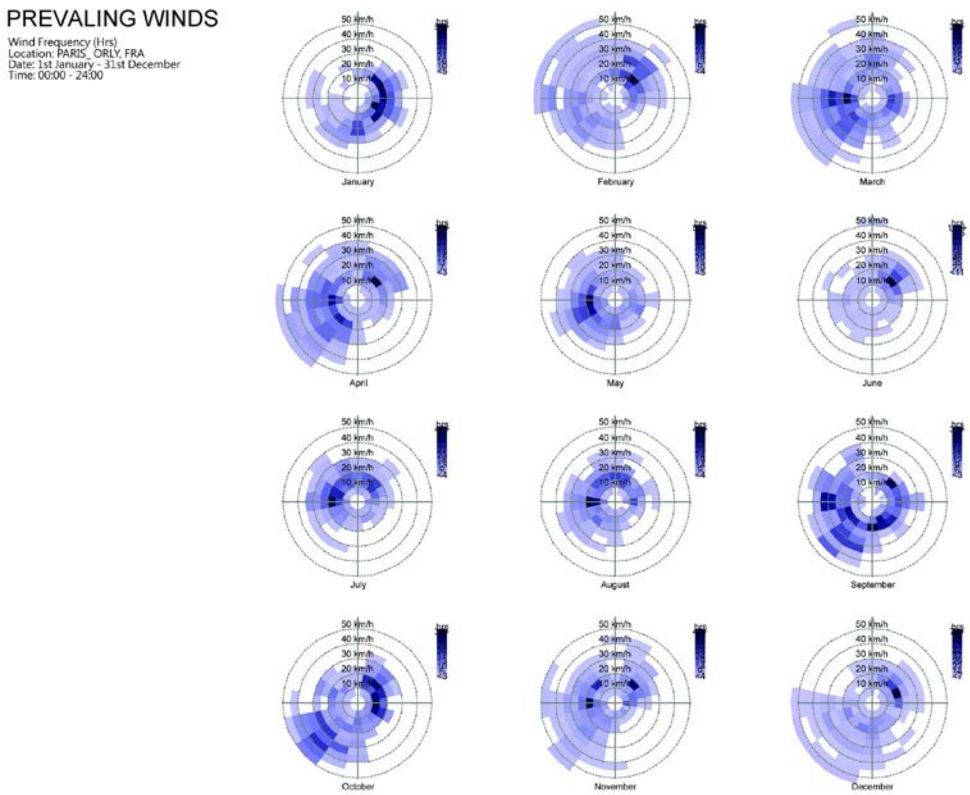


Figure 3.1.3.4 Surface Wind Rose Chart of Versailles

3.1.4 Team Energy Strategy

In order to address the conditions of summer hot humidity and winter cold humidity, our team proposes the following strategies to maximize comfort while minimizing the electricity use. The overall energy strategy is to first use the passive methods followed by the semi-passive methods, and as the final resort, the mechanical system when no passive methods are available. The electricity to operate the semi-passive and active system comes from sustainable photovoltaic cells.

1. The cooling strategies include:
   - Shading
   - Natural ventilation
   - Solar chimney
   - Earth and vegetation cooling
   - Evaporative cooling
   - Phase change materials
   - Heat exchanger
   - Heat pump cooling
2. The heating strategies include:
   - Direct solar gain
   - Greenhouse effect
   - Thermal wall
   - Heat exchanger preheated by solar hot water
   - Heat pump heating

3.2 Housing Unit and Systems' Description

HVAC System

- The HVAC System consists of cooling, heating and ventilation system.

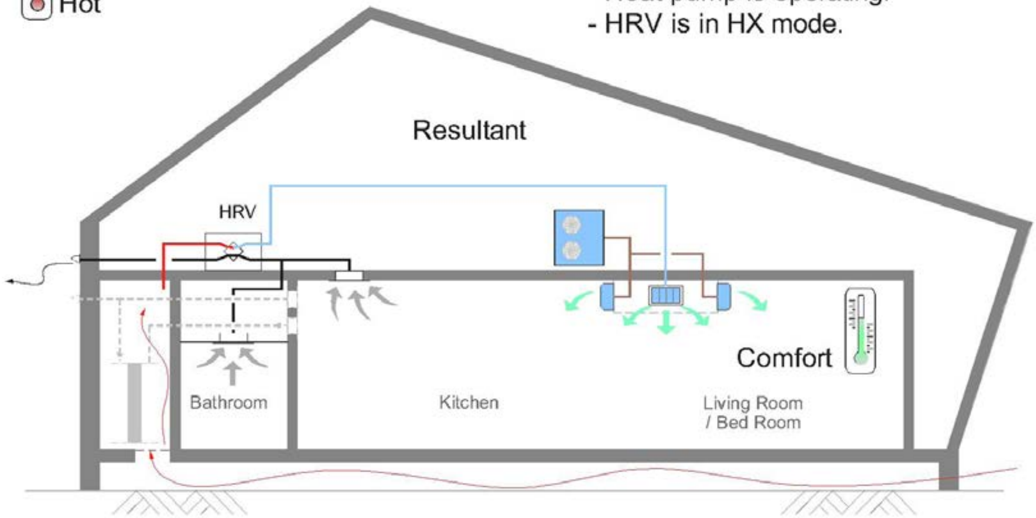
i. Cooling System

- The air-conditioning equipment for the space cooling is a heat pump system comprising one outdoor units 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 3.67 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 achieve the excellent partial load performance.

Summer - Day

Hot

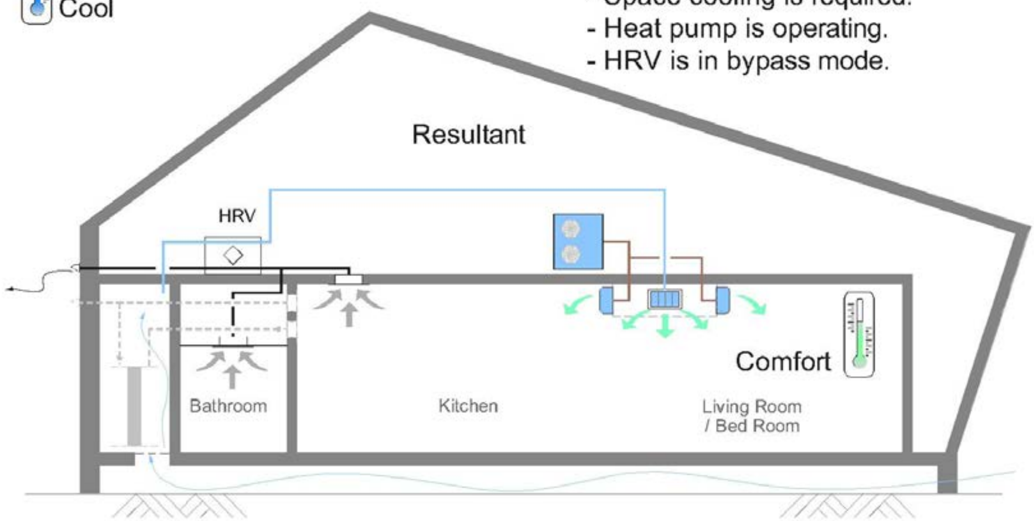
- Typical of summer day.
- Space cooling is required.
- Heat pump is operating.
- HRV is in HX mode.



Summer - Early Morning

Cool

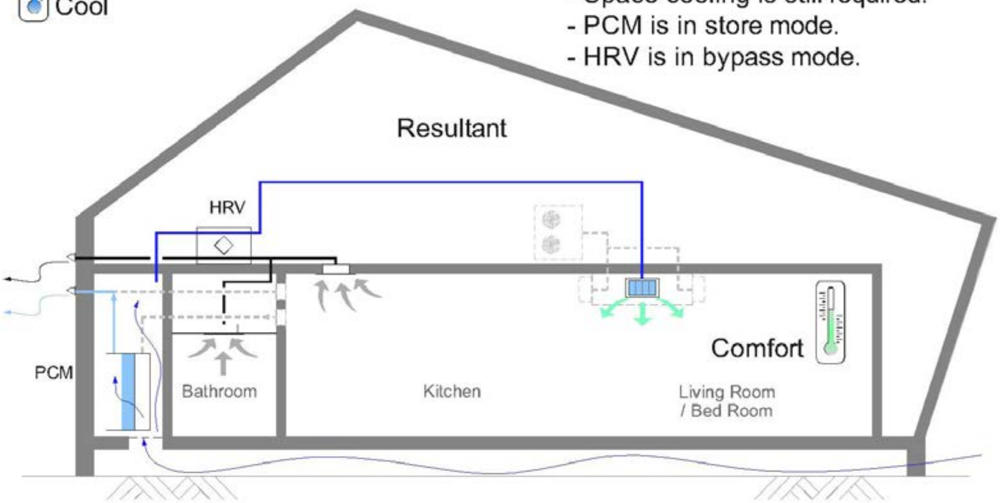
- Outdoor temperature is less than room temperature.
- Space cooling is required.
- Heat pump is operating.
- HRV is in bypass mode.



Spring - Night

Cool

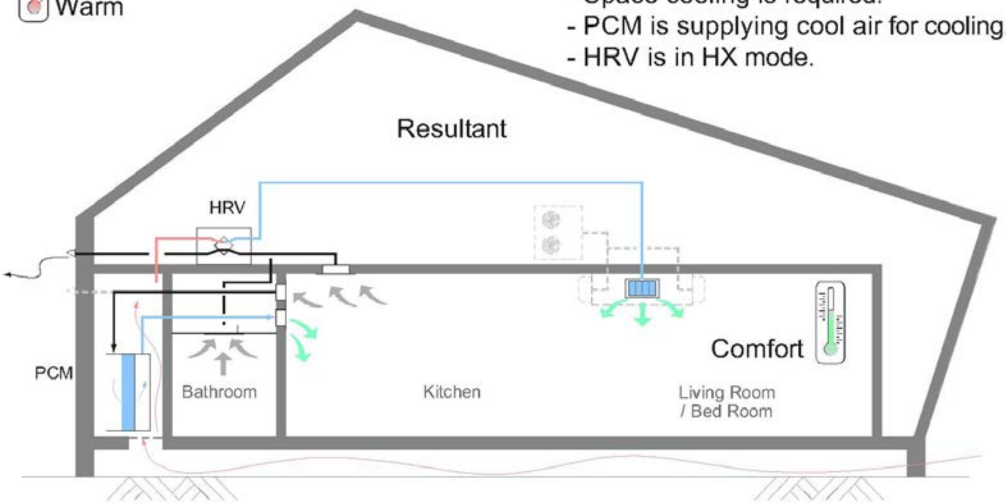
- Outdoor temperature is much less than room temperature.
- Space cooling is still required.
- PCM is in store mode.
- HRV is in bypass mode.



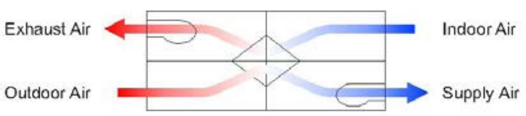
Spring - Day

Warm

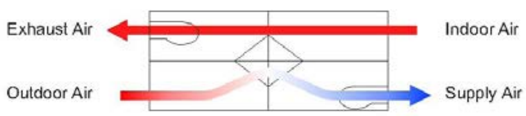
- Outdoor temperature is higher than room temperature.
- Space cooling is required.
- PCM is supplying cool air for cooling.
- HRV is in HX mode.



Legend:



HRV - Heat Exchange Mode

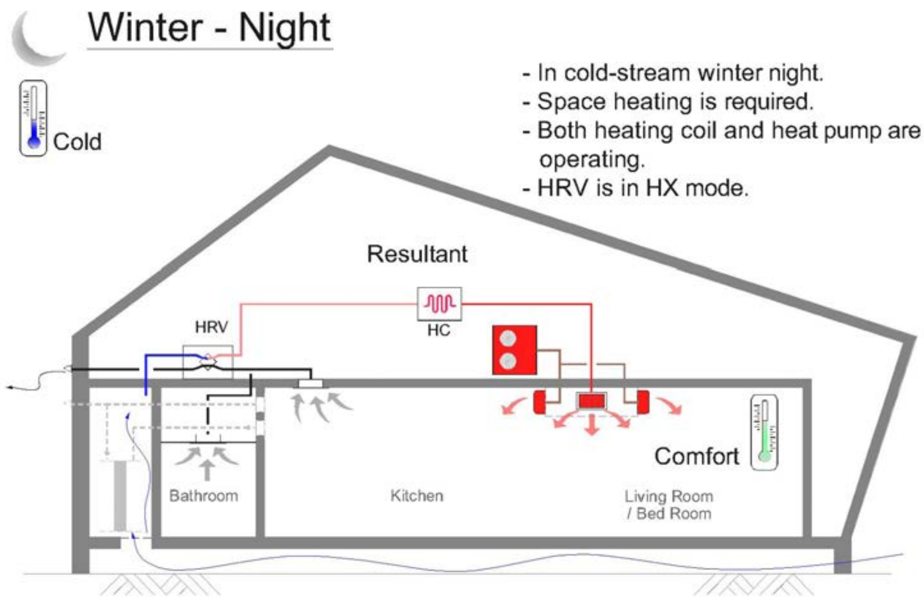


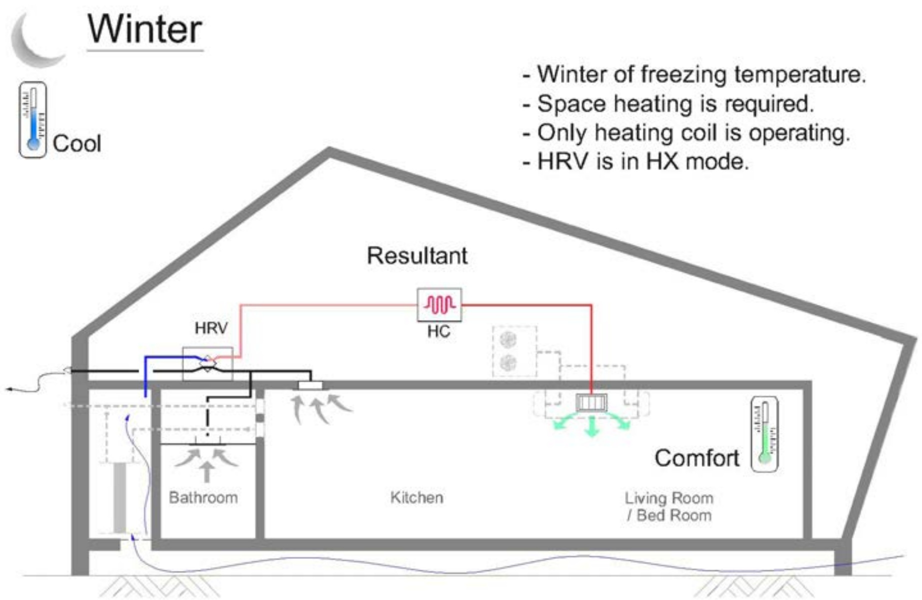
HRV - Bypass Mode

- Hot Air
- Warm Air
- Cool Air
- Cold Air
- Exhaust Air
- Refrigerant Pipe

ii. Heating System

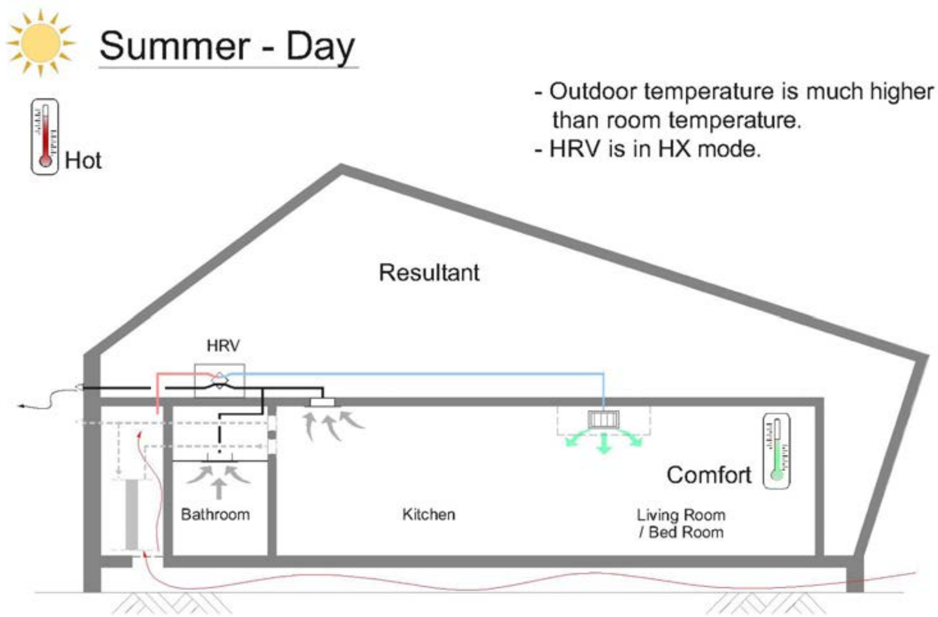
- Since the winter temperature is not severe in Taiwan, the required heat can be provided from the ventilation system – the heating coil on the fresh air supply duct. The heat source of the heating coil comes from the solar energy, i.e. the energy harnessed by the solar thermal collector.
- During a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

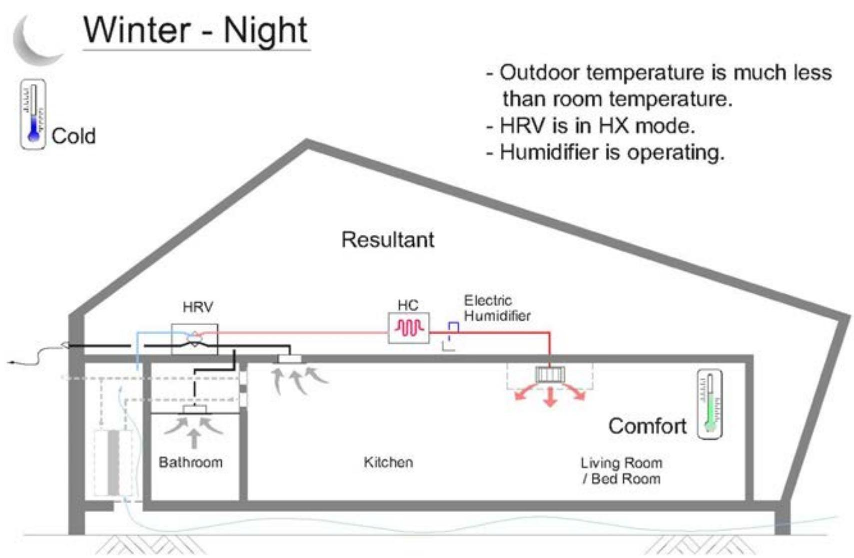




iii. Ventilation System

- Fresh air is supplied at all times of the day. 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.

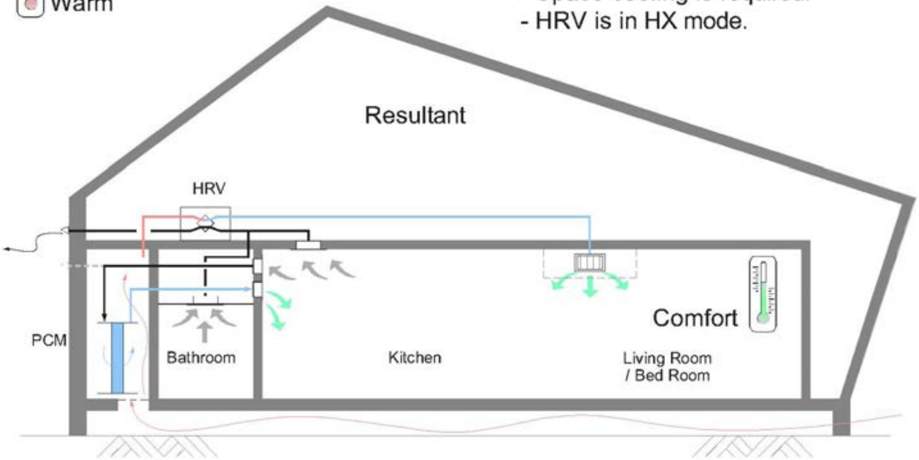




Spring - Day

Warm

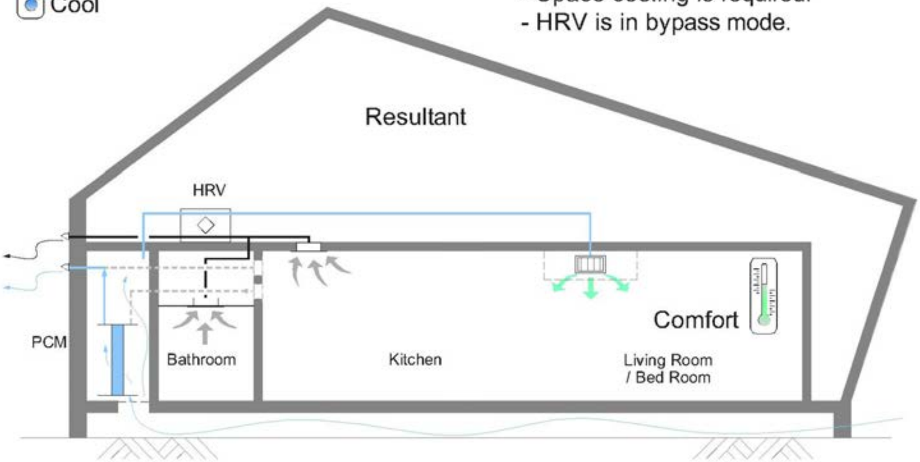
- Outdoor temperature is higher than room temperature.
- Space cooling is required.
- HRV is in HX mode.



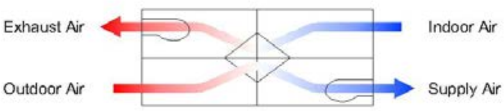
Spring - Night

Cool

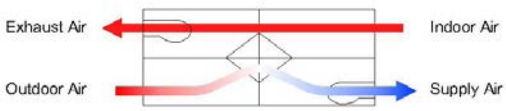
- Outdoor temperature is less than room temperature.
- Space cooling is required.
- HRV is in bypass mode.



Legend:



HRV - Heat Exchange Mode



HRV - Bypass Mode

- Hot Air
- Warm Air
- Cool Air
- Cold Air
- Exhaust Air

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.

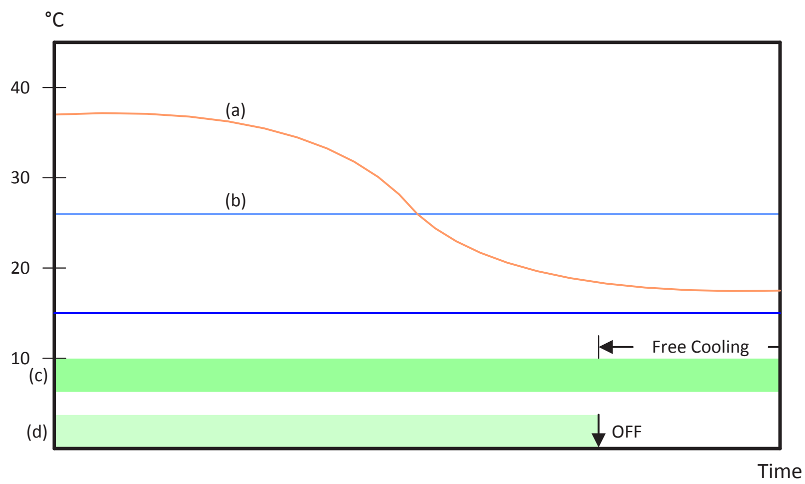
v. Other High Efficiency and Performance Strategies

- 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.

- Phase Change Material (PCM)
  1. Phase change materials, one kind of material used for latent – heat storage, are contained in the still ventilation unit to supply cool fresh air to the living areas. Because PCM changes its aggregate state (solid or liquid), a large amount energy can be stored or released at an almost constant temperature.
  2. During the cool night-time, the storage medium is cooled and change its aggregate state from liquid to solid. When day time arrives, but the outside temperature is still lower than the temperature within the home, the storage medium becomes to absort the heat of fresh air and cool the fresh air by changing its aggregate state from liquid to solid. The cooling potential of this application is almost 19 times greater than concrete at the came weight.
  3. When the temperature outside is higher than inside, the unit re-circulates air from within the room and passes it over the PCM to provide cooling.

- The Optimal Operations

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

3.2 Housing Unit and System's Description

3.2.1 Project's geometric envelope

- Blocking north: To decrease the heat loss of the house, the machine room and the bathroom are placed on the north side, with small strip windows for natural lighting and ventilation.
- South façade's angle: The envelope angles in 12degrees to cut direct heat gain on the south side during noon.
-

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 (52.92 m^2), surrounded by a larger envelope (133 m^2).

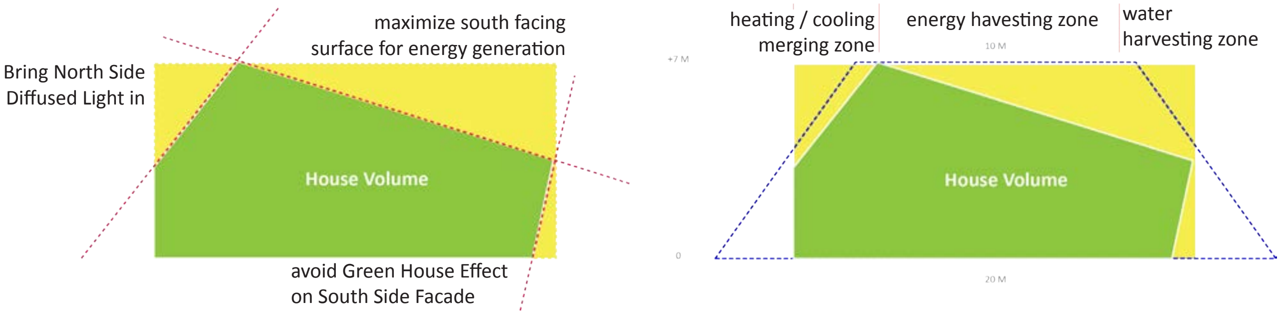


Figure 3.2.1.1 Geometry Aticulation to the environment

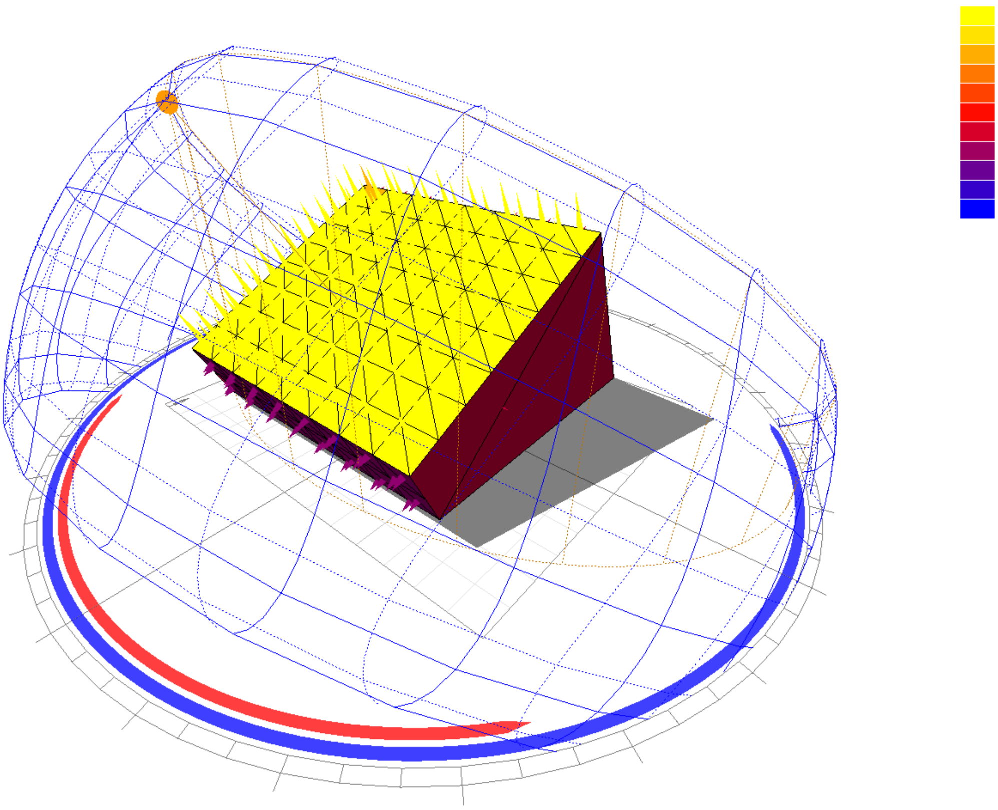


Figure 3.2.1.2 Ecotect Analysis

3.2.2 Passive Design Strategies

The passive design strategies for Cooling are:

1. Shading: Based on the climate analysis of Taipei, the comfortable indoor temperatures 22°C ~ 29°C result from the outdoor balance point temperature 19°C ~ 26°C. As a result, the indoor generated from human, appliances, and PV panels may be released to the outdoor space through conductivity. When we plotted the average temperatures of Taipei to the balance point temperature, we found the overheated period is from June 1st to September 21st, and the underheated period is from December 1st to March 21st. For cooling purposes, we need to shade the south openings from sunlight that comes down at latitude 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 in Taipei.

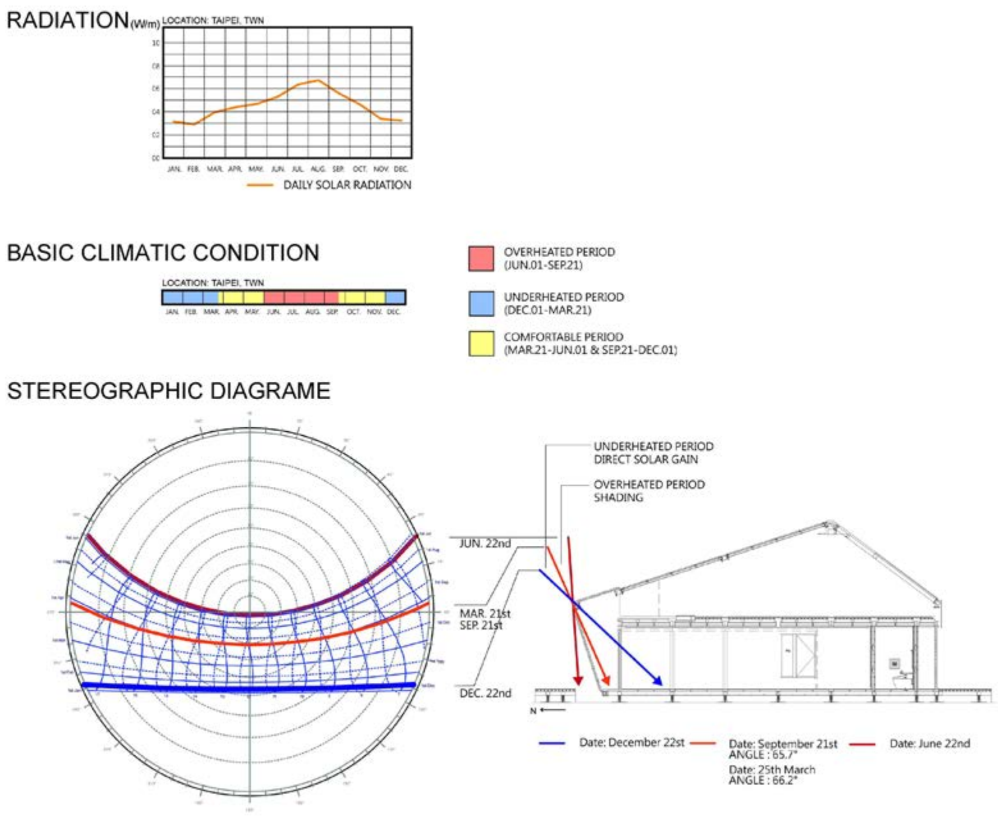


Figure 3.2.2.1 Solar Angle and Shading Diagram

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 southwest 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 by 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.

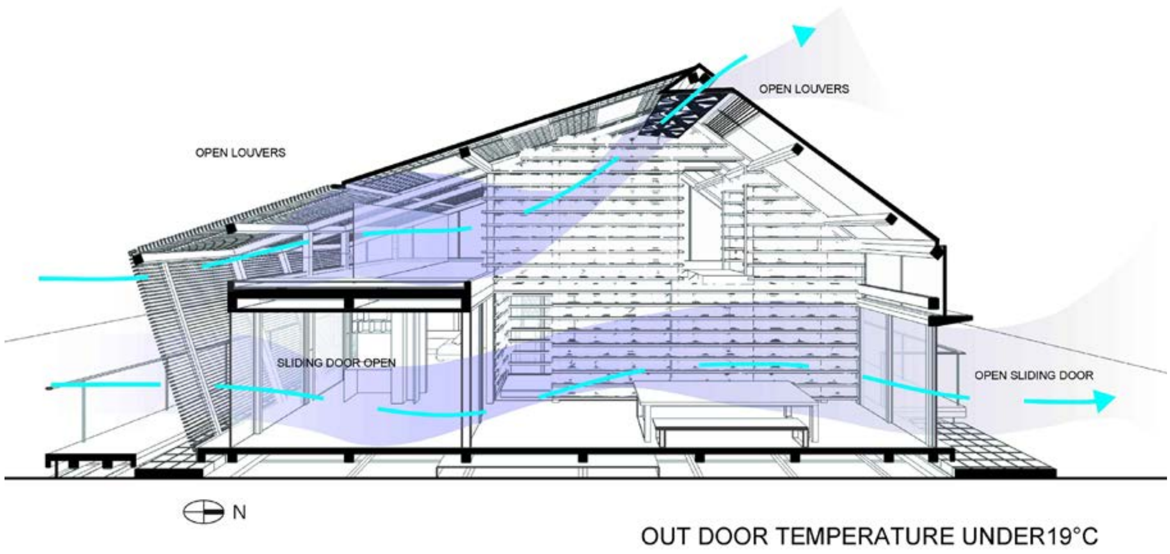


Figure 3.2.2.2 Natural Ventilation Diagram

3. Solar Chimney: When the outdoor temperature is comfortable and no wind, the waste heat generated on the underside of 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 will not exist otherwise. The indoor warm air would rise and escape through the ridge opening. All exterior windows and louvers need to be open to allow outdoor air to enter. This air movement will drive away the heat and humidity from 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.

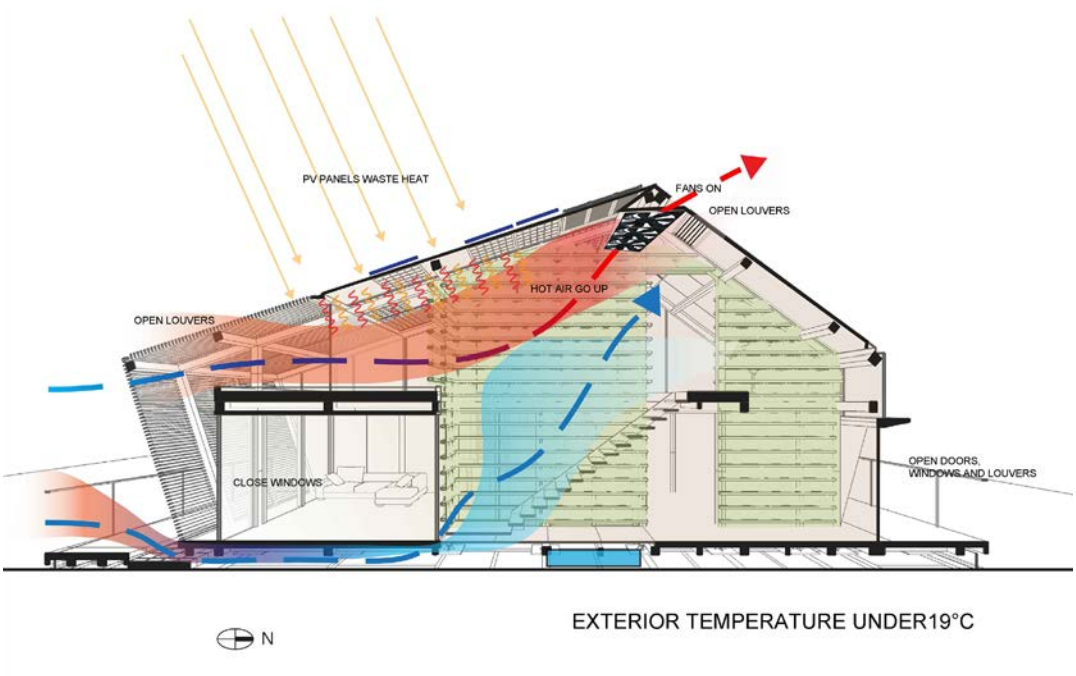


Figure 3.2.2.3 Solar Chimney Diagram

4. Earth 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 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 earth and rain water tank under the floor and then cooled by the evaporative effect of the plants.

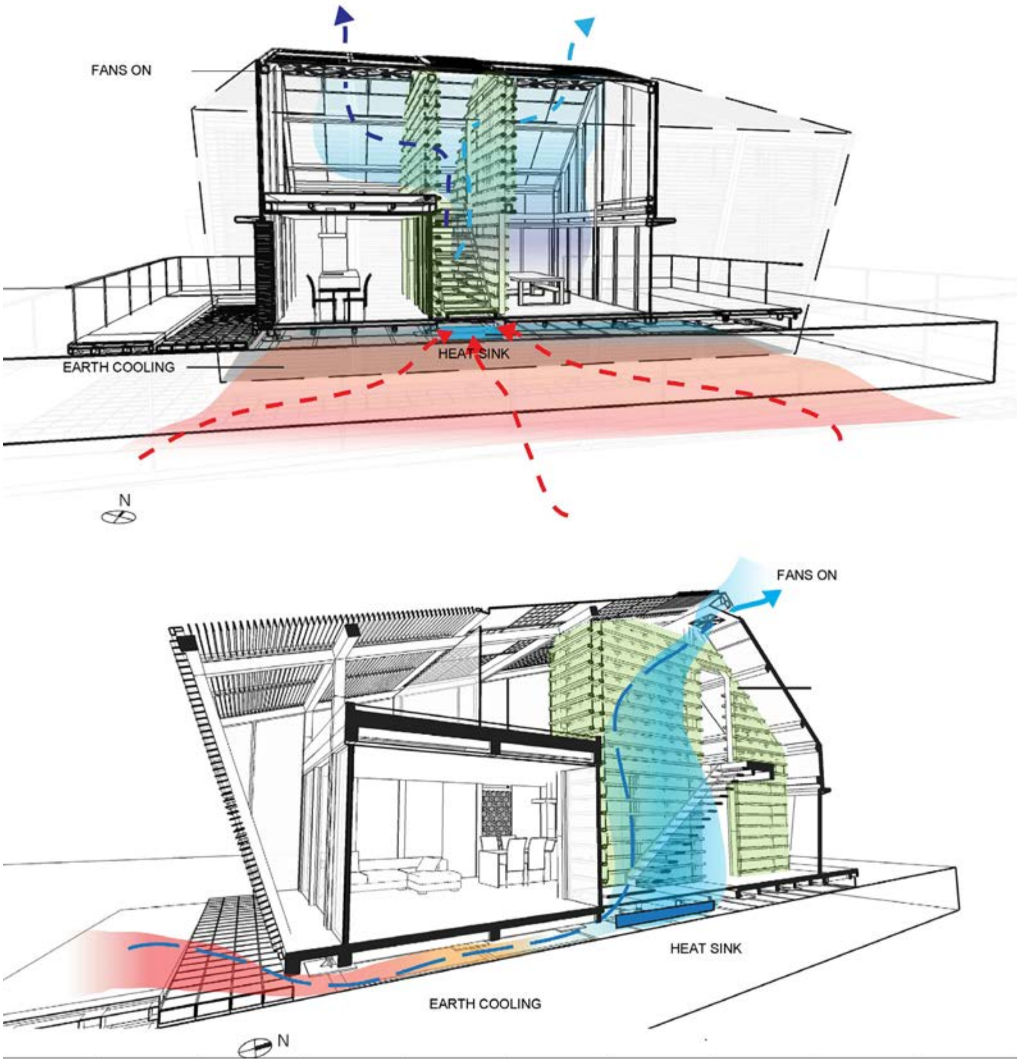


Figure 3.2.2.4 Earth and Vegetation Cooling Diagram

5. Evaporative Cooling: When the outdoor temperature is above the comfortable level, a 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. When the warm outdoor air passes through the water wall, the sensible heat in the air turns to the latent heat of water vapor. The outdoor air temperature is lowered by the 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.

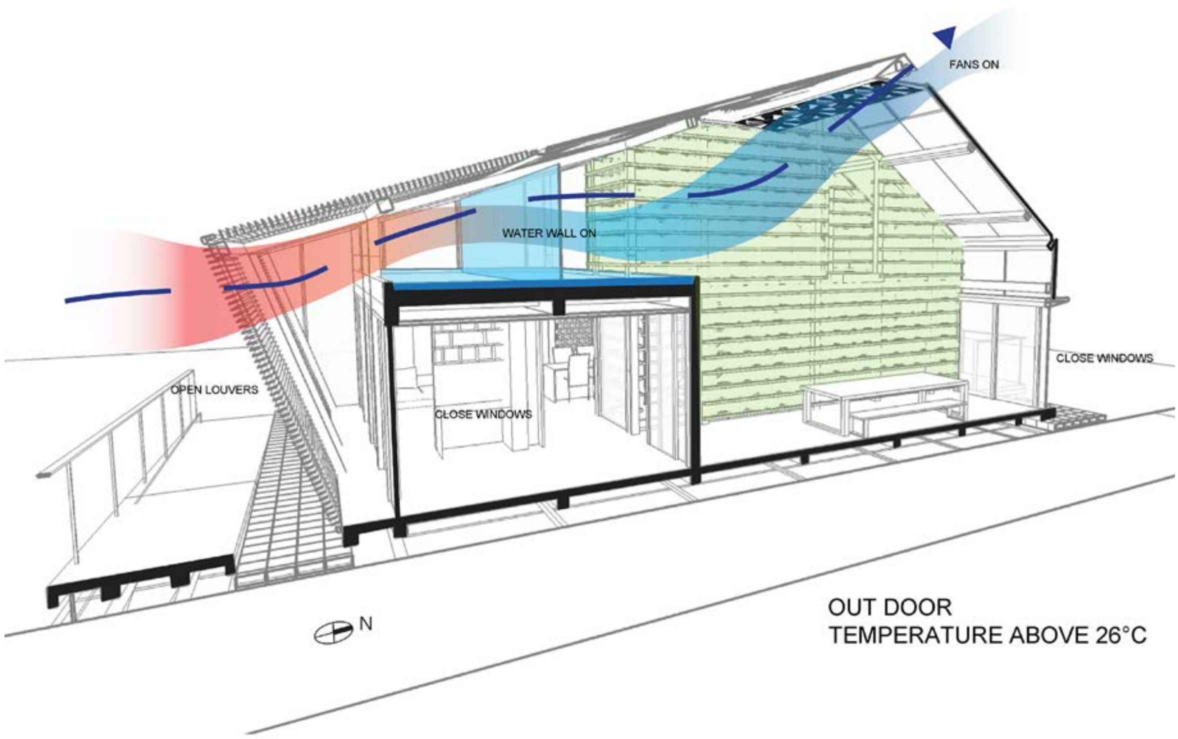


Figure 3.2.2.5 Evaporative Cooling Diagram

The passive 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 in the living spaces during the under-heated season.

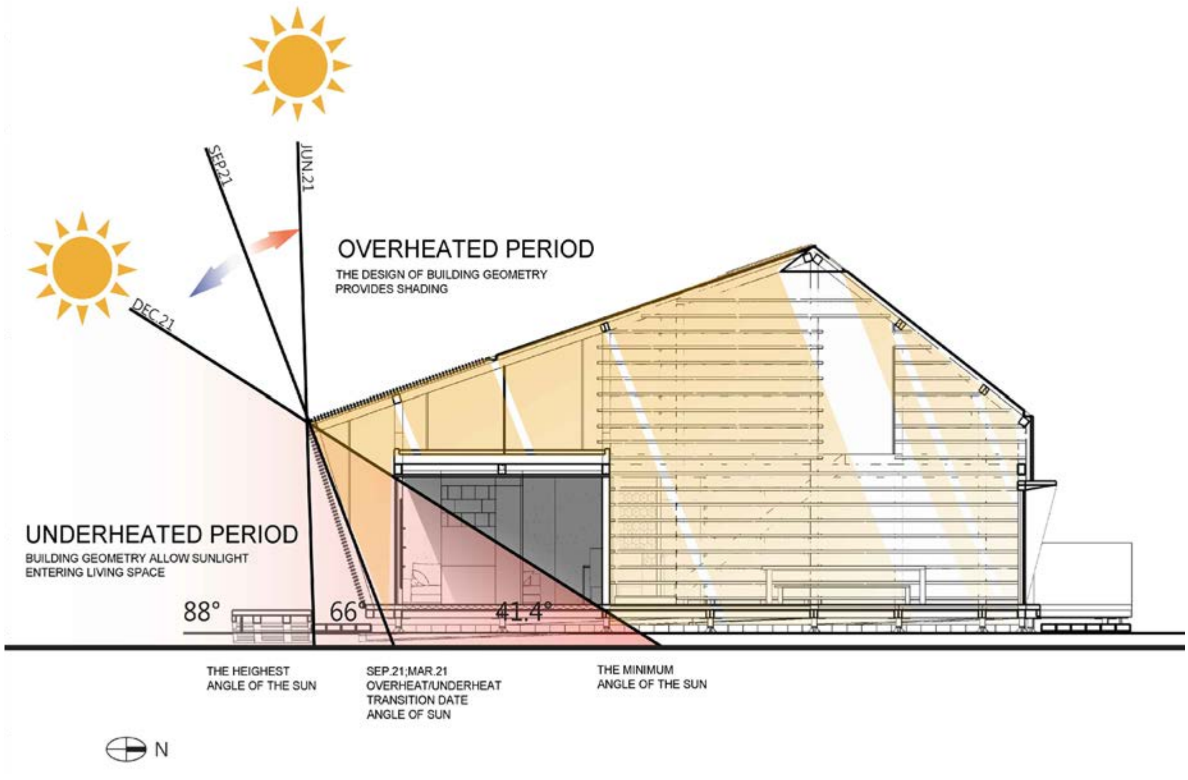


Figure 3.2.2.6 Solar Angle and Direct Solar Gain Diagram

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 green house uses a Polycarbonate sheet - Makrolon that allows 90% of solar radiation to penetrate.
After the short wave solar radiation are 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.

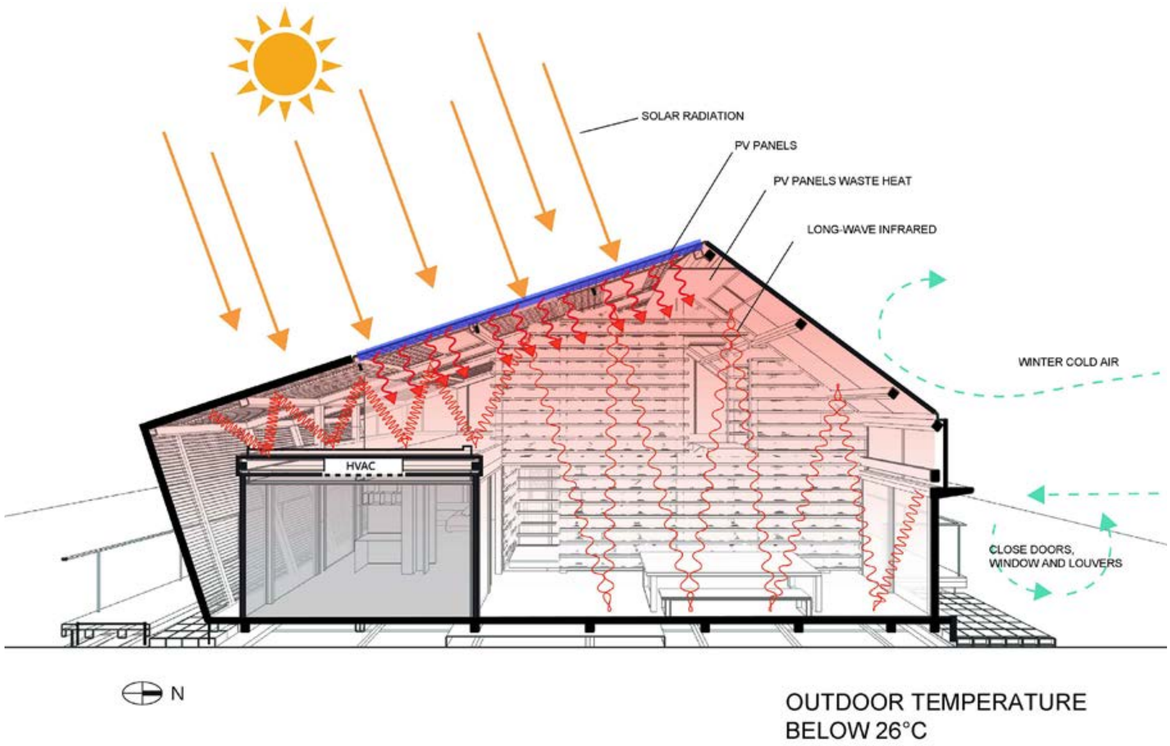


Figure 3.2.2.7 Greenhouse Effect Diagram

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 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 prevents radiant heat loss at night.
A three day experiment showed the thermal wall could keep the indoor temperature constant even when the outdoor temperature may fluctuate drastically.

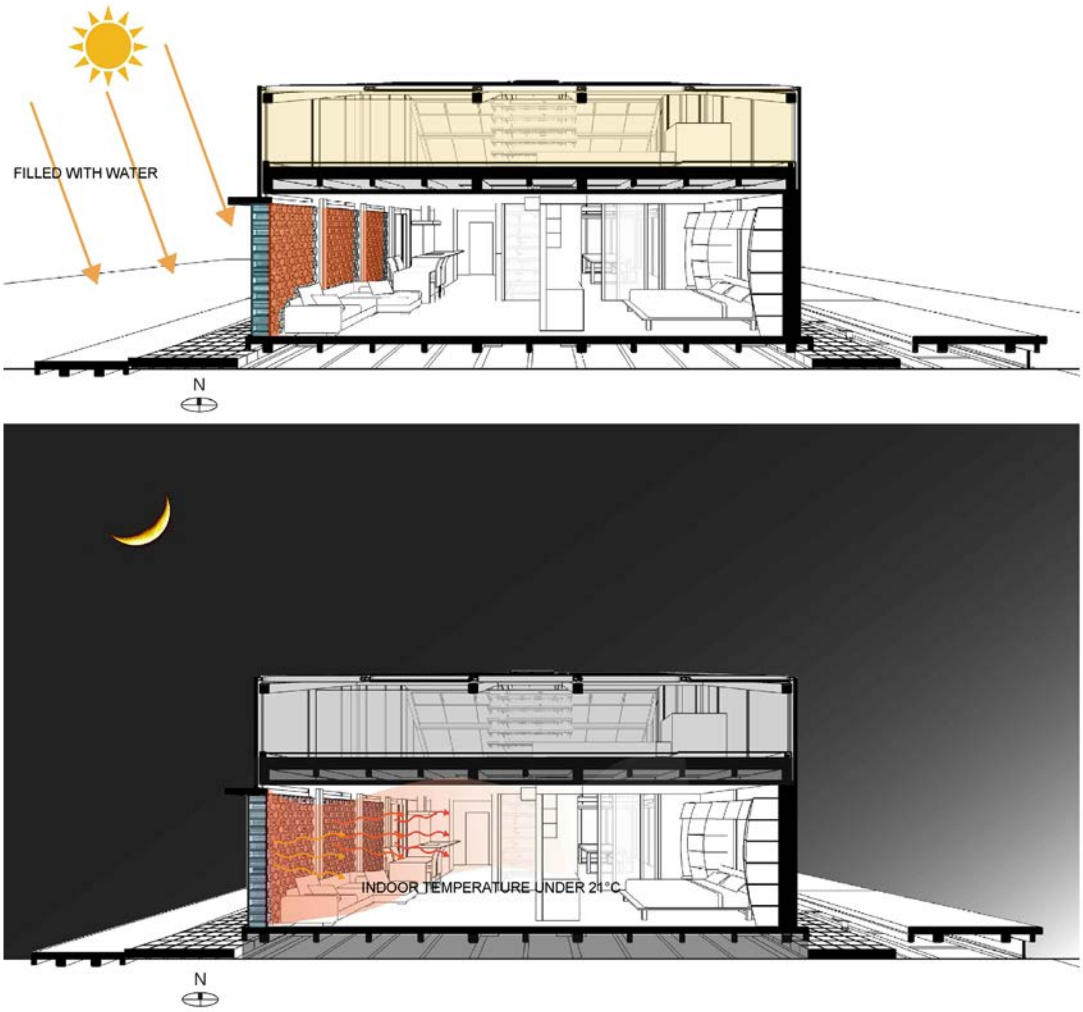
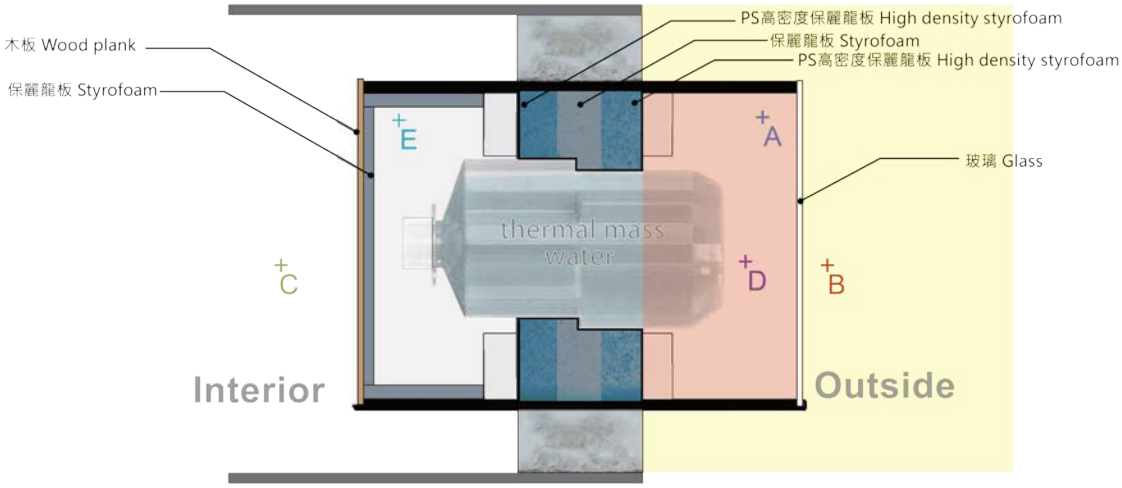


Figure 3.2.2.8 Thermal wall diagram



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

Temperature Records
2013/10/07-09

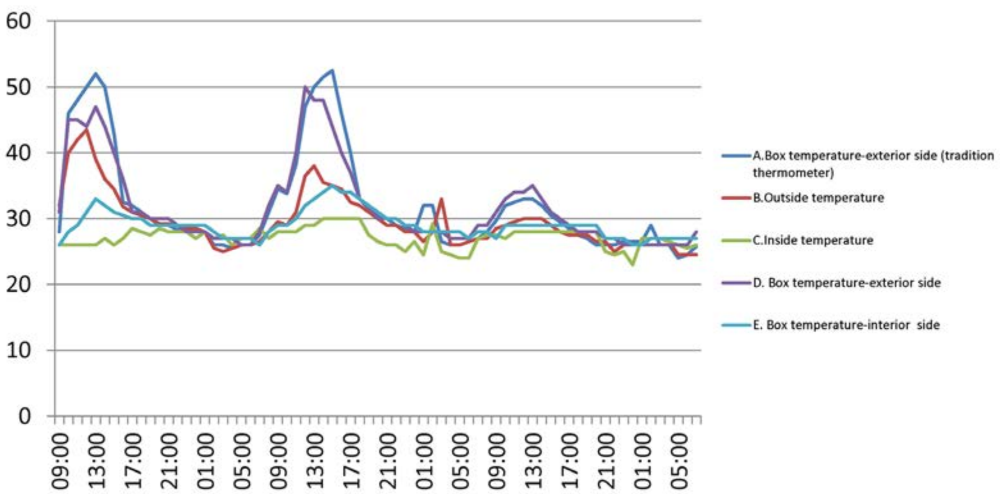


Figure 3.2.2.9 Thermal wall experiment diagram

4. Heat exchanger preheated by solar hot water: The solar hot water system on the roof provides domestic hot water as well as 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 for heating purpose.

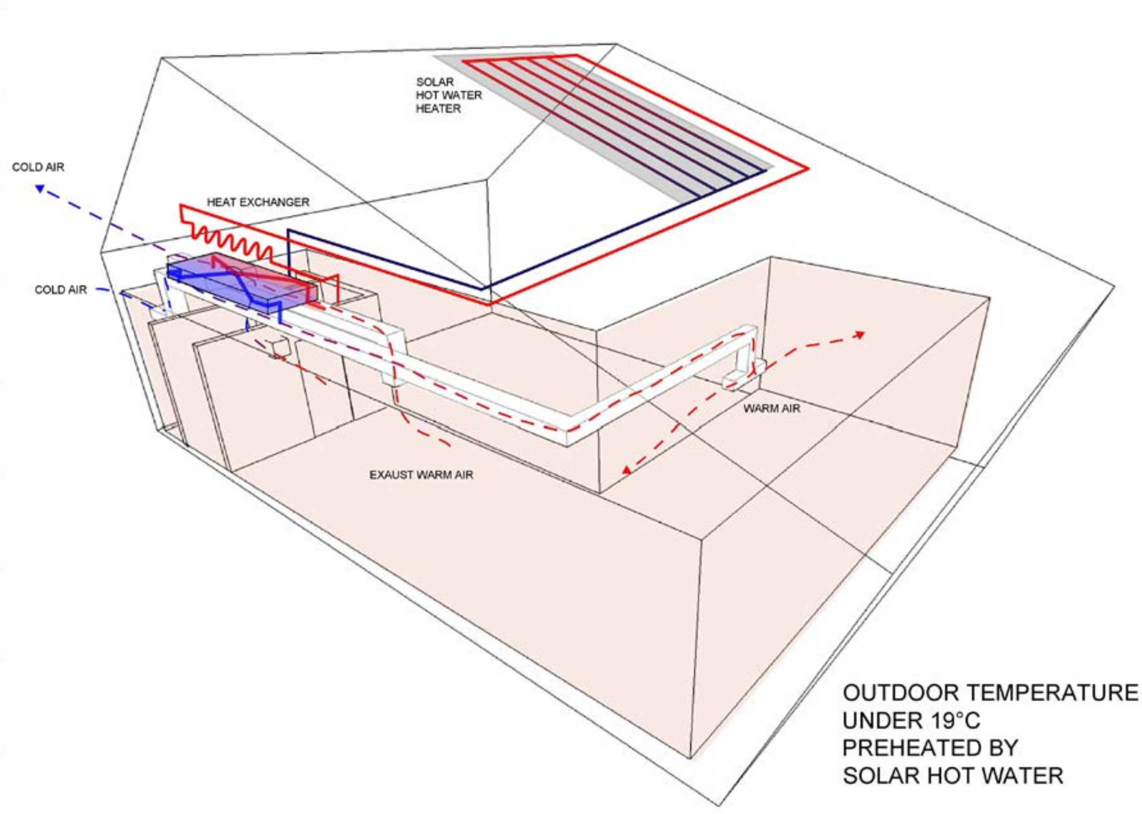


Figure 3.2.2.10 Heat Exchanger Preheated by Solar Hot Water Diagram

3.3 House and HVAC Simulations (Annual and during competition weeks)

3.3.1 Description

・ Building Simulation Software Introduction

Brief simulation descriptions, tools used (capabilities and limitations)

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, Design Builder uses the Energy Plus dynamic thermal simulation engine developed under the U.S. Department of Energy. In this project, DesignBuilder was used to model internal temperature fluctuations, HVAC loading, and building 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 the lack of accurate Computational Fluid Dynamics (CFD) simulation which is needed to model natural ventilation and air flow within the project building.

3.3.2 Housing unit modeling

¡ Building material thermal properties

Table 2.1.1 Windows / Glass Doors

Bayer Transparent Double Layer panel

Thickness (mm)	U Value ($w/m^2.k$)	SHGC (%)	VLT (%)
10	2.8	0.435	39

Skylight/Windows Material

Bayer Transparent solid panel

Thickness (mm)	U Value ($w/m^2.k$)	SHGC (%)	VLT (%)
6	5.5	0.58	55

Wall Construction Material (Bayer Double Low E Panel 40mm)

U value = 0.603 $w/ m^2.k$

Material	**Thickness**	**K value**	**Heat capacity**	**Density**
	mm	**w/m.k**	**J/KgK**	**Kg/m^3**
Polycarbonates	15	0.028	1200	1200
Air	10	0.024	1008	1.23
Polycarbonates	15	0.028	1200	1200

Roof Construction Material (Bayer Multiwall Sheet 16mm)

U value = 1.297 $w/ m^2.k$

Material	**Thickness**	**K value**	**Heat capacity**	**Density**
	mm	**w/m.k**	**J/KgK**	**Kg/m^3**
Polycarbonates	3	0.028	1200	1200
Air	10	0.024	1008	1.23
Polycarbonates	3	0.028	1200	1200

Table 2.1.2 Roof PV Panels
U value = 5 w/ m².k

Material	Thickness	K value	Heat capacity	Thickness
	mm	w/m.k	J/KgK	Kg/m³
Soda lime glass	0.6	1	750	2500

Table 2.1.3 Thermal Wall Miniwiz Polli-Brick
U value = 0.11 w/ m².k

Material	Thickness	K value	Heat capacity	Thickness
	mm	w/m.k	J/KgK	Kg/m³
Polycarbonates	40	0.028	1200	1200
Air	60	0.024	1008	1.23
Plywood	20	0.13	2500	560
Glass Foam	65	0.071	840	117
Vacuum Insulation Panel	30	0.007	687	177
Plywood	18	0.13	2500	560

Table 2.1.4 Interior Floor
U value = 0.169 w/ m².k

Material	Thickness	K value	Heat capacity	Thickness
	mm	w/m.k	J/KgK	Kg/m³
Plywood	18	0.13	2500	560
Glass Foam	130	0.071	840	117
Vacuum Insulation Panel	30	0.007	687	177
Plywood	30	0.13	2500	560

Table 2.1.5 Interior Wall

U value = 0.15 w/ m^2.k

Material	**Thickness**	**K value**	**Heat capacity**	**Thickness**
	mm	**w/m.k**	**J/KgK**	**Kg/m³**
Plywood	18	0.13	2500	560
Glass Foam	130	0.071	840	117
Vacuum Insulation Panel	30	0.007	687	177
Plywood	18	0.13	2500	560

ii. Occupancy Schedule & Heat Gain Assumptions

1.Schedule：9am-6 pm, 6 persons; 5 pm-9 pm, 4persons

2. Metabolic rate per person - Walking：180W/person

3.Clothing：Summer - 0.5；Winter – 1

iii. Appliance, time, and Heat

Item	End Use Breakdown	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM
Appliances	Refrigerator/Freezing	45	45	45	45	45	45	45	45	45	45	45	45
	Clothes Washer												
	Clothes Dryer												
	Cooking												
	Oven												
	Hood												
	Dishwashing												
Devices	TV	33	33	33	33	33	33	33	33	33	33	33	33
	DVD/Projector	30	30	30	30	30	30	30	30	30	30	30	30
	Notebook	36	36	36	36	36	36	36	36	36	36	36	36
Lighting	Kitchen												
	Living Room							23.4	23.4				
	Workstation/Bedroom												
	Bathroom												
Total Electricity Consumption (wh)		144	144	144	144	144	144	167.4	167.4	144	144	144	144

Item	End Use Breakdown	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Appliances	Refrigerator/Freezing	45	45	45	45	45	45	45	45	45	45	45	45
	Clothes Washer					495							
	Clothes Dryer					495							
	Cooking			480									
	Oven			645									
	Hood			99									
	Dishwashing			660									
Devices	TV	33	33	33	33	33	33	33	33	33	33	33	33
	DVD/Projector	30	30	30	30	30	30	30	30	30	30	30	30
	Notebook	36	36	36	36	36	36	36	36	36	36	36	36
Lighting	Kitchen	21.9	21.9	21.9									
	Living Room								46.8	46.8			
	Workstation/Bedroom										42	42	42
	Bathroom											15	15
Total Electricity Consumption (wh)		165.9	165.9	2049.9	144	1134	144	144	190.8	190.8	186	201	201

Interior Appliance Heat Schedule

Category	Name	Heat (W/ m^2)
Process	Refrigerator/Freezing	0.75
Miscellaneous	Clothes Washer/dryer	8.25
Catering	Cooking	8.00
	Oven	10.75
	Hood	1.65
	Dishwashing	11.00
Computers	TV	0.55
	DVD/Projector	0.50
	Notebook	0.60
Lighting	Lighting	0.93

iiii. Natural Ventilation Setting

Measurable space: In Passive control period, when interior temperature is above 27°C and outdoor temperature is higher than indoor temperature. All windows are open，net open area 50%。

iiiii. Measurable area HVAC type:

1. Heating

(1)Boiler：Gas-fired condensing boiler

(2)Heat coil Cop：1.00

(3)Unitary distribution loss：0

(4)Corresponding outdoor high temperature：-6.7℃

(5)Max off-coil set point temperature：12℃

(6)Corresponding outdoor low temperature：10℃

2. Cooling

(1)Packaged direct expansion

(2)Chiller：DOE-2 Centrifugal/5.50 CoP

(3)Unitary cooling CoP：2.5

(4)Unitary distribution loss：0

(5)Corresponding outdoor high temperature：26.7℃

(6)Max off-coil set point temperature：18℃

(7)Corresponding outdoor low temperature：15.6℃

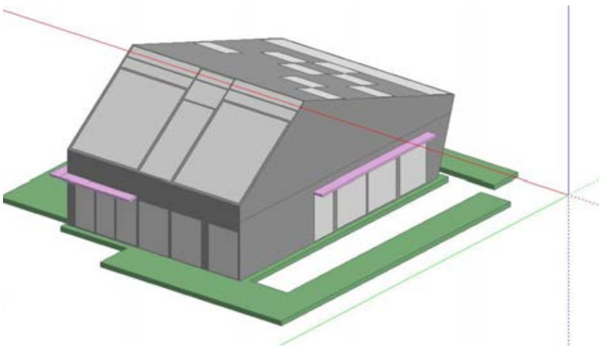
iiiiii. HVAC System Temperature Setting & Operation Schedule

France: Heating 23.5℃

France: Whole year energy-use analysis - Cooling 26℃; Heating 17℃

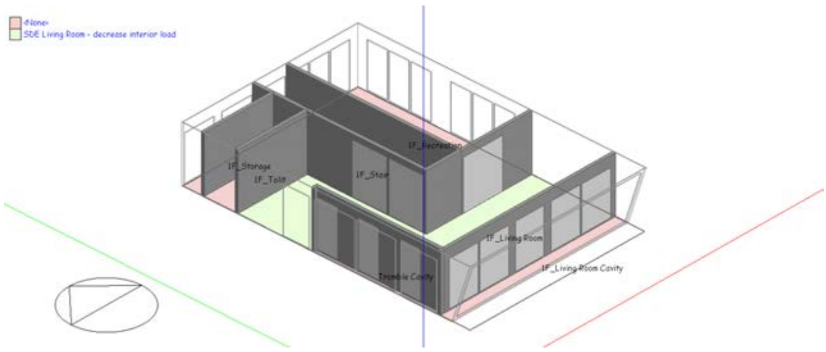
Taiwan: Whole year energy-use analysis - Cooling 26℃; Heating 17℃

iiiiiii. Analysis model outlook:

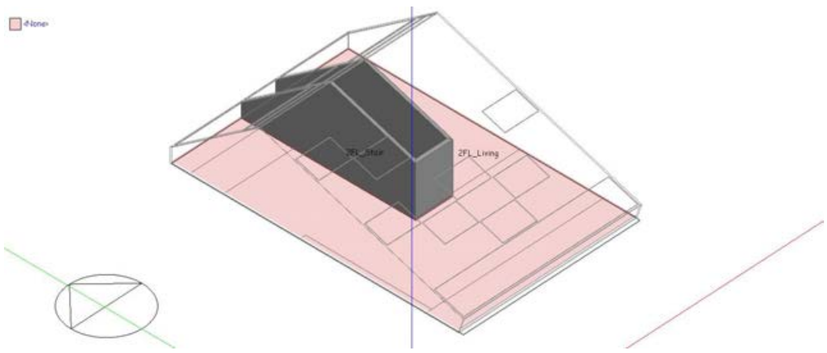


Normal Layout

Visualization Mode



Ground Floor Layout



Second Floor Layout

3.3.3 Housing unit energy loads

Date/Time	Glazing	Walls	Ceilings (int)	Ground Floors	Partitions (int)	Internal Natural vent.	Sensible Cooling	Mech Vent + Nat Vent + Infiltration	External Infiltration
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	ac/h	kWh
2002/1/1	-84.4	-8.411	-33.5	-40.92	-35.73	-137.8	-72.93	0.056968	-16.09564
2002/2/1	-45.69	-7.559	-32.04	-40.53	-37.17	-78.02	-123.3	0.064838	-15.12093
2002/3/1	-34.53	-6.76	-21.46	-52.29	-9.602	-50.04	-226.6	0.052858	-13.68486
2002/4/1	49.86	-1.824	10.763	-58.36	34.905	87.999	-531.2	0.050042	-5.254974
2002/5/1	109.85	3.511	45.37	-63.04	84.11	192.01	-799.6	0.040983	1.848278
2002/6/1	148.69	5.0849	55.219	-63.48	108.46	274.74	-980.9	0.053914	4.37889
2002/7/1	224.86	9.8478	94.276	-67.93	164.44	448.93	-1347	0.037846	7.229541
2002/8/1	210.34	9.1489	87.005	-67.5	156.47	407.83	-1277	0.043586	7.841147
2002/9/1	134.88	5.2832	54.617	-62.36	105.5	251.29	-914.6	0.032698	3.30071
2002/10/1	67.575	2.1297	30.798	-60.66	72.149	134.32	-654.4	0.05552	1.374659
2002/11/1	-34.56	-5.477	-19.41	-50.64	-13.08	-40.52	-206.1	0.05835	-9.212753
2002/12/1	-65.57	-7.058	-27.18	-44.07	-19.38	-95.33	-146.5	0.063707	-14.18388

Date/Time	Mech Vent + Nat Vent + Infiltration	External Infiltration	Total Cooling	Zone Heating	General Lighting	Miscellaneous	Process	Catering Gains	Computer + Equip	Occupancy
	ac/h	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
2002/1/1	0.056968	-16.09564	-100.2	48.422	35.493	15.188	132.55	57.989	72.901	37.253
2002/2/1	0.064838	-15.12093	-158.1	17.447	32.058	13.718	119.72	52.377	65.846	33.549
2002/3/1	0.052858	-13.68486	-285.3	1.5851	35.493	15.188	132.55	57.989	72.901	35.284
2002/4/1	0.050042	-5.254974	-707.8	0	34.348	14.698	128.27	56.118	70.549	33.648
2002/5/1	0.040983	1.848278	-1165	0	35.493	15.188	132.55	57.989	72.901	34.757
2002/6/1	0.053914	4.37889	-1401	0	34.348	14.698	128.27	56.118	70.549	33.636
2002/7/1	0.037846	7.229541	-2001	0	35.493	15.188	132.55	57.989	72.901	34.743
2002/8/1	0.043586	7.841147	-1885	0	35.493	15.188	132.55	57.989	72.901	34.755
2002/9/1	0.032698	3.30071	-1337	0	34.348	14.698	128.27	56.118	70.549	33.629
2002/10/1	0.05552	1.374659	-957.3	0	35.493	15.188	132.55	57.989	72.901	34.757
2002/11/1	0.05835	-9.212753	-272.6	0	34.348	14.698	128.27	56.118	70.549	33.939
2002/12/1	0.063707	-14.18388	-206	34.727	35.493	15.188	132.55	57.989	72.901	36.966
			-10475	102.18						

Date/Time	Solar Gains Interior Windows	Solar Gains Exterior Windows	Zone Sensible Heating	Zone Sensible Cooling	Air Temperature	Radiant Temperature	Operative Temperature	Room Electricity	Lighting	Heating (Electricity)	Cooling (Electricity)	Outside Dry-Bulb Temperature
	kWh	kWh	kWh	kWh	蚓	蚓	蚓	kWh	kWh	kWh	kWh	蚓
2002/1/1	13.93894	21.36035	48.424	-72.94	23.743	23.277	23.51	278.62	35.49299	13.83487	40.08256	17.00727
2002/2/1	16.08179	29.84236	17.447	-123.3	23.737	23.507	23.622	251.66	32.05818	4.98484	63.22545	18.07007
2002/3/1	22.12147	39.71315	1.5851	-226.6	24.557	24.682	24.62	278.62	35.49299	0.452875	114.1231	19.07749
2002/4/1	25.7751	42.92284	######	-531.2	24.958	25.894	25.426	269.64	34.34805	0	283.1119	22.99788
2002/5/1	25.73623	42.05091	0	-799.6	25	26.54	25.77	278.62	35.49299	0	465.8228	26.20795
2002/6/1	33.10796	60.35592	0	-980.9	25	26.946	25.973	269.64	34.34805	0	560.4909	27.24387
2002/7/1	36.96981	59.75757	0	-1347	25.002	27.497	26.249	278.62	35.49299	0	800.2278	29.78184
2002/8/1	37.50171	60.33686	0	-1277	25	27.4	26.2	278.62	35.49299	0	754.0291	29.42955
2002/9/1	26.74796	46.02879	0	-914.6	25.001	26.799	25.9	269.64	34.34805	0	534.6875	27.25533
2002/10/1	19.19164	32.98632	0	-654.4	25	26.185	25.592	278.62	35.49299	0	382.9019	25.71013
2002/11/1	15.82132	26.85575	######	-206.1	24.715	24.707	24.711	269.64	34.34805	0	109.0272	20.5259
2002/12/1	13.23069	23.93966	34.727	-146.5	23.919	23.707	23.813	278.62	35.49299	9.921898	82.3945	18.38624

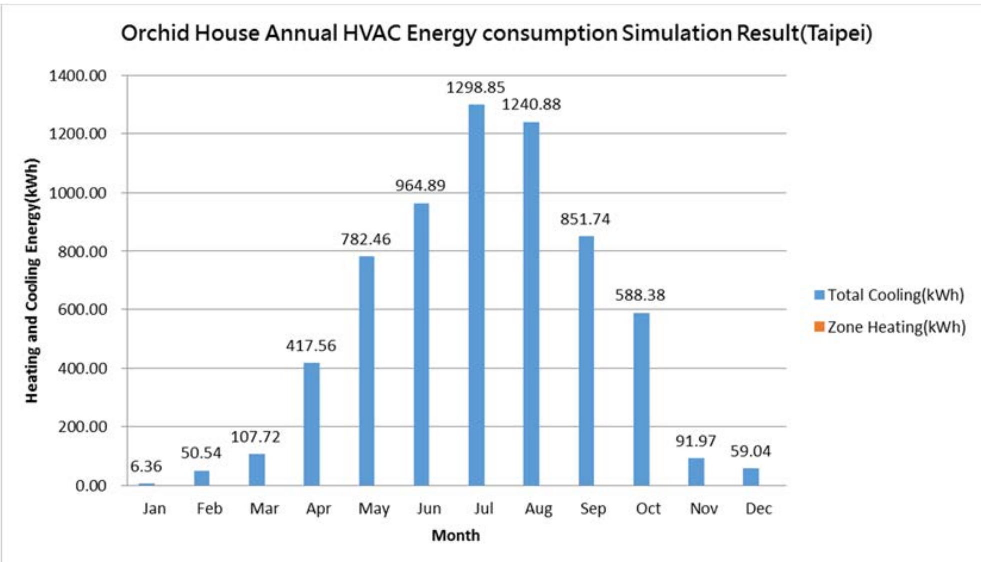
3.4 Results and Discussions

3.4.1 Energy Performance

The average annual electricity consumption, Energy Usage Intensity (EUI), is 34 kWh/m²y for residential housing units in Taiwan. HVAC in Residential houses consumes30% of the total electricity. Therefore, the annual HVAC electricity consumption is 34 x 0.3 =10.2 kWh/m²y.
According to this simulation, annual EUI for HVAC is 50 kWh/m²y, which is much higher than the average residential EUI in Taiwan. The reason is that we simulated the HVAC system operating 24 hours a day, which is very different from the operation time in regular residential houses. Regular houses run HVAC only at night when family members are home from work and school. Therefore, the energy consumption is higher than the typical housing units. As we changed the HVAV operation time from 6pm to 7am, we got the results as the following table:

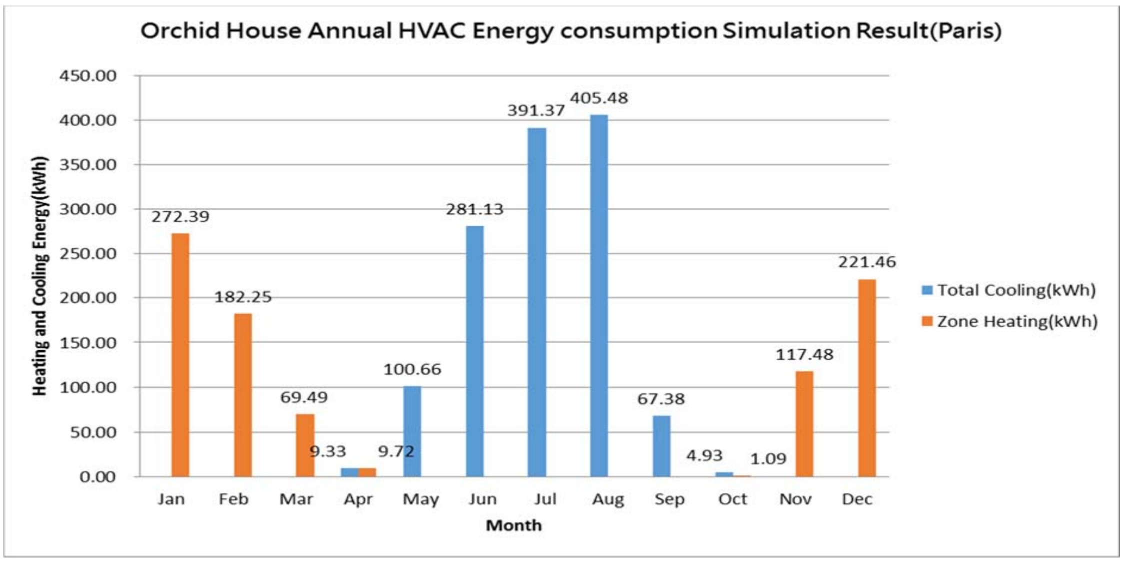
Orchid House in Taipei Annual Electricity consumption by HVAC simulation

Month / Energy Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Cooling (kWh)	6.36	50.54	107.72	417.56	782.46	964.89	1298.85	1240.88	851.74	588.38	91.97	59.04
Zone Heating (kWh)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Monthly Summary (kWh)	6.36	50.54	107.72	417.56	782.46	964.89	1298.85	1240.88	851.74	588.38	91.97	59.04
Annual Summary (kWh)	6460.39											
Unit Housing Energy Using (kWh/m².y)	32.46											



Orchid House En France Annual Electricity consumption by HVAC simulation

Month / Energy Consumption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Cooling (kWh)	0.00	0.00	0.00	10.40	167.29	471.59	683.95	654.40	133.05	10.67	0.00	0.00
Zone Heating (kWh)	495.03	361.60	154.27	26.82	0.00	0.00	0.00	0.00	0.00	10.17	251.00	468.33
Monthly Summary (kWh)	495.03	361.60	154.27	37.23	167.29	471.59	683.95	654.40	133.05	20.84	251.00	468.33
Annual Summary (kWh)	3898.58											
Unit Housing Energy Using (kWh/m².y)	19.59											



3.4.2 Predicted indoor temperatures in passive days

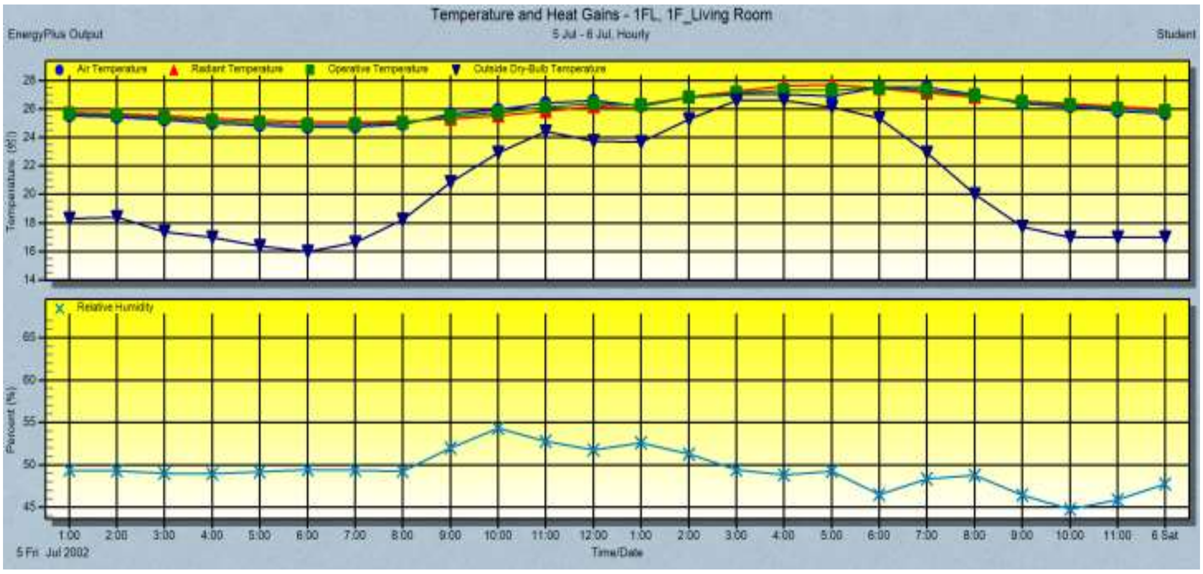


Figure 3.4.2.1 Jul. 5 living room interior temperature

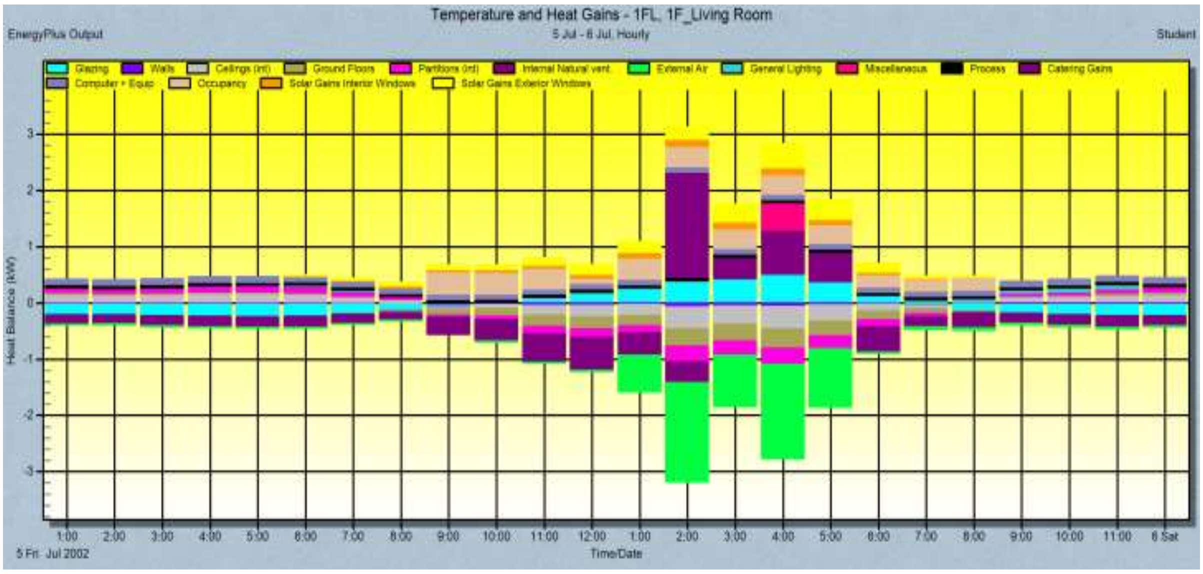


Figure 3.4.2.2 Jul. 5 Living room Heat balance Analysis

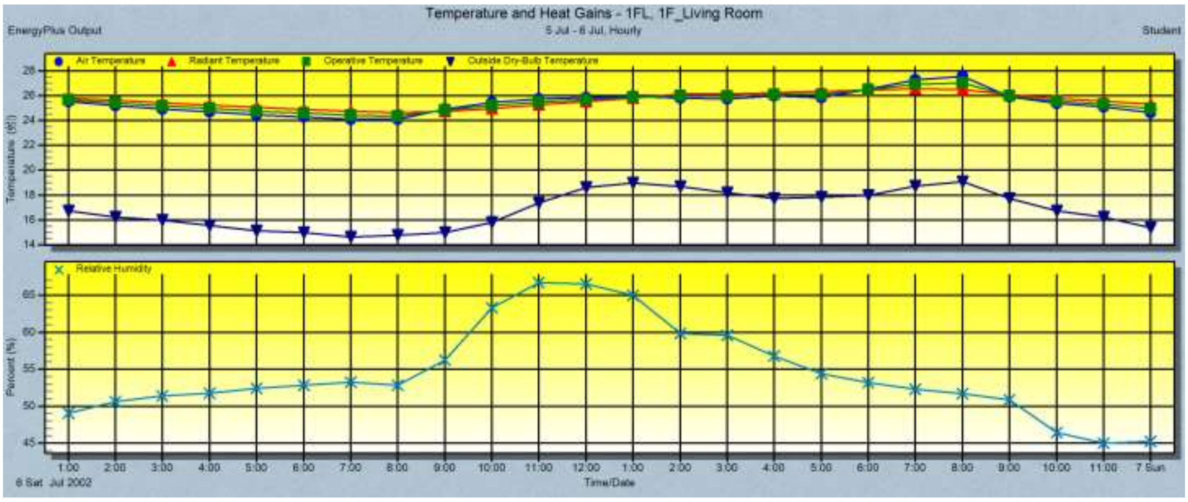


Figure 3.4.2.3 Jul-6 Living room interior temperature

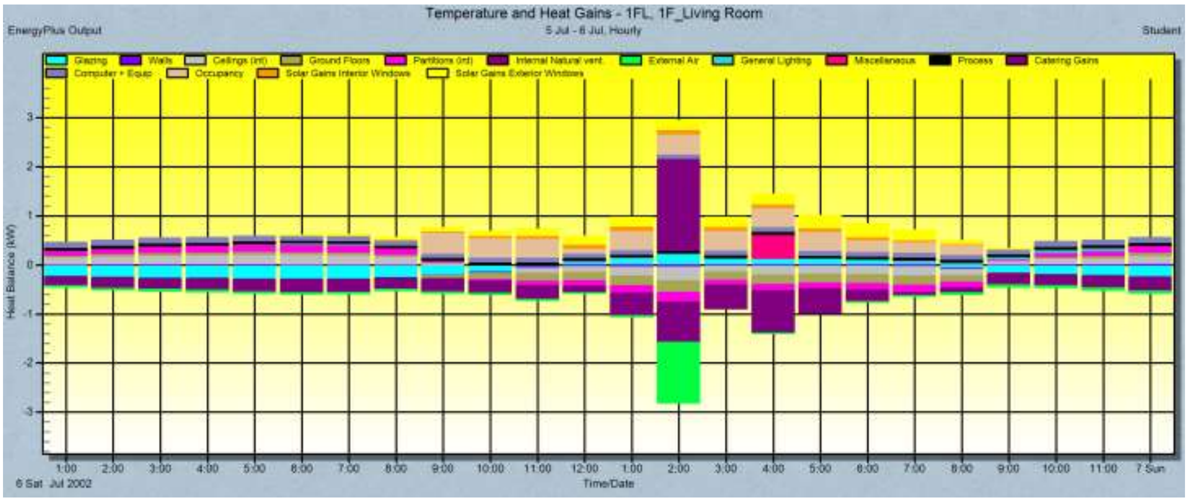


Figure 3.4.2.4 Jul-6 Living room Heat balance Analysis

From the result of our simulation, we understood that the majority of heat would be generated by visitors and appliances. That raises the indoor temperature significantly.
In order to maintain the indoor comfortable temperature between 23-27°C, it is necessary to induce outdoor cool air into interior space when the outdoor temperature is low.

3.4.3 HVAC systems selection criteria, description and simulations

HVAC Systems Selection Criteria, Description and Simulations
One of the design goals is to achieve the best indoor environmental quality including the thermal comfort, indoor air quality and ventilation, acoustics comfort, indoor air quality and ventilation, lighting levels and visual perception all the time. According to the results of house and HVAC simulation, the HVAC system is designed and equipment are selected to meet the cooling, heating and ventilation demands. The discussions about the HVAC systems selection criteria, description and simulations are as follows:

- The heat pump is capable of .generating the maximum cooling power of 11.2 KW which exceeds the maximum cooling-load demands 7.4 KW occurs on JUL. 07, 2002.

- The heating coil unit installed on the fresh air supply stream should have the capacity of 0.7 KW, which is able to handle the most space heating loads throughout the year.

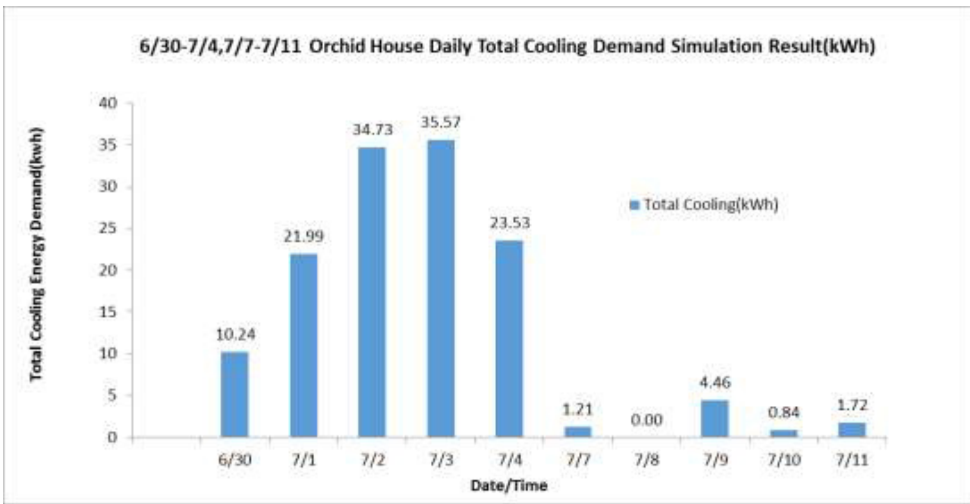
- The heating capacity of 12.5 KW of heat pump is capable of meet the demands of maximum heating loads of 0.7 KW which occurs on based on the estimation DEC. 24, 2002.

- Other criteria for the selection of HVAC equipment are:
    i. Sound level of indoor units of heat pump and heat reclaim ventilator is checked to meet the room's acoustic requirements.
    ii. The reliability and life time is the major concern.
    iii. All equipment shall be easily purchased and guaranteed the good after-service.

3.4.4 Predicted Heating and cooling loads and HVAC energy

Jun. 30 – Jul. 4 and Jun. 7 - Jun. 11 Electricity consumed by HVAC simulation

Date/Time	6/30	7/1	7/2	7/3	7/4	7/7	7/8	7/9	7/10	7/11
Total Cooling(kWh)	10.24	21.99	34.73	35.57	23.53	1.21	0.00	4.46	0.84	1.72



III. Orchid House En France Annual Electricity consumption by HVAV simulation

IV. Orchid House in Taiwan Annual Electricity consumption by HVAV simulation

3.5 Conclusions

The predicted heating and cooling loads and HVAC energy demand shows that our cooling load is higher than expected, possibly due to the radiant heat coming through the sliding door on the east side. Also, we have input the occupancy up to 20 people, and all the body heat generated during the tour will be captured. After the calculation of cooling loads, we will begin to adjust openings of the house, and control the number of visitors to 10, to avoid overheat. Also, shading device is the next element we will implement in the house. The east and south façade have large translucent materials, therefore shading device should be properly installed. Our smart skin will serve as a control which reacts to the heat and respond to create comfortable living. (Please refer to Innovation Report Section 7.0)

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

4.1 Influence of the energy analysis in the project design(Project design optimization)

According to this analysis, we may save (10082.13-6460.39)/10082.13x100%=39.85% of electricity in HVAC by changing the operation strategy. However, the EUI is still as high as 32.46 kWh/m²y, we are seeking design and simulation modifications as follows:

1. The Orchid house in Taiwan should reduce the windows and provide more shading.
2. We need to establish a more reasonable model to represent a living style which may closely represents the typical Taiwanese family.

4.2 Influence of the energy analysis in the HVAC design(System optimization)

Introduction

This is the first time we complete the energy consumption estimation and energy balance tasks, and many energy saving measures have been used comparing to the previous HVAC system design. Deliverable #3 is in the middle of the total seven Deliverables, however, the HVAC system aiming to achieve the most energy efficiency has to be continually refined. The following measures are used in the Deliverable #3.

- Cooling

The energy balance reveals the cooling energy consumption in hot climatic zone like Taiwan, summer cooling loads can be reduced through sustainable building design, but a cooling energy demand still remains, which can be covered by active cooling system – heat pump, hybrid cooling strategy, HRV-driven natural ventilation strategy, and PCM.

i. Heat Pump Operation
When the cooling is required in the room, and the outdoor temperature is higher than the indoor temperature, heat pump is operating in cooling mode.

ii. Hybrid Cooling Operation
When the cooling is required in the room, and the outdoor temperature is lower than the indoor temperature, HRV is automatically switched to bypass mode providing the cooling to the room; if the natural cooling alone is insufficient for cooling the room, the heat pump also operates.

iii. Natural Ventilation Operation
When the cooling is required in the room and the outdoor temperature is cold, the HRV is switched to bypass mode and the cooling by the fresh air is sufficient to maintain the room temperature.

iv. Phase Change Material (PCM)
The phase change material stores the cooling energy when the outdoor temperature is cold and discharges it to cool the room independently or to supplement the heat pump.

- Heating

According to the heating loads estimation, the heating energy demand is mild in Taiwan, therefore, the fresh air heated by the heating coil is sufficient to maintain the room temperature except just a few days of severe temperature – the heat coil is placed in the fresh air supply stream with the energy source from the solar thermal collector. If the thermal energy harnessed by the solar thermal collector is insufficient for both domestic hot water and space heating, a dedicated heat pump can supplement. This heat pump with the heat source of air is used because this smaller unit operates more efficiently than the heat pump used for cooling and heating the room – this larger set is still required to operate in a few freezing days.

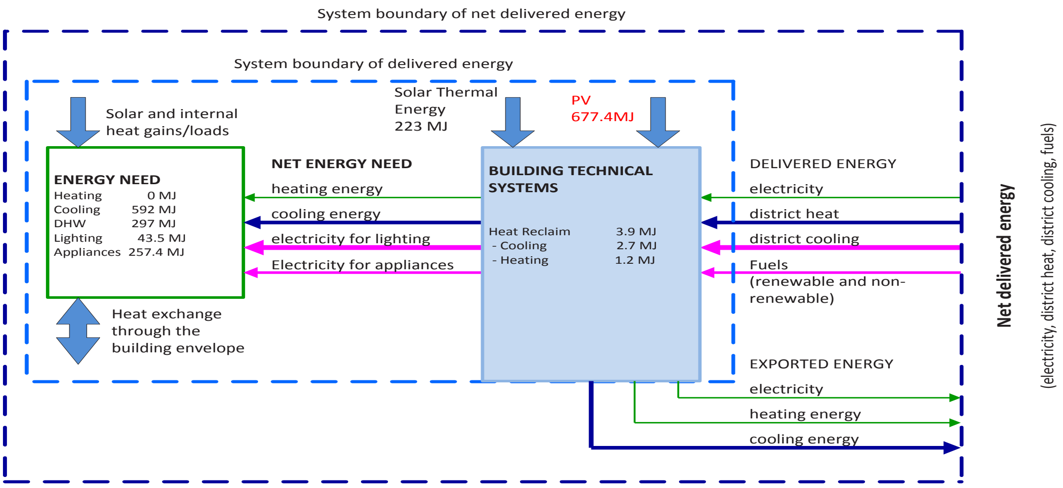
- Ventilation
    i. Heat Reclaim Ventilation

    The HRV is used to recover the thermal energy of exhaust air and reuse it for heating or cooling of fresh air.

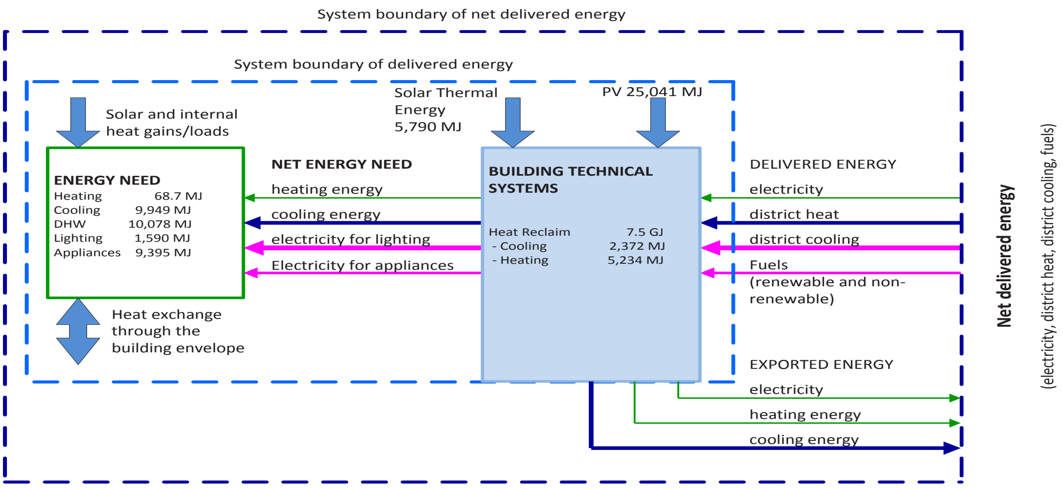
    ii. Automatic Control
    - Automatic ventilation mode changeover: heat recovery / bypass.
    - Interlocked with heat pump: ON/OFF.
    - Should the CO_2 level within the room decrease below a preset level the fan speed is reduced, providing ventilation proportional to the requirements of the room.

Conclusion

After the above measures are implemented, the energy consumption by active HVAC system will help achieve the goal – a very high energy performance home. The energy analysis is as shown below.



• Energy Balance for Orchid House Taiwan – 1 Year



Innovation report

1.0 Innovation in Architecture

- *Greenhouse Water Wall*: Air enters the house through louvers set in the roof and passes over the subunit water tank and through the water wall. This lowers the temperature due to evaporative cooling and the cool air is circulated and drawn out by fans at the opposite end of the house. The idea for this technique originated from the orchid greenhouses of Taiwan, but we made improvements and adapted it to our solar house. Instead of having water pumped up from underground, we save energy by placing the water supply under the roof, in contact with the water wall. This also increases efficiency because the water supply is already exposed to air and cooled down before being pumped to the water wall, and sanitation because under the louvers cut horizontally into the roof, water is not exposed to unsanitary materials.

- *Slanted Roof*: Our roof is angled 18º due south. For maximum exposure to sunlight, but this slope has the additional purpose of guiding rainwater into the subunit water tank. We took an integral part of the house – roof and made modifications to it so that it has multiple purposes and cotributes to conserving energy and sustainability.

- *Buffer Zone*: Another technique we observed in local greenhouses, a buffer zone is an additional enclosed area around the main body meant to trap heat. In our Orchid House, instead of only trapping heat, the buffer zone also keeps the house cool in the summer. The PV panels on the roof allow in light but not much heat, so the buffer zone remains shaded and keeps the inner enclosure cool.

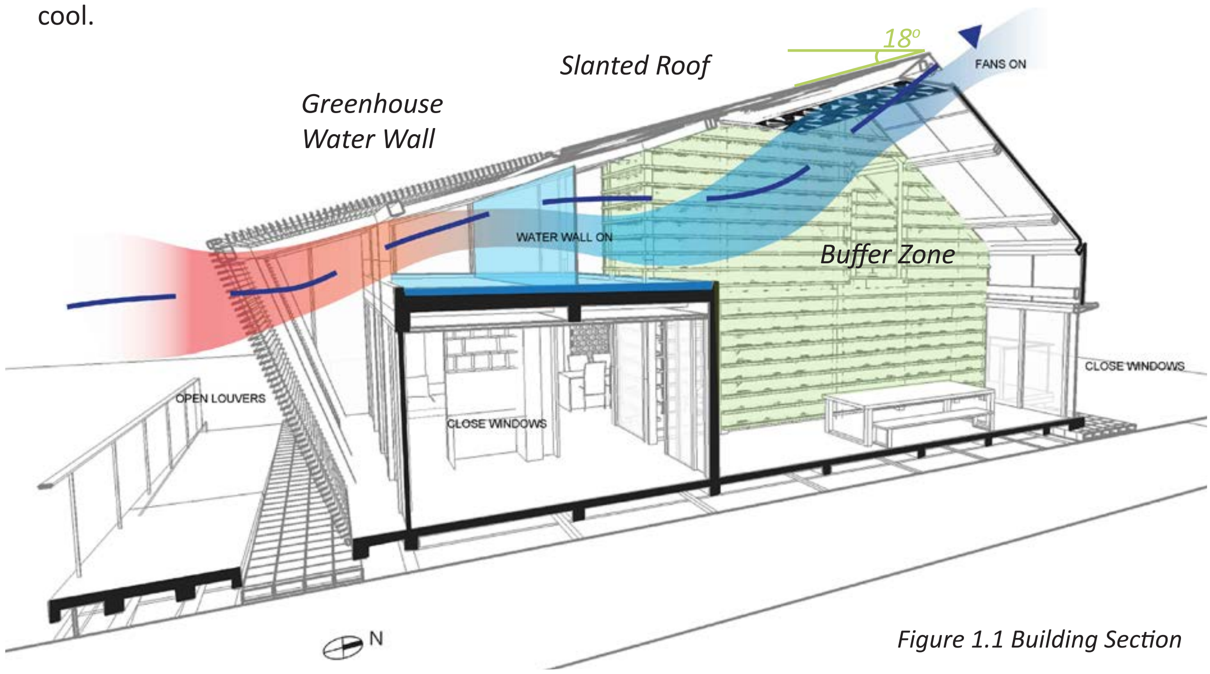


Figure 1.1 Building Section

Bayer Makrolon

Delta DC Fan

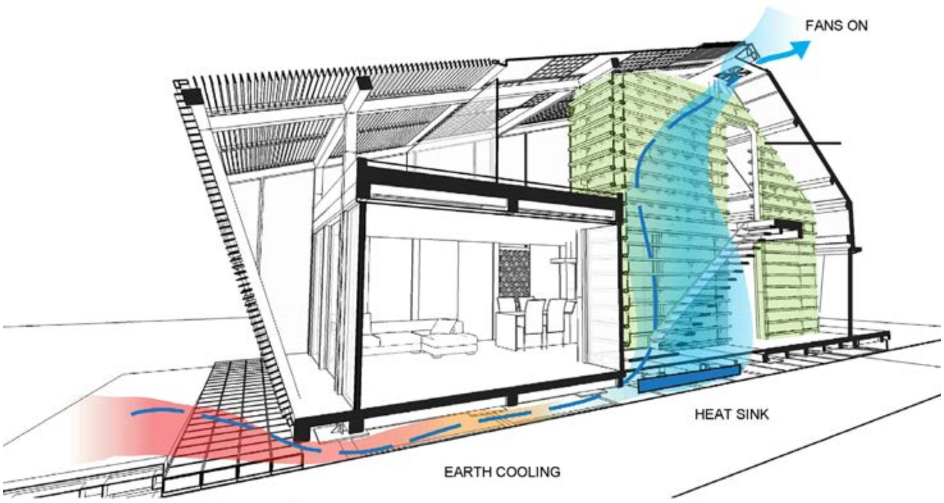
PV Technology

Water Wall

Natural Resource

- *Multi-functional vertical circulation core:*
  The circulation core between ground level and mezzanine level also act as passive cooling chimney, which draws cool air from below the floor and exhaust out to the Delta DC fan on the roof when outside temperature is over 26 degree.

  The green core is not only providing passive cooling opportunity to the Orchid house, but also adding two story tall vertical garden. In high density cities such as Taipei, the vertical garden will provide soothing living environment. The usage of this large area of garden also customized by the resident of the building. It could be planting vegetable to solve future food shortage problem in urban area.

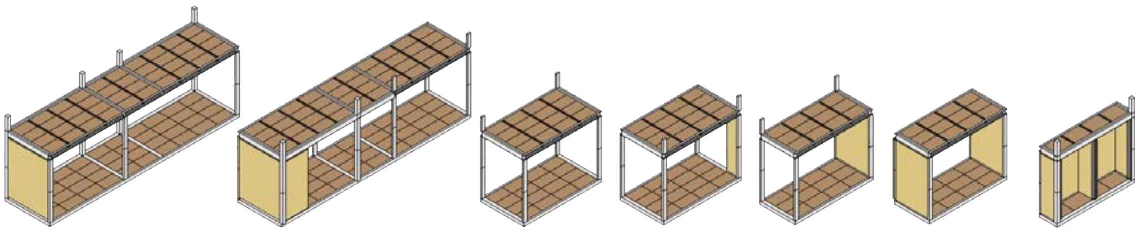


- *Thermal Mass POLLIBrick™*
  POLLI-Brick™ is a revolutionary building material made from 100% recycled Polyethylene Terephthalate Polymer. It is translucent, naturally insulated, and durable. The modular 3-D honeycomb self-interlocking structure makes it extremely strong without any chemical adhesives, while weighing only one-fifth of standard curtain wall systems. The cross industry R&D hybridization keeps the recycling process economically efficient since POLLIBrick™ can be mass manufactured on site, dramatically reducing the carbon footprint when compared with conventional glass and steel structures.

The west side of Orchid House utilize this unique building material and bring to next level of experimentation as water filled thermal mass. The strong afternoon sun will be filtered by water filled POLLIBrick™, yet still transmit day-light to the living space until sun set.

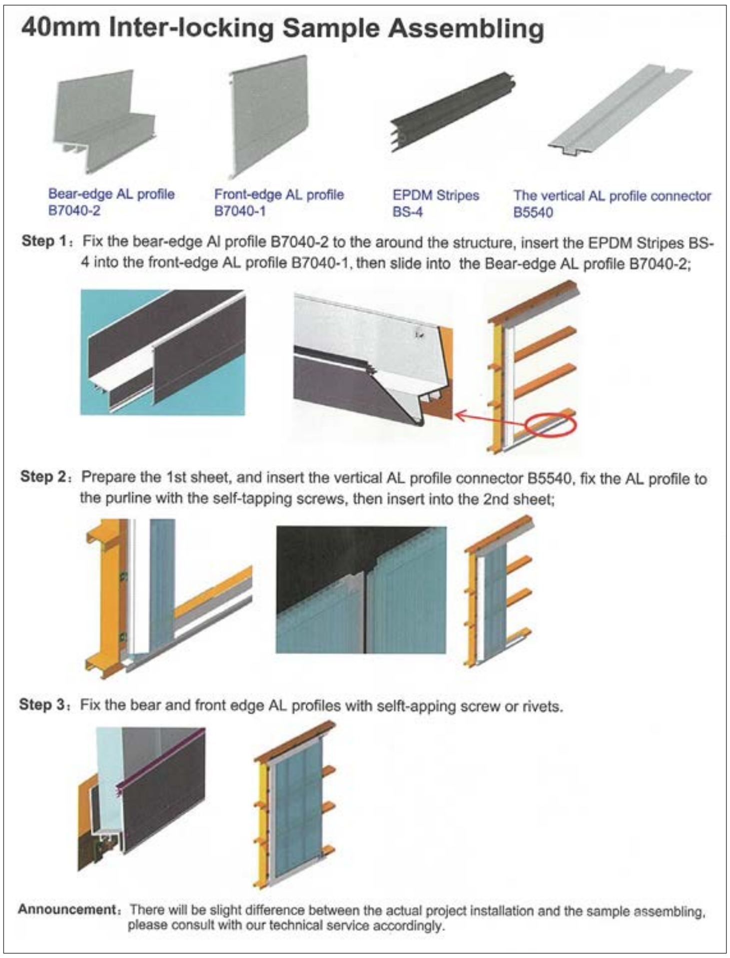
2.0 Innovation in Engineering and Construction

- *Modularized Structural Frame box:*
  The Orchid House main living space is composed with 7 structural framing box, which designed with the ordinary Moment Resistant Frame System (OMRF). Those modules are sized to fit in standard container as well as the surface truck transportation. Due to the OMRF system, the joints of each frame boxes require no welding on site or any other complex joining. This innovative structural system will help the Orchid House prototype to be shipped from Taiwan to France for Solar Decathlon Europe 2014 as well as when the house will be allocated on the rooftops in Taipei city.



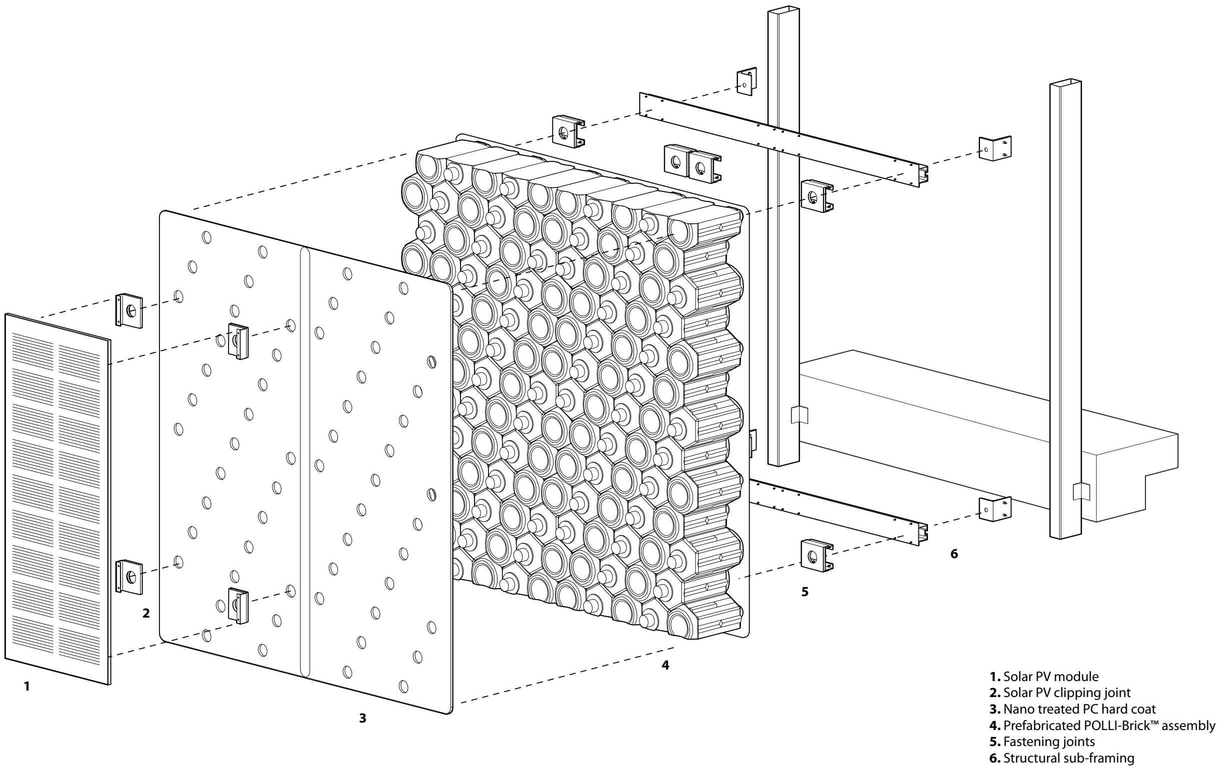
Prefabricated Structural Modules

- *Inter-locking Facade system:*
  The Orchid House construction emphasizes the short construction time requirement as well as the simple installation process during the construction. The Makrolon® polycarbonate 40mm Low-E coated Inter-locking sheet from Bayer Material Science is chosen for the façade material. This inter-locking system will replace the complex metal mullion curtain wall system to simple aluminium back support with interconnectable light weight polycarbonate sheet. With this façade system, the total construction time is drastically reduced and also the accident during the installation will be avoided.



Makrolon® Installation Manual

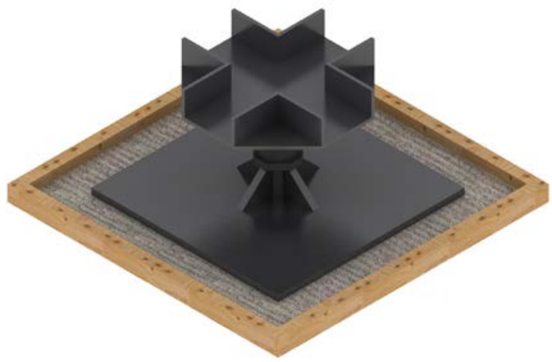
- *Thermal mass installation:*
  Thermal mass in general is considered as heavy concrete or glass/metal tube system, however, in our Orchid House, the POLLIBrick™ will be installed. POLLIBrick™ installation is simple and easy due to its inter-locking joint system. Each POLLIBrick™ is 6,000 mL capacity, which equal to 6 kg in weight. Even though the Orchid House install over 500 of POLLIBrick™, the construction will be easy and done in a few hours. For the security and earthquake proof, the POLLIBrick™ wall will be secured with high strength polycarbonate in front and back to tight all the brick together into one thick wall.



POLLIBrick™ *Installation Manual*

- Adjustable Footing
  The Orchid House structural team has developed special adjustable footing system and the structural framing system in case of uneven ground condition. The footing will also incorporate sand box to distribute the load of house to the ground equally to reduce the impact on site and also easy cleaning after the competition.

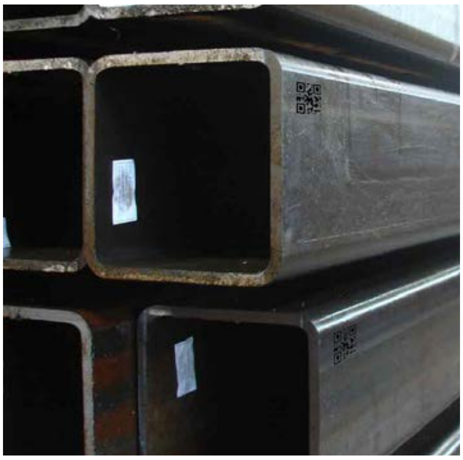
  This footing system will evolve to adjustable framing system in order for the Orchid House to be placed on top of the existing rooftop in Taipei City in the future. The framing will be adjusted with the existing building structure grid to match with existing structure.



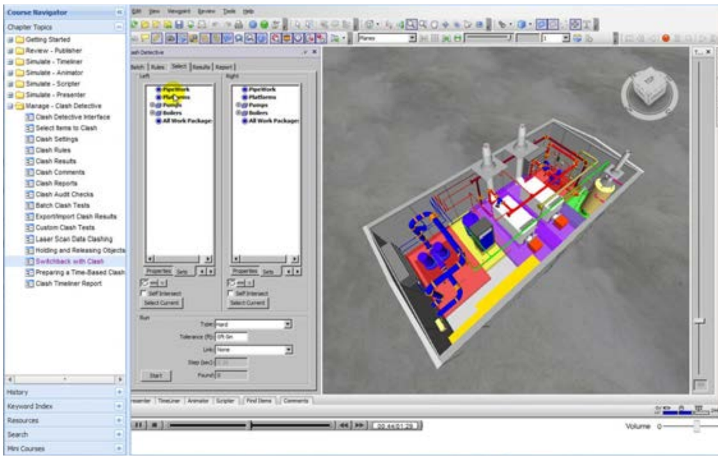
Adjustable Footing

- *QR Code + BIM Construction Management:*
  During each phase of the Orchid House construction, QR code management will be utilized. All the structural members are pre-marked at the factory while it is manufactured. Other equipment, such as HVAC, Interior finishes, furniture and appliances are also marked with specifically generated QR Code in order not to be misallocated.

  During the construction, construction manager and site operation manager will carry tablet PC provided by our digital device sponsor ASUS to scan and record the QR code and reflect to the BIM model through AUTODESK NAVISWORKs.



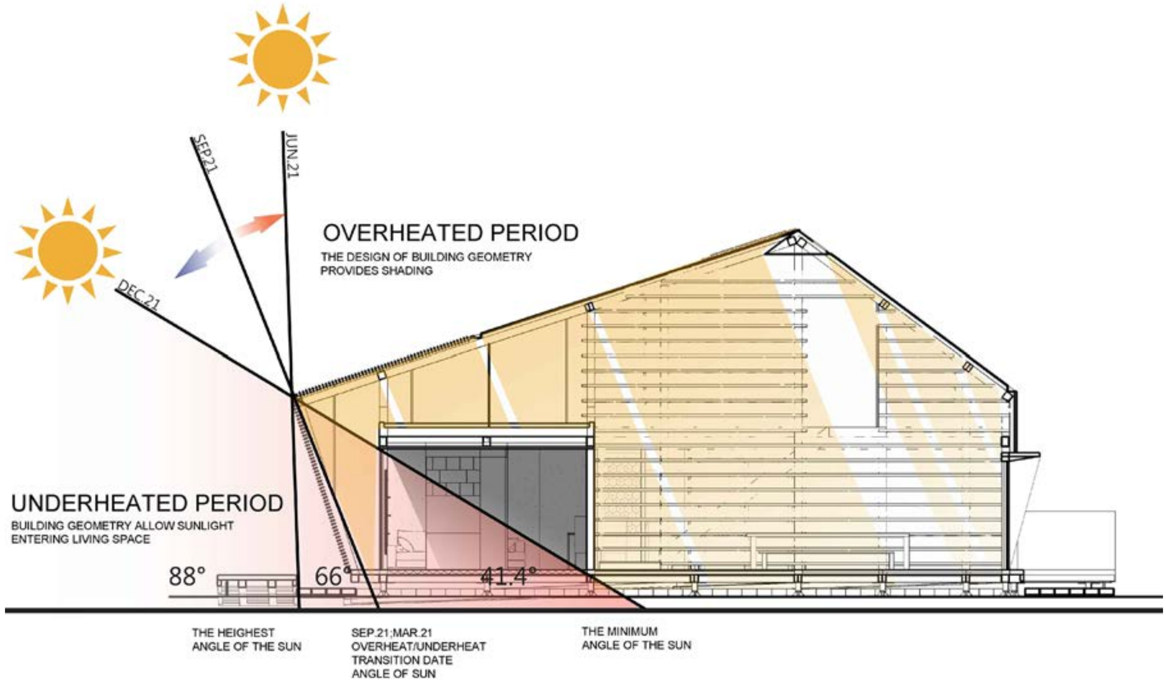
QR CODE on Structure



Autodesk Navisworks

3.0 Innovation in Energy Efficiency

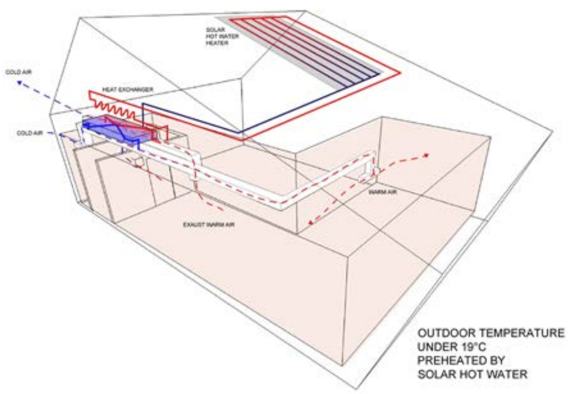
- Adopted geometry
  The Orchid House's southern side façade is adopted with the highest sun angle during the summer time in Taiwan to avoid heat gain and creating greenhouse effect. However, during the cold winter time the low sun angle still reach to the living area and heat the interior space. The glass louvers on south façade will be controlled by temperature sensors located on outside and inside of the house. The open louver during the hot climate promotes natural ventilation as well as the semi-passive water cooling filter function with the high efficiency Delta DC exhaust fan installed at the highest point of envelope. Meanwhile the closed louvers will maintain heat from the sun and resist the cold wind to come in to the interior space during the cold weather. This Orchid House adopted geometry will reduce the energy usage for cooling and heating of the space.



Sun angle study

- *Heat Exchanger*
  Heat exchanger is an innovative way to heat the interior space with low energy consumption. The Orchid House utilizes this method in order to reduce energy load.

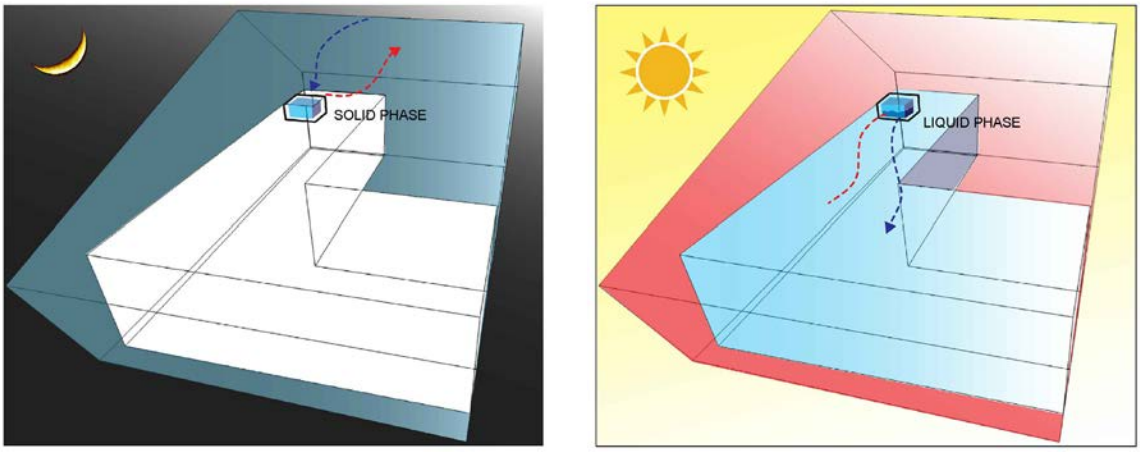
  Heat exchanger is preheated by solar hot water: The solar hot water system on the roof provides domestic hot water as well as preheats inlet air in heat exchanger for winter heating. The hot water is drawn to the coil in the inlet duct of the heat exchanger which preheats the inlet air before it enters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



Heat Exchange Diagram

- *Phase Change Material*
  As new application of Phase Change Material for building cooling and heating, the Orchid House finds way to be innovative in this material use.

  Phase change material: The Orchid House uses Phase Change Material (PCM) as a passive method to lower the daytime temperature on overheated days. The PCM 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

- *Delsolar PV Panel*
  The Delsolar D6P Multi-Crystalline Photovoltaic Module is chosen for the Orchid House PV system due to its high efficiency and cost performance. D6P panel is able to generate 230 W to 250 W per module with excellent low light performance, 4% relative efficiency reduction at low-irradiance (200W/m^2). D6P panel has longer life cycle than normal PV systems on the market, which has been proven by prolonged aging test - 2000 hours damp heat test; 400 thermal cycles. The panel power output is minimum 80% in 25 years, while the first 10 years minimum 90% output.

Delsolar D6P Module

- *Micro Inverter Deleco*
  The Orchid House PV system will include innovative Micro Inverter Deleco from Delta Electronics. As the main features of Deleco Micro Inverter, there are impressive MPPT algorithm for each PV panels (for 60 Cell PV), no hazardous DC voltage compared with string inverter, ease of installation, Smart data collector for remote monitoring and control of the Micro Inverter, as well as high efficiency up to 96% for better energy harvesting.

  With this Deleco Micro Inverter system, the Orchid House PV system will be the next generation of smart solar energy generator to harvest cleaner and smarter.

Micro Inverter Deleco

- *High efficiency solar inverter*
  The Orchid House will incorporate High efficiency solar inverter, SOLIVIA 5.0 EU G4 TR for the prototype at Solar Decathlon Europe 2014. SOLIVIA 5.0 EU G4 TR is especially designed for EU condition and the efficiency is up to 94.7%.

  SOLIVIA 5.0 EU G4 TR offers and extended MPP tracking function to improve the yield. The comprehensive statistics as well as all messages about the current operating status and the complete life-time operating behavior can be read out on the easy-to-use display. When the inverter is connected to a monitoring system, such as the Delta SOLIVIA Monitor 2.0. it can be supervised online.

- *VIVITEK projector QUMI*
  The Orchid House replace ordinary LED TV to new generation compact projector QUMI Q7. QUMI series is industry leading high performance compact projector from VIVITEK. QUMI Q7 is as compact as 23.8cm x 18cm x 4cm in size, however it resolution is 1280 x 800 pixel and the brightness is 800 lm, which is the brightest in this size of all. QUMI Q7 also requires minimum distance of 800mm to the projecting surface to reduce the heat gain in the space. This new high resolution compact projector will define new contemporary life style in the Orchid House.

QUMI Q7

- *Delta EV Charger station*
  As future project development of urban regeneration, the Electrical Vehicle charging station will be installed as part of PV system for the Orchid House. Delta EV AC Charger 230 Vac / 16 A will add the Orchid House a stylish ergonomic design as well as high technology features, such as RFID cared reader for user authentication and wireless network capability for back office integration. For the Solar Decathlon Europe 2014 Orchid House prototype, the charging station will be located by the deck for possible charging experience and public exposure.

Delta EV Charger

4.0 Innovation in Communication and Social Awareness

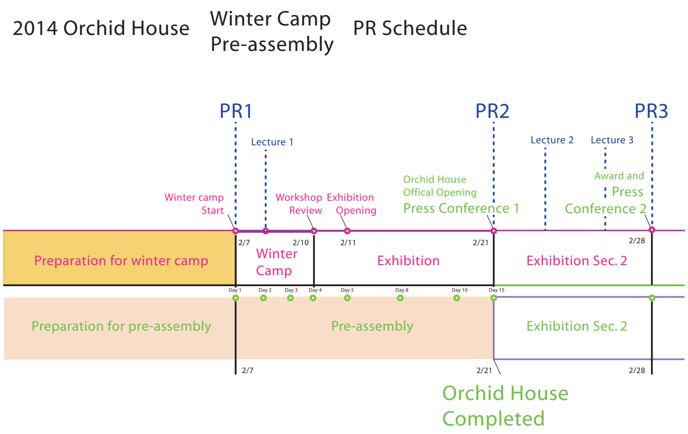
- Pre-assembly phase at Huashan 1914, Taipei City
  During the Orchid House pre-assembly phase in Taiwan, NCTU UNICODE will maximize this opportunity for the social awareness by collaborating with Huashan 1914 Creative Park as the one of most innovative ways to communicate with the society in Taiwan.

  Huashan 1914 Creative Park is a renewed urban industrial site with historical significance. It is now the hotspot for cultural activities in Taipei. Within the creative park, there is large open space, which fits perfect for the Orchid House Construction, and NCTU UNICODE and Huashan 1914 will host multiple events during the construction including site visits, lectures, press conferences, and winter camp for younger generation.

  As Huashan 1914 Creative Park has been valued one of the most important cultural hotspot past years, they are celebrating 100th year anniversary 2014. The Orchid House construction will be one of their kick starting events for very special year, which ensure the incredible social awareness to wide range of media and public.

Huashan 1914 Creative Park Open Space

- *Winter Camp at the Orchid House Site*
  As the seeding of sustainable city development to next generations is one of the most important mission for the Orchid House Project, NCTU UNICODE will invite highly motivated young talent from national wide high schools and universities to join winter camp at the Orchid House Construction site.

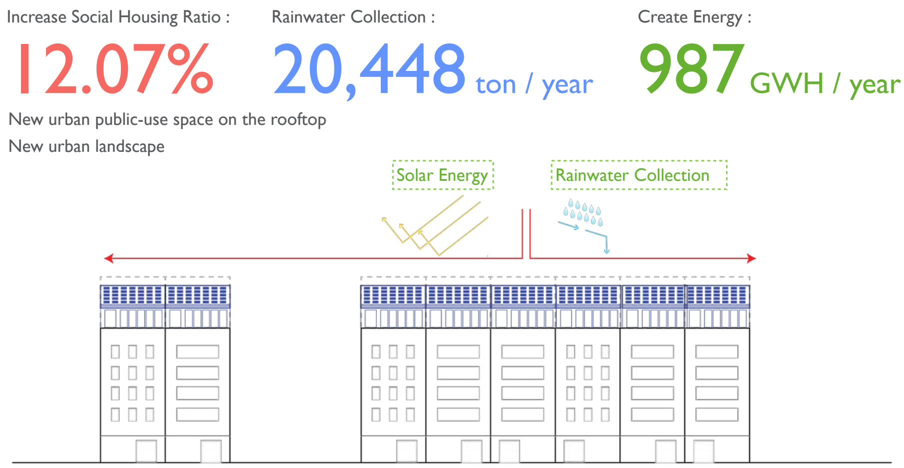


  During the Winter Camp, NCTU UNICODE will host the lecture and workshop for students to learn the sustainable design and ecofriendly life style. Each student will develop own design during the workshop and create scaled models. These models will be exhibited at the creative park afterwards. As the conclusion phase of winter camp, NCTU UNICODE and Huashan 1914 Creative Park will invite national media for press conference. During the conference, the progress of house construction as well as the result of workshop will be exposed for making sure the young talents has disseminated with sustainable development for the society.

5.0 Innovation in Urban Design, Transportation, and Affordability

5.1 Urban Regeneration:

We use the word “regeneration” to indicate our dedication to cause as little disturbance as possible in our mission to revamp the city and its social housing system. Taipei city has very little available space, and we do not wish to destroy pre-existing buildings, so our solution is to build on rooftops. We studied the rooftop configurations of Taiwan, and came up with dimensions for our house that are adaptable to the most common forms of buildings in the city.



Our design also contributes to improving the conditions of urban life such as:

- Water: The Orchid House collects and uses rainwater and dew for maintenance of the house, which prevents rainwater from leaking into buildings, reduces the burden placed on city sewage systems, and contains stormwater runoff
- Power: The Orchid House can generate up to 987,000 KWH per year. As the house is extremely electricity-efficient, other occupants of the buildings can also share the power.
- Public Amenities: On duplex apartments when the Orchid House module is mirrored to create a “C” shape, the empty area within can be used by all the occupants of the building, whether for socializing or for an extension of the elevator.
- Heat-Island Effect: Our design includes various areas within and around the house dedicated to growing plants, which will help reduce the urban heat island effect and alleviate carbon emissions in the city.
- Social Housing: The Orchid House is a prototype for future homes built for the social housing system. Taipei’s statistics for social housing is currently low at 0.64%; with our project, the city will see an increase up to 12.71%.
- Skyline: The Orchid House provides green vegetation among the concrete and glass buildings during the day and gives off a soft glow at night. This will be a vast improvement from the current shoddy sheet metals and water tanks that dot the skyline.

5.2 Transportation

Our main strategy for efficient transportation is pre-fabrication. We designed the house as a module, which when combined with use of RFID, decreases construction time, increases quality control, lowers costs, and allows for easy assembly. Furthermore, because the Orchid House is designed as parts, if it ever needs to be removed from the rooftop – perhaps if the original building is being renovated or torn down – it is easily disassembled and moved to another location.

5.3 Affordability

Our plan for the Orchid House to act as a prototype for social housing includes making sure that it is not only affordable to maintain, but also to construct. The costs for building the Orchid House will be split into three parts: 30% paid by the government, 30% by the residents of the original building, and 40% by energy serving companies (ESCO).

- Government: Since social housing is supposed to be the government's responsibility, paying only 30% of the constructions cost will be an added incentive.
- ESCO: ESCO's will be willing to shoulder part of the costs because their company mission is to provide comprehensive energy solutions.
- Residents: Residents of row houses and duplex apartments will be willing to pay for 30% because they will receive rent. The costs for building an extension on the apartments is already low because the rooftop land is for free; when the 30% is further divided among the multiple households of the row house or duplex apartment. Also, because the houses are pre-fabricated and can be manufactured by parts, the more houses that are commissioned, the lower the cost.

6.0 Smart Living

"Smart living" in a home setting normally refers to the use of emerging technologies to enhance the quality of life, which might include designs to support physical as well as psychological comfort and convenience/efficiency in modern household activities. However, instead of planning a complete smart living system, which might cover designs that do not have a strong connection to the performance of the house, we focus on the applications of technologies in two directions:

1. To raise the comfort level, both physical and psychological
2. To support the awareness in the condition of living environment

Moreover, the designs we propose are centered on a key element of everyday life – lighting, and we believe that a "smart" design should be built on minimal elements.

6.1 Environmental Awareness

In addition to using technologies to endow a house with the capability to perform automation which leads to lower energy consumption and higher comfort level, we believe it is important to support inhabitants' awareness of the conditions of the environment they live in. It is the inhabitants who have the ultimate ability and right to actually change the environment and make it better. Therefore, developing designs to support conscious awareness of the environmental conditions is no less important than designs that reduce human efforts and enhance a house's performance through home automation.

Our aim is to turn architectural space into an interface for information visualization. By visualizing information about environmental conditions - average indoor temperature/humidity or overall energy consumption for instance - with key elements that constitute a living environment, it is possible to make inhabitants aware of the conditions without using conventional information interface such as display monitors or projections. The developed design strategy is to use the element of "light" as the main means for such information visualization and we choose to visualize two major factors of environmental conditions: temperature and energy consumption.

6.2 Visualization of Temperature

For the factor of temperature, we use color to visualize it. The temperature is translated as the color of ambient light, arranged at the boundaries of ceilings, visible to the inhabitants. Instead of using a simple analogy – the temperature of the environment corresponding to the temperature of light – the relationship between the color of light and the temperature of the environment is reconsidered based on the concern of psychological comfort. Therefore, rather than using a warmer color to indicate a higher temperature, a cooler color can be used to provide a psychological comfort during an overly warm day or in a warm space. Consequently, changes in the color of lighting becomes readable and yet has effect to the level of comfort at the same time.

On the top of this basic strategy for the use of light and its color, we have developed two possible rules to guide the use of colors for ambient lights, and the two rules describe the change of ambient lighting colors as a response to the two possible factors explained below.

Outdoor Temperature:

The ambient lighting color changes according to the variation of the environment temperature in real time. We hope to let people feel more comfortable by surrounded in the different ambient lighting color. Warm colors give people the feeling of heat. Cool colors give people opposite feeling. If the outdoor temperature is too cold, the warm coloring lighting warms you up. On the contrary, if the outdoor temperature is too hot, the cool coloring lighting cools you down.

Average Temperature of Each Defined Space:

The ambient lighting in the house is divided into a few zones, and each of which can be controlled individually. The color of ambient lighting is determined according to the long-term average temperature in each defined space (living space or dining space, for instance). Consequently, the color of ambient lighting in a space may be distinguished from that in another space due to the difference in average temperature between the two spaces over a long period of time.

6.3 Visualization of Energy Consumption

The factor of energy consumption is visualized through the pattern of light and shadow generated by the indoor artificial lighting. Translating the abstract quantity of electricity consumption into a visual pattern shown on the surfaces of the interior spaces provides a

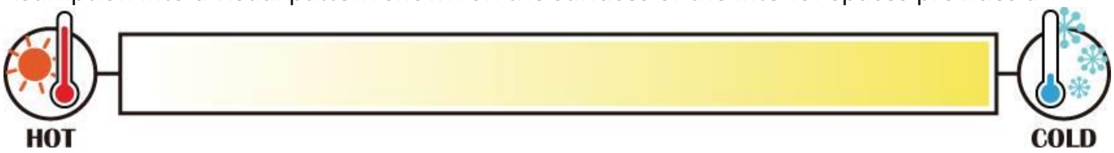


Fig.5.2.2.1 Variation of color temperature for ambient lighting

natural and ambient way for the inhabitants to be aware of the status of the house's energy consumption. We propose to show such "energy pattern" on ceilings, and it is generated by a specially designed lighting fixture. The pattern is designed to have features of a flower, by which we hope to create a connection to the "Orchid House".

Fig.6.3.1 The lighting pattern on the ceiling
The lighting pattern changes according to the electricity consumption in corresponding spaces.

Each petal of the "flower" corresponds to the energy consumption of each defined space, including living space, kitchen, and bedroom. The length of the petal represents the quantity of the electricity consumption. The more electricity used, the longer the petal is.

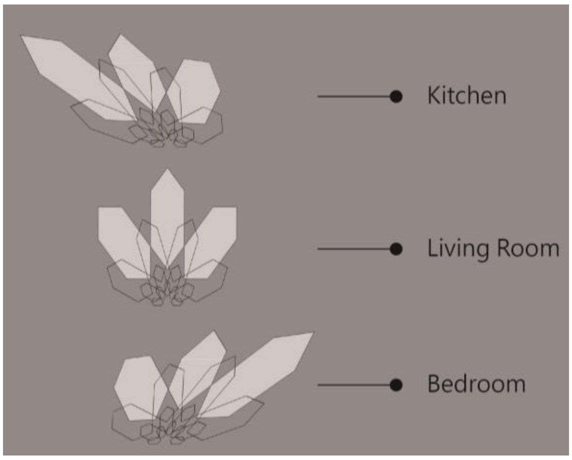


Fig.6.3.2 The lighting pattern
The "flower" represents the status of energy consumption. The length of each petal changes in response to the quantity of the energy consumption in each corresponding space.

Fig.6.3.3 Changing of the lighting pattern

6.4 Visualization of Outdoor Air Quality

Following the concept of social housing, visualization of environmental conditions may take place in an urban scale, in addition to the inside of each Orchid House. Similar to the idea of turning architectural space into interface for information visualization, the exterior of the house, as part of the urban space, can be used to convey information to users of the city. Through the status of the house envelope, signified by the lighting, information about the city's environmental condition at the location of the house can be made visible.

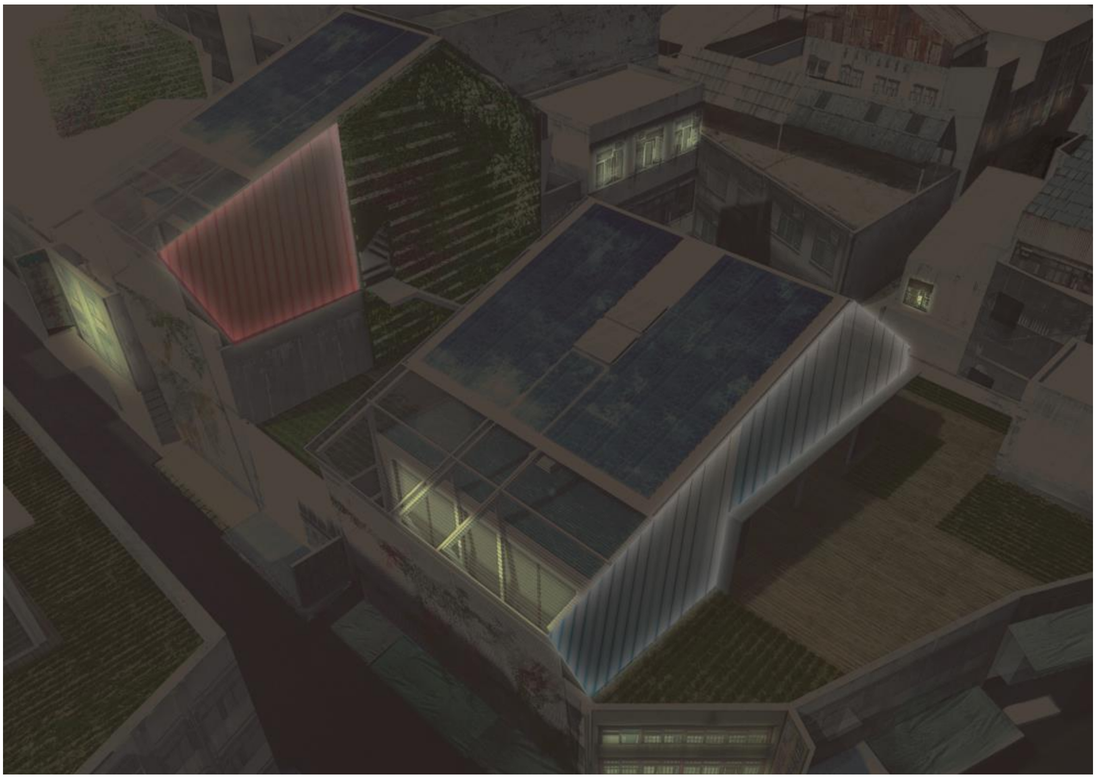


Fig.6.4.1. The lighting color on the envelope represents the quality of outdoor air

We propose visualization for the quality of outdoor air, which is a crucial information about the city-wide environmental condition. By controlling LED lighting on the exterior envelope according to the data of air quality collect from the weather station installed on each Orchid House, the exterior envelope becomes a signifying interface. The residents in the city can get a sense of the outdoor air quality by just looking at the houses. Lighting color is used as the way to represent the air quality. Blue color, for instance, tells that the outdoor air is in a relatively good condition. Red color, by comparison, may tell that the air pollution is severe.

6.5 Lighting Automation

In addition to the use of light and its associated properties as a way to visualize information about environmental conditions, as described above, the controlling of lighting, including both natural and artificial lighting, may be done automatically according to the lighting conditions and the presence of people in a space monitored by sensors. On the top of this automation, a manual override is also provided.

In general, automation of artificial lighting control is provided constantly in each space of the house. Automatic control for the combination of both natural and artificial lighting, in contrast, is provided at the bedroom and the living space. The adjustment of lighting is determined based on the scenarios of activities taking place in a space. The scenarios and rules of automation are presented below.

Living Room Scenario

To increase the convenience of the house, we integrate light with automatic curtain into the Living Room Scenario Control System. You can adjust both lighting and curtain at the same time by just touching the button on mobile device. There are two modes of the scenario control system, Default Mode and Movie Mode.

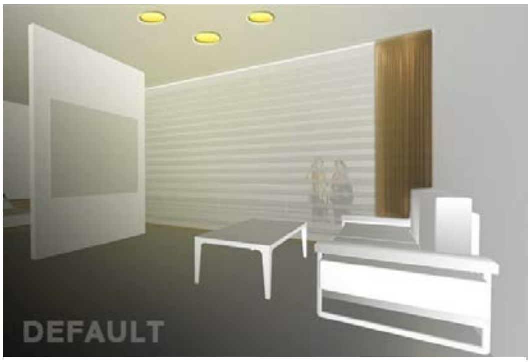


Fig.6.5.1. General Mode for the living space
The curtain is opened in order to provide natural lighting.

Fig.6.5.2 Movie Mode for the living space
This mode is for watching TV/movies. The artificial lighting is dimmed and the curtain is closed.

Bedroom Scenario

There are two modes in this scenario control system, “Wake-Up Mode” and “Sleep Mode”. Similar to the living room scenario, in the bedroom scenario, the controls of artificial lighting and natural lighting, though the electric curtain system, are integrated and may be automatically performed. The Sleep Mode is manually triggered through buttons or interface on the remote control device. The Wake-Up Mode allows the user to specify a wake-up time, when the electric curtain along with artificial lighting are controlled to provide proper lighting for the ease and comfort of morning wake-up.

Fig.6.5.3. Sleeping Mode for the bedroom

Fig.6.5.4 Wake-Up Mode for the bedroom

6.6 Interface for Smart Living System

Fig.6.6.1 Interface of Scenario Control System on Mobile Device
Use mobile device to remote control the light and automatic curtain.

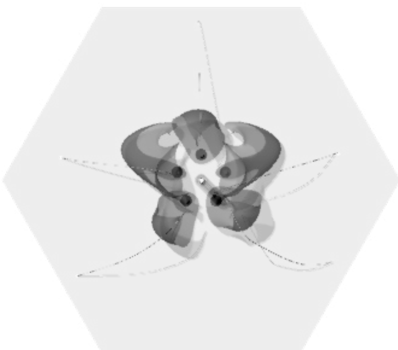
A controlling interface is provided based on a mobile device, a smart phone or a tablet computer. This gives users a convenient way to control the house when needed. The interface allows users to manually select the operations modes, as described above, or control certain devices such as lighting fixtures or electric curtains. Instead of using conventional 2D maps to organize controlling functions, we may use a 3D model of the house as the basis of an interactive interface design. This leads to an interface through which navigation of location-based information becomes natural and understandable. Such a 3D interface serves two purposes. Firstly, it allows its users to locate device items to control based on their locations in the 3D model. Secondly, it presents information about environmental conditions based on corresponding three-dimensional locations.

7.0 Smart Skin

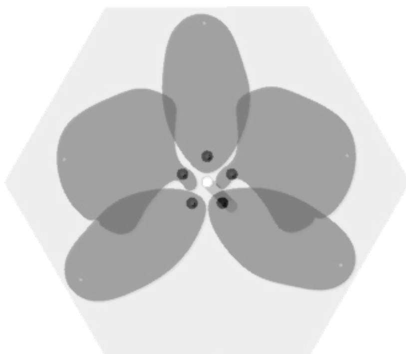
In Taiwan, the average temperature in summer is rather high. During this season, a thermal wall cannot offer any benefit to the house. Instead, it would accumulate heat and consequently lead to unwanted warmth to houses. Therefore, an additional controlling layer of sunlight to a thermal wall is necessary. Such a “skin” layer responds to the level of sunlight (or temperature) and changes it physical status which results in a change of sunlight passage through itself.

Rather than using a conventional electrical-mechanical solution to achieve a layer of adaptive skin, which normally relies on complicated electrical-mechanical mechanisms including motors and gears, we are developing an innovative solution which is based on the use of smart materials. SMA (shape memory alloy) and thermo bi-metal are perhaps the most common smart materials available, and they have similar behaviors in terms of physical reactions to the temperature. We choose SMA as the major material to achieve kinetic movements in the building envelope. It has the ability to return from a deformed state (temporary shape) to their original (permanent) shape induced by an external stimulus (trigger), such as temperature change.

With smart materials, it is then possible to develop kinetic mechanisms which can perform designed movements without electricity. Combining such kinetic mechanisms with the design of building envelope lead to a special architectural skin which adapts to environmental conditions. In our case, the “smart skin” reacts to the temperature. As the outdoor temperature rises, units in the smart skin deform to block partial sunlight, resulting in change of sunlight passing through. In this way, we expect that the smart skin can increase the performance of the thermal wall by reducing unnecessary heat in warm days. Other than this, it is generally a light-filtering layer of skin which can be fitted to other part of the Orchid House’s envelope.

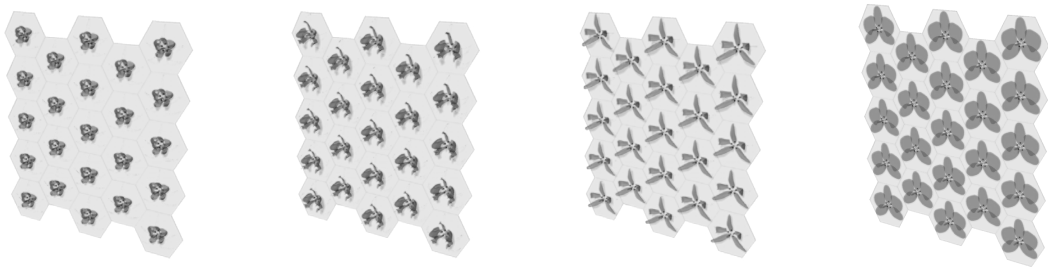


Temperature low (less shadowing area)



Temperature high(most shadowing area)

The key component of the smart skin – the kinetic mechanism with smart material – is designed as a unit with the shape of an orchid flower. Therefore, the smart skin appears as an array of orchid flowers that react to the sunlight. In direct sunlight which causes high temperature on the surface of the smart skin, the orchids bloom, and the petals become flat, allowing less sunlight to enter. On the contrary, when there is less sunlight and the temperature is low, the orchids shrink, and the petals curl. This allow relatively more sunlight to go through and reach the thermal wall. The heat stored during the day time is released during the night to keep the interior at a moderate temperature.



less shadowing -- most shadowing

Similar device can also be used in indoor space, for instance, to replace automatic curtain. Instead of using electricity or human power to change the status of sunlight shading, this device enables architecture to interact with the environment and climate. In addition to the thermal wall, this smart skin can also be installed on the 2nd floor west façade and under the north roof. This does not only offer sunlight shadings, but also provide an interesting pattern which gives the house a strong feature.

1.0 General Concept of the Project and Sustainability

Cities in Taiwan contain buildings with illegal structures. Everyone tries to gain a little more living space by encroaching vertically. Solar Decathlon is an opportunity to make people rethink what they have done, and what is crucial for a better world. Orchid House strives to solve problems such as electricity and water usage, along with social housing at once, in a smarter and more sustainable way.

2.0 Bioclimatic Strategies : Passive Design Strategies

There are three key bioclimatic strategies we have learned from Orchid's eco-system:

- Indirect sunlight
- Good ventilation
- No excess water

To mimic the living environment, the Orchid House's outer skin serves as a canopy to filter direct sunlight and reduce heat gain in the interior space. Large swinging doors opens up and let in cool air, which then go out through the operated windows on the mezzanine level. The sloped solar panel harvest rainwater which are stored, filtered, and can be used for irrigation.

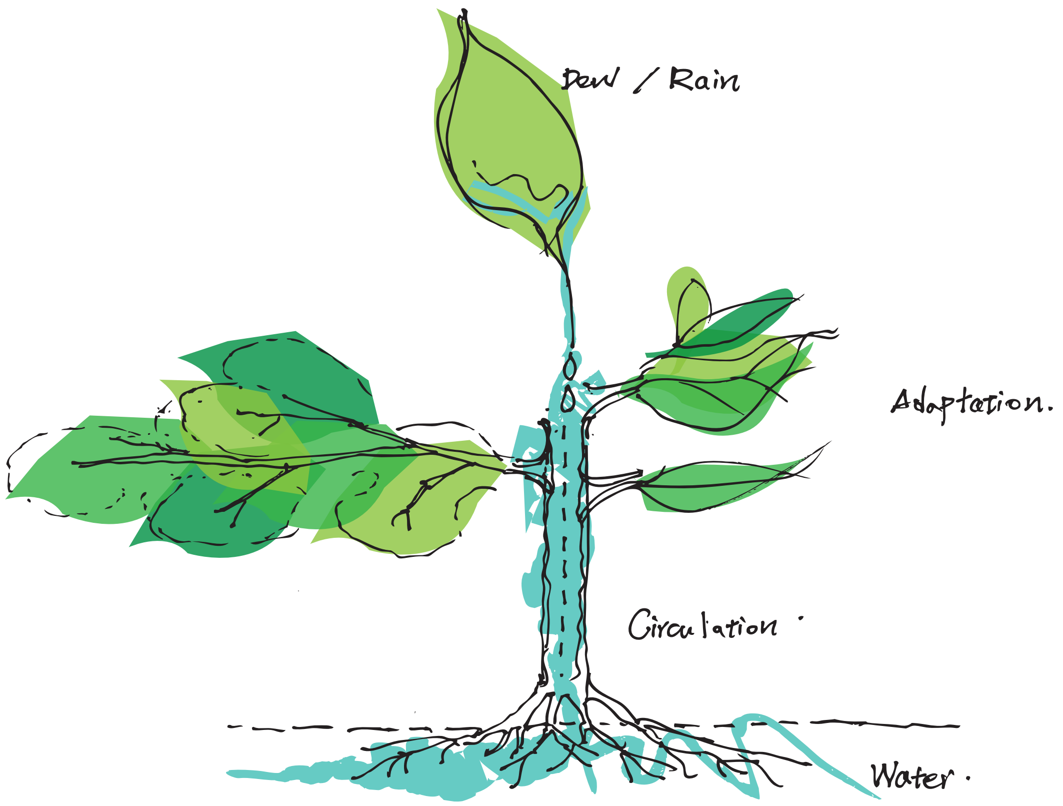


Figure 2.1 Concept Sketch of Living Plant

2.1 Poject’s envelope

The Orchid House is the composition of two different type of volume, the exterior volume and the L-shape living space volume. This two different volumes play different roles in terms of climate control and spacing.

2.1.1 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.

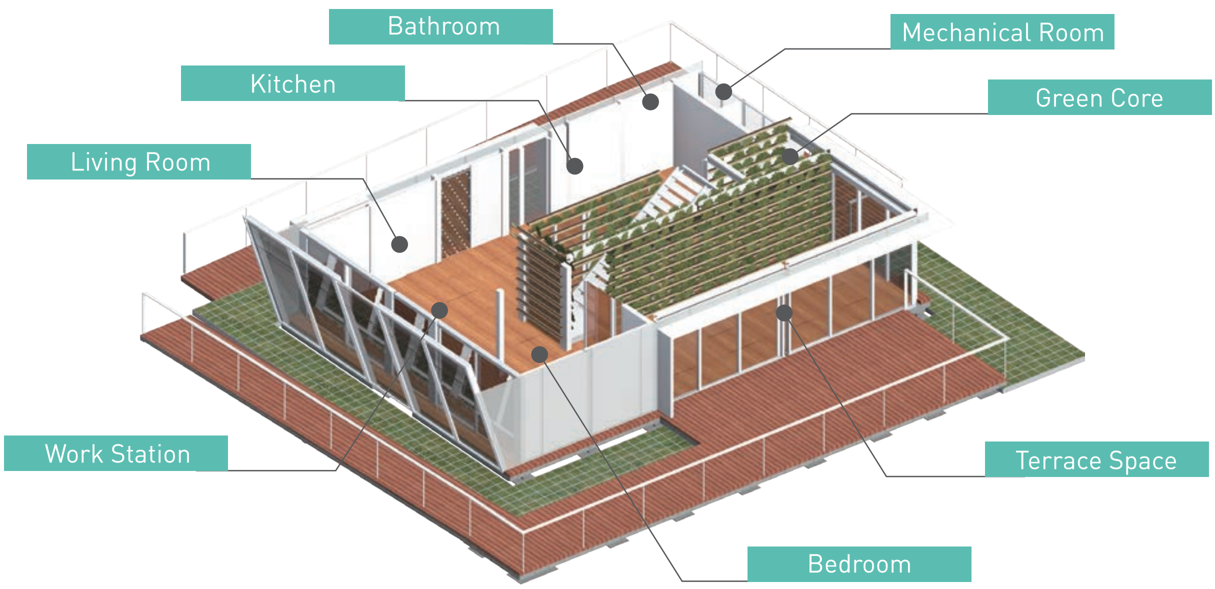
Even though the Makrolon® polycarbonate 40mm is 55% transparent and its U-value is 1.1 W/m²*K, the installation process and supporting materials are far less than conventional glass curtain wall system. The Orchid House will already eliminate large amount of material usage and human resource by incorporating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

2.1.2 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.



2.2 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.

2.3 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.

Figure 2.3.1 View to thermal mass and Green core

2.4 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.

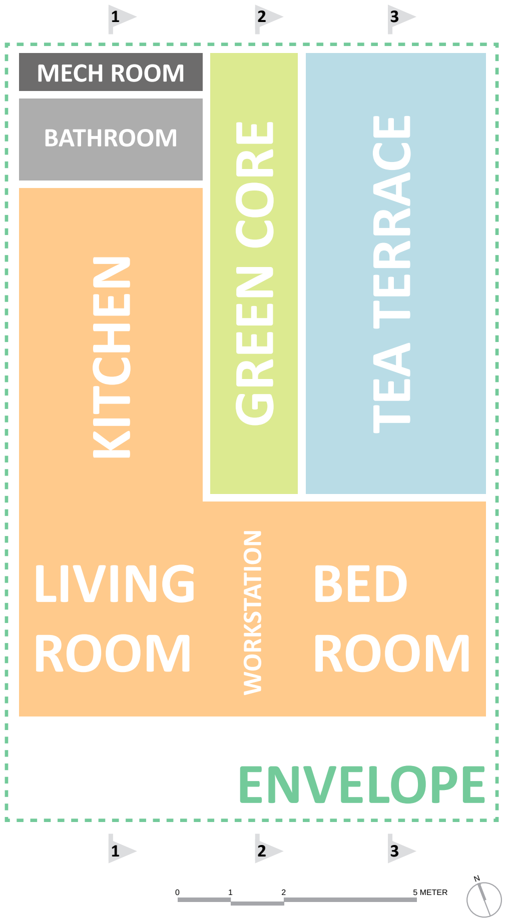


Figure 2.4.1 Program Plan Diagram

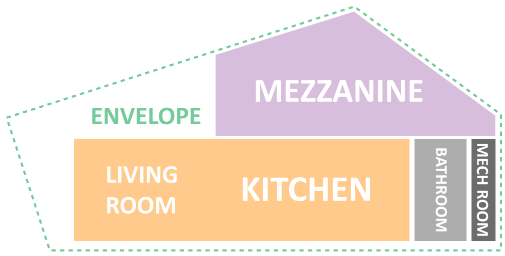


Figure 2.4.2 Program Section Diagram 1

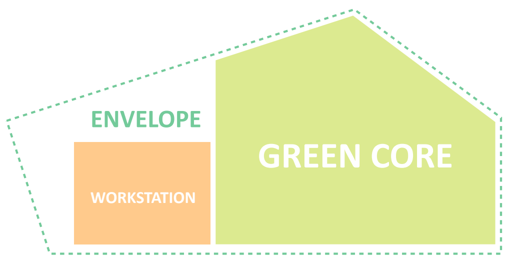


Figure 2.4.3 Program Section Diagram 2

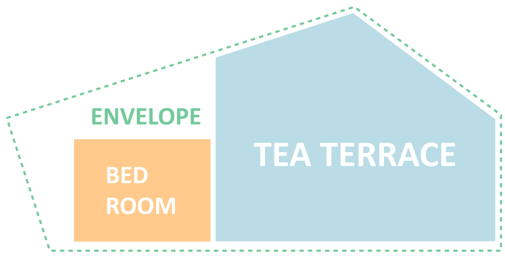


Figure 2.4.4 Program Section Diagram 3

2.5 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.

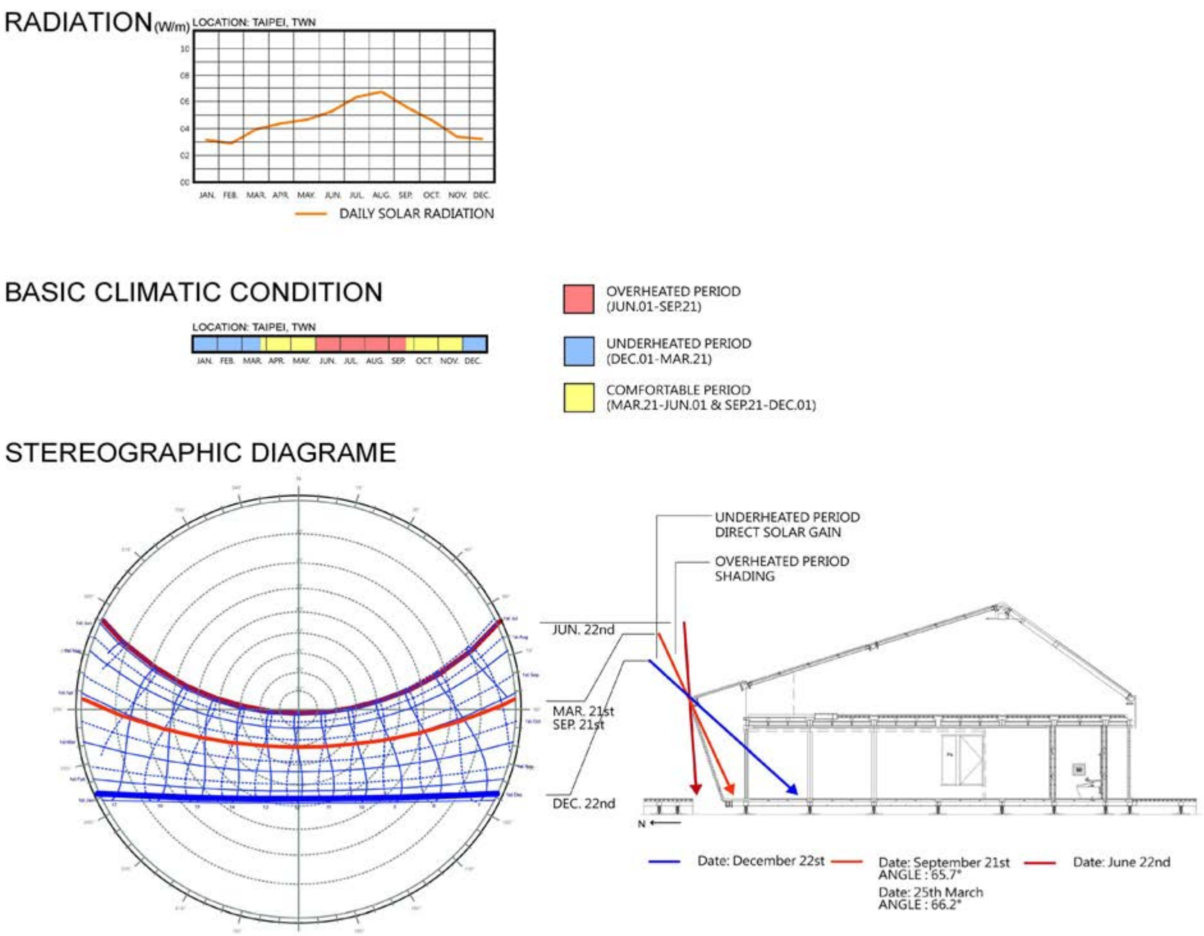


Figure 1.5.1 Solar Angle and Direct Solar Gain Diagram

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.

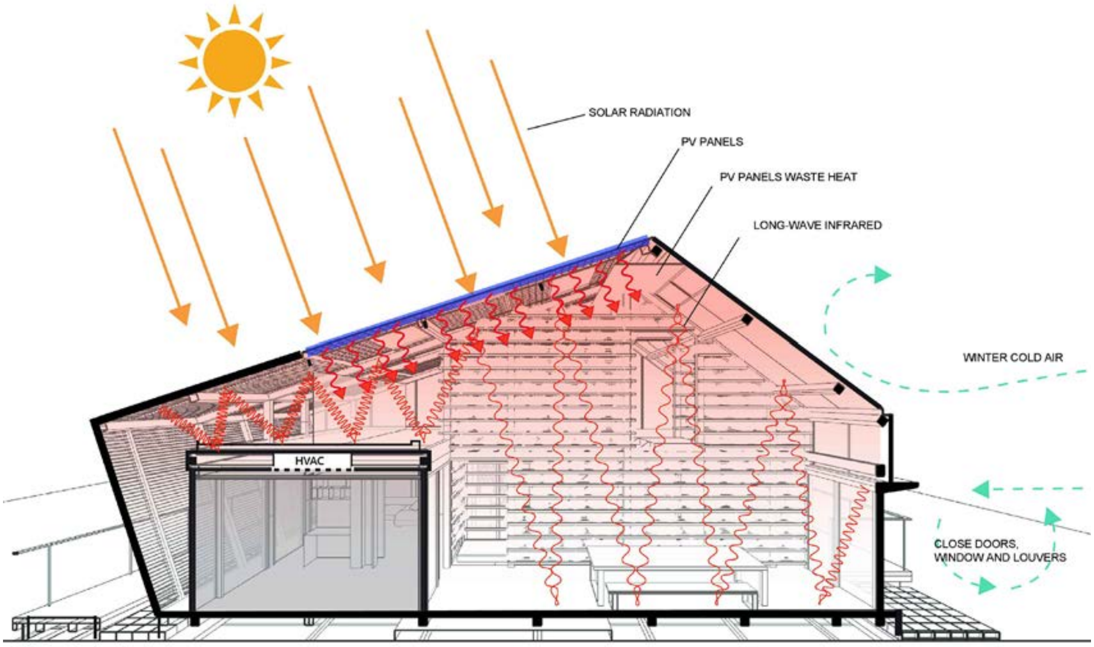


Figure 1.5.2 Greenhouse Effect Diagram

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.

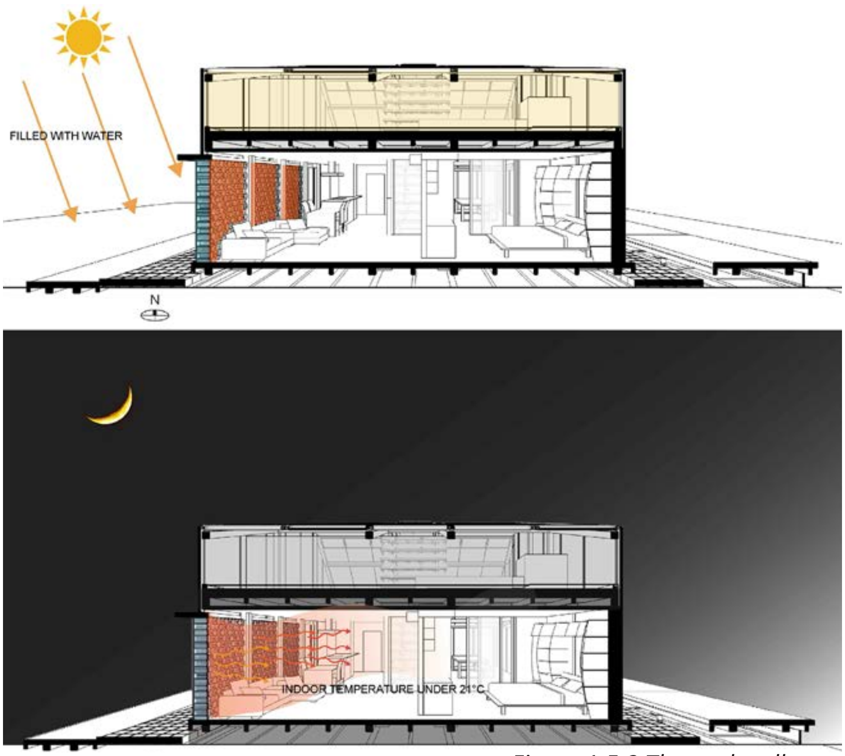


Figure 1.5.3 Thermal wall experiment diagram

2.6 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.

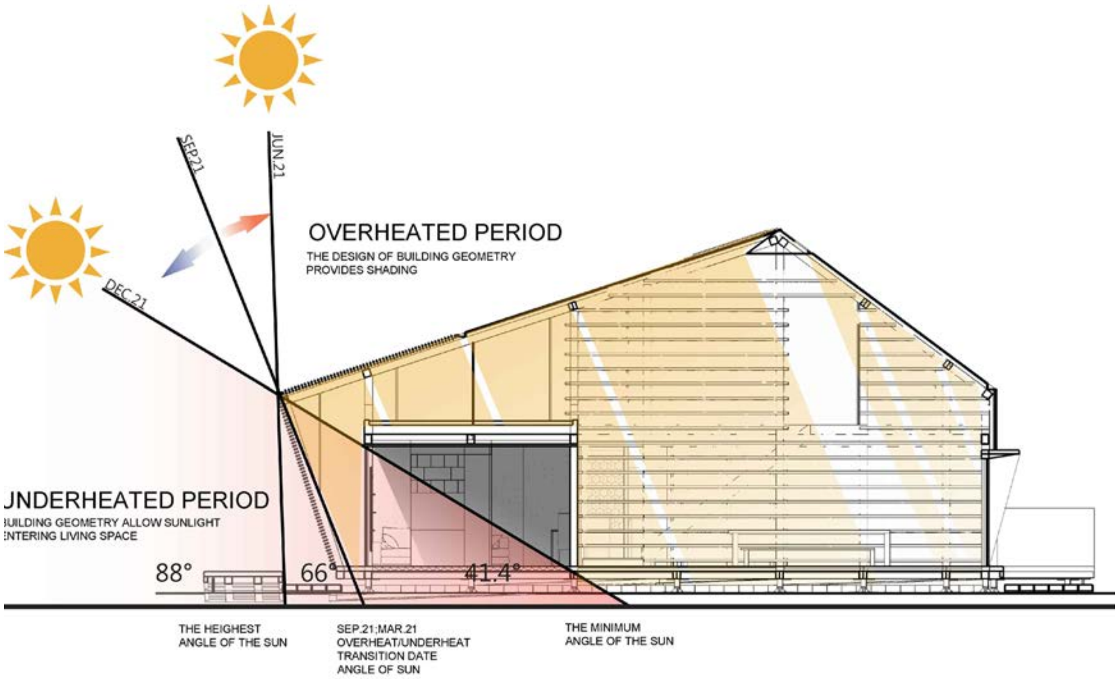


Figure 1.6.1 Solar Angle and Shading Diagram

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.

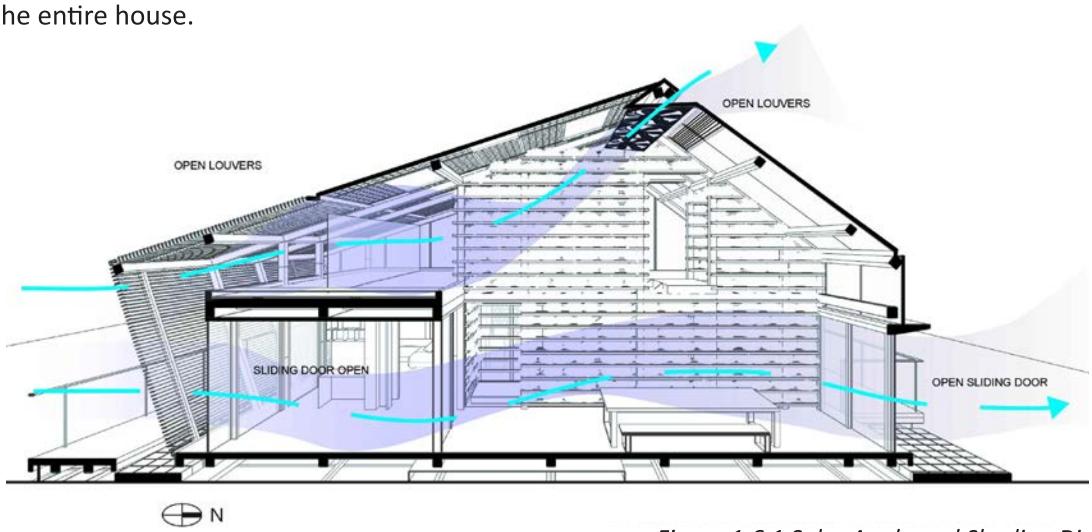


Figure 1.6.1 Solar Angle and Shading Diagram

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.

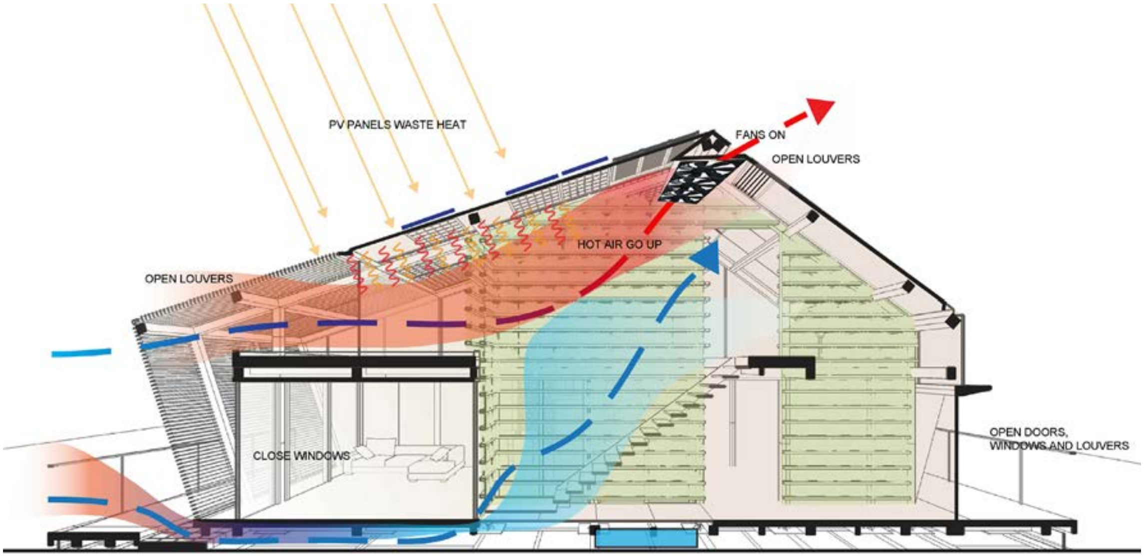


Figure 1.6.3 Solar Chimney Diagram

2.7 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.

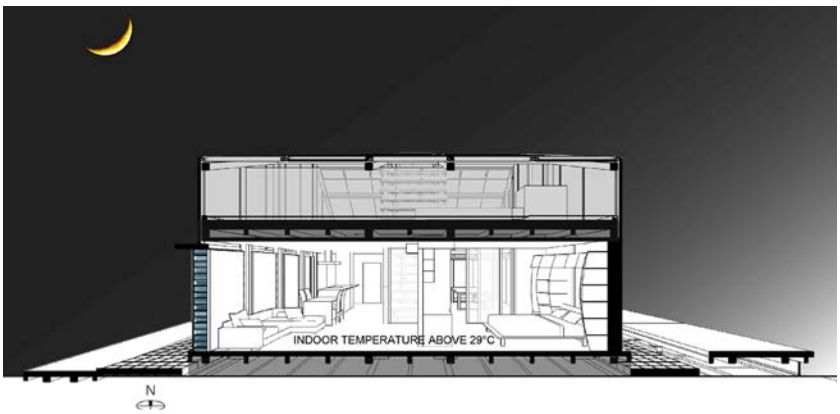


Figure 2.7.1 Thermal wall at overheated night

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.

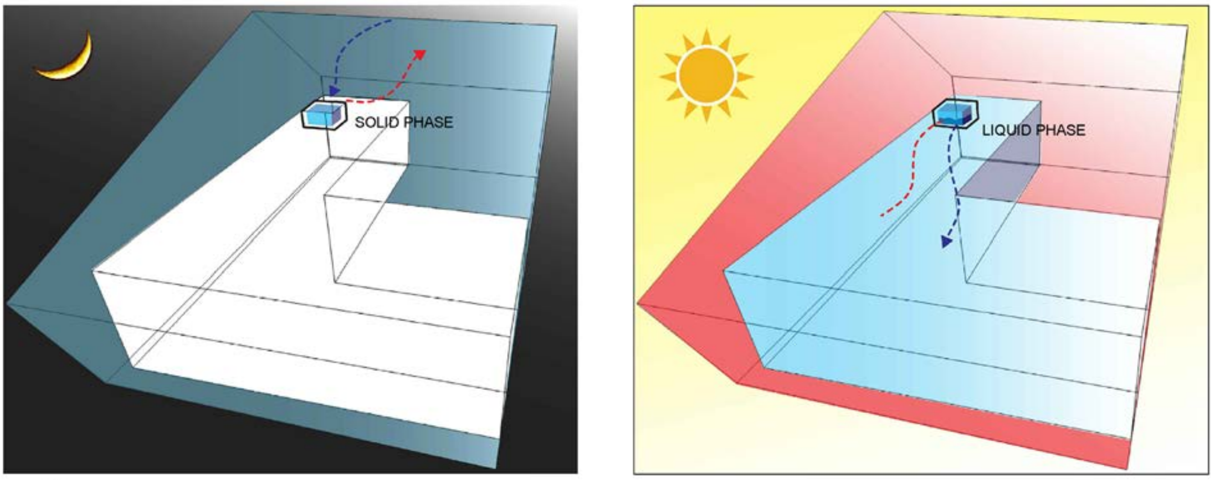


Figure 2.7.3 Phase Change Material Diagram

2.8 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

2.9 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.

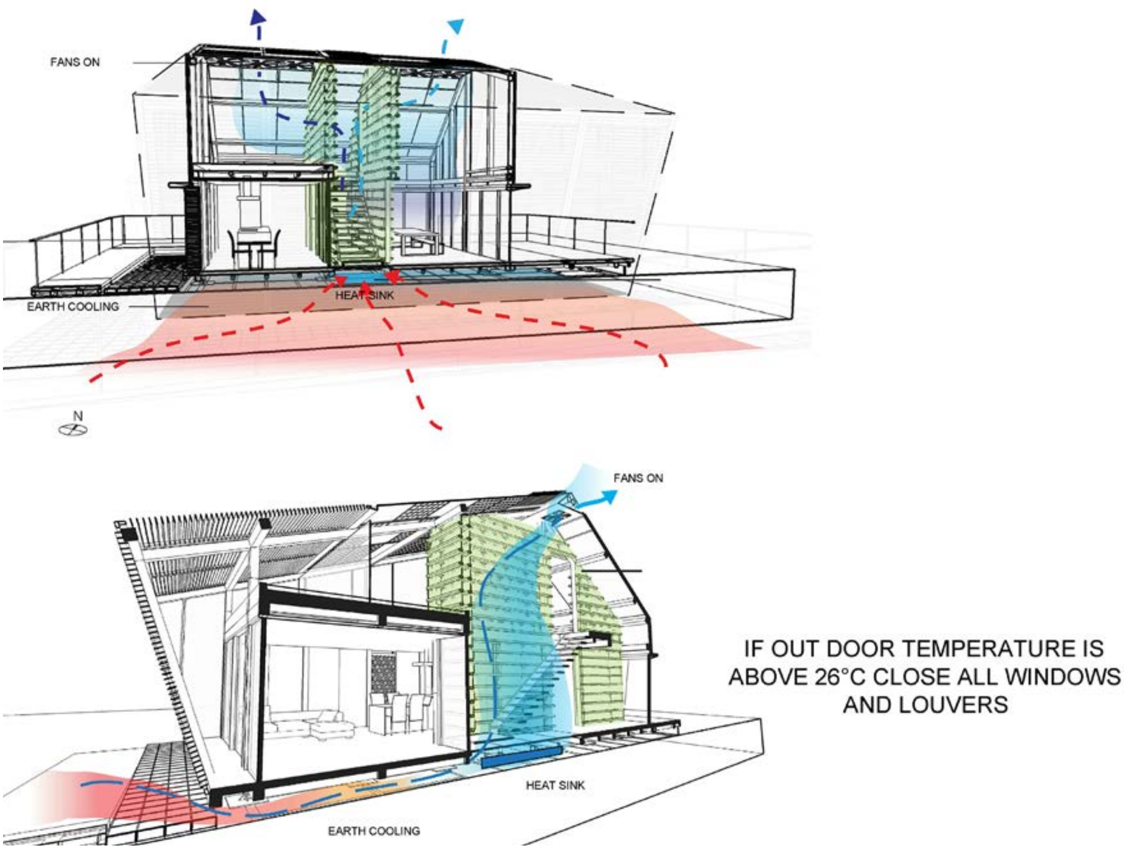


Figure 2.9.1 Earth and Vegetation Cooling Diagram

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.

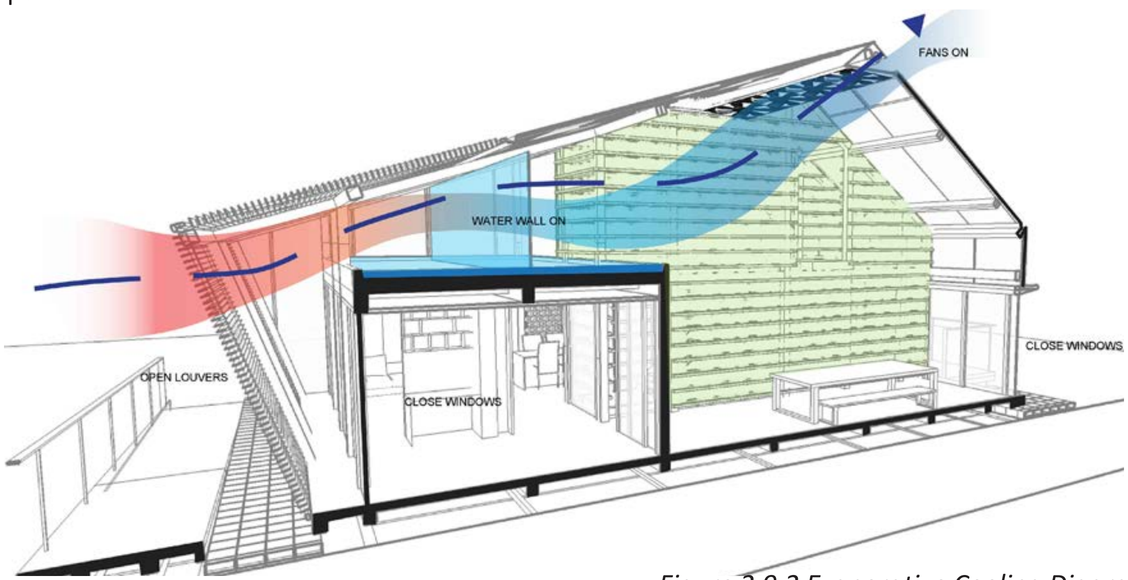


Figure 2.9.2 Evaporative Cooling Diagram

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 .

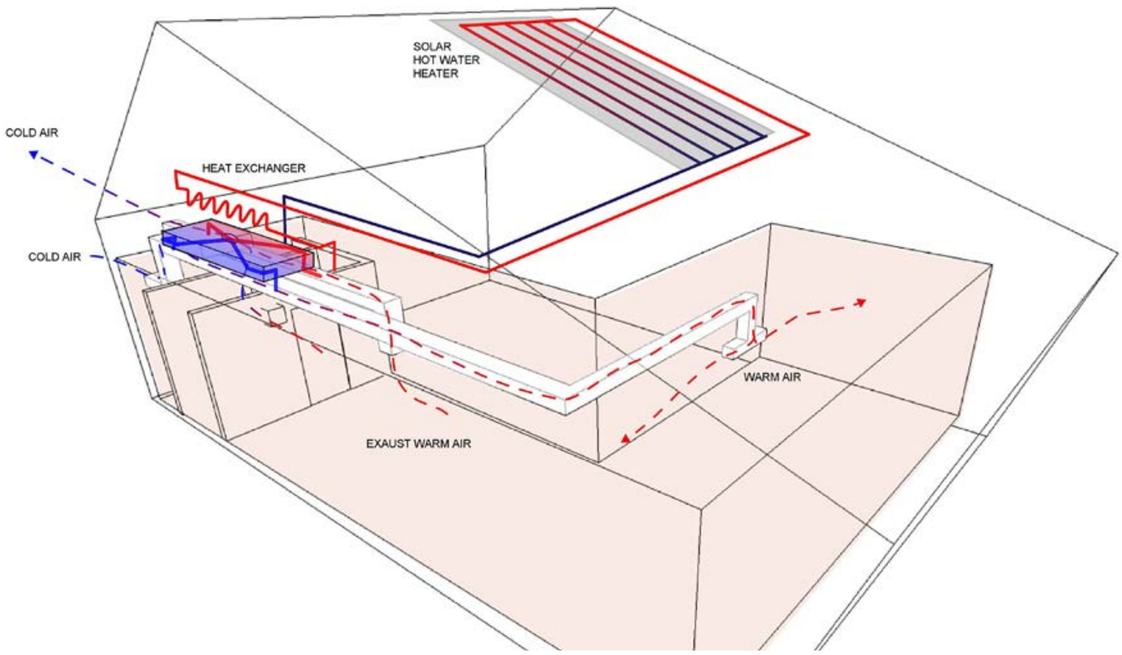


Figure 2.9.3 Solar hot water preheat air handling system

2.10 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.

Figure 2.10.1 East side view at Solar Decathlon Europe

3.0 Materials

The Orchid House incorporates many sustainable materials available in Taiwan. NCTU UNICODE pays deep attention to the manufacturing location and travel distance of the product for reducing the carbon footprint. During the material investigation, the team found that mixing recycled material with bio-chemical material to create composite material is becoming more and more popular in Taiwan. Therefore, the Orchid House will be showcasing those material in live performance of their efficiency.

3.1 Materials selection

The Orchid House material selection is including:

3.1.1 Façade

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

3.1.2 Structure

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

3.1.3 Floor

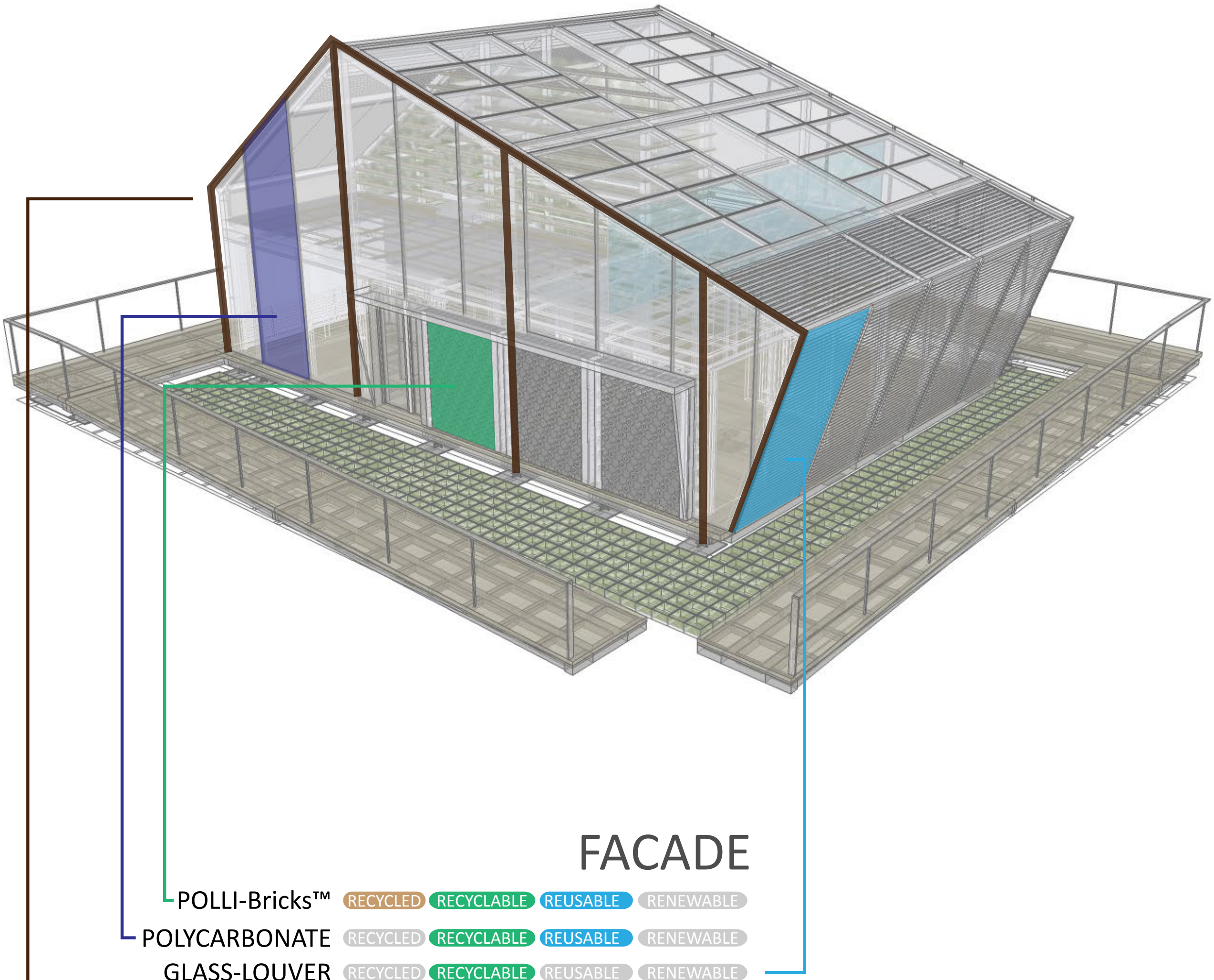
UA Floor: Recyclable and Renewable
Wood Plastic Composite: Recycled, Recyclable and Reusable

3.1.4 Insulation

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

3.1.5 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

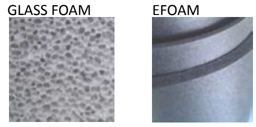
STEEL RECYCLED RECYCLABLE REUSABLE RENEWABLE
STRUCTURAL PLYWOOD RECYCLED RECYCLABLE REUSABLE RENEWABLE

FLOOR

UA FLOOR :R1621 RECYCLED RECYCLABLE REUSABLE RENEWABLE
WOOD PLASTIC COMPOSITES RECYCLED RECYCLABLE REUSABLE RENEWABLE

INSULATION

GLASS FOAM FOAM RECYCLED RECYCLABLE REUSABLE RENEWABLE
EFOAM RECYCLED RECYCLABLE REUSABLE RENEWABLE



INTERIOR

PLY WOOD RECYCLED RECYCLABLE REUSABLE RENEWABLE

Figure 3.1 Sustainable Material Matrix

3.2 Incorporated Energy

This calculation will be included in the next deliverables.

3.3 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**

3.4 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.

4.0 Construction System

The Orchid House construction fully engages the advantage of prefabrication methods to reduce solid waste during the construction and water use for the construction as well as shortening construction time for reducing economic impact of the project.

The detailed sustainable construction system includes:

1. Modular structural system: See Engineering and Construction design narrative 1.3
2. QR Code + BIM management system: See Engineering and Construction design narrative 1.5
3. Prefabricated façade system: See Constructive design narrative 2.2

5.0 Active System and Equipment

Active Systems and Equipment
The active systems mentioned here include the active solar thermal system and active HVAC system. Those two systems are to be discussed about their system and equipment efficiency of energy.

Active HVAC System
Active HVAC system operates to provide comfort conditions in the room – temperature, relative humidity and IAQ. The active HVAC system includes this equipment: heat pump, heat reclaim ventilators and phase change material. The following strategies are now included to help maximize the performance of active HVAC systems:

- Although ground-source heat pump (GSHP) is also an option for cooling efficiency due to the ground is cooler in summer and warmer in winter than the outdoor air, the air-source heat pump is chosen because the site limitation. The energy efficiency of heat pump is still high, which is shown in the section – Technical project Summary / HVAC Systems / Heat Pump
- High-efficiency heat reclaim ventilator is used to recover near 80% of exhausted energy to greatly reduce the ventilation energy while maintaining a good IAQ.
- Te heat pump is interlocked to the heat reclaim ventilator to attain an optimal combined operation, which is a typical application configured by the supplier.
- Phase change material is an air-based system providing cooling without a refrigerating machine en vironmentally friendly as a result of cooling without refrigerant and CO2-nentral
- The re-circulation and cooling is the best strategy to use the stored energy.
- The automatic control systems should optimize the overall operation to achieve the maximum en ergy saving.

6.0 Solar Systems

Solar Thermal System
The active solar thermal system is used primarily for space and DHW heating – includes collection, storage and use of solar energy.
The following strategies are now included to help maximize the performance of active thermal solar design:

- hink about conservation first. Minimizing the heating load will reduce heat pump and solar thermal system's sizes, and yield the best economics.
- Active solar energy systems must be engineered; otherwise, poor performance is likely. Good design tools, such as F-Chart software shall be used.
- Well-designed, factory-assembled collectors are used to achieve higher thermal performance.
- he solar collectors face due south for optimal performance.
- Use evacuated-tube collectors with the efficiency of 73%. Mount them at an angle of 18 degrees.
- Use optimal storage – about two day's heat storage to yield the best economies. Add excellent insu lation to the tank and place the tank indoors.
- The automatic control system should help optimize energy collection and storage.

6.1 Energy Recovery Time

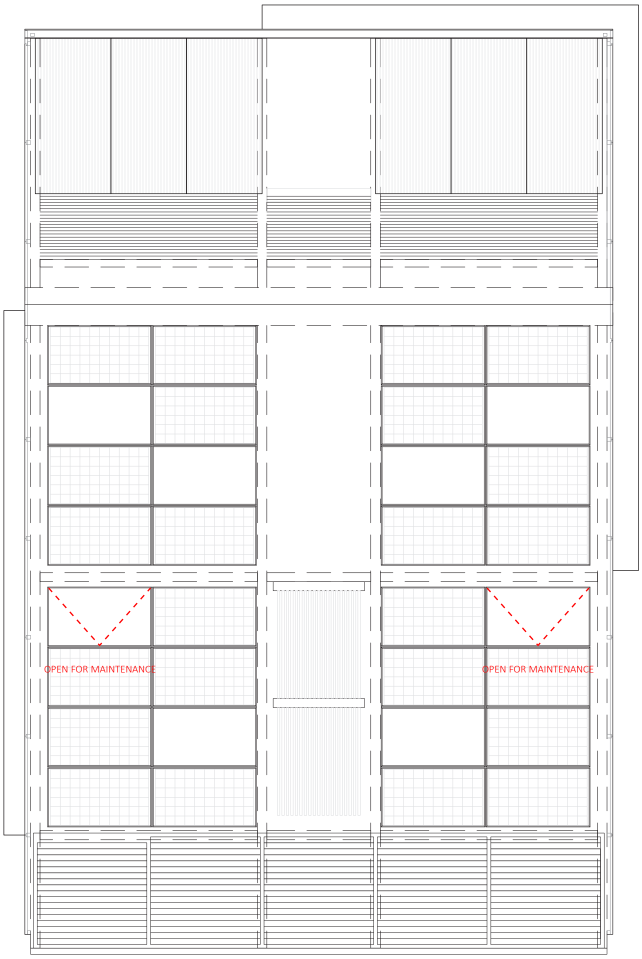
This section will be included next deliverables

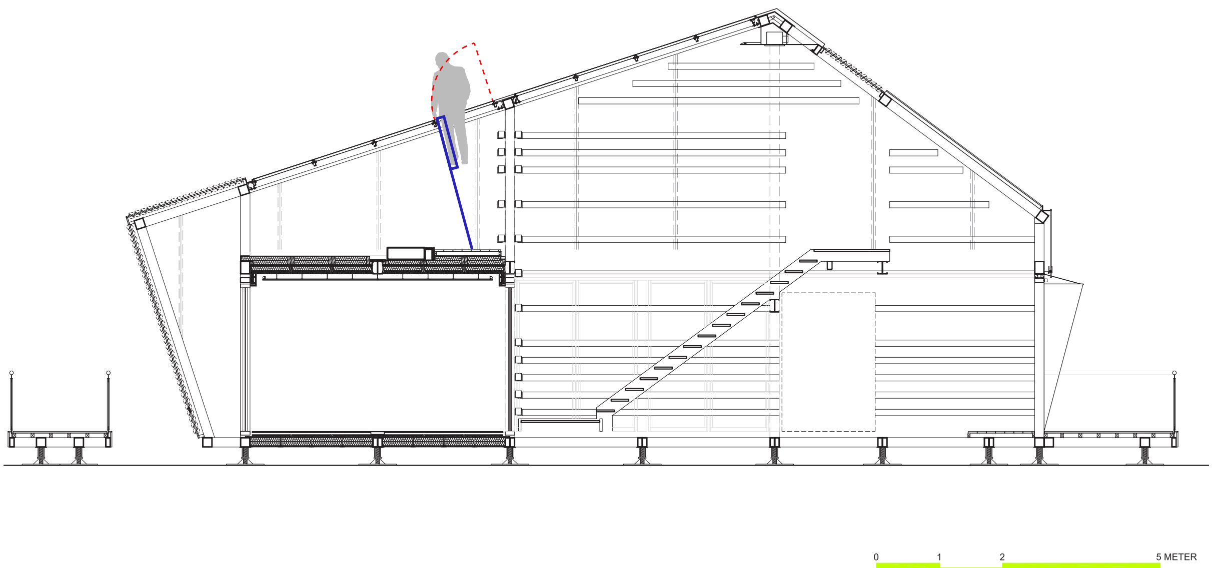
6.2 CO2 emissions

This section will be included next deliverables

6.3 Accessibility

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.





7.0 Water

The water management strategies for the Orchid House include:

7.1. The general water use, management, conservation concept of the Orchid House is to utilize rain water in order to reduce the use of potable water from the city water system. Taiwan has a very long rainy season. Even during the non-rainy season, such as summer, we still get heavy down pours from the tropical storms and typhoons, which bring substantial amount of rain water to this island. Rain water harvest is a major water strategy in the Orchid House. We also collect grey water for further use.

7.2. The strategy for water consumption reduction is to use water saving fixtures. Water saving faucets, toilets, dish washers, and laundry machine are all handpicked for the Orchid House. Moisture sensors are installed in all planters to monitor the water level and the automatic watering system irrigates only when watering is necessary.

7.3. Treatment of waste water: The drained water from the shower pad and laundry machine is considered as grey water. Grey water will be filtered and collected in the grey water tank under the raised floor.

7.4. Grey water system: The grey water tank is used to store filtered grey water which will be recycled for irrigation use and toilet flushing. The grey watver tank also serves as a heat sink for incoming air – it generates cool air by absorbing the heat from the air before it enters the house. The grey water in the tank is pumped into the water closet for flushing. Grey water is not allowed by SDE for toilet reuse, so this application will be used only in Taipei.

7.5. Recycling and reuse: The Orchid house recycles gray water and rain water for irrigation and toilet. The reuse of the grey water and rain water may prolong the time water stays on city surface, and by so doing, reduce the heat island effect in the city.

7.6. Rain water: Rain water falling on the roof of the Orchid House is collected in a gutter, and then drained into a water pan on the mezzanine level. Finally, it is collected in a rain water tank under the raised floor. The water in the rain water tank serves as a cooling heat sink, which cools down the incoming air that goes through the tank before entering the house. The collected rain water will be pumped into the planters on the green wall for irrigation. The water also irrigates outdoor plants. All plants are designed to cool the air through evaporation.

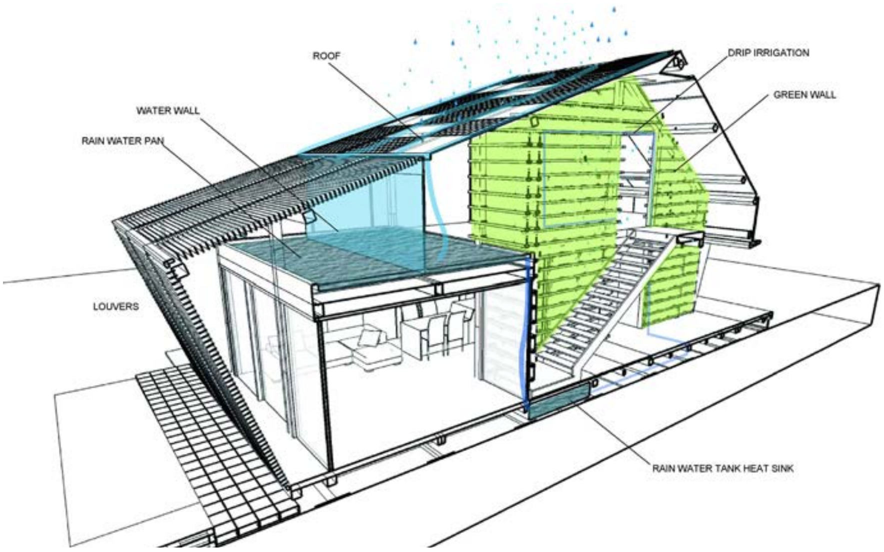


Figure 7.6.1 Rain water recycling system Diagram

7.7 With all these water recycling and reuse strategies, we expect the Orchid House will reduce the water consumption. The water budget shows a 395.8 liter daily consumption for two persons in the Orchid House. The average daily water consumption in Taipei for two persons is 670 liters. Therefore, the Orchid House achieves a 41% reduction in water consumption.

8.0 Solid Waste

8.1 Assessment Plan

The pre-fabricated method allows 90% of the materials to be fabricated off-site. During construction process, any wasted material need to recycled directly in the plant. The building parts will be designed to be fabricated with numerically controlled machine, which as laser cutter or CNC machine. Detail assessment plan will be described in the next deliverables.

8.2 Management of Domestic Waste

The people of Taiwan have progressed far in recycling and minimizing waste, and it is mandatory to separate and recycle garbage in cities. Kitchen waste is especially separated for making fertilizer or pig fed. Currently, Taiwan has 24 incinerators, and all of these incinerators are the waste-to-energy type. The heat generated from burning garbage is converted into electricity and sold to the electric company. Kitchen waste takes up to 20-30% of the weight of household garbage. We want to advocate the policy of sorting, collecting and recycling, then the expected landfills maybe lengthened.

9.0 Life Cycle Analysis

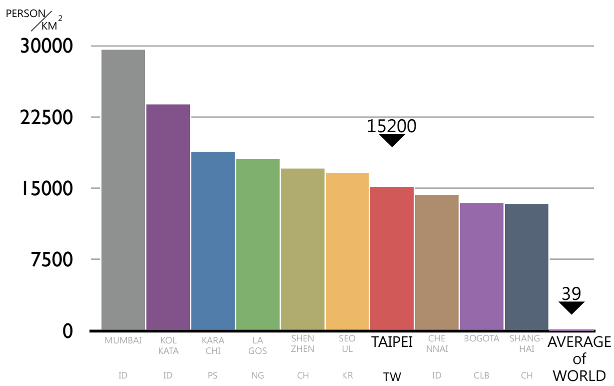
This section will be included next deliverables

10.0 Urban Design and Transportation

Our goal is to revamp the social housing system of Taiwan and integrate more eco-friendly buildings in the process. As one of the aspects of environmental architecture is to disturb the surroundings as little as possible, one of the things we hope to accomplish is to create a design that causes minimal disturbance and even contributes aesthetically to its surroundings. Our solution is to build on top of existing buildings – specifically, the row houses and duplex apartments that are extremely common in Taipei.

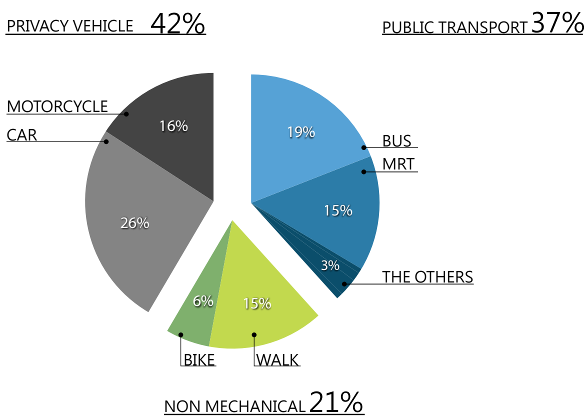
TAIPEI DENSITY of POPULATION

NO.7 in the world



The increasing population density have resulted in the congestion in traffic. It is also a national issue, when single occupancy vehicle simply does not work. Taipei city government have provided the following public transportation systems such as: Metro Rail Transit, Inter-city bus, UBike: public rental bicycle. Other private transportation means including private cars and motorcycles. Most peopel prefer to ride motorcycle to work due to the convience in parking. By 2006, exhaust emissions from new motorcycles will be the same as for cars. Therefore, we believe the key to reduce CO2 emission, it is necessary to use renewable energy and promote pedestrian friendly streetscape.

TAIPEI TRAFFIC



Greenhouse Warming Potential in grams CO2-equivalent per passenger-kilometer Urban Rural Highway

Car - driving solo	310	180	220
Motorcycles & Scooters	260	190	330
Car - driving with one passenger	155	90	110
Car - driving with three passengers	78	45	55

Although these infrastructure were implemented, it is still not enough to ease the traffic congestion. Taipei public transportation is widely used by around 37.7% of all transportation systems. However, it is only 1/3 compare to Hong Kong, which is nearly 92%.

To effectively reduce the emission of CO2, we propose a few strategies:
1. Promote walking
2. Increase residential units in the city to reduce commute time
3. Install electric vehicle charging station

Since using cars is unavoidable, we also want to make sure that green energy can help ease the usage of gasoline. With the Orchid House, we will introduce the EV charger, which promote using renewable energy rather than gasoline. Electric cars have a key advantage of regenerative braking and suspension, and it has the ability to recover energy during braking and store it in the battery. We expect each building can have 3 EV charger, which will reduce the total car CO2 emission in the city to 1/10.

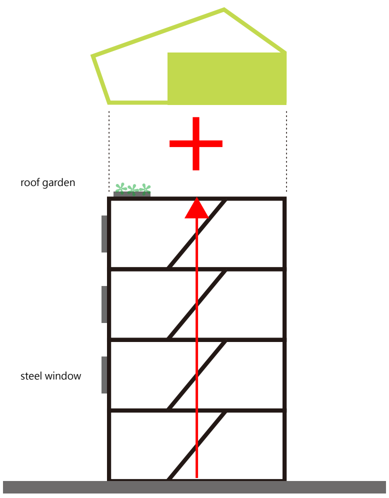
Motorcycle and electric car chargning stations example

Delta Charging Network Management System (CNMS):
Delta's CNMS is a smart and centralized management of electric vehicle charging network for multiple system integration capabilities and scalability.

This EV Charging Solutions contribute to a faster development of EV charging infrastructure and accelerate the adoption of EVs. The aim is, "To provide innovative, clean and energy-efficient solutions for a better tomorrow.

Not only will our design support a sustainable system that increases energy conservation and cuts down on house utility costs, but it will also improve the visual landscape of the Taipei skyline. At the present, most of the roofs are either concrete with metal water tanks placed in the most convenient position or covered by metal roofs to prevent rainwater leakage. Our plan is to place the aesthetically-pleasing solar house on the rooftops of existing buildings, creating a place to live and socialize, as well as to put the necessary mechanical features.

Essentially, the best and primary intention of NCTU Unicode is to create a single dwelling prototype that focuses on environmental and social issues. Our design will reduce the heat island effect of Taipei and encourage households to conserve resources and use less destructive forms of energy. In addition to our "green rooftop system" we also intend to create passive wind ventilation systems that will save energy in the naturally hot and humid Taiwan environment. Furthermore, our design will also contribute greatly to improving the social housing program of Taiwan and provide better living conditions for the population.



Communications Plan

1.0 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.

2.0 Communication Project

2.1 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 upcoming 18 months towards SDE 2014, our actions will roll 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 sepcifically 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):

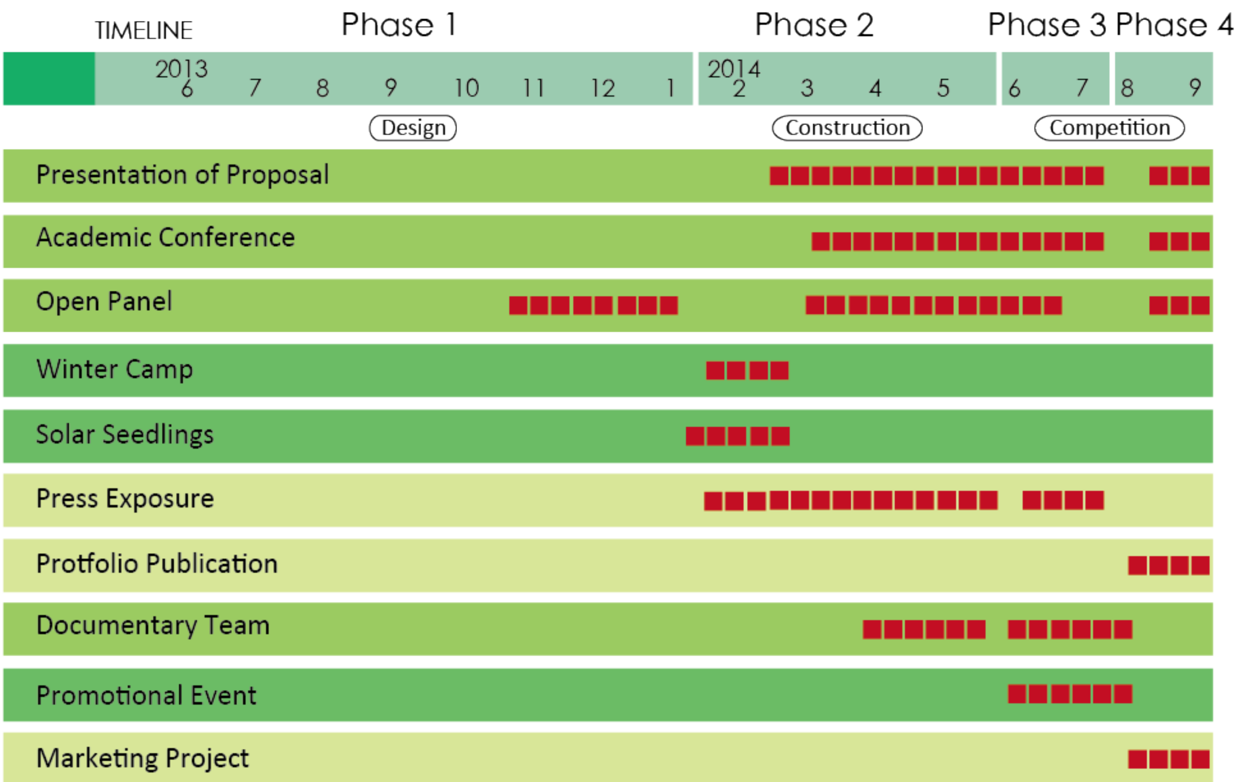
1) Forum,
2) Media,
3) Publishing, and
4) Workshop.

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

The second arm of our Communication Project concerns negotiations with potential sponsors. Because we represent National Chiao Tung University (NCTU), we have certain regulations that limit our interactions with certain sponsors.As a result, our policies for finding and negotiating with sponsors have a certain strategy to them. Our strategy is uniquely suited to our situation in Taiwan, dealing with companies in the Hsinchu Science Park, which is a prominent technology hub in the global scene.

2.2 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 2014
- 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 presescribe 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 enterprises - 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

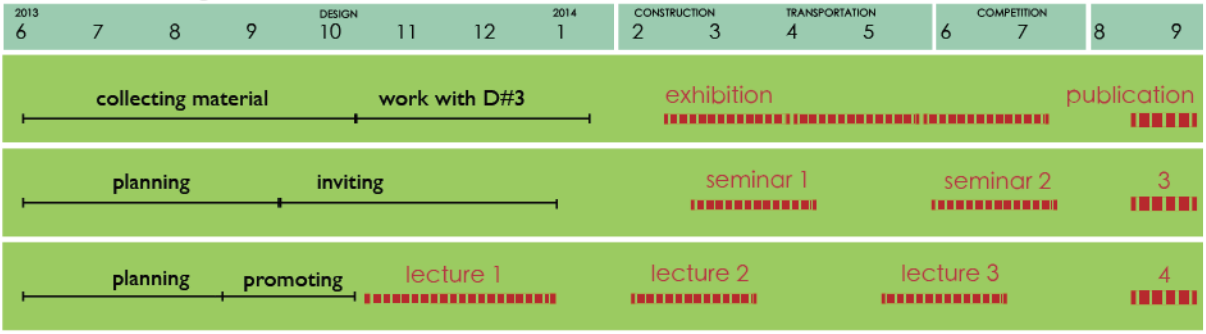
2. NCTU, seminars on Transdisciplinary Integration and Innovation is a class designed for every Tuesday in Graduation Institute of Architecture. This seminar offers series of lectures on various topics and subjects and hands-on workshops related to how urban and architectual issues to be solved through 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

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.

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.

TIMELINE - Exchange



2.3 *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 dierctly reaches our next generation – the foundation for our future. Therefore, we have designed such strategy to aim at mainly the high schoolers 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: 2014/02/07~2014/02/10
  - Channel: Exhibition, lectures and workshop.
  - Audience: High school students, university students.
  - Leader: NCTU/Unicode students and faculty.
  - Execution: 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 Orchid House 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. 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 and college students

Workshop:
(i) Members will be divided into smaller groups (4-5 people per group), maybe two college students from design background, one from non-design background, and two more from high school.
(ii) Each group will be guided to start generating visions, ideas, and concepts, followed by discussion and the physical production of presentation by using any material pertinent to their needs.

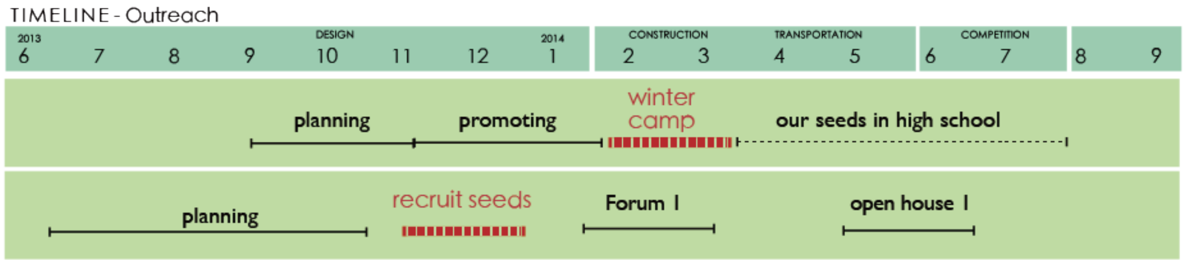
Exhibition:
Following the Winter Camp, an exhibition of their projects as well as other information of Orchid House design will be held and open to the general public.

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 re-newed news, messages, updates, and records of activities such as photos and videos.



2.4 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 imple-mented through Phases 2 and 3.

- **Definition of the Communication Objective**
  Maximize the public exosure 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.

- 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.

EXPECTED MEDIA LIST

Media	Type of Media	Type of Publication	Website address
CTNews	newspaper	print	http://www.chinatimes.com/
UDN	newspaper	print	http://udn.com/NEWS/mainpage.shtml
The Liberty Times	newspaper	print	http://www.libertytimes.com.tw/
NextMedia	newspaper	print	http://tw.nextmedia.com/
Upaper	newspaper	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	print	http://edn.udn.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	print	http://www.interior-mj.com.tw/
DFUN	magazine	print	http://www.dfunmag.com.tw/
La Vie	magazine	print	http://www.wowlavie.com/
IOH	website	online	http://ioh.tw/
xin forum	website	online	http://www.xinmedia.com/xinforum/
Forgemind ArchiMedia	website	online	http://www.forgemind.net/xoops/modules/news/
JUT Foundation For Arts and Architecture	website	online	http://www.jut-arts.org.tw/cht/index.php
City yeast	website	online	http://www.cityyeast.com/
Archicake	website	online	http://www.mmag.com.tw/ad/
Change Taipei	website	online	http://changetaipei.net/
Village Taipei	website	online	http://www.urstaipei.net/

- *Appendix 1 _ Expected Media List*

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?

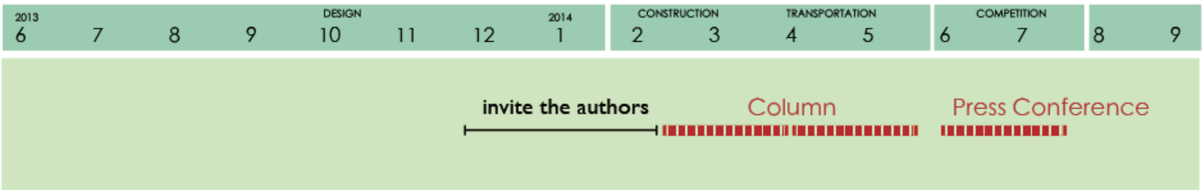
(ii) Sustainability - What does sustainability truly mean?
NCTU/UNICODE use the rooftop as a penertrating object to explore the social significance of a building componant. Roofscape aside, discussion will also evolve around its influence in the future. We will further investigate the feasibility of 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.

TIMELINE - News



2.5 Production - Documentary Team (information production team)

Analysis of the situation

Interactive and entertaining documentaries about urban rooftop regeneration.

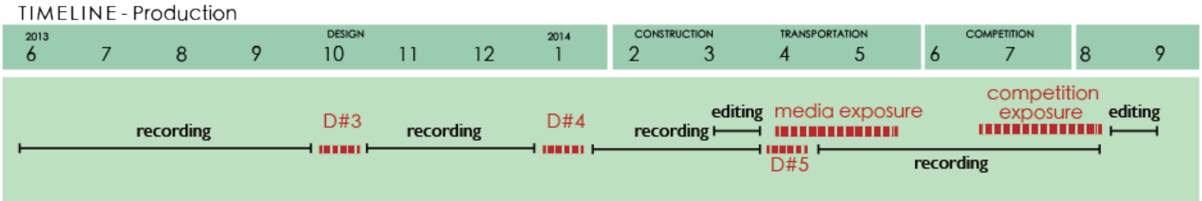
The main goal is to provide records in various forms such as text, charts, drawings, photograph, and video. We have been carefully keeping records and documents through the process. Additionally, images and videos will be used in the presentation of the Orchid House during the competition. This will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

TIMELINE - Production



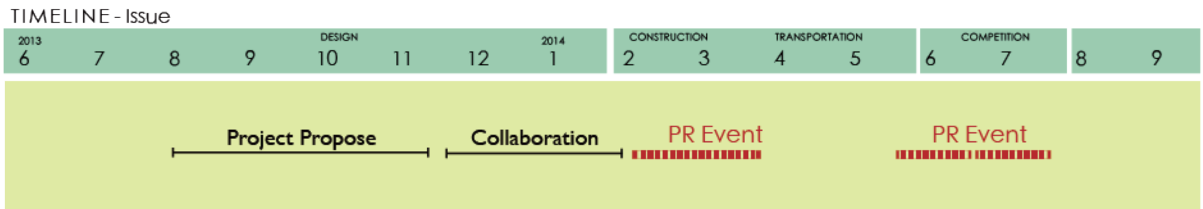
2.6 *Issues - Promotional Events*

Analysis of the situation
Exhibition in Huashan 1914 Creative Park, Taipei.

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 activites. 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 in Huashan 1914 Creative Park, Taipei
  - Project: Public exhibition.
  - Objectives: To demonstrate and showcase our commitment and achevement pursuing SDE 2014.
  - Time: February 2014~April 2014
  - Channel: Exhibition, lectures and workshop.
  - Audience: General public.
  - Leader: Team NCTU/UNICODE
  - Execution: It will be a combination of the Winter Camp presentation and the pre-assembly Orchid House on February. 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.



2.7 *Marketing - Marketing Projects*

Analysis of the situation
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 permenant milestone display. The marketing projects will take place in phase 4, after the SDE competition.

- **Definition of the Communication Objective / Message**

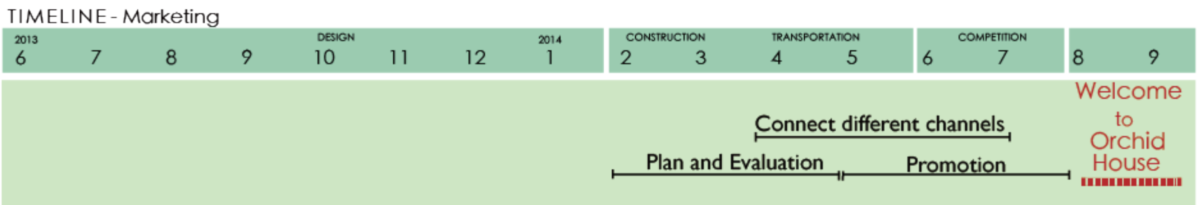
Maintain the focus on sustainable energy, urban renewal, and improvements on social housing after the competition.

- **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. Exhibition in Huashan 1914 Creative Park, Taipei

- 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 Versaille campus, mug, notebook, DVD, etc. The design and production of these merchandising may be done via collaborations between our students and sponsoring enterprises.



2.8 Previous to the competition

Before the Competition is phase 1 and 2, we develop our design and disseminate to general public. Firstly, we focus on sharing what we have learned and experienced through research and design. Seminars and Forums will be hled for the purpose. Secondly, academic and education is the most important communication strategy in our plan since it dierctly reaches our next generation – the foundation for our future. Therefore, we have planned to hold a winter camp, aim at mainly the high schoolers who have the basic interest in architecture, urban living, sustainability and renewable energy.

2.9 During the Competition

During the Competition, public tours are provided for the general public on site. Visitors will be guided throughout the house to experience, feel and appreciate this project from all perspectives. Furthermore, we will provide a brochure while general public is visiting Orchid House.

3.0 Tracking Table of the Communication actions

TRACKING TABLE OF THE COMMUNICATION ACTIONS

September, 2013: w40 w39 w38 w37 | October, 2013: w36 w35 w34 w33 | November, 2013: w32 w31 w30 w29 | December, 2013: w28 w27 w26 w25 | January, 2014: w24 w23 w22 w21 | February, 2014: w20 w19 w18 w17 | March, 2014: w16 w15 w14 w13 | April, 2014: w12 w11 w10 w9 | May, 2014: w8 w7 w6 w5 | June, 2014: w4 w3 w2 w1 | July, 2014: W2 W3 W4 W5 W6 | August, 2014: W7 W8 W9 W10 | September, 2014: W11 W12 W13 W14 | October, 2014: W15 W16 W17 W18 | November, 2014: W19 W20 W21 W22

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
Lecture 6	Eric Chuang
Lecture 7	Eric Chuang
Lecture 8	Eric Chuang
Lecture 9	Eric Chuang
Lecture 10	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	Shu Chang Kung
Lecture 2_TED X NCTU	Shu Chang Kung
Lecture 3	Shu Chang Kung
Lecture 4	Shu Chang Kung
Lecture 5	Shu Chang Kung
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Orchid House Solar Seedling Recruitment	Shu Chang Kung
Forum 1	Shu Chang Kung
Forum 2	Shu Chang Kung
Forum 3	Shu Chang Kung
Forum 4	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
Elite Display	Eric Chuang
others	Eric Chuang
Others	Eric Chuang
Orchid House Solar Seedling Actions	Shu Chang Kung
Lecture 1	Shu Chang Kung
Lecture 2	Shu Chang Kung
Lecture 3	Shu Chang Kung
Lecture 4	Shu Chang Kung
Lecture 5	Shu Chang Kung
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
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
Press Conference 2	Eric Chuang
Exhibition 1	Eric Chuang

TRACKING TABLE OF THE COMMUNICATION ACTIONS

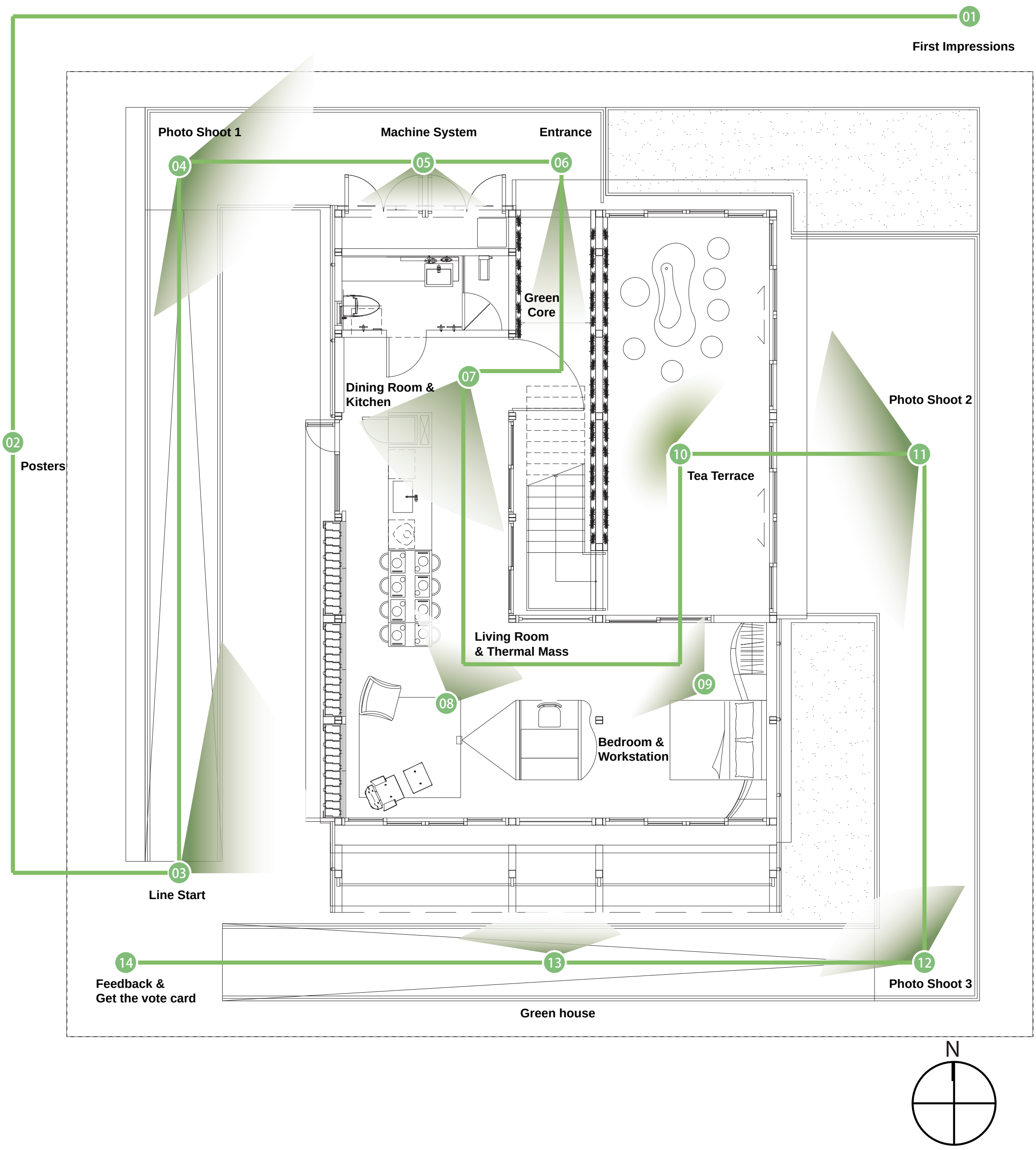
Month	Weeks
September, 2013	w40 w39 w38 w37
October, 2013	w36 w35 w34 w33
November, 2013	w32 w31 w30 w29
December, 2013	w28 w27 w26 w25
January, 2014	w24 w23 w22 w21
February, 2014	w20 w19 w18 w17
March, 2014	w16 w15 w14 w13
April, 2014	w12 w11 w10 w9
May, 2014	w8 w7 w6 w5
June, 2014	w4 w3 w2 w1
July, 2014	W2 W3 W4 W5
August, 2014	W6 W7 W8 W9
September, 2014	W10 W11 W12 W13
October, 2014	W14 W15 W16 W17 W18
November, 2014	W19 W20 W21 W22

ITEM	PERSON IN CHARGE
Exhibition 2	Eric Chuang
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	C David Tseng
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	B Benjimin Tang
Opening	Eric Chuang
PR 1	Eric Chuang
Press Conference	Eric Chuang
Exhibition	C David Tseng
others	Eric Chuang
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
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Video Display in Competition	B Benjimin Tang
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Disassembly after Competition	B Benjimin Tang
Dissemination	Eric Chuang
website	Eric Chuang
posters	Eric Chuang
newsletters	Eric Chuang
others	Eric Chuang
Orchid House Display	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

TRACKING TABLE OF THE COMMUNICATION ACTIONS																																																														
ITEM	PERSON IN CHARGE	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
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																																																													

3.0 Public Tour Description

3.1 Drawings Showing the route and contouring



1. First Impressions
2. Posters
3. Line Started
4. Photoshoot .1
5. Machine system
6. Entrance & Green Core
8. Living Room & Thermal Mass
9. Bedroom & Workstation
10. Tea Terrace
11. Photoshoot .2 & Garden
12. Photoshoot .3 & Garden
13. Green House planning

3.2 Visit 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.

Guided Tour

i. The Appearance of Orchid House

1. First Impression and Posters

Visitors will be mostly drawn towards our house from the first impression of the green garden on the northeast side of Orchid House. While they are in the waiting line, there will be the posters showing all the imformation of Orchid House. After that, vistors will be in 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 end of the west wall, the south side offers the transluscent glimpse into the house through the blinds. Visitors will be invited to enjoy two layers of the lush greeneries at the east side. The first layer shows the green which serves as the garden, and the other layer is the green core in the center of the house, and we offer special photo shots agianst the elegant backdrop of the House.

ii. The Tour in the Orchid House

1. Line Start

By walking over the ramp, visitors will be invited to our journey in Orchid House.

2.Photoshot 1

At the endof the ramp, we will provide a selected photo opportunity before entering the Orchid House.

3. Machine System

Prior to entering the Orchid House, visitors will be able to see the engine/hub of the House - mechanical room and be briefed of its functionalities.

4. Entrance and Green Core

The Green Core serves as the heart/engine of the House - it keeps the temperature in balance, provide the exchange of fresh air, and kick off recycling system for the irrigation of plants. Thedifference 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.

5. Kitchen and Bathroom

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.

6. Living Room and Thermal Mass

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.

7. Working Station and Bedroom

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.

8. Tea Terrace
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.

9. Photoshoot 2&3
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. Besides, there are two selected photo opportunities.

10. Get the vote Card
After the tour in Orchid House, visitors will be given a vote card which we expect to get some feedback from them.

The overall guided tour will conducted in both English and Mandarin. Each tour will be organized up to eight people at a time. The entire tour is estimated to take 20 minutes, with four minutes scheduled for each station inside the House.

VIP: 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.

3.3 Sketches Showing Public Safety Measures for

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

3.4 Sketches Showing Public Safety Measures for

While visitors are queued at the ramp around the House, the interactive wall made with recycled material will offer a demonstration of how it changes with the difference in temperature.

4.0 Visual Identity Manual

4.1 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.

4.2 Rule of Use

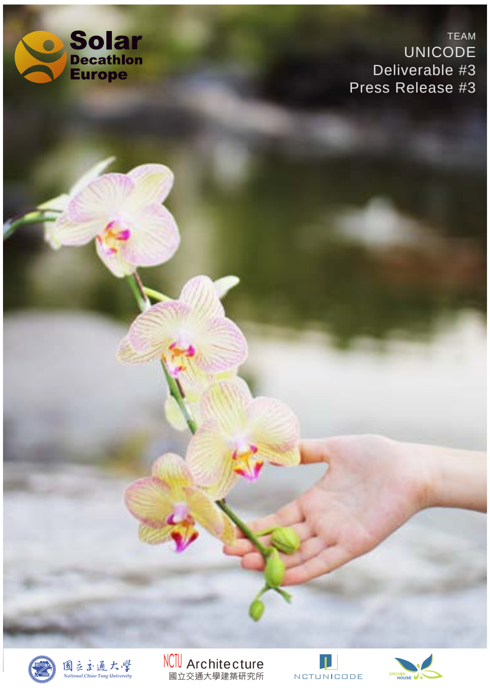
The NCTU/UNICODE logo and the Orchid House logo should only be applied to relevant and appropriate material by NCTU or SDE 2014. Any other parties that wish to use the logos must contact the NCTU/UNICODE team for negotiations.

4.3 Main Logo and Chosen Typography

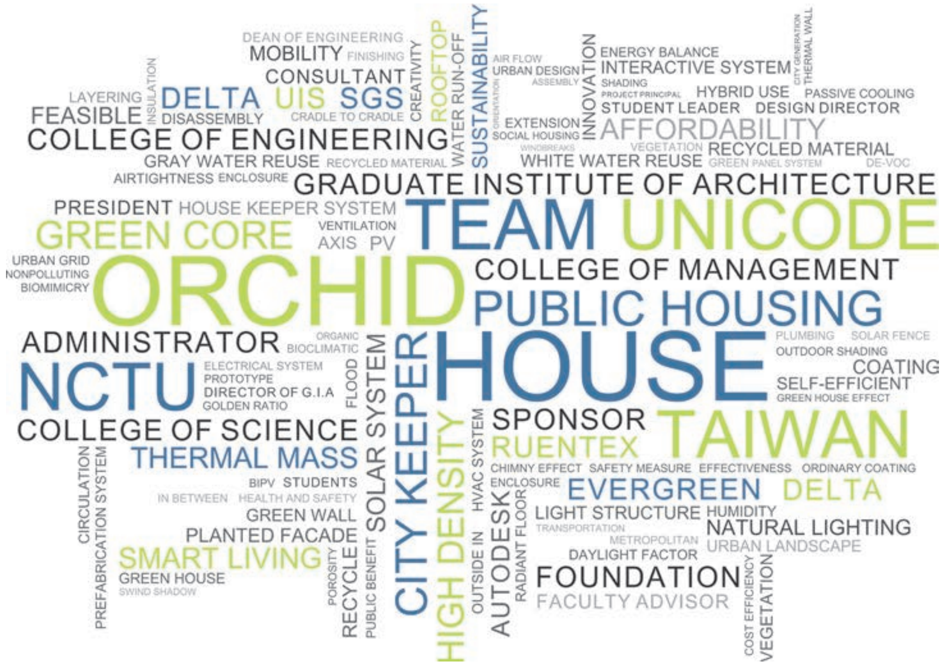
green_C:35 M:4 Y:73 K:0 / R:182 G:208 B:98
blue_C:96 M:99 Y:38 K:4 / R:43 G:42 B:107
BACK GOTHIC / LIGHT FOR NCTU
Arial / regular for ORCHID HOUSE

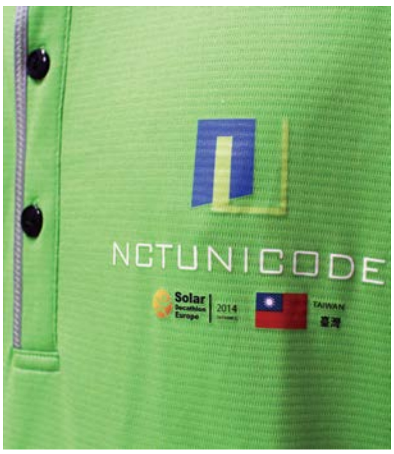
4.4 Supporting institutions and Sponsor`s Logos

4.5 Three Logo Versions



4.6 Keyword, Slogen and Uniform





GREEN TOPS!!

5.0 Sponsorship Manual

5.1 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	04-2359-4922	cdtseng@arch.nctu.edu.tw
Bureau France in Taipei	cultural support	David Tseng	04-2359-4922	cdtseng@arch.nctu.edu.tw
STRUCTURE AND CONSTRUCTION				
Ruentex	financial, design and construction support	Bojiun Tang	0911-792-289	benjamin@arch.nctu.edu.tw
ELECTRICITY				
Delta	financial, technica and product support	Bojiun Tang	0911-792-289	benjamin@arch.nctu.edu.tw
MECHANICAL				
SGS	technical support	Minnie Jan	0986-772-367	mjan@nctu.edu.tw
UIS	technical support	Chenwu Chung	0988-933-333	chenwu_chung@yahoo.com
MATERIAL				
Bayer	product support	Minnie Jan	0986-772-367	mjan@nctu.edu.tw
Miniwiz	product support	David Tseng	04-2359-4922	cdtseng@arch.nctu.edu.tw
COMPUTER DEVICES				
ASUS	devices support	Minnie Jan	0986-772-367	mjan@nctu.edu.tw
ORCHID				
Grand Biotechnology	product support	Minnie Jan	0986-772-367	mjan@nctu.edu.tw
BATHROOM				
HCG	product support	Eric Chuang	0933-859-673	ec2331@gmail.com
SOFTWARE				
AUTODESK	software support	Pei Hsien Hsu	0976-037-108	phsu@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

5.2 Presentation used to raise sponsorships

6.0 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 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 PLAN BUDGET

UNIT : EURO

ITEM	UNIT	NUMBER	SUBTOTAL	VAT	TOTAL
Architecture Models			3,000	150	3,150
Videos			2,000	100	2,100
Web Page(create and maintenance)			2,000	2,100	4,100
Communication Documentation			5,000	250	5,250
Exhibitions			25,000	1,250	26,250
Total			37,000	3,850	40,850
					Grand Total

7.0 Winter Camp

NCTUNICODE

Solar Decathlon Europe X NCTU Architecture

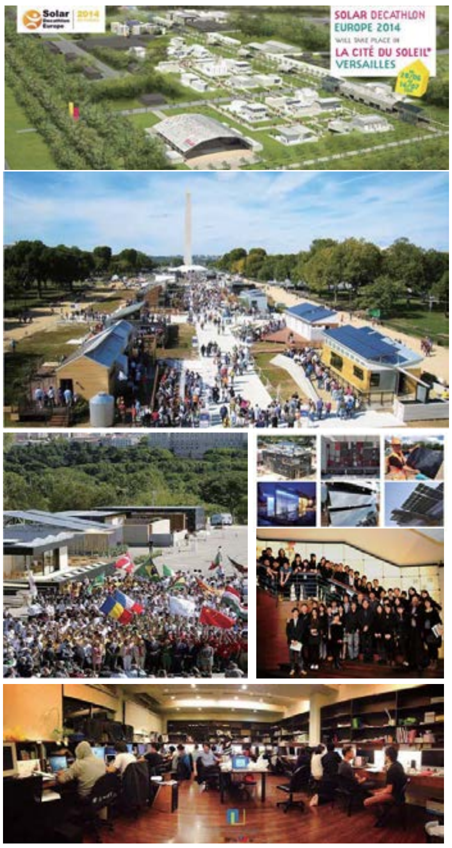
2014 Winter camp

Solar Decathlon Europe

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

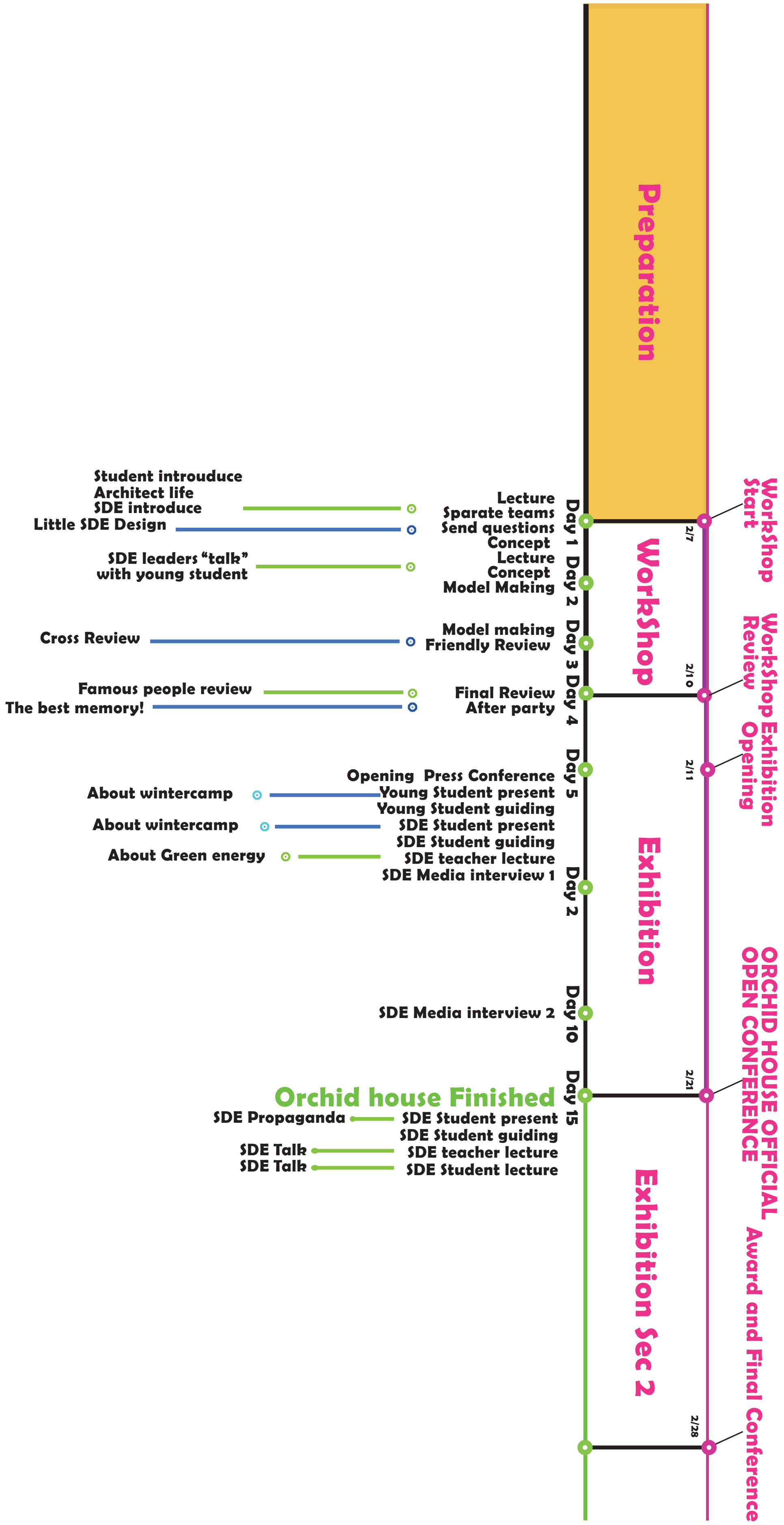
• Host: NCTU / UNICODE
• Site: Huashan 1914, Creative Park
• Time: 2014/02/07-2014/02/10
• Audience: High school students, university students who are interesting in design
• Leader: NCTU/Unicode students and faculty
Bernard Yang
mobile: 0953961109
e-mail: bernard1109@arch.nctu.edu.tw
• Mission:
To Publicize - 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 Orchid House 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.

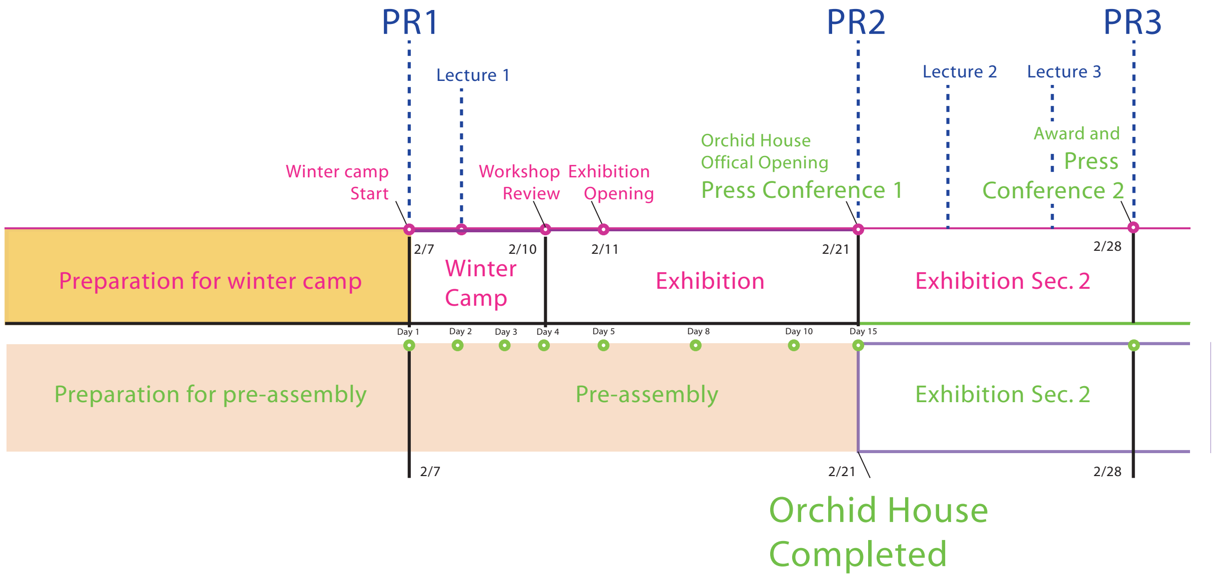
At the end of the winter camp, it will be the apex of the entire activity – a final presentation of their ideas! Various types of presentation methods will be encouraged, whether drawing, collage, model, slides, animations, or any type of performing arts.

WinterCamp



Preparation
WorkShop
Exhibition
Exhibition Sec 2
Workshop Start
2/7
Workshop Review
2/10
Workshop Exhibition Opening
2/11
ORCHID HOUSE OFFICIAL OPEN CONFERENCE
2/21
Award and Final Conference
2/28
Day 1
Lecture
Sparate teams
Send questions
Concept
Day 2
Lecture
Concept
Model Making
Day 3
Model making
Friendly Review
Day 4
Final Review
After party
Student introuduce
Architect life
SDE introduce
Little SDE Design
SDE leaders “talk” with young student
Cross Review
Famous people review
The best memory!
Day 5
Opening Press Conference
Young Student present
Young Student guiding
SDE Student present
SDE Student guiding
SDE teacher lecture
SDE Media interview 1
About wintercamp
About wintercamp
About Green energy
Day 2
Day 10
SDE Media interview 2
Day 15
Orchid house Finished
SDE Propaganda
SDE Student present
SDE Student guiding
SDE teacher lecture
SDE Student lecture
SDE Talk
SDE Talk

2014 Orchid House Winter Camp Pre-assembly PR Schedule



Objectives:

1. SDE 2014 project-Orchid House start! and highly exposure
2. give an chance to do a real project to those who are interested in architecture and green issues
3. exchange the various aspects of green issues via forum and collaboration with academic and enterprise
4. the athletes can show not only our concern about the sustainable issues to general public, but also our professional know-how to society
5. to accelerate government of modification of urban polic
6. make the good ideas of younger generation be listened by enterprise
7. to elaborate the core spirit of SDE 2014: good enterprise support good ideas from students
8. to gain more supports and earn more attention from the society

2014 Orchid House winter camp

Time	2014/2/7	STAFF Timetable	2014/2/8	STAFF Timetable	2014/2/9	STAFF Timetable	2014/2/10	STAFF Timetable
0730-0800								
0800-0900		Prepared	Check in		Check in		Check in	
0900-1000								
1000-1100	Check in	CHECK HELP	Concept Model making	SDE STUDENT JOIN	Design Drawing	SDE STUDENT JOIN	Model Making	Young student interview
1100-1200	SDE Opening	PARTY Prepared						
Lunch	Welcome Party							
1200-1300	SDE Intro							
1300-1400	Grouping & Send questions	Leader						
1400-1500			SDE TALK - Present	SDE STUDENT	SDE TALK - Design Life	SDE STUDENT		Famous talk
1500-1600	Concept Design	SDE STUDENT JOIN					Presentation	
1600-1700			Basic Drawing	SDE STUDENT JOIN	Design Drawing			
1700-1800	SDE TALK	Young student interview						PARTY Prepard
Dinner	Dinner Talk		Dinner Talk		Dinner Talk			
1800-1900	Concept Model making						PARTY	
1900-2000		SDE STUDENT JOIN	Model making	Young student interview	Model Making	Young student interview		PARTY
2000-2100	Concept system Design							
2100-2200			FREE TIME					
							After Party	PARTY

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.

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

SDE 2014 COMPETITION EN FRANCE

Team's Abbreviations		UNI			
School's Name		National Chiao Tung University			
Team's Name		UNICODE			

Nº	Name	Description	Budget ex VAT	Budget VAT	% Total on ex VAT
A. DEVELOPMENT PHASE_COST ESTIMATE					
A.1	**Personnel**				
	Professors & Researchers	80h/week*52weeks*€12 Hourly Rate	49920	2496	4.6%
	Granted Students	600h/week*52weeks*€6 Hourly Rate	187200	9360	17.3%
	Consultants	36h/week*40weeks *€20 Hourly Rate	28800	1440	2.7%
		Personnel	**265,920.00 €**	**13,296.00 €**	24.5%
A.2	**Communication**				
	Architectural Models		3000	150	0.3%
	Videos		2000	100	0.2%
	Web Page (creation and maintenance)		2000	2100	0.2%
	Communication documentation		5000	250	0.5%
	Exhibitions		25000	1250	2.3%
		Communication	**37,000.00 €**	**3,850.00 €**	3.4%
A.3	**First Workshop**				
	Travel & Transport	Team Members 4 * Unit Cost €1000	4000	200	0.4%
	Lodging	Team Members 4* Unit Cost €600	2400	120	0.2%
	Expenses Allowance	Team Members 4 * Unit Cost €250	1000	0	0.1%
	Miscellaneous Expenses	Team Members 4 * Unit Cost €100	400	0	0.0%
		First Workshop	**7,800.00 €**	**320.00 €**	0.7%
A.4	**Second Workshop**				
	Travel & Transport	Team Members 10* Unit Cost €1000	10000	500	0.9%
	Lodging	Team Members 10* Unit Cost €800	8000	400	0.7%
	Expenses Allowance	Team Members 10* Unit Cost €400	4000	0	0.4%
	Miscellaneous Expenses	Team Members 10* Unit Cost €250	2500	0	0.2%
		Second Workshop	**24,500.00 €**	**900.00 €**	2.3%
A.5	**Administrative and miscellaneous**				
	Consumables and office supplies	bills/ tel/ fax/ IT units/ plotter/ printer/ stantionary	1800	90	0.2%
	Administrator & Assistant	2 *40h/week*52weeks*€6 Hourly Rate	24960	1248	2.3%
	…				0.0%
		Administrative and miscellaneous	**26,760.00 €**	**1,338.00 €**	2.5%
		Sub-Total_Development Phase Cost Estimate	**361,980.00 €**	**19,704.00 €**	33.4%
B. HOUSE CONSTRUCTION_COST ESTIMATE					
B.1	**Direct Materials**				
	Raw Materials	materials for Foundation, Deck and Landscape/ L Shape indoor space/ Green Core/ Upper Floor/ Shell	85000	4250	7.8%
	Purchased Materials & Parts		35000	1750	3.2%
	Purchased Services	electricity/ plumbing/ installation etc	28500	1425	2.6%
	Purchased Equipment	Plumb, PV, HVAC, Domestic appliance system, furniture and decoration	285000	14250	26.3%
	…				0.0%

SDE 2014 COMPETITION EN FRANCE

Team's Abbreviations	UNI			
School's Name	National Chiao Tung University			
Team's Name	UNICODE			

Nº	Name	Description	Budget		% Total
			ex VAT	VAT	on ex VAT
		Total Direct Materials	433,500.00 €	21,675.00 €	40.0%

Solar Decathlon Europe	SDE 2014 COMPETITION EN FRANC	
	Team's Abbreviations	UNI
	School's Name	National Chiao Tung Universi
	Team's Name	UNICODE

Nº	Name	Description	Budget ex VAT	Budget VAT	% Total on ex VAT
B.2	Material Overhead				
		6% Estimated Rate * Total Direct Materials	26010	1301	2.4%
	…				0.0%
		Total Material Over	26,010.00	€ 1,300.50	€ 2.4%
B.3	Direct Labor				
	Professors & Researchers	Estimated 800 Hours *€12 Hourly Rate	9600	480	0.9%
	Granted Students	Estimated 2400 Hours*€6 Hourly Rate	14400	720	1.3%
	Laborers	Estimated 240Hours * €8Hourly Rate	1920	96	0.2%
	Administrative	Estimated 240Hours * €6 Hourly Rate	1440	72	0.1%
	…				0.0%
		Total Direct La	27,360.00	€ 1,368.00	€ 2.5%
B.4	Lower - Tier Subcontractors				
	Subcontractor for electricity installa		1600	80	
	Subcontractor for HVAC installation		1200	60	0.1%
		Total Lower - Tier Subcontr	2,800.00	€ 140.00	€ 0.3%
		2800			
B.5	Consultants				
	Local architectural advisors		1600	80	
	Building Code advisors		1200	60	
	Structural Engineer (licensed engineer		1200	60	
	Delta PV and electricity design and installation advisor		800	40	
	HVAC and plumbing engineer		600	30	
	Graphic design		800	40	
	Landscape and vegetation consultant		600	30	
	…				0.0%
		Total Consulta	6,800.00	€ 340.00	€ 0.6%
B.6	Other Direct Costs				
	General & Administrative Expenses		1500	75	0.1%
	Indirect Expenses		720	36	0.1%
	Security		1500	75	0.1%
	…				0.0%
		Other Direct Co	3,720.00	€ 186.00	€ 0.3%
		Sub-Total_House Construction Cost Es	500,190.00	€	#DIV/0!
C.	HOUSE DISASSEMBLY IN ORIGIN AND TRANSPORTATION				
C.1	Disassembly in origin				
	Personnel	Estimated 2400 Hours*€6 Hourly Rate	14400	720	1.3%
	Material and equipment		600	30	0.1%
	Other Expenses	package/ protection/ QR code	1800	90	0.2%
	….				0.0%
		Disassembly in or	16,800.00	€ 840.00	€ 1.5%
C.2	House Transportation				
	Transport	Shlpping & customs (freights an transport)	56000	2800	5.2%
	Transport Insurance		300	90	0.0%
	Other Expenses				0.0%
	…				0.0%

SDE 2014 COMPETITION EN FRANCE

Solar Decathlon Europe		Team's Abbreviations	UNI		
		School's Name	National Chiao Tung University		
		Team's Name	UNICODE		
Nº	Name	Description	Budget		% Total
			ex VAT	VAT	on ex VAT
		House Transportation	56,300.00 €	2,890.00 €	5.2%
		Sub-Total_House Disassembly in Origin Cost Estimate	56,300.00 €	2,890.00 €	5.2%
D. FINAL PHASE IN LE CITE DU SOLEIL:COST ESTIMATE					
D.1	Travels & Costs for Final Phase in Versailles				
	Travel & Transport	Team Members 40* Unit Cost €1000 (ticket purchase in Taiwan)	40000	2000	3.7%
	Lodging	Team Members 40* Unit Cost €300 Lodging in SDE decathletes village	12000	2352	1.1%
	Expenses Allowance	Team Members 40 * Unit Cost €300 (30days) local transportation/ meals/ calls	12000	0	1.1%
	Miscellaneous Expenses	Team Members 40 * Unit Cost €150 (30days)	6000	0	0.6%
	…				0.0%
		Total Travels & Costs for Final Phase in Madrid	70,000.00 €	4,352.00 €	6.5%

SDE 2014 COMPETITION EN FRANCE

Team's Abbreviations	UNI
School's Name	National Chiao Tung University
Team's Name	UNICODE

Nº	Name	Description	Budget ex VAT	Budget VAT	% Total on ex VAT
D.2	**Assembly and Disassembly Processes**				
	Cranes	Apply for SDE crane arrangement	7000	1372	0.6%
	Equipment and machinery	forklift, cherry-picker, scaffolding.	5000	980	0.5%
	Assembly in Le Cité du Soleil ©	tool rents/ fences/ H&S	2000	392	0.2%
	Disassembly in Le Cité du Soleil ©	tool rents/ fences/ H&S	2000	392	0.2%
	…				0.0%
		Total Assembly, Transport, Disassembly Processes	**16,000.00 €**	**3,136.00 €**	1.5%
D.3	**Insurance Policies**				
	Liability Insurance		400	78.4	0.0%
	Transport Insurance		600	117.6	0.1%
	Accident Insurance		1200	235.2	0.1%
	Medical Insurance		400	78.4	0.0%
	…				0.0%
		Total Insurance Policies	**2,600.00 €**	**509.60 €**	0.2%
		Sub-Total_Final Phase in La Cité du Soleil® Cost Estimate	**88,600.00 €**	**7,997.60 €**	8.2%
E. POST EVENT COST ESTIMATE					
E.1	**House Permanent Assembly**				
	Personnel		36000	1800	3.3%
	Materials		3000	150	0.3%
	Machinery and Equipment		10000	500	0.9%
	…				0.0%
		Sob-Total House permanent Assembly	**49,000.00 €**	**2,450.00 €**	4.5%
E.2	**As built**				
	Professors & Researchers	Estimated Hours 400h*€12 Hourly Rate	4800	240	0.4%
	Granted Students	Estimated Hours 1200h*€6 Hourly Rate	7200	360	0.7%
	Consumables and office supplies		5000	250	0.5%
	Administrative expenses	tour guide/ PR/ media/ press conference	12000	600	1.1%
	…				
		As Built	**29,000.00 €**	**1,450.00 €**	2.7%
		Sub-Total_Post Event Cost Estimate	**78,000.00 €**	**3,900.00 €**	7.2%
		Total Price / Cost Estimated	**1,085,070.00 €**	**34,491.60 €**	**100 % Total**
	Please CHECK (X) your status >>	x If you benefit VAT Recovering		-34,491.60 €	
		If you don't	34,491.60 €		
		Total Price / Cost Estimated included VAT	**1,119,561.60 €**	**##########**	

Solar Decathlon Europe

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RÉPUBLIQUE FRANÇAISE

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

Site Operations 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

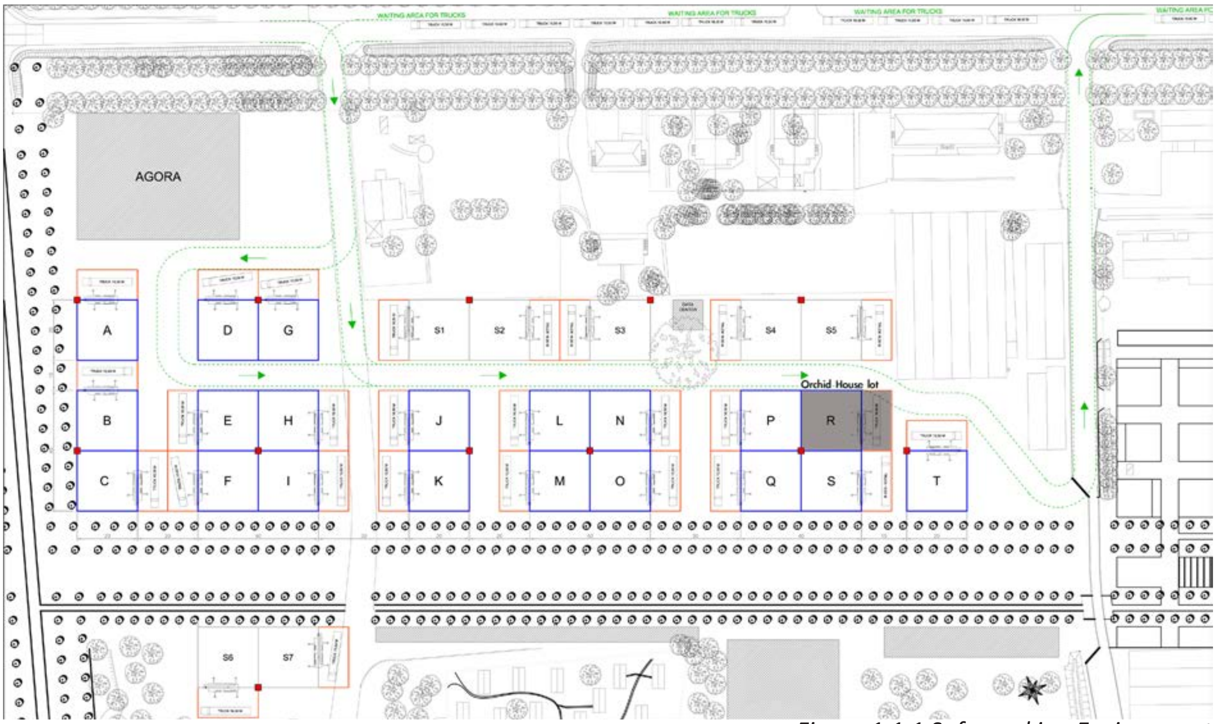


Figure 1.1.1 Safe working Environment

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 Coordinations
- 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

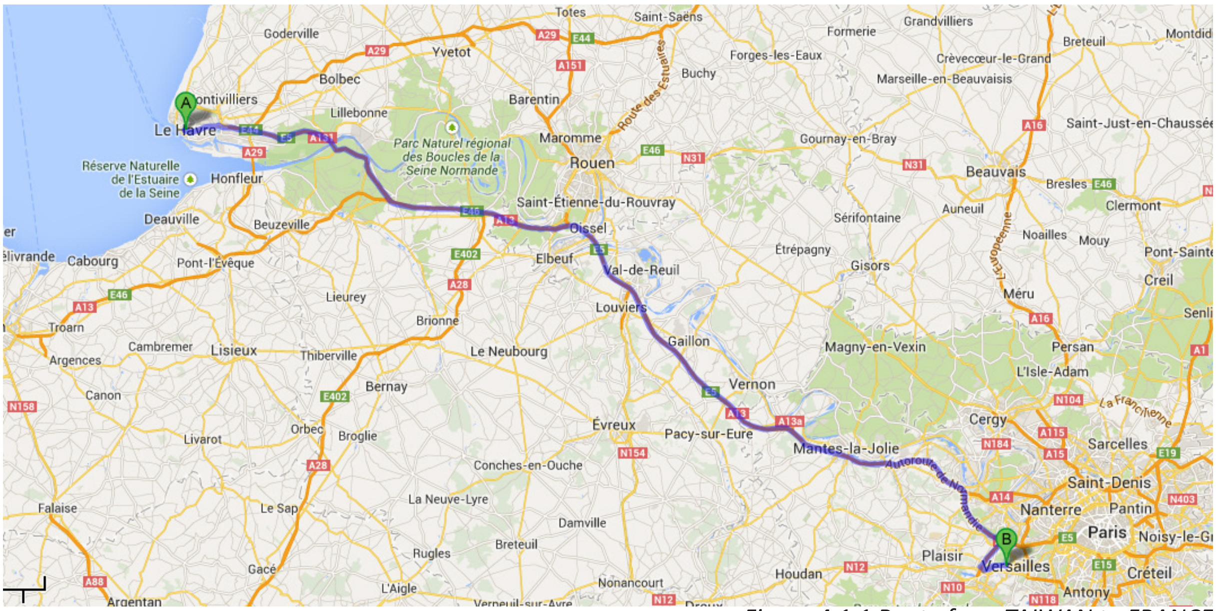


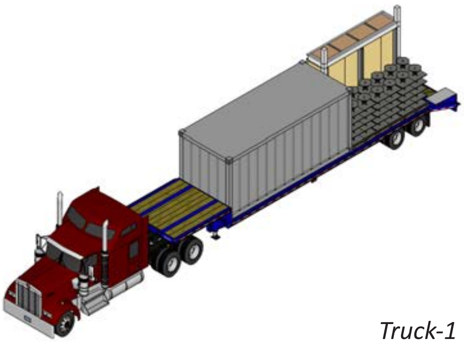
Figure 4.1.1 Route from TAIWAN to FRANCE

Figure 4.1.2 Route from TAIWAN to FRANCE

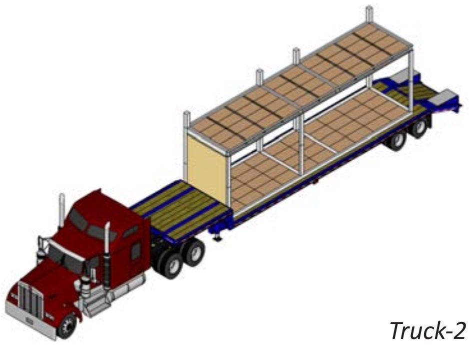
4.1.1 Shipping Timetable

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

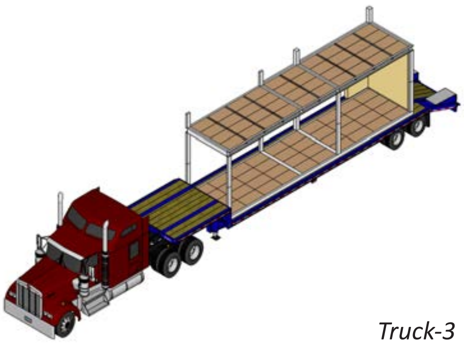
4.1.2 Trucks specifications and shipments



Truck-1



Truck-2



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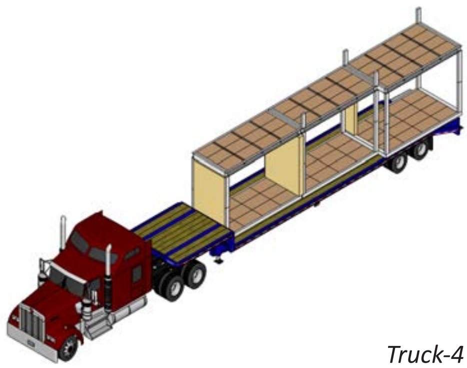

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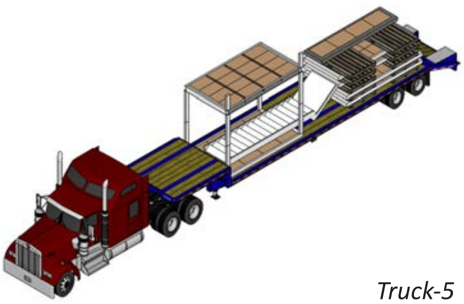

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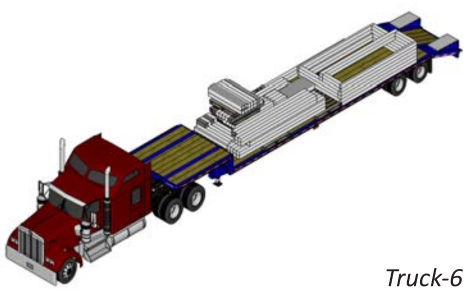

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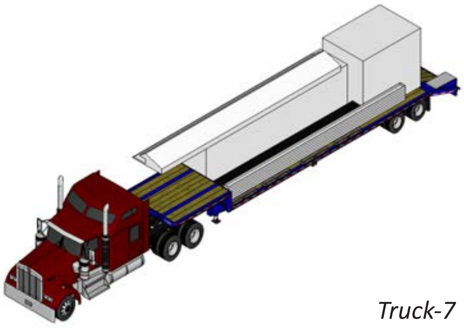

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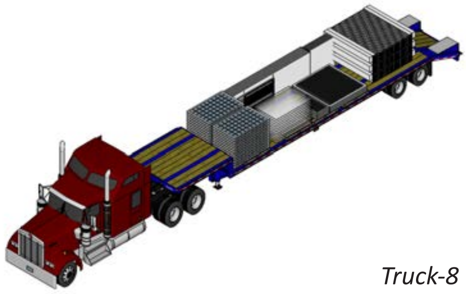

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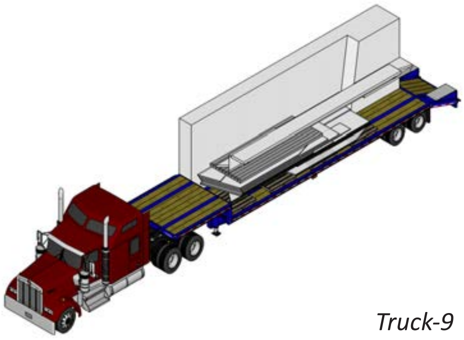

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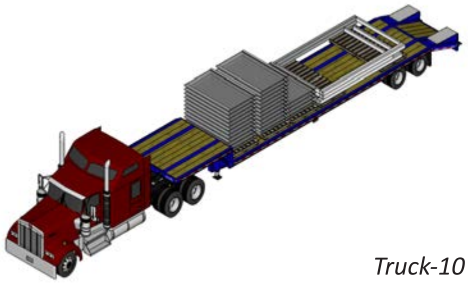

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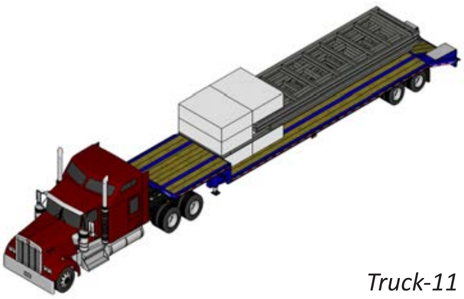

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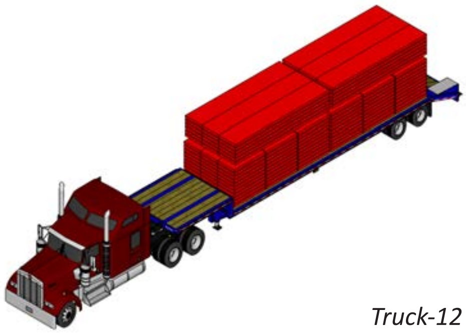

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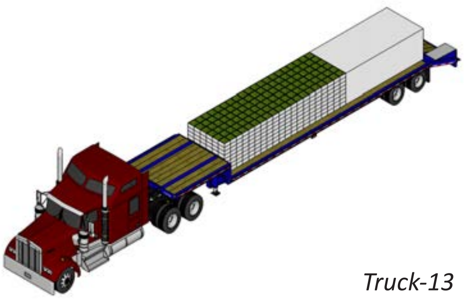


Truck-13

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*
Daisuke Nagatomo	Project Architect	dnagatomo@misosoupdesign.com
Yating Wu	Worker(student leader)	yatingwu@arch.nctu.edu.tw
Ching-Ju Chen	Worker(team 1)	chen.chin.ju@arch.nctu.edu.tw
-	Worker(team 2)	-
Kelly Chen	Worker(team 3)	gooa1121@arch.nctu.edu.tw
Andrew Lu	Worker(team 4)	happydada0810@arch.nctu.edu.tw
Ming-Hung She	Worker(team 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(team 1)	chian@arch.nctu.edu.tw
Yu-hsien Lin, Jeff	Worker(team 2)	bluerice@arch.nctu.edu.tw
Rui Lin	Worker(team 3)	ruikisa@arch.nctu.edu.tw
Bernard Yang	Worker(team 4)	bernard1109@arch.nctu.edu.tw
Wan-Ling Cheng	Worker(team 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(team 1)	cyfan@arch.nctu.edu.tw
Trista Wang	Worker(team 2)	jou-hsuan@arch.nctu.edu.tw
Ruby Tu	Worker(team 3)	Ruby_@arch.nctu.edu.tw
Sophie Chen	Worker(team 4)	wantsi@arch.nctu.edu.tw
-	Worker(team 5)	-

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

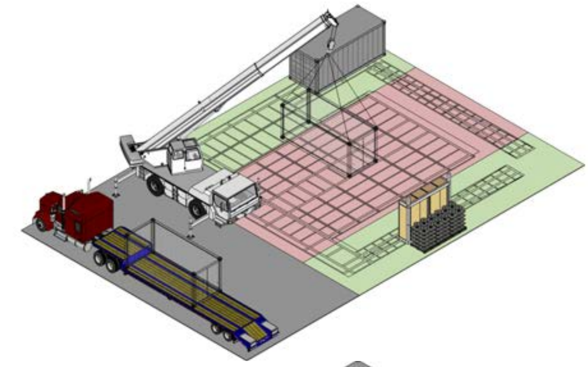
Phase 08 Furniture & Planting
The final installation is the positioning of plants and furniture

Phase 09 Lot clean & Test
Clean around the base
Environmental Systems Testing

5.3 Phases description

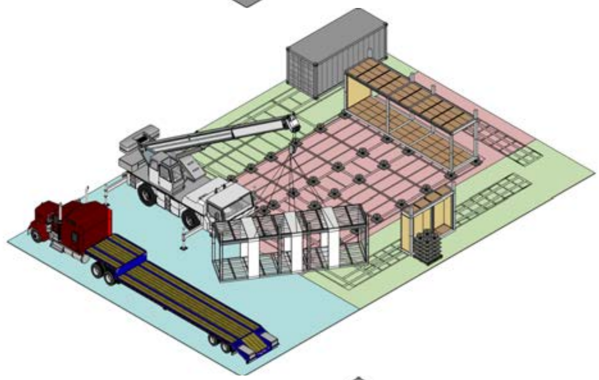
Phase 1: Site Preparation

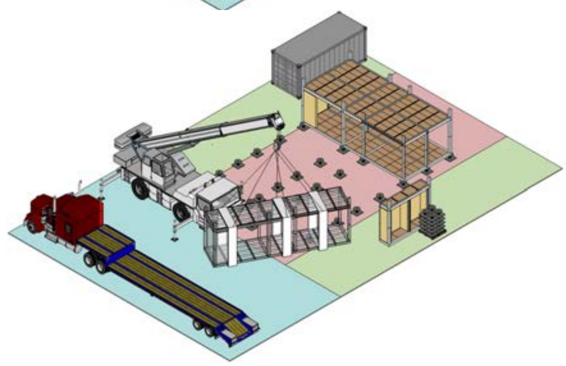
Truck-1
-Tool cantainer
-Foundation
-Construction Safety Box
-Unit-7

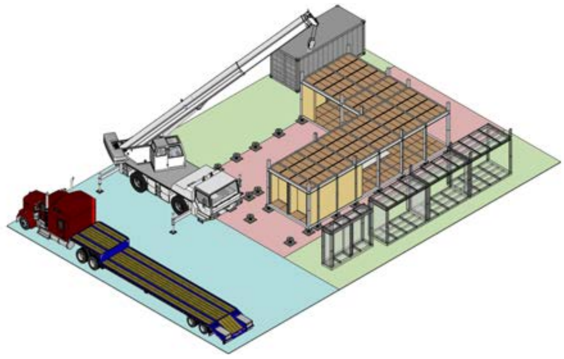


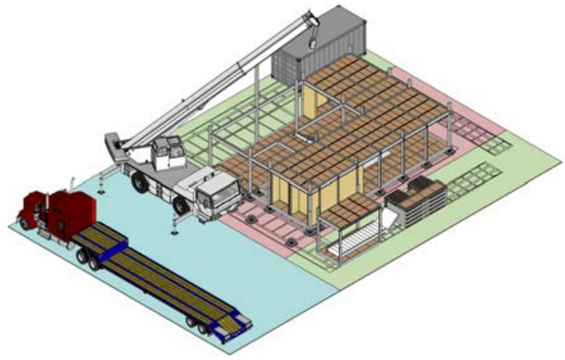
Phase 2: Establishment of the module unit

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



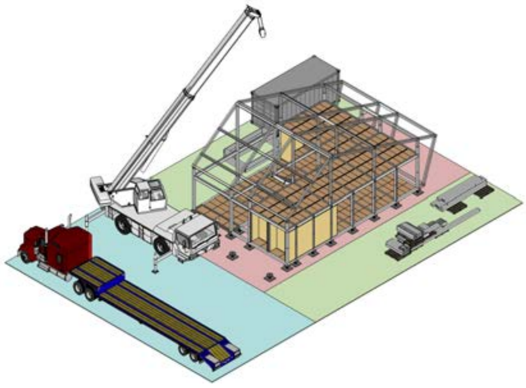






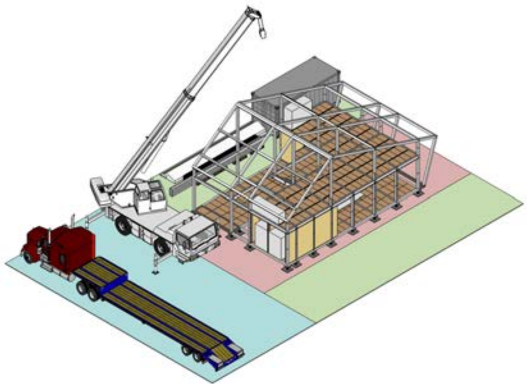
Phase 3: Installation of the main structure

Truck-6
-Roof
-Structure frame



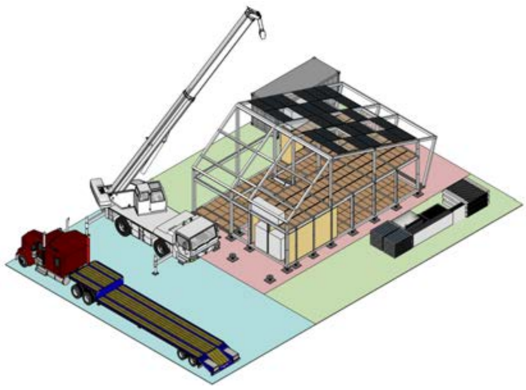
Phase 4: Installation of the Appliance & electricity

Truck-7
-Appliance & electricity
-Lifting and electricity Pipeline installation



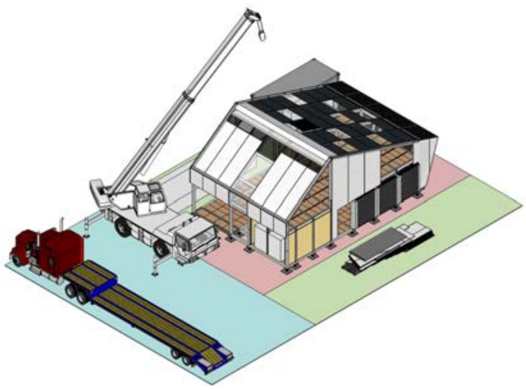
Phase 5: Building of the roof structure

Truck-8
-Solar panels and Roof panels
-Blinds



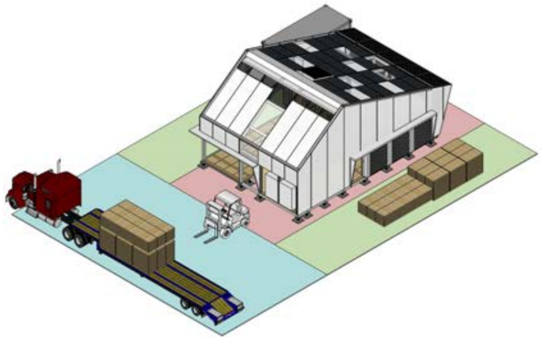
Phase 6: Installation of exterior wall

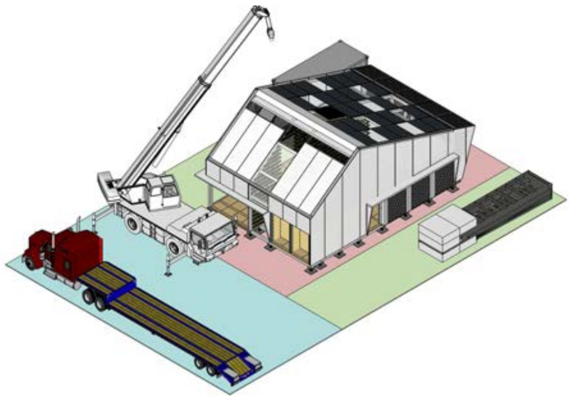
Truck-9
-Bayer

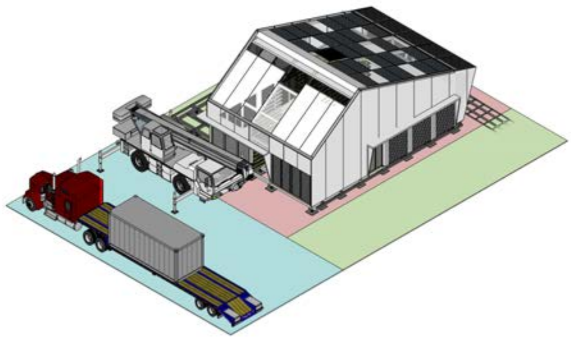


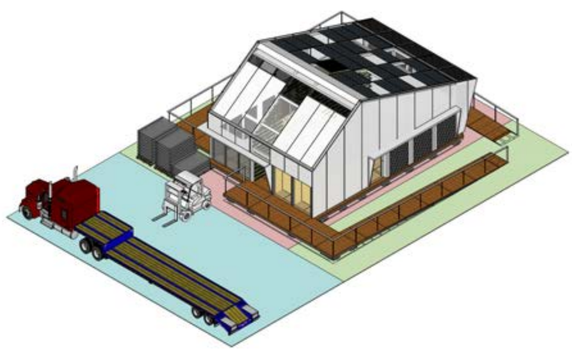
Phase 7: Installation of floors and windows

Truck-10,11,12
-Floor finish
-Ceiling
-windows



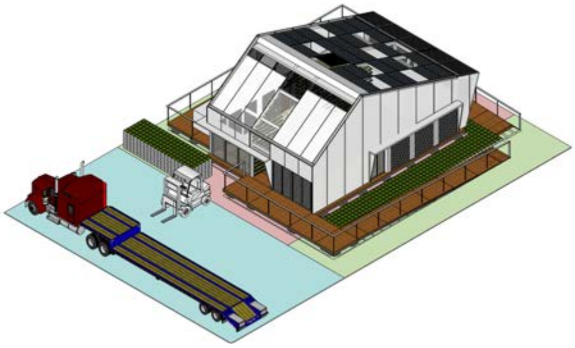






Phase 8: Installation of the furniture and planting

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

ITEM	WORK DETAIL	date	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-A						TEAM-B				
SITE PREPARATION	Truck-1																									
	Forklift																									
	Crane Lifting																									
	Forklift																									
	Layout	6/17																								
	Foundation																									
MODULE UNIT	Truck-2																									
	U1-Fixed																									
	Truck-3																									
	U2-Fixed																									
	Truck-4																									
	U3.4.5-Fixed																									
	Adjustment																									
UNIT MODULES	Adjustment																									
	TRUCK-5																									
	Crane Lifting																									
	Forklift																									
	Discharge																									
	U6.7-Fixed																									
	U8-Combine																									
	Beam Fixed																									
	U8-Fixed	6/18																								
MAIN STRUCTURE	Temporary SR																									
	Stair																									
	Pillar																									
	Beam Fixed																									
	TRUCK-6																									
	Discharge																									
	Unit combine																									
	TRUCK-7																									
	Discharge																									
	Roof Frame																									
	Appliances																									
APPLIANCE & ELECTR	Roof Frame																									
	Water System																									
	Electronicity																									
	Appliances																									
ROOF	TRUCK-8	6/19																								
	Crane Lifting																									
	Discharge																									
	Combination																									
	Solar Panel																									
	Roof																									
	Gutter																									
	Roof Top																									

6.1 *ASSEMBLY TIME TABLE*

CHART TEAM UNI

ITEM	WORK DETAIL	date	0	1	2	3	4	5	6	7	8	9	10	11		13	14	15	16	17	18	19	20	21	22	23
ROOF	Roof	6/20																								
	Gutter																									
	Roof Top																									
EXTERIOR WALL	TRUCK-9																									
	Forklift																									
	Discharge																									
	Combination																									
	Bayer																									
	Thermal wall	5																								
	Window frame																									
INTERIOR	TRUCK-10	6/21																								
	Forklift																									
	Discharge																									
	Floor finish																									
	Ceiling																									
	Lighting																									
	Lighting	6/22																								
	Green core																									
WINDOW	TRUCK-11																									
	Forklift																									
	Discharge																									
	Windows																									
OUT DOOR	TRUCK-12																									
	Out door																									
	Deck																									
	Out door	6/23																								
	Deck																									
ADORNMENT	TRUCK-13																									
	Crane Lifting																									
	Forklift																									
	Discharge																									
	Furniture																									
	Planting																									
Adjustment																										
Adjustment		6/24																								
CLEAN																										
TEST																										
Adjustment		6/25																								
CLEAN																										
TEST																										

Solar Decathlon Europe

6.2 DISASSEMBLY TIMETABLE

CHART TEAM UNI

ITEM	WORK DETAIL	date	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-A						TEAM-B				
SITE PREPARATION	Crane Lifting	7/15																								
	Out Deck																									
	Floor																									
	Wall																									
EXTERNAL COMPONENT	Truck-1	7/16																								
	Forklift																									
	Crane Lifting																									
	Furniture																									
	Planting																									
	Out Deck																									
	Truck-2																									
	Windows																									
	Truck-3																									
	Floor+Celing																									
	Pipe																									
	Appliance																									
	Electricity																									
ROOF WALL	Truck-4	7/17																								
	Truck-5																									
	Crane Lifting																									
	Forklift																									
	Wall																									
	Roof																									
	Truck-6																									
STRUCTURE	Crane Lifting	7/18																								
	Roof Frame																									
	Truck-7																									
	U8+stair																									
	Truck-8																									
	U.7.6.5																									
	Crane Lifting	7/19																								
UNIT	Truck-9																									
	U.4.3																									
	Truck-10																									
	U.2																									
	Truck-11																									
	U.1																									
	Truck-12																									
	TOOL																									
	Truck-12																									
LOT CLAEAN																										

7.0 Equipment requirement Chart

As the SDE organization has not provide form “Site operations chart ”, we will include it in the next deliverable.

8.0 Assembly & Disassembly Chart

8.1 ASSEMBLY CHART
TEAM UNI

DAY 1 - 16.06.2014	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks	T1					T2		T3				T4				
Crane						A										

DAY 2 - 17.06.2014	0	1	2	3	4	5	6	7	8	9	10	11		13	14	15	16	17	18	19	20	21	22	23
Trucks								T5									T6			T7				
Crane														A										

DAY 3 - 18.06.2014	0	1	2	3	4	5	6	7	8	9	10	11		13	14	15	16	17	18	19	20	21	22	23
Trucks								T8																
Crane								A																

DAY 4 - 19.06.2014	0	1	2	3	4	5	6	7	8	9	10	11		13	14	15	16	17	18	19	20	21	22	23
Trucks								T9																
Crane								B																

DAY 5 - 20.06.2014	0	1	2	3	4	5	6	7	8	9	10	11		13	14	15	16	17	18	19	20	21	22	23
Trucks								T10																
Crane								B																

DAY 6 - 21.06.2014	0	1	2	3	4	5	6	7	8	9	10	11		13	14	15	16	17	18	19	20	21	22	23
Trucks								T11								T12								
Crane								B																

DAY 7 - 22.06.2014	0	1	2	3	4	5	6	7	8	9	10	11		13	14	15	16	17	18	19	20	21	22	23
Trucks								T13																
Crane								B																

DAY 8 - 23.06.2014	0	1	2	3	4	5	6	7	8	9	10	11		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		13	14	15	16	17	18	19	20	21	22	23
Trucks																								
Crane																								

DAY10 - 25.06.2014	0	1	2	3	4	5	6	7	8	9	10	11		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
A-100 Tn-Crane	27 hour
B-Forklift	10 hours

8.2 *DISASSEMBLY CHART*

TEAM UNI

DAY 1 - 15.07.2014	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks			T1					T2				T3				
Crane																

DAY 2 - 16.07.2014	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	T4										T5												T6	
Crane																								

DAY 3 - 17.07.2014	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									T7											T8				
Crane																								

DAY 4 - 18.07.2014	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 5 - 19.07.2014	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																								

USAGE OF THE CRANE	
Crane capacity	Usage time
Crane	44

9.0 Site Operations Chart

9.0 SITE OPERATION CHART

TEAM UNI

0. GENERAL INFORMATION		CONSTRUCTION WORKING TEAM	NAME	TELEPHONE NUMBER
	1	Working Team A	Yating Wu	
	2	Working Team B	Sheng-Kay Sky Tseng	
	3	Working Team C	Dennis Lin	

1. MODULES AND MAIN COMPONENTS		DIMENSIONS [m]	WEIGHT [kg]	MACHINERY USE FOR UNLOADING/LOADING
	1	9.15*2.1*3.55	5100	Crane
	2	9.15*2.1*3.55	5100	Crane
	3	3.6*2.1*3.55	4975	Crane
	4	3.75*2.1*3.55	1640	Crane
	5	3.75*2.1*3.55	1640	Crane
	6	3.75*2.1*3.55	1640	Crane
	7	3.75*0.875*3.55	600	Crane
	8	6.2*1.6*0.15*8pc	6647	Crane
	...			

2. VEHICULES (Trucks, Vans, etc.)		DIMENSIONS [m] (Tractor unit + Trailer)	WEIGHT [kg] (Truck + Loading)
	1	4.5*4.2*4.0+13.6 m	7000+3000
	2	4.5*4.5*4+15.5 m	7000+5100
	3	4.5*4.5*4+15.5 m	7000+5100
	4	4.5*4.5*4+15.5 m	7000+4975
	5	4.5*4.5*4+15.5 m	7000+4000
	6	4.5*4.2*4.0+13.6 m	7000+5721
	7	4.5*4.2*4.0+13.6 m	7000+3525
	8	4.5*4.2*4.0+13.6 m	7000+4750
	9	4.5*4.2*4.0+13.6 m	7000+2570
	10	4.5*4.2*4.0+13.6 m	7000+5021
	11	4.5*4.5*4+15.5 m	7000+4360
	12	4.5*4.2*4.0+13.6 m	7000+3500
	13	4.5*4.2*4.0+13.6 m	7000+2200
	...		

9.0 SITE OPERATION CHART
TEAM UNI

3. CRANES		CAPACITY	USAGE TIME
	1	Mobile Crane - Liebherr-LTM 1050-3.1	8days
	…		

4. GENERAL DESCRIPTION OF THE PHASES			MATERIAL AND EQUIPMENT RESOURCES	HUMAN RESOURCES	DURATION
	ASSEMBLY	1	Site preparation	12 people working	6 hours
		2	Module Unit	16 people working	24 hours
		3	Main structure	16 people working	12 hours
		4	Appliance & electricity	16 people Working	6 hours
		5	Roof	16 people working	24 hours
		6	Exterior Wall	16 people working	24 hours
		7	INTERIOR & WINDOWS & Out door	16 people working	24 hours
		8	Adorment & Furniture & Planting	16 people working	12 hours
		9	Lot cleaning	16 people working	8 hours
		10	Test	16 people working	8 hours
		…			
	DISASSEMBLY	1	Out door & Furniture & Planting	16 people working	3 hours
		2	INTERIOR & WINDOWS	16 people working	24 hours
		3	Exterior Wall	16 people working	24 hours
		4	Roof	16 people working	12 hours
		5	Main structure	16 people working	12 hours
		6	Module Unit	16 people working	20 hours
		7	Lot cleaning	16 people working	6 hours
		8			
		9			
		…			

5. WASTE MATERIALS			TYPE	VOLUM [m3] or WEIGHT [kg]
	ASSEMBLY	1	Sawdust	5
		2	electricity cable	2
		3	Plastic	5
	DISASSEMBLY	1	Sawdust	1
		2	Hardware	5
		3	electricity cable	2
		…		

6. COMPONENTS TO BE STORED DURING COMPETITION PHASE		DIMENSIONS [m]	WEIGHT [kg]
	1		
	2		
	3		
	4		
	5		
	6		
	7		
	…		

Health & Safety Plan Report

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.

National Chiao Tung University

Solar Decathlon Europe

ORCHID HOUSE

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*
Site Preparation	HS-404
Establishment of the module unit	HS-405
Installation of the main structure	HS-406
Building of the roof structure	HS-407
Installation of exterior wall	HS-408
Installation of floors and windows	HS-409
Installation of the furniture and planting	HS-410
Cleaning of the construction site and test of the house	HS-411
Disassembly of the furniture and planting	HS-412
Disassembly of floors and windows	HS-413
Disassembly of exterior wall	HS-414
Disassembly of the roof structure	HS-415
Disassembly of the main structure	HS-416
Disassembly of the module unit	HS-417
Disassembly of site facilities and cleaning	HS-418

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
Glass	Splinter Cutting 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.

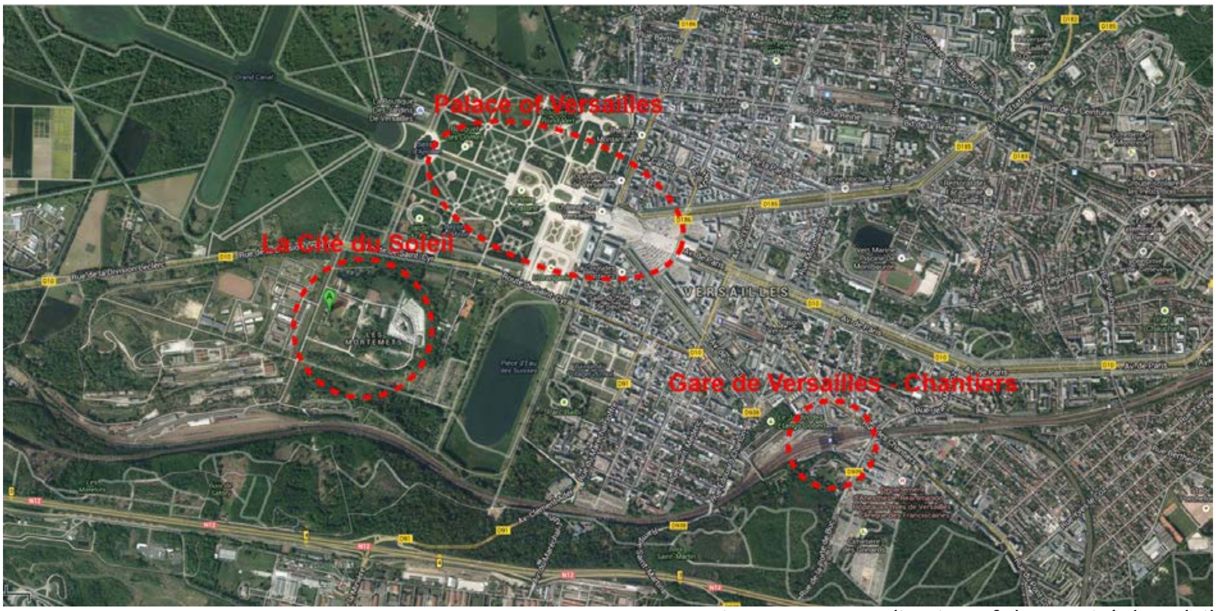


Figure 4.3.1 Lacalization of the La Cité du Soleil

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

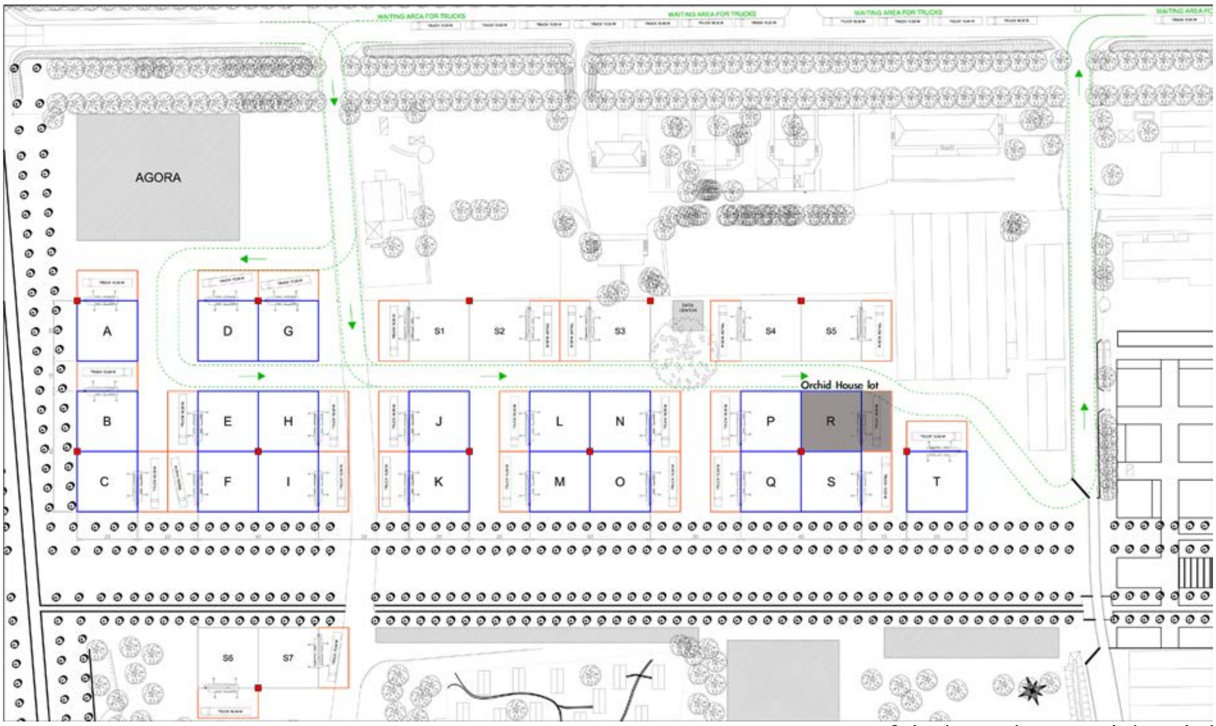


Figure 4.3.2 Repartition of the lot in the La Cité du Soleil

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: 25°C
Average Low Temp: 15°C
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

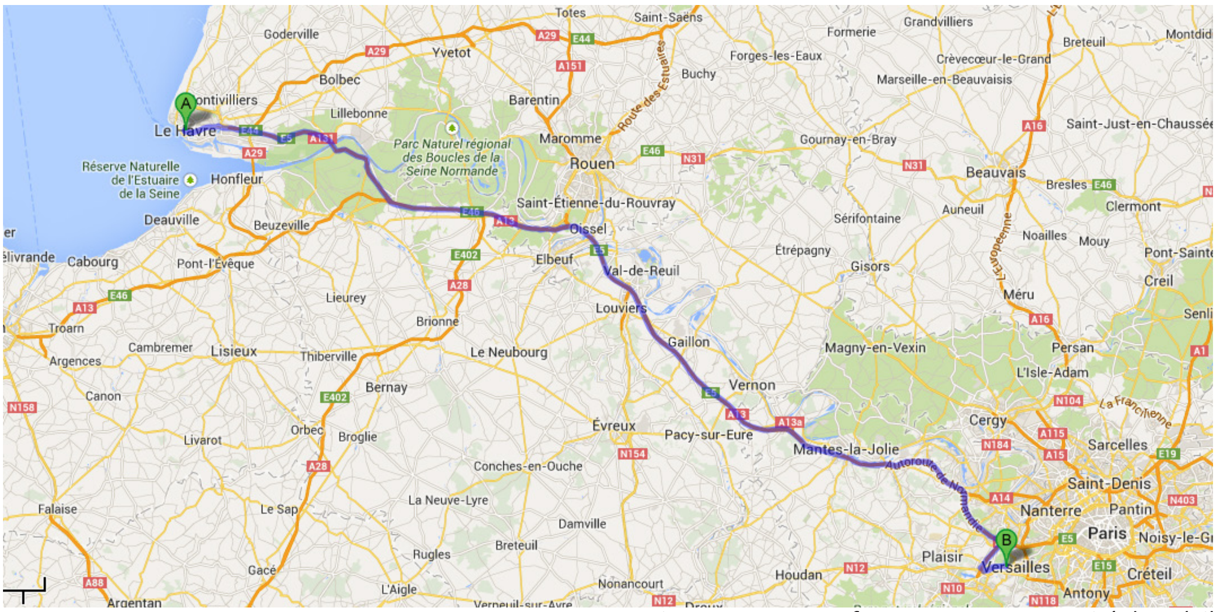


Figure 4.5.2 Route from LE HAVRE to La Cité du Soleil

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

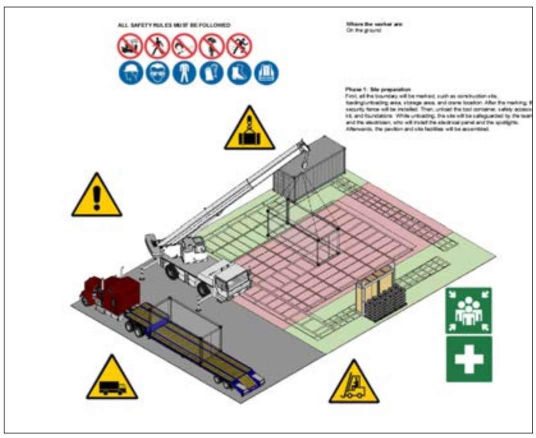
The possible assembly activities may cause conflicts are interface of crane, trucks, and electricity installation. Those activities are of danger and require highly skills. Hence the operators of these activities have been fully informed the risks and other team's process. This is to ensure all process are learned by each teams.

4.8 Planned activities

Assembly

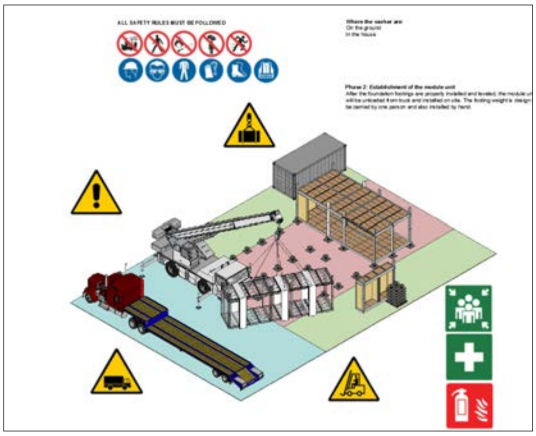
Phase 1: Site Preparation

First, all the boundary will be marked, such as construction site, loading/unloading area, storage area, and crane location. After the marking, the security fence will be installed. Then, unload the tool container, safety accessory kit, and foundations. While unloading, the site will be safeguarded by the team and the electrician, who will install the electrical panel and the spotlights. Afterwards, the pavilion and site facilities will be assembled.



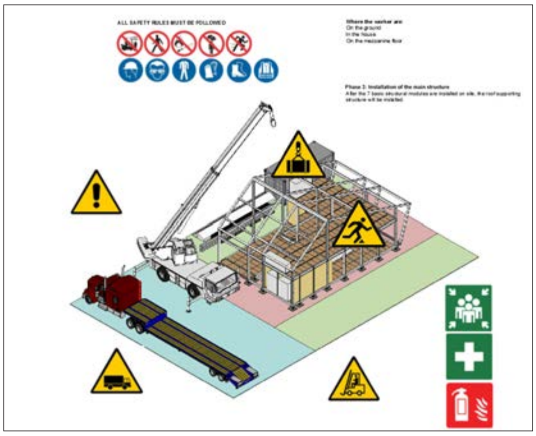
Phase 2: Establishment of the module unit

After the foundation footings are properly installed and leveled, the module units will be unloaded from truck and installed on site. The footing weight is design to be carried by one person and also installed by hand.



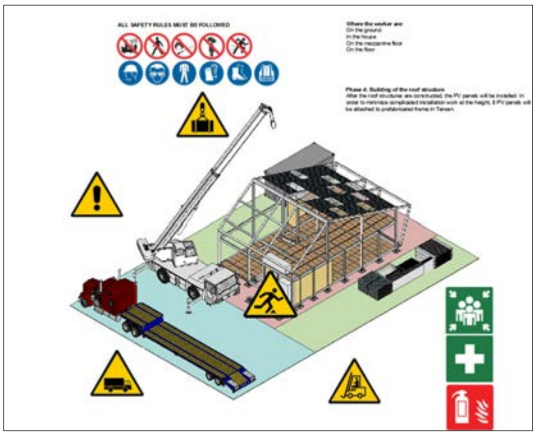
Phase 3: Installation of the main structure

After the 7 basic structural modules are installed on site, the roof supporting structure will be installed.



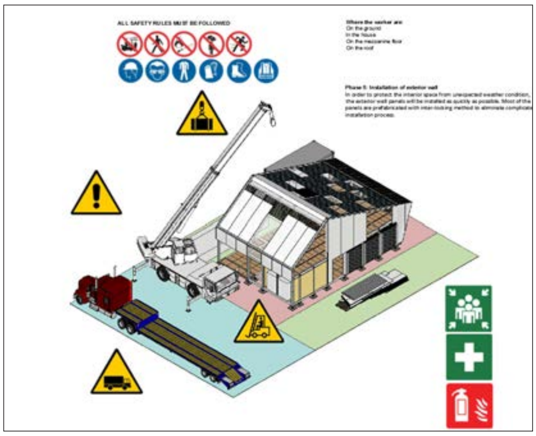
Phase 4: Building of the roof structure

After the roof structures are constructed, the PV panels will be installed. In order to minimize complicated installation work at the height, 8 PV panels will be attached to prefabricated frame in Taiwan.



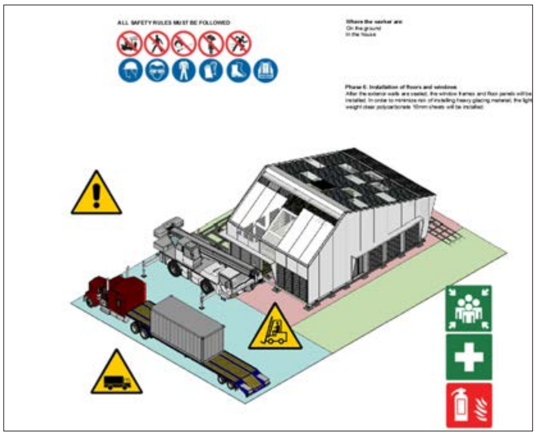
Phase 5: Installation of exterior wall

In order to protect the interior space from unexpected weather condition, the exterior wall panels will be installed as quickly as possible. Most of the panels are prefabricated with inter-locking method to eliminate complicated installation process.



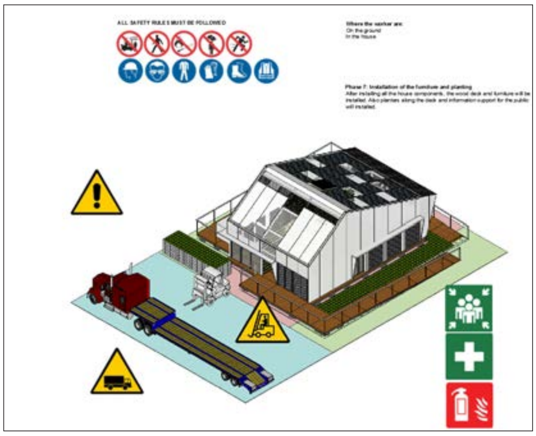
Phase 6: Installation of floors and windows

After the exterior walls are sealed, the window frames and floor panels will be installed. In order to minimize the risk of installing heavy glazing material, the light-weight clear polycarbonate 10mm sheets will be installed.



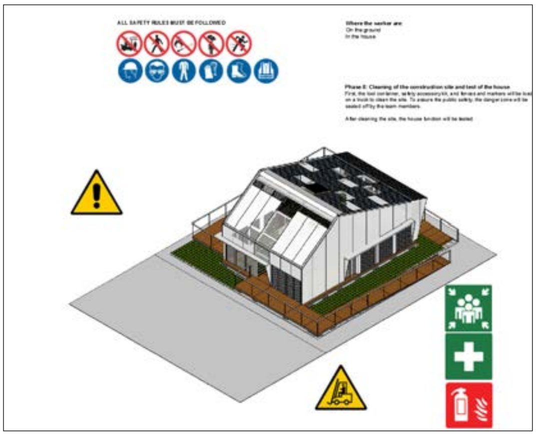
Phase 7: Installation of the furniture and planting

After installing all the house components, the wood deck and furniture will be installed. Also planters along the deck and information support for the public will installed.



Phase 8: Cleaning of the construction site and test of the house

First, the tool container, safety accessory kit, and fences and markers will be loaded on a truck to clean the site. To assure the public safety, the danger zone will be sealed off by the team members.

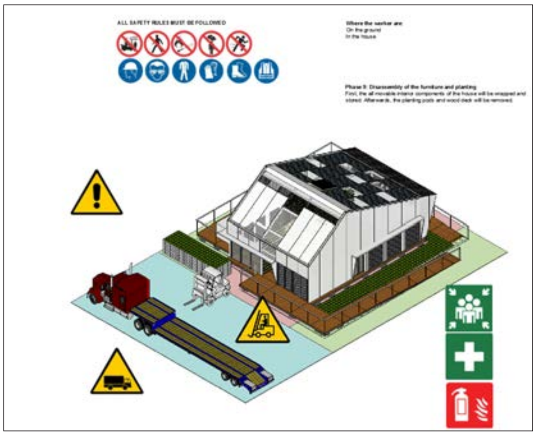


After cleaning the site, the house function will be tested.

Disassembly

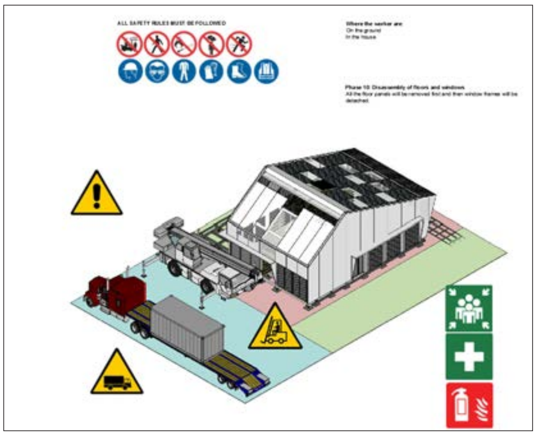
Phase 9: Disassembly of the furniture and planting

First, the all movable interior components of the house will be wrapped and stored. Afterwards, the planting pods and wood deck will be removed.



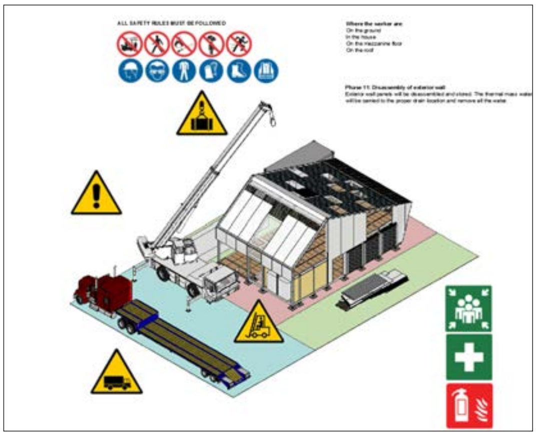
Phase 10: Disassembly of floors and windows

All the floor panels will be removed first and then window frames will be detached.



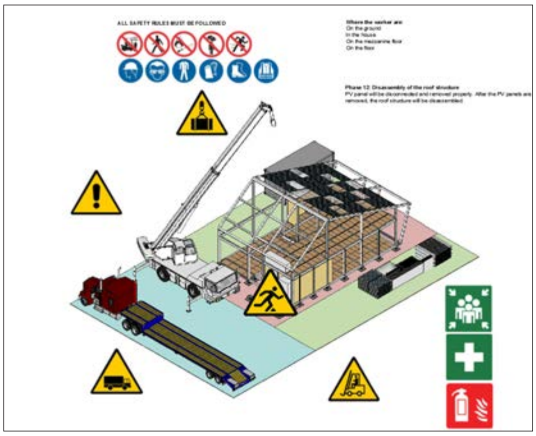
Phase 11: Disassembly of exterior wall

Exterior wall panels will be disassembled and stored. The thermal mass water will be carried to the proper drain location and remove all the water.



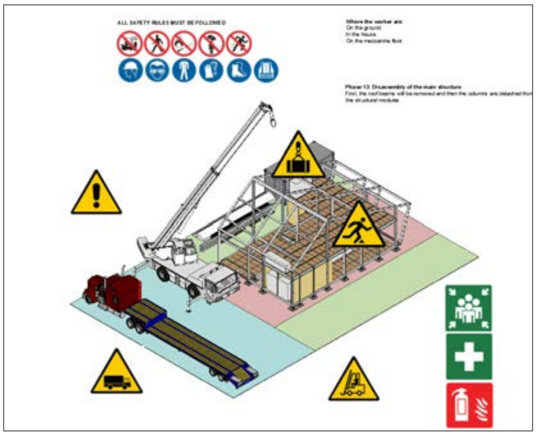
Phase 12: Disassembly of the roof structure

PV panel will be disconnected and removed properly. After the PV panels are removed, the roof structure will be disassembled.



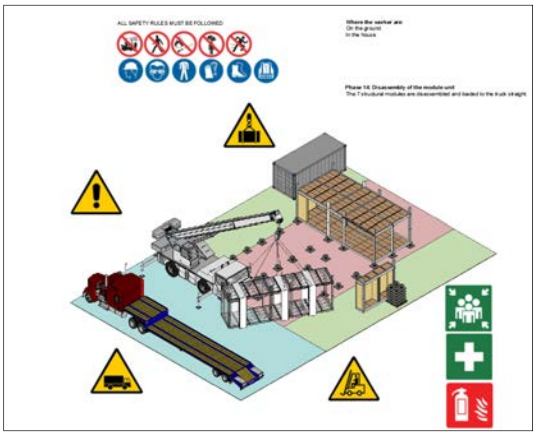
Phase 13: Disassembly of the main structure

First, the roof beams will be removed and then the columns are detached from the structural modules.



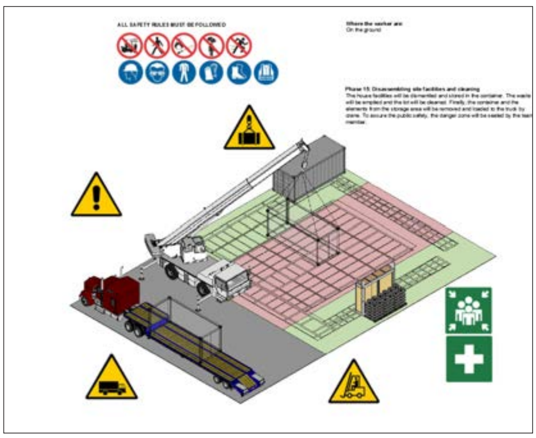
Phase 14: Disassembly of the module unit

The 7 structural modules are disassembled and loaded to the truck straight.



Phase 15: Disassembly of site facilities and cleaning

The house facilities will be dismantled and stored in the container. The waste will be emptied and the lot will be cleaned. Finally, the container and the elements from the storage area will be removed and loaded to the truck by crane. To assure the public safety, the danger zone will be sealed by the team member.



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.

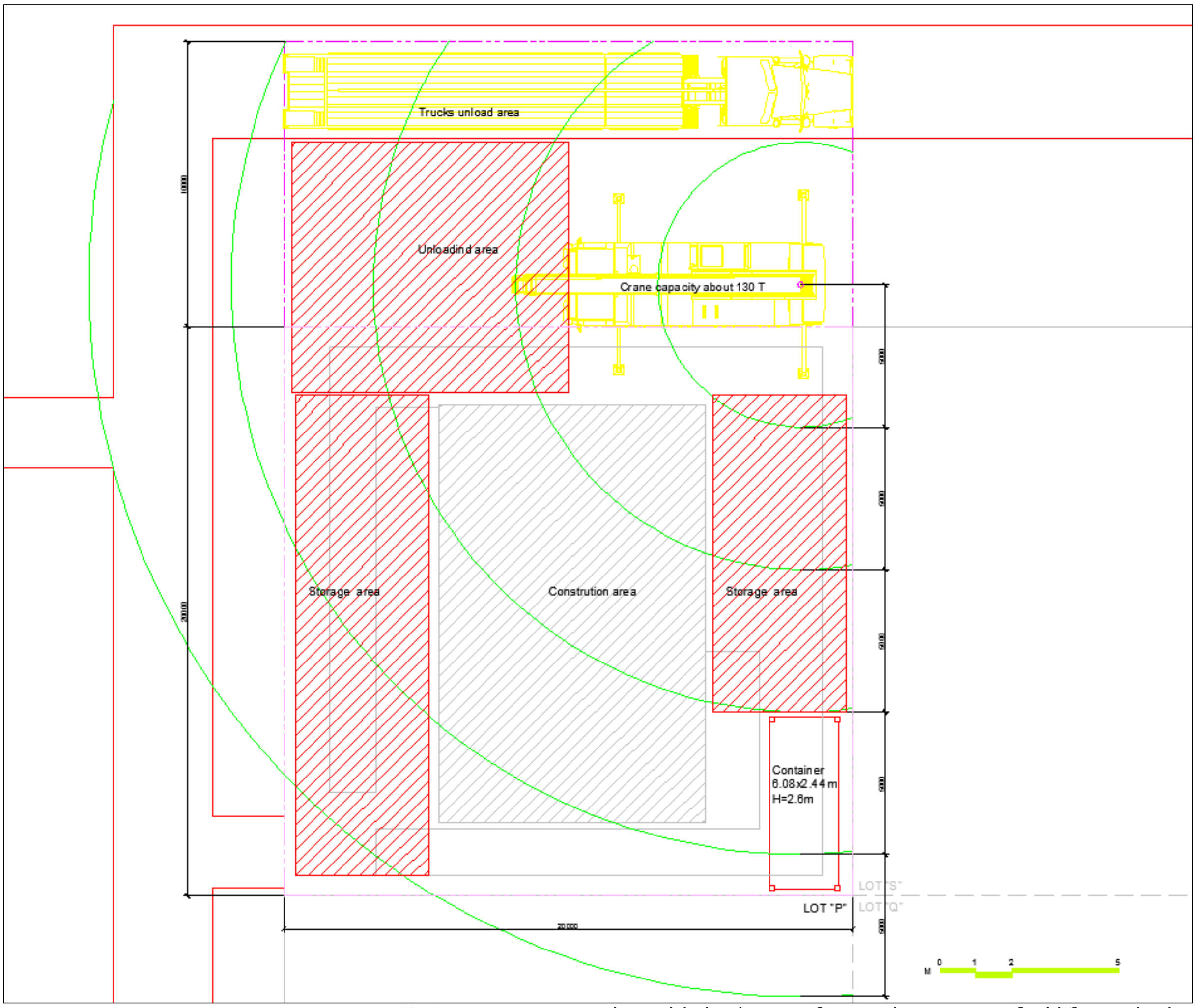


Figure 4.10.1 Movements and established areas for trucks, cranes, forklifts in the lot

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) L	W	H	Weight (kg)	Arrival
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(team 1)	chen.chin.ju@arch.nctu.edu.tw
-	Worker(team 2)	–
Kelly Chen	Worker(team 3)	gooa1121@arch.nctu.edu.tw
Andrew Lu	Worker(team 4)	happydada0810@arch.nctu.edu.tw
Ming-Hung She	Worker(team 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(team 1)	chian@arch.nctu.edu.tw
Yu-hsien Lin, Jeff	Worker(team 2)	bluerice@arch.nctu.edu.tw
Rui Lin	Worker(team 3)	ruikisa@arch.nctu.edu.tw
Bernard Yang	Worker(team 4)	bernard1109@arch.nctu.edu.tw
Wan-Ling Cheng	Worker(team 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(team 1)	cyfan@arch.nctu.edu.tw
Trista Wang	Worker(team 2)	jou-hsuan@arch.nctu.edu.tw
Ruby Tu	Worker(team 3)	Ruby_@arch.nctu.edu.tw
Sophie Chen	Worker(team 4)	wantsi@arch.nctu.edu.tw
-	Worker(team 5)	-

6.0 Critical work phases for risks prevention

ITEM	WORK DETAIL	date	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-A						TEAM-B				
SITE PREPARATION	Truck-1	6/17																								
	Forklift																									
	Crane Lifting																									
	Forklift																									
	Layout																									
	Foundation																									
MODULE UNIT	Truck-2																									
	U1-Fixed																									
	Truck-3																									
	U2-Fixed																									
	Truck-4																									
	U3.4.5-Fixed																									
	Adjustment																									
UNIT MODULES	Adjustment	6/18																								
	TRUCK-5																									
	Crane Lifting																									
	Forklift																									
	Discharge																									
	U6.7-Fixed																									
	U8-Combine																									
	Beam Fixed																									
	U8-Fixed																									
MAIN STRUCTURE	Temporary SR																									
	Stair																									
	Pillar																									
	Beam Fixed																									
	TRUCK-6																									
	Discharge																									
	Unit combine																									
	TRUCK-7																									
	Discharge																									
	Roof Frame																									
	Appliances																									
	Roof Frame	6/19																								
APPLIANCE & ELECTR	Water System																									
	Electronicity																									
	Appliances																									
ROOF	TRUCK-8																									
	Crane Lifting																									
	Discharge																									
	Combination																									
	Solar Panel																									
	Roof																									
	Gutter																									
	Roof Top																									

ITEM	WORK DETAIL	date	0	1	2	3	4	5	6	7	8	9	10	11		13	14	15	16	17	18	19	20	21	22	23
ROOF	Roof	6/20																								
	Gutter																									
	Roof Top																									
EXTERIOR WALL	TRUCK-9																									
	Forklift																									
	Discharge																									
	Combination																									
	Bayer																									
	Thermal wall	5																								
	Window frame																									
INTERIOR	TRUCK-10	6/21																								
	Forklift																									
	Discharge																									
	Floor finish																									
	Ceiling																									
	Lighting																									
	Lighting	6/22																								
	Green core																									
WINDOW	TRUCK-11																									
	Forklift																									
	Discharge																									
	Windows																									
OUT DOOR	TRUCK-12																									
	Out door																									
	Deck																									
	Out door	6/23																								
	Deck																									
ADORNMENT	TRUCK-13																									
	Crane Lifting																									
	Forklift																									
	Discharge																									
	Furniture																									
	Planting																									
Adjustment																										
Adjustment		6/24																								
CLEAN																										
TEST																										
Adjustment		6/25																								
CLEAN																										
TEST																										

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

基本救命術合格證書 / Certificate of Basic Life Support Training — 臺灣急救教育推廣與諮詢中心 / National Resuscitation Council of Taiwan

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
陳佺婷	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

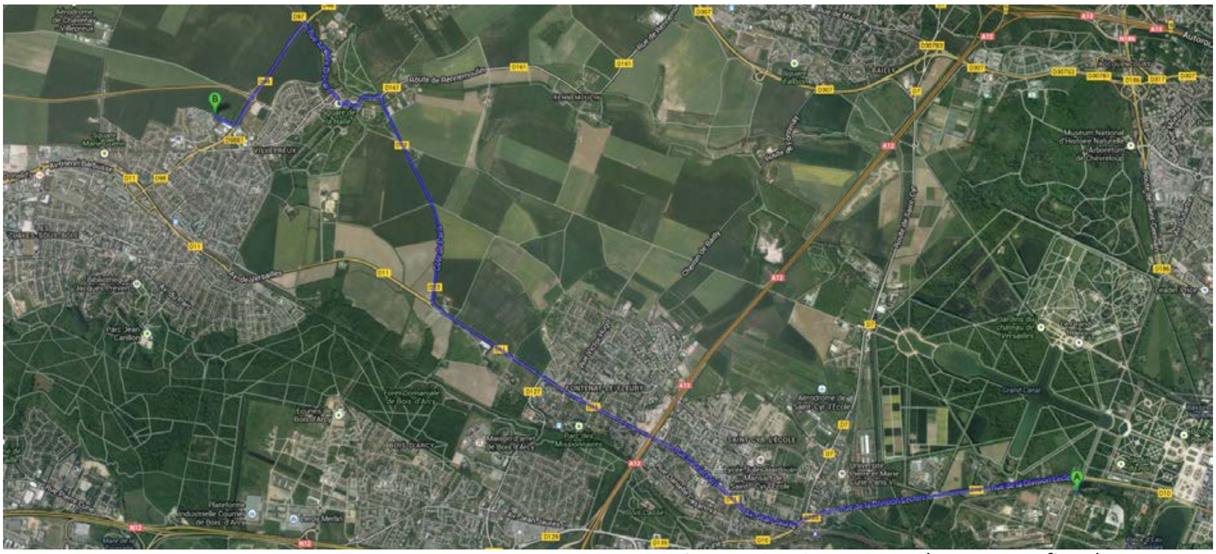


Figure 12.4.2 Route to the nearest fire department

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

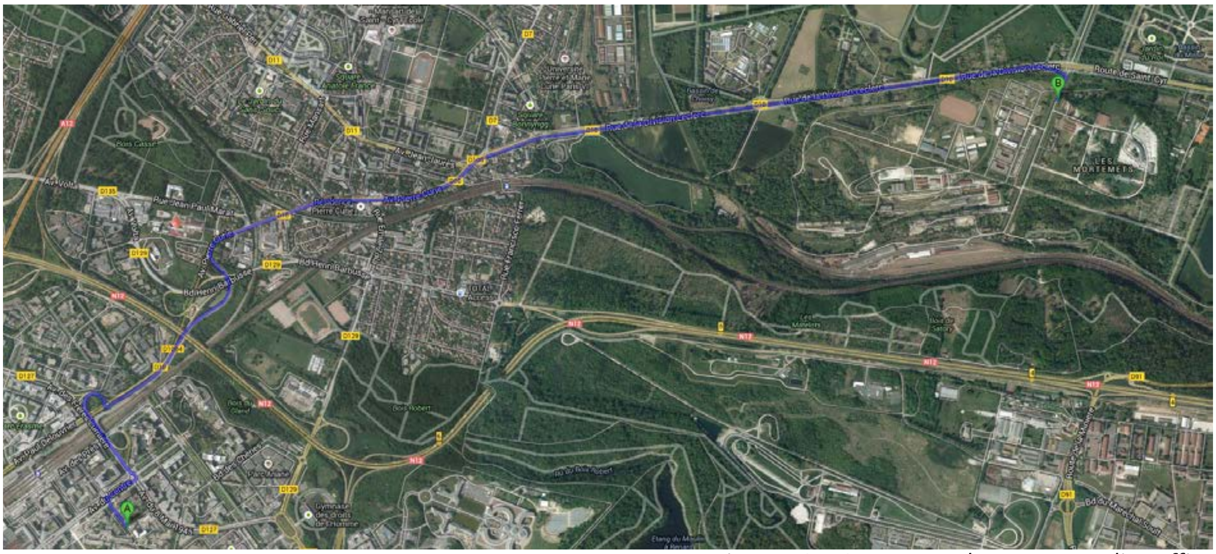


Figure 12.4.3 Route to the nearest police office

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

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 0919-088-626
Project Manager	Benjamin Tang	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 benjamin@arch.nctu.edu.tw 0911-792-289
Project Architect	Daisuke Nagatomo	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 dnagamoto@nctu.edu.tw 0978-081-580
Project Engineer	Shao-Bing Chen	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 sbcaia@yahoo.com.tw 0958-122-365
Structural Engineer	Sheng-I Yen	Ruentex Construction Group 10/F, No.308, Sec. 2, Bade Road, Taipei, Taiwan 10492 0939-603-396 rt009172@mail.ruentex.com.tw
Electrical Engineer	Robert Lour	Delta Electronics, Inc. 186 Ruey Kuang Rd, Neihu, Taipei 11491 Taiwan 02-8797-2088#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 0988-204-763
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 0929-588-039
Safety Officers	Vicky Lai	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 vickylai@arch.nctu.edu.tw 0912-750-220
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 0936-075-392
Contest Captain	Ya-Ting Wu	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 yatingwu@arch.nctu.edu.tw 0921-147-216
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 0961-070-768
Communications Coordinator	Eric Chuang	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 ec2331@gmail.com 0933-859-673
Sponsorship Manager	Rick Lee	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 leetzungchi@gmail.com 0958-396-182

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 0919-088-626
Project Manager	Benjamin Tang	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 benjamin@arch.nctu.edu.tw 0911-792-289
Project Architect	Daisuke Nagatomo	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 dnagamoto@nctu.edu.tw 0978-081-580
Project Engineer	Shao-Bing Chen	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 sbcaia@yahoo.com.tw 0958-122-365
Structural Engineer	Sheng-I Yen	Ruentex Construction Group 10/F, No.308, Sec. 2, Bade Road, Taipei, Taiwan 10492 0939-603-396 rt009172@mail.ruentex.com.tw
Electrical Engineer	Robert Lour	Delta Electronics, Inc. 186 Ruey Kuang Rd, Neihu, Taipei 11491 Taiwan 02-8797-2088#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 0988-204-763
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Sponsorship Manager	Rick Lee	National Chiao Tung University, Graduate Institute of Architecture, 1001 Ta Hsueh Road Hsinchu, TW, 300 leetzungchi@gmail.com 0958-396-182

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

A Team working

Name	Position	Telephone numbers
Daisuke Nagatomo	Project Architect	+886-978-081-580
Yating Wu	Worker(student leader)	+886-921-147-216
Ching-Ju Chen	Worker(team 1)	+886-910-651-371
-	Worker(team 2)	–
Kelly Chen	Worker(team 3)	+886-921-134-112
Andrew Lu	Worker(team 4)	+886-918-861-399
Ming-Hung She	Worker(team 5)	+886-936-075-392

B Team working

Name	Position	Mail
Minnie Jan	Project Manager	+886-986-772-367
Sheng-Kai Sky Tseng	Worker(student leader)	+886-988-204-763
Chester Hu	Worker(team 1)	+886-961-106-633
Yu-hsien Lin, Jeff	Worker(team 2)	+886-939-752-075
Rui Lin	Worker(team 3)	+886-975-503-591
Bernard Yang	Worker(team 4)	+886-953-961-109
Wan-Ling Cheng	Worker(team 5)	+886-929-558-039

C Team working

Name	Position	Mail
Bojiun Tang	Project Manager	+886-911-792-289
Dennis Lin	Worker(student leader)	+886-961-070768
Chin Yuan Fan	Worker(team 1)	+886-963-098-037
Trista Wang	Worker(team 2)	+886-926-379-838
Ruby Tu	Worker(team 3)	+886-920-393-946
Sophie Chen	Worker(team 4)	+886-932-905-816
-	Worker(team 5)	-

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.

Detailed Water Budget

Use	Draws/Day (1)	Litres / Each Draw		Demand in Litres	
		Cold	Warm	Day	10 Days
Water Closet (2)	2	6 (L/f)		12	120
Water Closet (3)	10	3 (L/f)		30	300
Shower Head	2		50 (40°C)	100	1000
Faucet (Hand Sink)	12		108 (35°C)	108	1080
Kitchen Sink	2		36 (55°C)	36	360
Dishwashing	1		9.8 (50°C)	9.8	98
Cloth Washing	1		100 (45°C)	100	1000
Gardening (4)	1				
Total				**395.8**	**3958**

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 gray water.

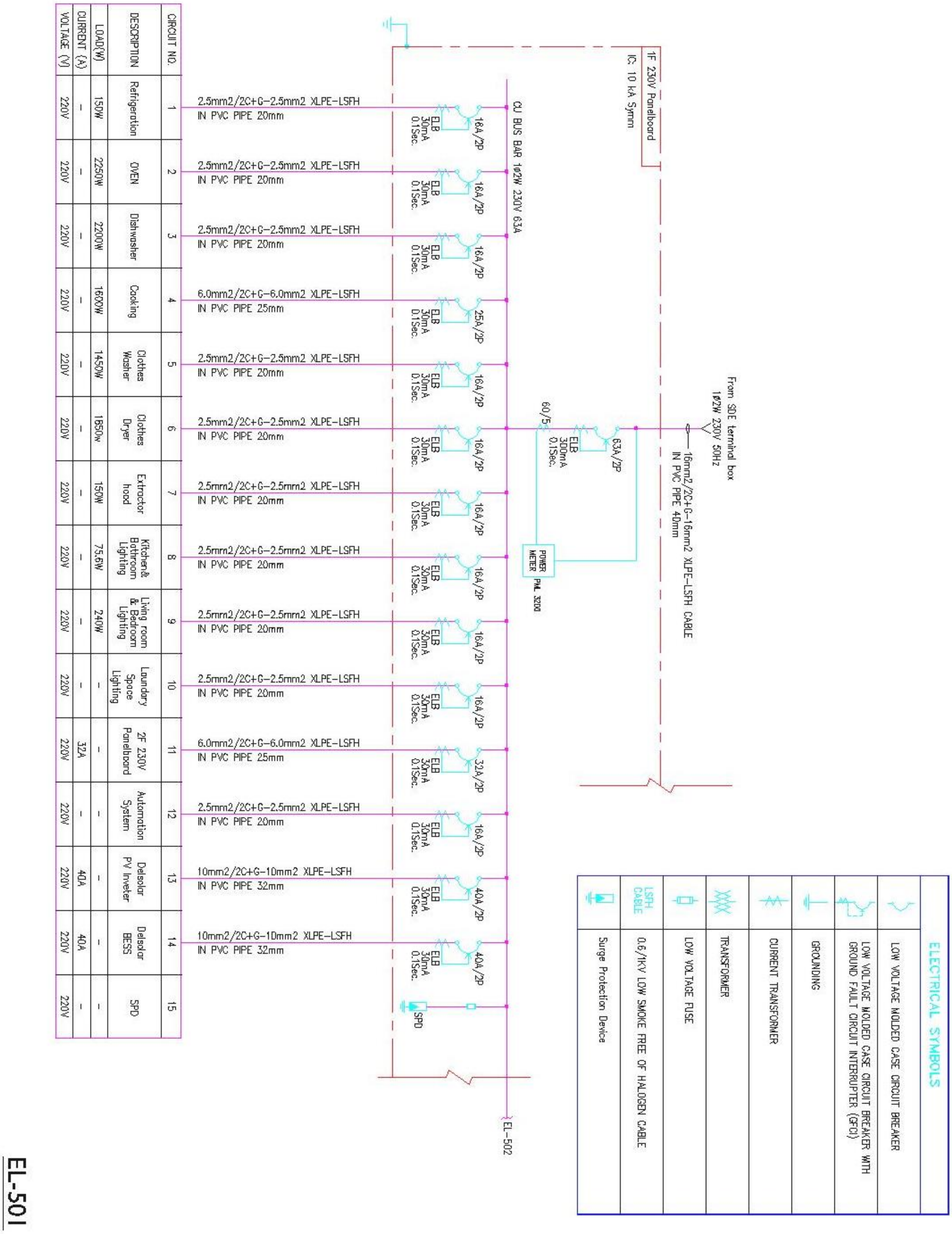
National Chiao Tung University

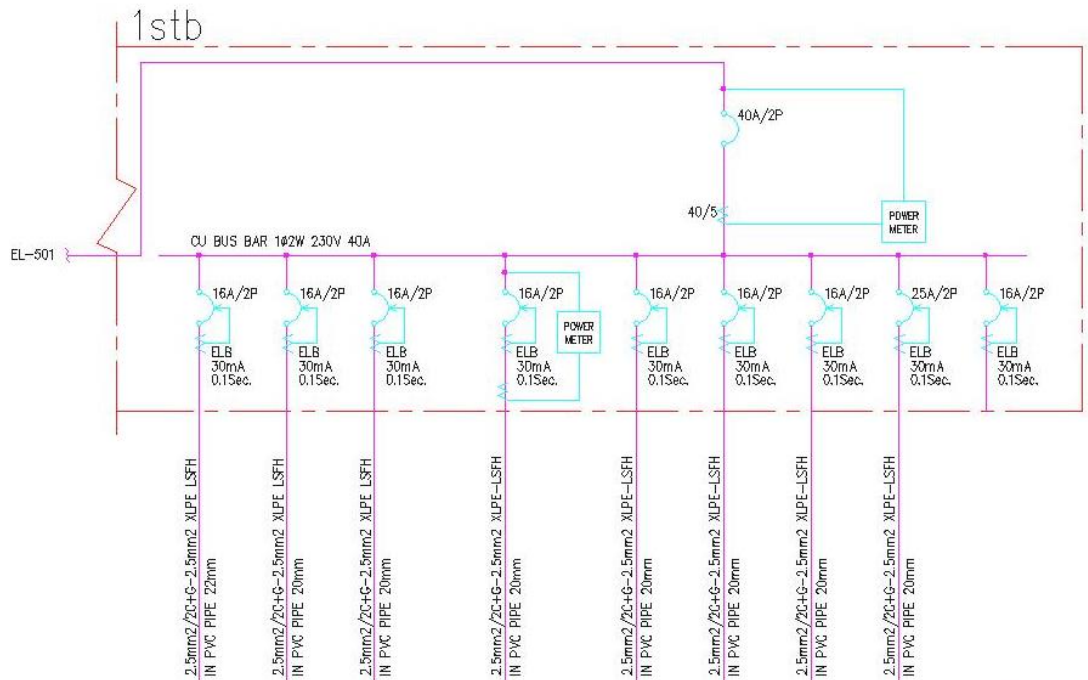
Solar Decathlon Europe

ORCHID HOUSE

Electric and PV Desing Systems Information

One-Line Diagram

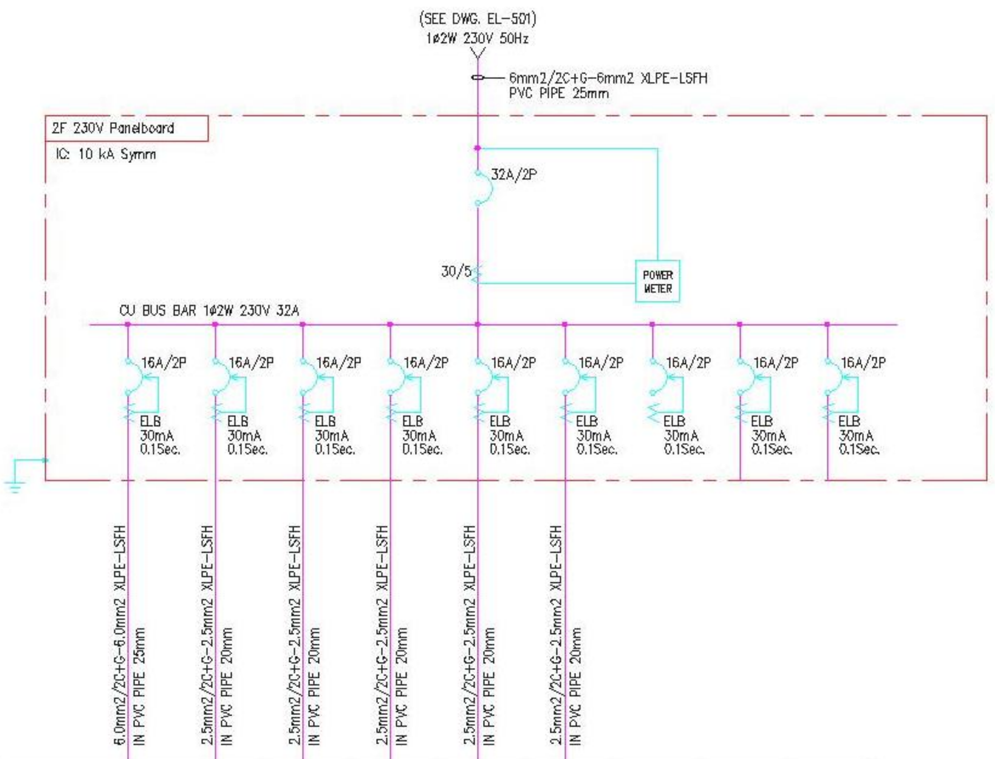




CIRCUIT NO.	16	17	18	19	20	21	22	23	24
DESCRIPTION	Domestic Water Pump	Gray Water Pump	BathRoom & Tea Terrace Receptacle	Lving Room & Workstation Receptacle (Home Electronics)	Pump 01 –	Pump 02 –	Pump 03 –	ELECTRIC CAR CHARGER	SPARE
LOAD(W)	373W	200W	–	–	435W	435W	435W	–	–
CURRENT (A)			–	–				16A	
VOLTAGE (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

Solar Decathlon EUROPE 2014 EN FRANCE

Electric and PV Chart and Checklists

November 1, 2013

www.solardecathlon2014.fr

UNI - NCTU UNICODE

Solar Decathlon Europe | 2014 EN FRANCE

Table of Contents

Electric and Photovoltaic Chart

Team ID	Team Name	Country
UNI	NCTU UNICODE	Taiwan
	University	Date
	National Chiao Tung University	11/01/2013

	GENERAL ELECTRICAL AND PHOTOVOLTAIC INSTALLATIONS	
1	Electrical supply voltage (phase-neutral) for which both installations have been designed (unit: V)	230 V
2	Electrical supply frequency for which both installations have been designed (unit: Hz)	50 Hz

ELECTRICAL INSTALLATION

• No details are required in this document about interior circuits, due to the fact that an electrical system design checklist will validate your choice separately.
• The Organization will supply the teams with a one-line diagram with the distribution and protections of the interior circuits, according to the French standard NF C 14 100.
• Teams are reminded of the fact that the electrical installations shall be designed for a single-phase supply with a maximum power of 15 kW, equivalent to 63 A (230 V / 50 Hz). For other voltages and/or frequencies the equivalent limit shall apply, by making use of the corresponding transformation relation.

3	House inner surface (unit: m2)	
4	Expected maximum power (unit: W)	29,200 W
	Individual branch:	
5	Type of cable	
6	Cross-section (unit: mm2)	
	General magnetothermic protection:	
7	Nominal current (unit: A)	
8	Circuit-breaking capacity (unit: A)	
	General differential protection:	
9	Nominal current (unit: A)	
10	Sensibility / Trip value (unit: mA)	

	PHOTOVOLTAIC INSTALLATION:	
11	Nominal power of the inverter, or sum of the nominal power of inverters in case several inverters are used) (unit: W) Nominal power of the inverter is the maximum output power without time limitations	5,000 VA
12	Inverter(s) Brand	Delta Electronics, Inc
13	Inverter(s) Model(s)	Solivia 5.0 EU G4 TR

	HARD-WIRED BATTERY BANK + BATTERY INVERTER: (Only if apply)	
14	Nominal operation voltage of the battery bank (unit: V)	24 V
15	Nominal capacity of the battery bank (unit: Ah)	60
16	Nominal power of the inverter (unit: W) Nominal power of the inverter is the maximum output power at the AC side without time limitations	260 VA
17	Inverter(s) Brand	Delco

18	Inverter(s) Model(s)	**DDP-260-AB-1**

Electric System Design Checklist

Team ID	Team Name	Country
UNI	NCTU UNICODE	Taiwan
	University	Date
	National Chiao Tung University	11/01/2013

Subject	Element	Required specification or information	Comment	Location
Connection to grid	Individual branch cable	Cross section of 3x16 mm2	3x16 mm²	EL-001
		way taken by the conduit between General Box and Distribution Board	40mm	EL-001
		cable reference and specifications		PM Chap 13.4
Distribution board and circuits	Main circuit breaker	The Main circuit breaker must have:		
		breaking capacity of 6kA minimum	observed, 10kA	EL-501
		rated current of 63A maximum	observed	EL-501
		overload and short circuit trip mechanism	observed	EL-501
		RCD of medium sensitivity(300mA)	observed	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.	observed	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)	observed	EL-501
	Lighting point circuit	French standard recommend 8 lighting point maximum per circuit. (With wire cross section 1,5mm² at 230V)	observed	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)	observed	EL-501
Wiring	Wire insulation	Wires to use must be insulated, made of copper and have a minimum nominal voltage of 450/750V.	observed	PM Chap 13.4
	Wire mechanical protection	Single insulated conductors must be drawn into conduits	observed	PM Chap 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. (insulation class and IP codes of equipment and	observed	PM Chap 5.2.4 + EL-301

		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.	observed	EL-501 + Chap 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.	observed, 10kA	EL-501 + Chap 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	observed	PM Chap 13.4
	Insulation class	Class 0 not allowed	observed	PM Chap 13.4
	Socket	Socket must have children protection	observed	PM Chap 13.4
	Residual current device	Obligatory protection by 30 mA sensitive RCDs for all the circuit except :	observed	
		- Circuit with a insulation transformer	observed	EL-501
		- Surge protection device which is under the main RCD Type S	observed	EL-501
		- If equipment current has a DC component, used an RCD type A	observed	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, …)	See Grounding system	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.	observed	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.	observed	EL-601
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	NCTU UNICODE	Taiwan
	University	Date
	National Chiao Tung University	11/01/2013

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)	6.0 kW
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
Not Photovoltaic electricity generation	
Technology used	NA
Installation size. Nominal power of all power conditioning (units: kW)	NA
Brand(s), model(s) and nominal power (units: kW) of DC/AC power conditioning equipment (inverters)	NA
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
Nominal operation voltage of the battery bank (units: V)	48 V
Nominal capacity of the battery bank (units: Ah)	125 Ah
Small "stand-alone" Secondary batteries	
Utilisation of secondary batteries	NA
Brand, model and nominal power of secondary batteries charger, inverter, or inverter charger (units: kVA)	NA
Nominal operation voltage of the secondary batteries (units: V)	NA

Nominal capacity of the secondary batteries (units: Ah)	NA

.

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	C
		SDE	
6.2	Earthing on DC side	Team	C
		SDE	
6.3	Grounding system	Team	C
		SDE	
7	**Protection against electric shock**		
7.2	Protection against direct contact	Team	C
		SDE	
7.3	Protection against indirect contact	Team	C
		SDE	
8	**Protection against short circuit and overload**		
8.1	Protection on DC side	Team	C
		SDE	
8.2	Protection on AC side	Team	C
		SDE	
9	**Anti islanding protection**		
	Compliance with standard DIN VDE 0126-1-1	Team	C
		SDE	
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	
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 4mm^2 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 4mm^2 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%
		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%
		SDE	
12	**Breaking and isolation devices**		
12.2	Isolation device	Team	C (with DC switch)
		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.
		SDE	
13.2.1	Surge arrester on AC side	Team	C
		SDE	
13.2.2	Surge arrester on DC side	Team	C
		SDE	
14	**Wiring**		
		Team	REF MANUAL 36.5
		SDE	
		Team	C
		SDE	
		Team	C
		SDE	
		Team	C
		SDE	
		Team	C
		SDE	
		Team	REF MANUAL 36.5
		SDE	
		Team	C
		SDE	

	Compliance with standard EN61646 for amorphous silicon solar panels	Team	NA
		SDE	
14.5	Electrical devices on DC side	Team	C
		SDE	
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	
14.7	Photovoltaic connector: Compliance with standard EN50521	Team	C
		SDE	
14.8	Surge arrester	Team	C
		SDE	
14.8.1	Compliance with standard EN61643-11 for surge arrester on AC side	Team	C
		SDE	
14.8.1	Compliance with standard UTE C 61-740-51 for surge arrester on DC side	Team	C
		SDE	
14.8.2	Wiring of surge arresters	Team	C REF DRAWING
		SDE	
15	**Photovoltaic warning labels**		
15.1	All devices and cables are identified	Team	C
		SDE	
15.2	Label on DC side, AC side and on the inverter	Team	C
		SDE	
16	**Dossier technique**	Team	C drawing, certification and supplemental document
		SDE	
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	

Photovoltaic system design – Compliance with standards for the inverters

Description		Comments
Compliance with standard DIN VDE 126-1-1	Team	C
	SDE	
Voltage operating range (230 V – 20% < V < 230 V + 15%)	Team	C (195 V < V < 253 V)
	SDE	
Frequency operating range (50 Hz – 2.5 Hz < f < 50 Hz + 0.2 Hz)	Team	C (47.5 Hz < f < 50.2 Hz)
	SDE	
Harmonics		
Compliance with standard CEI 61000-3-2	Team	C (EN61000-3-2)
	SDE	
Compliance with standard CEI 62109	Team	C (IEC62109-1 / -2)
	SDE	

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** This drawing shall be electrical and include the interfaces with the electrical installation of the house and the electricity distribution network	Team SDE	**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	**C**
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	**C**
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	**C**

Electrical Storage System Checklist

Team ID	Team Name	Country
UNI	NCTU UNICODE	Taiwan
	University	**Date**
	National Chiao Tung University	11/01/2013

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
	Nominal capacity (units: Ah)	125 Ah
	Type	LiON
	Brand and model	TBD
Battery inverter	Nominal power (units: kW)	0.260 kVA
	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	
3	Grounding: system of hard-wired battery bank and battery inverter.	Team	positive grounded
		SDE	
	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	MCB80
		SDE	
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	
7	Selection criteria of DC and AC wire conducts.	Team	Follow national electrical code
		SDE	
	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	
9	Ventilation system used.	Team	System is placed in indoor cabinet without additional ventilation.
		SDE	
10	Proximity to the battery.	Team	The battery cabinet is stand alone
		SDE	
	Battery housing, battery covering (section 10)		
11	Battery housing	Team	Plastic
		SDE	
12	Battery sealing	Team	Need more information from the selected vendor
		SDE	
	General labels and danger labels (section 12)		
13	General labels and danger labels.	Team	As standard from vendor
		SDE	
	General Security		
14	Material Safety Data Sheet (MSDS) of the batteries.	Team	Need more information from the selected vendor
		SDE	

Construction Spefcifications

1.0 Structure

1.1 Foundation

To be included next deliverables

1.2 Structural floors and sections

To be included next deliverables

2.0 Architecture

2.1 Enclosure

To be included next deliverables

2.2 Openings

To be included next deliverables

2.3 Partitions

To be included next deliverables

2.4 Finishes

To be included next deliverables

2.5 Appliances

To be included next deliverables

2.6 Furnishings

To be included next deliverables

3.0 Systems Installations

3.1 Fire Suppression

To be included next deliverables

3.2 Plumbing

To be included next deliverables

3.3 HVAC

To be included next deliverables

3.4 Electrical

To be included next deliverables

3.5 Solar Systems - Photovoltaic and thermal

3.5.1 PV Module

DelSolar

D6P_B3A-WS
230 W - 250 W
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/m²)

PID resistant
Enhanced module reliability

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 cadmium content test
According to IEC 62321

Reliability & Certification

- Performance warranty
  25-year: minimum 80% power output
  10-year: minimum 90% power output
- Product guarantee: 5-year
- IEC 61215 / IEC 61730, UL 1703, CE, MCS, CEC

About DelSolar

Established as a subsidiary of Delta Electronics, Inc., the world's number one switching power supplies provider, DelSolar is dedicated to the research, development, and production of high-quality solar cells, modules, and photovoltaic (PV) systems. DelSolar strives to become the world's leading solar supplier through continuous innovation, outstanding production processes, high yield rates, and world-class product efficiency. Under its parent company's leadership, DelSolar is committed to providing clean and effective solar energy for a sustainable world.

More Information, please visit us at: **www.delsolarpv.com**

Contact Us

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US Contact
Tel: +1-888-880-8868
Email: solar.sales@delta-corp.com

Europe Contact
Tel: +31 (0)20 6550953
Email: sales.europe@delsolarpv.com

 MQWRD-01-01-93-D6P_B3A-WS Ver. 1.0

National Chiao Tung University

Solar Decathlon Europe

ORCHID HOUSE

DelSolar

Electrical Data

MODEL	D6P230B3A	D6P235B3A	D6P240B3A	D6P245B3A	D6P250B3A
Maximum Rating Power (Pmax)	230 W	235 W	240 W	245 W	250 W
Module Efficiency	14.1 %	14.4 %	14.7 %	15.0 %	15.3 %
Open Circuit Voltage (Voc)	36.33 V	36.82 V	36.96 V	37.10 V	37.37 v
Maximum Power Voltage (Vpm)	29.53 V	29.71 V	30.20 V	30.65 V	30.95v
Short Circuit Current (Isc)	8.35 A	8.44 A	8.49 A	8.54 A	8.63 A
Maximum Power Current (Ipm)	7.79 A	7.91 A	7.97 A	8.02 A	8.12A

*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	19 kg / 42.0 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

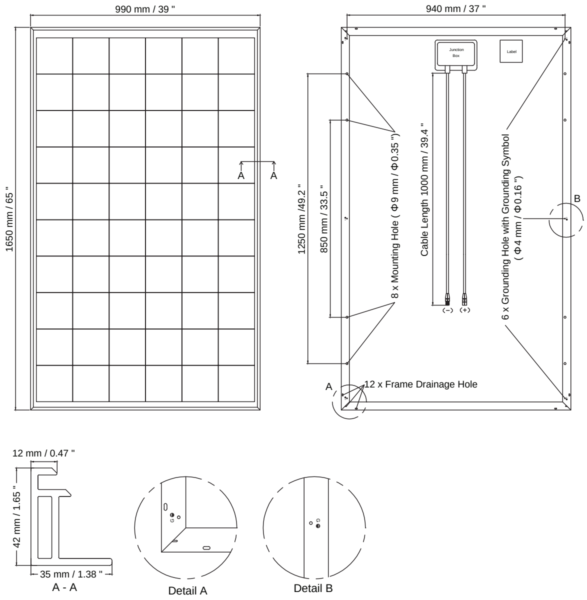
Item	Specification
Mechanical Load	5400 Pa (Certified by TUV Rheinland)
Maximum System Voltage	IEC: DC 1000 V / UL: DC 600 V
Series Fuse Rating	15 A
Operating Temperature	-40 to 85 °C

Temperature Characteristics

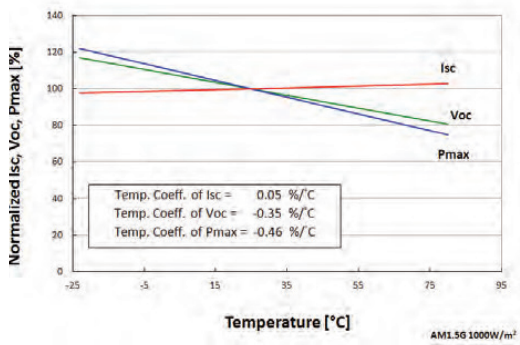
Item	Specification
Nominal Operating Cell Temperature	44.1 °C ± 2°C
Temperature Coefficient of Isc	0.05 % / °C
Temperature Coefficient of Voc	-0.35 % / °C
Temperature Coefficient of Pmax	-0.46 % / °C

* Normal Operating Cell Temperature (NOCT): Irradiance 800W/m², Ambient Temperature 20 °C, Wind Speed 1 m/s
* Please refer to DelSolar’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 %

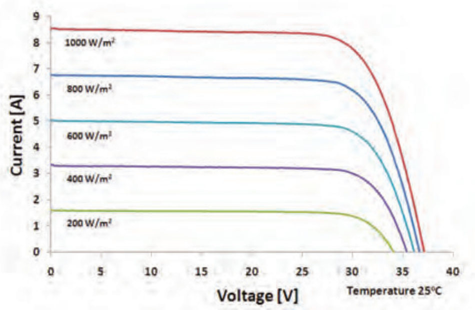
Front View & Back View



Dependence on Temperature



Dependence on Irradiance



 MQWRD-01-01-93-D6P_B3A-WS Ver. 1.0

TÜVRheinland®

Certificate

Registration No.: PV 50165819 Page 1 **Report No.: 12605939 001**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Manufacturing Plant:
DelSolar Co., Ltd.
No. 6, Industry East Road 3
Science-Based Industrial Park
Hsinchu, 300, Taiwan, R. O. C.

Product:
PV Module
Type: D6MxxxB3A
(xxx = 215, 220, 225, 230, 240, 245, 250, 255)
D6PxxxB3A
(xxx = 210, 215, 220, 225, 230, 240, 245, 250)
D6MxxxB2A
(xxx = 170, 175, 180, 185, 190, 195, 200)
D6PxxxB2A
(xxx = 170, 175, 180, 185, 190, 195, 200)
D6MxxxB1A
(xxx = 130, 135, 140, 145, 150)
D6PxxxB1A
(xxx = 125, 130, 135, 140, 145)

Basis:

☒ **IEC 61215:2005**
EN 61215:2005
"Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

www.tuv.com
TÜVRheinland®
ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
-The details of the factory inspection are documented in report no. 10026913.
-Mechanical Load was performed at 5400 Pa.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate has a validity of 5 years counting from date of issue.

TÜV Rheinland Japan Ltd. TÜVRheinland® Certification Body

Certification body

Yokohama, 21 October 2009

Dipl.-Ing. S. Hartter

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165829 Page 1 **Report No.: 12605939 002**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Manufacturing Plant:
DelSolar Co., Ltd.
No. 6, Industry East Road 3
Science-Based Industrial Park
Hsinchu, 300, Taiwan, R. O. C.

Product:
PV Module
Type: D6MxxxB3A
(xxx = 215, 220, 225, 230, 240, 245, 250, 255)
D6PxxxB3A
(xxx = 210, 215, 220, 225, 230, 240, 245, 250)
D6MxxxB2A
(xxx = 170, 175, 180, 185, 190, 195, 200)
D6PxxxB2A
(xxx = 170, 175, 180, 185, 190, 195, 200)
D6MxxxB1A
(xxx = 130, 135, 140, 145, 150)
D6PxxxB1A
(xxx = 125, 130, 135, 140, 145)

Basis:

☒ **IEC 61730-1:2004**
IEC 61730-2:2004
EN 61730-1:2007
EN 61730-2:2007
"Photovoltaic (PV) module safety qualification"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

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TÜVRheinland®
ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
- IEC EN 61730 consists of part 1 (Requirements for construction) and part 2 (Requirements for testing).
- The above listed PV modules fulfil the requirements of Application Class A (Safety Class II). They may be used in PV plants at a maximum system voltage (Voc at STC) of up to **1000 VDC.**
- The fire test (IEC 61730-2 / MST 23) was not performed.
- The details of the factory inspection are documented in report no. 10026913.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate has a validity of 5 years counting from date of issue.

TÜV Rheinland Japan Ltd. TÜVRheinland® Certification Body

Certification body

Yokohama, 21 October 2009

Dipl.-Ing. S. Hartter

TÜVRheinland

Certificate

Registration No.: PV 50165819 Page 2 **Report No.: 12605939 003**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Product:
PV Module

Addition

Type: D6M235B3A, D6P235B3A

Manufacturing Plant:
DelSolar Co., Ltd.
No. 6, Industry East Road 3
Science-Based Industrial Park
Hsinchu, 300, Taiwan, R. O. C.

Basis:

☒ **IEC 61215:2005**
EN 61215:2005
"Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

www.tuv.com
TÜVRheinland
ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
-Additional type designations see above.
-The details of the factory inspection are documented in report no. 10026913.
-Mechanical Load was performed at 5400 Pa.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Product Safety GmbH
TÜVRheinland
Zertifizierungsstelle

Certification body

Yokohama, 18 December 2009

Dipl.-Ing. W. Herlitschke

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165829 **Page 2** **Report No.: 12605939 004**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Product:
PV Module

Addition

Type: D6M235B3A, D6P235B3A

Manufacturing Plant:
DelSolar Co., Ltd.
No. 6, Industry East Road 3
Science-Based Industrial Park
Hsinchu, 300, Taiwan, R. O. C.

Basis:

☒ **IEC 61730-1:2004**
IEC 61730-2:2004
EN 61730-1:2007
EN 61730-2:2007
"Photovoltaic (PV) module safety qualification"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

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TÜVRheinland®
ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
- Additional type designations see above.
- IEC EN 61730 consists of part 1 (Requirements for construction) and part 2 (Requirements for testing).
- The above listed PV modules fulfil the requirements of Application Class A (Safety Class II). They may be used in PV plants at a maximum system voltage (Voc at STC) of up to **1000 VDC.**
- The fire test (IEC 61730-2 / MST 23) was not performed.
- The details of the factory inspection are documented in report no. 10026913.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Product Safety GmbH
TÜVRheinland®
Zertifizierungsstelle

Certification body

Yokohama, 18 December 2009

Dipl.-Ing. W. Herlitschke

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165819 **Page 3** **Report No.: 12605939 007**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Manufacturing Plant:
DelSolar Co., Ltd.
No. 6, Industry East Road 3
Science-Based Industrial Park
Hsinchu, 300, Taiwan, R. O. C.

Product:
PV Module

Addition

Type: D6MxxxB5A
(xxx = 190, 195, 200, 205, 210, 215, 220, 225, 230)

D6PxxxB5A
(xxx = 185, 190, 195, 200, 205, 210, 215, 220, 225)

Basis:

☒ **IEC 61215:2005**
EN 61215:2005
"Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

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ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
-Additional type designations see above.
-The details of the factory inspection are documented in report no. 10026913.
-Mechanical Load was performed at 5400 Pa.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Japan Ltd. TÜVRheinland® Certification Body

Certification body

Yokohama, 25 February 2010

Dipl.-Ing. W. Herlitschke

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165829 **Page 3** **Report No.: 12605939 008**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Manufacturing Plant:
DelSolar Co., Ltd.
No. 6, Industry East Road 3
Science-Based Industrial Park
Hsinchu, 300, Taiwan, R. O. C.

Product:
PV Module

Addition

Type: D6MxxxB5A
(xxx = 190, 195, 200, 205, 210, 215, 220, 225, 230)

D6PxxxB5A
(xxx = 185, 190, 195, 200, 205, 210, 215, 220, 225)

Basis:

☒ **IEC 61730-1:2004**
IEC 61730-2:2004
EN 61730-1:2007
EN 61730-2:2007
"Photovoltaic (PV) module safety qualification"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

www.tuv.com TÜVRheinland® ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
- Additional type designations see above.
- IEC EN 61730 consists of part 1 (Requirements for construction) and part 2 (Requirements for testing).
- The above listed PV modules fulfil the requirements of Application Class A (Safety Class II). They may be used in PV plants at a maximum system voltage (Voc at STC) of up to **1000 VDC.**
- The fire test (IEC 61730-2 / MST 23) was not performed.
- The details of the factory inspection are documented in report no. 10026913.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Japan Ltd. TÜVRheinland® Certification Body

Certification body

Yokohama, 25 February 2010

Dipl.-Ing. W. Herlitschke

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165829 Page 4 **Report No.: 12605939 012**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Manufacturing Plant:
DelSolar Co., Ltd.
No. 6, Industry East Road 3
Science-Based Industrial Park
Hsinchu, 300, Taiwan, R. O. C.

Product:
PV Module

Addition

Type: D6PxxxA5A
(xxx = 185, 190, 195, 200, 205, 210, 215, 220, 225)
D6PxxxA3A
(xxx = 210, 215, 220, 225, 230, 235, 240, 245, 250)
D6PxxxA2A
(xxx = 170, 175, 180, 185, 190, 195, 200)
D6PxxxA1A
(xxx = 125, 130, 135, 140, 145)

Basis:

☒ **IEC 61730-1:2004**
IEC 61730-2:2004
EN 61730-1:2007
EN 61730-2:2007
"Photovoltaic (PV) module safety qualification"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

www.tuv.com
TÜVRheinland®
ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
- Additional type designations see above.
- IEC EN 61730 consists of part 1 (Requirements for construction) and part 2 (Requirements for testing).
- The above listed PV modules fulfil the requirements of Application Class A (Safety Class II). They may be used in PV plants at a maximum system voltage (Voc at STC) of up to **1000 VDC.**
- The fire test (IEC 61730-2 / MST 23) was not performed.
- The details of the factory inspection are documented in report no. 10026913.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Japan Ltd. Certification Body TÜVRheinland®

Certification body

St Htto

Yokohama, 30 April 2010

Dipl.-Ing. S. Hartter

TÜVRheinland®

Certificate

Registration No.: PV 50165819 Page 4 **Report No.: 12605939 011**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Manufacturing Plant:
DelSolar Co., Ltd.
No. 6, Industry East Road 3
Science-Based Industrial Park
Hsinchu, 300, Taiwan, R. O. C.

Product:
PV Module

Addition

Type: D6PxxxA5A
(xxx = 185, 190, 195, 200, 205, 210, 215, 220, 225)
D6PxxxA3A
(xxx = 210, 215, 220, 225, 230, 235, 240, 245, 250)
D6PxxxA2A
(xxx = 170, 175, 180, 185, 190, 195, 200)
D6PxxxA1A
(xxx = 125, 130, 135, 140, 145)

Basis:

☒ **IEC 61215:2005**
EN 61215:2005
"Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

www.tuv.com
TÜVRheinland®
ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
-Additional type designations see above.
-The details of the factory inspection are documented in report no. 10026913.
-Mechanical Load was performed at 5400 Pa.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Japan Ltd. Certification Body TÜVRheinland

Certification body

St Htt

Yokohama, 30 April 2010

Dipl.-Ing. S. Hartter

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165819 **Page 5** **Report No.: 12605939 013**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Product:
PV Module

Addition

Type: refer to the preceding certificate pages

Manufacturing Plant:
DelSolar (Wu Jiang) Ltd.
No. 1688, Jiangxing East Road
Wujiang Economy Development Zone
Wujiang City, Jiangsu Province
215200, P.R.China

Basis:

☒ **IEC 61215:2005**
EN 61215:2005
"Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

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ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
-Additional Factory see above.
-The details of the factory inspection are documented in report no. 15036567.
-Mechanical Load was performed at 5400 Pa.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Japan Ltd.
TÜVRheinland
Certification Body

Certification body

Yokohama, 25 August 2010

Dipl.-Ing. W. Herlitschke

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165829 **Page 5** **Report No.: 12605939 014**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Product:
PV Module

Addition

Type: refer to the preceding certificate pages

Manufacturing Plant:
DelSolar (Wu Jiang) Ltd.
No. 1688, Jiangxing East Road
Wujiang Economy Development Zone
Wujiang City, Jiangsu Province
215200, P.R.China

Basis:

☒ **IEC 61730-1:2004**
IEC 61730-2:2004
EN 61730-1:2007
EN 61730-2:2007
"Photovoltaic (PV) module safety qualification"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

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ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
-Additional Factory see above.
- IEC EN 61730 consists of part 1 (Requirements for construction) and part 2 (Requirements for testing).
- The above listed PV modules fulfil the requirements of Application Class A (Safety Class II). They may be used in PV plants at a maximum system voltage (Voc at STC) of up to **1000 VDC.**
- The fire test (IEC 61730-2 / MST 23) was not performed.
- The details of the factory inspection are documented in report no. 15036567.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Japan Ltd. Certification Body

Certification body

Yokohama, 25 August 2010

Dipl.-Ing. W. Herlitschke

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165829 **Page 6** **Report No.: 12605939 016**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Product:
PV Module

Type: refer to the preceding certificate pages

Manufacturing Plant:
DelSolar Co., Ltd.
No. 25, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Basis:

☒ **IEC 61730-1:2004**
IEC 61730-2:2004
EN 61730-1:2007
EN 61730-2:2007
"Photovoltaic (PV) module safety qualification"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

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TÜVRheinland®
ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
- Address of Manufacturing Plant DelSolar Co., Ltd. changed to see above.
- IEC EN 61730 consists of part 1 (Requirements for construction) and part 2 (Requirements for testing).
- The above listed PV modules fulfil the requirements of Application Class A (Safety Class II). They may be used in PV plants at a maximum system voltage (Voc at STC) of up to **1000 VDC.**
- The fire test (IEC 61730-2 / MST 23) was not performed.
- The details of the factory inspection are documented in report no. 11022428.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Japan Ltd. Certification Body TÜVRheinland®

Certification body

Yokohama, 07 October 2010

Dipl.-Ing. W. Herlitschke

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

TÜVRheinland®

Certificate

Registration No.: PV 50165819 **Page 6** **Report No.: 12605939 015**

License Holder:
DelSolar Co., Ltd.
No. 2, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Product:
PV Module

Type: refer to the preceding certificate pages

Manufacturing Plant:
DelSolar Co., Ltd.
No. 25, R&D 2nd Road
Science-Based Industrial Park
Hsinchu, 30076, Taiwan, R. O. C.

Basis:

☒ **IEC 61215:2005**
EN 61215:2005
"Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval"

☒ **Factory Inspection**
To document the consistent quality of the product factory inspections are performed periodically.

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TÜVRheinland®
ID:0000023449

- **Periodic inspection**
- **Qualified, IEC 61215**
- **Safety tested, IEC 61730**

Remarks:
- Address of Manufacturing Plant DelSolar Co., Ltd. changed to see above.
-The details of the factory inspection are documented in report no. 11022428.

Conditions:
The product test is voluntarily according to technical regulations. Any change of the design, materials, components or processing may require the repetition of some of the qualification tests in order to retain type approval.
The certificate is valid for 5 years from the date of issue stated on page 1.

TÜV Rheinland Japan Ltd. Certification Body TÜVRheinland®

Certification body

Yokohama, 07 October 2010

Dipl.-Ing. W. Herlitschke

TÜV Rheinland Japan Ltd. – Yokohama 222-0033, Japan

3.5.2 BESS Inverter

Deleco

Micro Inverter 260W

Features

- Impressive MPPT algorithm for each PV panel (for 60 Cell PV)
- No hazardous DC voltage (vs. string inverter)
- Parallel connection allows AC line voltage output
- Ease of installation
- Smart Data Collector for remote monitoring and control of the Micro-Inverters
- High efficiency up to 96% for better energy harvesting
- Built-in mechanical switch (Relay) for safety disconnect

Please check our monitoring web site!

Apple iOS

Deleco Micro Inverter

Deleco

Micro Inverter Spec

DC Input	
Input Power	275W
Peak Power Tracking Voltage	25V to 50V
Operation Voltage	25V to 59V
Maximum DC Short CKT. Current	12A
Maximum Input Current	10A
Efficiency	
Peak Inverter Efficiency	96 %
CEC Weighted Efficiency	95.3 %
Nominal MPP Tracking	99.6 %
Mechanical Data	
Dimensions (L x W x H) / Weight	227 x 211 x 33.2mm^3/1.1kg
Cooling	Convection
Enclosure Environmental Rating	IP66
Connector	MC4 compatible or Tyco SOLAROK Photovoltaic
AC Input	
Night Time Power Consumption	<0.03W

AC Output	
Maximum Output Power	260W
Rated Output Current	0.88 A
Rated AC Voltage / Range	240V
Rated Frequency / Range	60Hz / 50Hz
Power Factor	>0.99
Maximum Units per Branch	12
Safety & Standard	
Compliance	UL1741 / IEEE1547 / AS4777 / G83
Communication	
Wire / Wireless	PLC / ZigBee
Environment	
Ambient Temp. Range	-40°C to +65°C
Noise Emission	Under 30 dB @ 1m
Relative Humidity	0%~95%

Data Collector Spec

Product features	
Display:	Two rows high quality OLED display with 20 characters & power saving mode
Communication:	To Micro Inverter: supports narrow band PLC technology / ZigBee
	To AP router: support wire (Ethernet/RJ-58) and wireless (WIFI) connection
Large Memory:	Built-in SD card for at least 2 month data collection
Easy Configuration:	Built-in DHCP client service / embedded web page inside for grid code setting

Deleco Micro Inverter

National Chiao Tung University

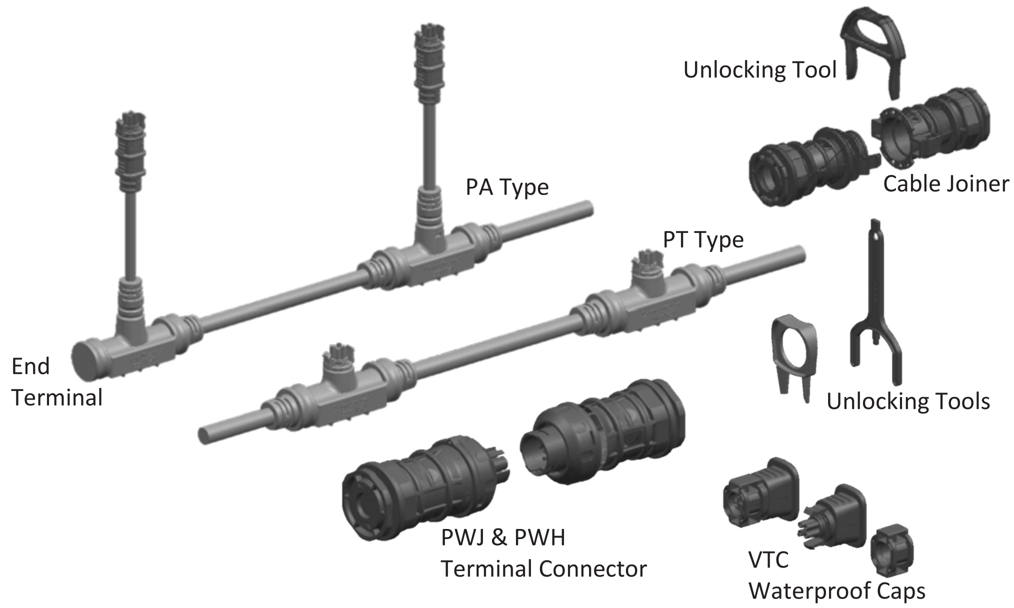
Solar Decathlon Europe

ORCHID HOUSE

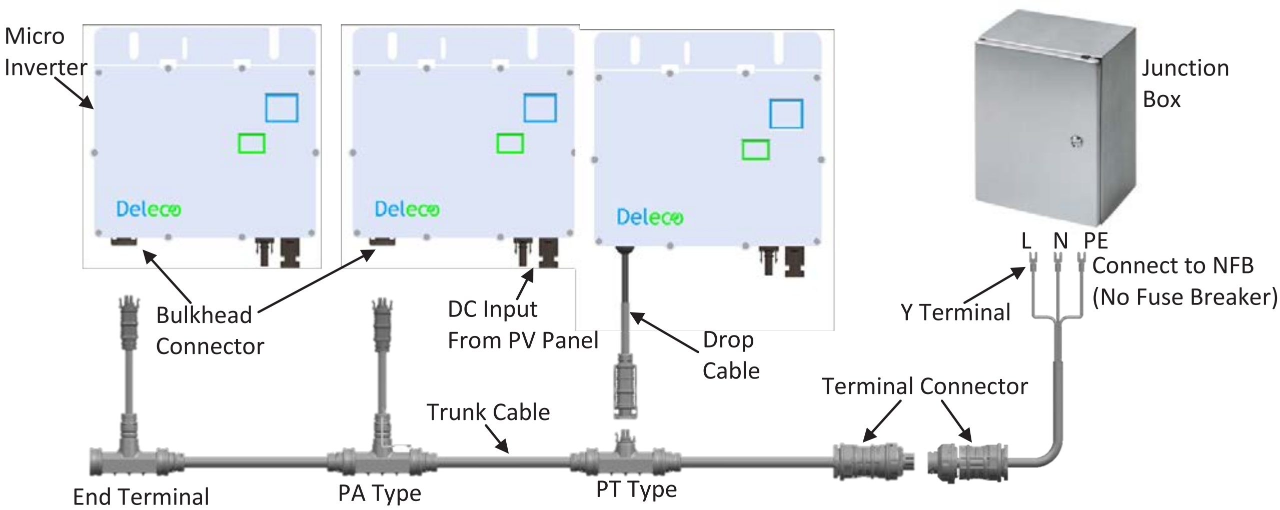
Deleco

Accessories

Part Name	Description	Length
PA / PT Series	Trunk Cable Configuration	Cable Pitch: 1m, 2m, Customized
Cable Joiner	Cable Interconnection	None
PWJ & PWH	Terminal Connector / Extension	None
VTC Series	Waterproof Caps	None



Connection



* Delta reserves the right for specification change

Contact Delta

www.deltaww.com
www.solar-inverters.com

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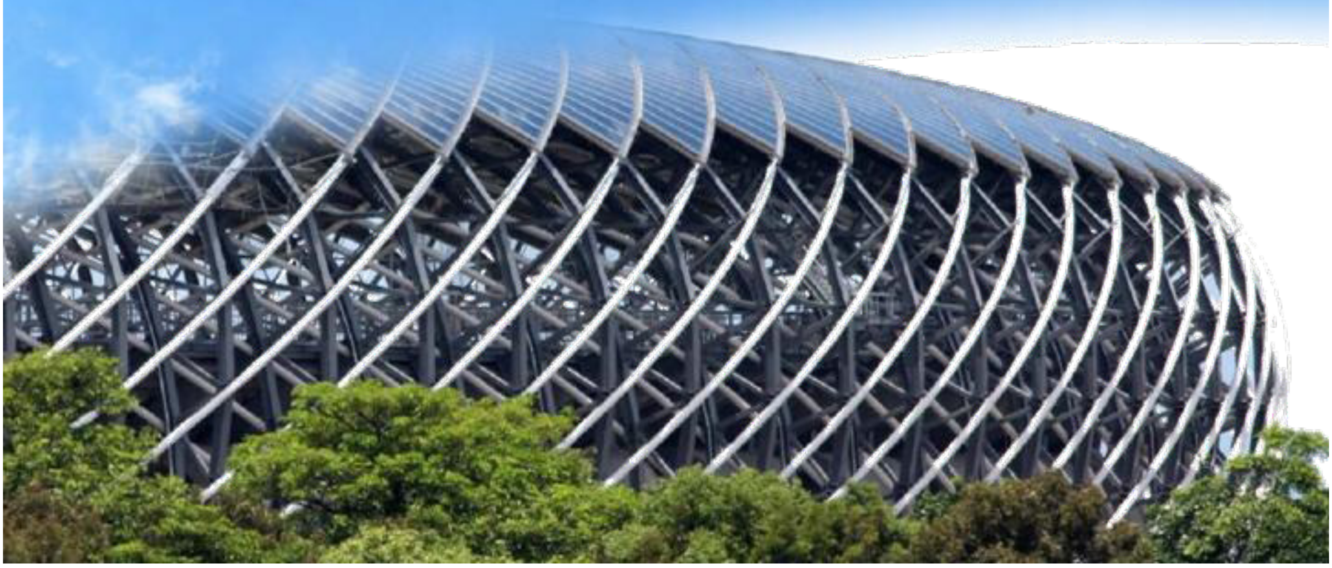

TÜVRheinland®

Konformitätsbescheinigung

Firmenname	: Delta Electronics, Inc.
Produkte getested	: PV MICRO-INVERTER
Firmwareversion	: Master CPU: V00.01.02.06, Slave CPU: S0.01
Bemessungsdaten und Kenngroessen	: DC Rated input voltage(MPPT): 25-50Vdc, DC Max. Input current/Tracker: 10A DC Max. input voltage: 59Vdc, DC Max. PV Isc/Tracker: 15A. AC Rated output: 230V, 50Hz, 1.2A, 260W, PF > 0.95. Ingress protection: IP66.
Identifizierung	: DDP-260AB-1 XX (X=any alphanumeric or blank)
Handelsname	: DELTA ELECTRONICS, INC.
Relevante Standard(s) / Specifikationen	: VDE-AR-N 4105:2011 VDE V 0124-100:2012
Projeht Nummer	: 114008885
Dateinummer Testreport	: 10041700 001 : Siehe Anhang (Total 5 pages)
Konformitätsbescheinigung ausstellende Behoerde Name & Address	: TÜV Rheinland Taiwan Ltd. 11F., No.758, Sec. 4, Bade Rd., Songshan Dist., Taipei City 105, Taiwan.

The above PV generation unit and designated NA-protection has been tested according to the test guideline VDE 0124-100 and VDE-AR-N 4105 certified

Diese Test und Konformitätsbescheinigung basiert auf der Auswertung einer Stichprobe von den oben genannten Artikeln.
Es wird überprüft, ob die untersuchten Proben im Einklang mit allen wesentlichen Anforderungen der revelant Norm(en) übereinstimmen. Darüber hinaus wird keine Einschätzung der Serienreife des Produkts überprüft.
Eine Verwendung des TÜV Rheinland-Prüfzeichen ist nicht erlaubt.
Die Test und Konformitätsbescheinigung dient nur der ausschließlichen Verwendung von TÜV Rheinland Kunden. Sie wird gemäß der Vereinbarung zwischen TÜV Rheinland und dem Kunden zur Verfügung gestellt.
Verantwortung und Haftung sind auf die Konditionen der allgemeinen Geschäftsbedingungen begrenzt. TÜV Rheinland übernimmt keine Haftung gegenüber Dritten, die nicht an den Vereinbarungen beteiligt sind. Desweiteren besteht keinerlei Verantwortung für Verlust, Kosten oder Schäden, die durch die Nutzung dieser Test und Konformitätsbescheinigung entstehen könnten. Nur der Kunde ist berechtigt, diese Bescheinigung zu kopieren oder zu verbreiten. Jegliche Nutzung des TÜV Rheinland-Namen oder einer seiner Marke für den Verkauf oder die Werbung des geprüften Objektes, Produkte oder Dienstleistungen müssen erst schriftlich durch den TÜV Rheinland genehmigt werden.

Date: 19.07.2013

Best C.C. Chen
Senior Manager
Power Supply Product Line

TÜV Rheinland Taiwan Ltd.
Tel.: (+886)2-2172-7000 http://www.tuv.com/safety
Fax.: (+886)2-2528-0018

Anhang

TÜVRheinland®

Projeht Nummer: 10041700

Firmenname	: **Delta Electronics, Inc.**
Produkte getested	: **PV MICRO-INVERTER**
Identifizierung	: **DDP-260AB-1 XX**

Active Power	
Model name	**DDP-260AB-1 XX**
P_{Emax}	**260W**
S_{Emax}	**276VA**

A.1 Requirements to the Test Report on Generation Units (DIN V VDE V 0124-100)
F.3 Requirements for the test report for power generation units (VDE-AR-N 4105)

Extract from the test report for unit certificate		No. 2011-nnnn (serial number):	**Engineering sample**
Type of system:	**PV MICRO-INVERTER**	Manufacturer's data	
System manufacturer:	**N/A**	Type of system: (CHP, PV-WT,...)	**N/A**
		Effective efficiency of normal output in nominal conditions):	**260W**
		Rating voltage:	**230 V**

Measuring period: **From 2013-04-08 to 2013-05-28**

Active power P_{Emax}

Reactive power reference

Acrive power P/P_n[%]	10	20	30	40	50	60	70	80	90	100
Maximum possible $\cos\varphi$ under-excited	–	**0.900**	**0.902**	**0.897**	**0.897**	**0.900**	**0.906**	**0.902**	**0.898**	**0.898**
Maximum possible $\cos\varphi$ over-excited	–	**0.900**	**0.901**	**0.900**	**0.899**	**0.902**	**0.905**	**0.907**	**0.910**	**0.904**

Compliance of required displacement factory $\cos\varphi$

Default in system control	0.900 over	0.920 over	0.940 over	0.960 over	0.980 over	1.000	0.980 under	0.960 under	0.940 under	0.920 under	0.900 under
Measured value at PGU terminals	**0.904**	**0.922**	**0.947**	**0.962**	**0.983**	**0.998**	**0.983**	**0.961**	**0.944**	**0.922**	**0.901**

Reactive power transifer function – standard $\cos\varphi$-(P) - characteristic

Active power P/P_n[%]	10	20	30	40	50	60	70	80	90	100
$\cos\varphi$	–	**0.995**	**0.997**	**0.997**	**0.998**	**0.983**	**0.961**	**0.941**	**0.927**	**0.902**

Conform to standard -$\cos\varphi$-(P) – characteristic.

Switching actions

Marking operation without default (of primary energy carrier)	k_i	**0.683**
Worst case at switch over of generator sections	k_i	**0.966**
Marking operation at reference conditions (of the primary energy carrier)	k_i	**0.700**
Breaking operation at normal power	k_i	**0.950**
Worst-case value of all switching operations	k_{imax}	**0.966**

Flicker					
	Angle of network impedance Ψ_k:	30°	50°	70°	85°
	Coefficient of system flicker $c\Psi$:	**8.7**	--	--	--

Geprüft und genehmigt (Reviewed and approved)

JUL 19. 2013

TÜV Rheinland Group

Harmonic											
Active power P/P_n[%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2	--	0.1676	0.0605	0.1063	0.1020	0.0747	0.0242	0.0539	0.0362	0.0356	0.0350
3	--	0.9959	1.4398	0.3958	0.0666	0.1512	0.2483	0.2661	0.3212	0.3142	0.7288
4	--	0.0298	0.0265	0.0404	0.0628	0.0898	0.1234	0.0184	0.0214	0.0312	0.0562
5	--	0.1866	0.8032	0.2535	0.0978	0.0416	0.1025	0.1223	0.2071	0.1261	0.1216
6	--	0.1320	0.0336	0.0418	0.1442	0.1320	0.0878	0.1023	0.0664	0.0842	0.0949
7	--	0.1098	0.6310	0.6950	0.3714	0.4875	0.6013	0.6308	0.6689	0.6473	0.6502
8	--	0.3146	0.0301	0.1101	0.0205	0.0470	0.0963	0.0330	0.0198	0.0176	0.0397
9	--	0.2216	0.5548	0.6620	0.2252	0.2999	0.3823	0.5119	0.5590	0.5171	0.5751
10	--	0.3711	0.0447	0.1409	0.0149	0.0889	0.0774	0.1063	0.0757	0.0695	0.0823
11	--	0.2324	0.4960	0.4464	0.0188	0.1408	0.2703	0.3483	0.3920	0.4130	0.4639
12	--	0.4919	0.0483	0.0514	0.0502	0.0444	0.0439	0.0212	0.0311	0.0290	0.0265
13	--	0.1489	0.4789	0.2659	0.0457	0.0773	0.1610	0.2879	0.3346	0.3248	0.3689
14	--	0.3564	0.0421	0.1439	0.1472	0.0492	0.0686	0.0886	0.0705	0.0711	0.0576
15	--	0.0953	0.4477	0.3474	0.1658	0.0822	0.0891	0.1724	0.2235	0.2220	0.2755
16	--	0.3449	0.0496	0.1468	0.1054	0.1040	0.0460	0.0361	0.0241	0.0321	0.0961
17	--	0.0327	0.4014	0.4226	0.2208	0.0841	0.0241	0.1745	0.2141	0.1799	0.2406
18	--	0.1119	0.0244	0.1922	0.2328	0.1051	0.0509	0.0393	0.0222	0.0206	0.0239
19	--	0.0708	0.3422	0.4861	0.1773	0.1478	0.0418	0.1018	0.1547	0.1662	0.2215
20	--	0.0457	0.0416	0.1482	0.2271	0.1096	0.0635	0.0404	0.0487	0.0543	0.0831
21	--	0.0709	0.3469	0.4491	0.1912	0.1038	0.0290	0.1323	0.1584	0.1526	0.2468
22	--	0.0866	0.0408	0.2154	0.2228	0.2014	0.0473	0.0559	0.0475	0.0383	0.0308
23	--	0.1388	0.3694	0.3309	0.2090	0.1596	0.1454	0.0427	0.0904	0.0804	0.1903
24	--	0.1916	0.0506	0.1721	0.3292	0.1613	0.0467	0.0581	0.0213	0.0374	0.0380
25	--	0.1684	0.3711	0.2072	0.1665	0.1950	0.1371	0.0345	0.0468	0.0347	0.1309
26	--	0.1313	0.0421	0.1651	0.2905	0.2100	0.1284	0.0681	0.0315	0.0197	0.0524
27	--	0.1578	0.3751	0.2504	0.2427	0.2102	0.1897	0.0348	0.0254	0.0274	0.0859
28	--	0.0919	0.0284	0.1203	0.2426	0.2505	0.0879	0.0717	0.0602	0.0553	0.0305
29	--	0.1437	0.3439	0.3002	0.1463	0.1990	0.1771	0.0851	0.0244	0.0247	0.0756
30	--	0.1337	0.0666	0.0668	0.2824	0.2088	0.1555	0.0440	0.0170	0.0250	0.0505
31	--	0.0855	0.3240	0.3474	0.1035	0.1833	0.1700	0.0902	0.0463	0.0401	0.0691
32	--	0.0430	0.0270	0.1327	0.2817	0.2445	0.2036	0.0717	0.0518	0.0382	0.0504
33	--	0.0428	0.3276	0.3355	0.0895	0.1653	0.1947	0.1073	0.0556	0.0938	0.0443
34	--	0.0264	0.0360	0.0826	0.1735	0.2770	0.1743	0.0972	0.0680	0.0827	0.0300
35	--	0.0939	0.3335	0.2942	0.1145	0.1696	0.1858	0.1522	0.1118	0.1242	0.0490
36	--	0.1045	0.0439	0.0383	0.1279	0.2137	0.2684	0.0833	0.0345	0.0271	0.0415
37	--	0.1069	0.3448	0.2586	0.0576	0.1354	0.1430	0.1129	0.1116	0.1196	0.0227
38	--	0.0655	0.0249	0.0469	0.1601	0.2178	0.2544	0.1103	0.0602	0.0557	0.0427
39	--	0.1474	0.3459	0.2950	0.0344	0.0750	0.1052	0.0915	0.0748	0.0817	0.0224
40	--	0.0503	0.0354	0.0457	0.1398	0.2418	0.1987	0.1556	0.1226	0.0976	0.0352
The harmonics are maximum values from all phases											

Subharmonic											
Active power P/Pn[%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [Hz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
75	--	2.1279	0.7473	0.7236	0.5200	0.5232	0.6377	0.4882	0.5024	0.4675	0.5199
125	--	0.6296	0.2806	0.2423	0.1726	0.1724	0.1776	0.1592	0.1413	0.1390	0.1503
175	--	0.5303	0.2471	0.1949	0.1367	0.1310	0.1470	0.1149	0.1033	0.1032	0.0979
225	--	0.5144	0.2398	0.1981	0.1264	0.1128	0.1262	0.0992	0.0862	0.0842	0.0796
275	--	0.4922	0.2219	0.1841	0.1183	0.1070	0.0966	0.0836	0.0805	0.0722	0.0689
325	--	0.4791	0.2232	0.1752	0.1197	0.1050	0.1117	0.0880	0.0773	0.0747	0.0731
375	--	0.4950	0.2214	0.1762	0.1211	0.1041	0.0845	0.0738	0.0743	0.0635	0.0606
425	--	0.4946	0.2290	0.1605	0.1201	0.1033	0.0943	0.0800	0.0766	0.0678	0.0668
475	--	0.4978	0.2330	0.1613	0.1205	0.1027	0.0920	0.0775	0.0723	0.0650	0.0644
525	--	0.5664	0.2482	0.1908	0.1369	0.1168	0.1088	0.0914	0.0831	0.0710	0.0749

575	--	0.5662	0.2521	0.2052	0.1436	0.1214	0.1069	0.0905	0.0831	0.0808	0.0765
625	--	0.5683	0.2668	0.2002	0.1473	0.1241	0.1116	0.0963	0.0874	0.0798	0.0775
675	--	0.6309	0.3025	0.2183	0.1678	0.1401	0.1193	0.1055	0.0971	0.0897	0.0805
725	--	1.0953	0.5712	0.3818	0.2971	0.2404	0.2016	0.1707	0.1484	0.1297	0.1162
775	--	0.5507	0.2830	0.1964	0.1528	0.1251	0.1055	0.0917	0.0835	0.0774	0.0697
825	--	0.5228	0.2532	0.1822	0.1389	0.1190	0.1045	0.0876	0.0825	0.0779	0.0729
875	--	0.5166	0.2498	0.1721	0.1350	0.1134	0.0998	0.0865	0.0792	0.0726	0.0677
925	--	0.8778	0.5527	0.3806	0.2826	0.2238	0.1873	0.1555	0.1340	0.1147	0.0966
975	--	0.5317	0.2576	0.1762	0.1371	0.1200	0.1053	0.0910	0.0821	0.0756	0.0701
1025	--	0.9762	0.5579	0.3865	0.2972	0.2356	0.1930	0.1623	0.1366	0.1184	0.0956
1075	--	0.5513	0.2629	0.1785	0.1380	0.1183	0.1015	0.0897	0.0823	0.0769	0.0709
1125	--	0.6171	0.2917	0.2095	0.1611	0.1400	0.1230	0.1070	0.0996	0.0930	0.0890
1175	--	0.6131	0.2936	0.2065	0.1596	0.1376	0.1259	0.1101	0.1018	0.0945	0.0901
1225	--	0.8228	0.4775	0.3447	0.2695	0.2214	0.1919	0.1666	0.1452	0.1318	0.1170
1275	--	0.6141	0.2980	0.2131	0.1640	0.1417	0.1275	0.1121	0.1016	0.0964	0.0923
1325	--	0.8661	0.5134	0.3456	0.2551	0.2043	0.1716	0.1469	0.1279	0.1138	0.0965
1375	--	0.5453	0.2609	0.1763	0.1380	0.1145	0.1001	0.0878	0.0799	0.0749	0.0699
1425	--	0.5404	0.2560	0.1816	0.1356	0.1158	0.1030	0.0892	0.0829	0.0772	0.0736
1475	--	0.5323	0.2535	0.1786	0.1333	0.1119	0.1002	0.0859	0.0807	0.0732	0.0694
1525	--	0.5572	0.2569	0.1727	0.1330	0.1122	0.0989	0.0861	0.0806	0.0732	0.0697
1575	--	0.5307	0.2488	0.1738	0.1308	0.1075	0.0975	0.0826	0.0761	0.0697	0.0660
1625	--	0.5254	0.2510	0.1659	0.1264	0.1043	0.0896	0.0792	0.0709	0.0662	0.0619
1675	--	0.5162	0.2455	0.1633	0.1248	0.1037	0.0890	0.0778	0.0703	0.0655	0.0608
1725	--	0.5498	0.2603	0.1763	0.1373	0.1135	0.0995	0.0882	0.0804	0.0751	0.0712
1775	--	0.5313	0.2533	0.1693	0.1325	0.1093	0.0966	0.0843	0.0768	0.0711	0.0680
1825	--	0.5572	0.2656	0.1759	0.1355	0.1120	0.0981	0.0864	0.0787	0.0725	0.0683
1875	--	0.5424	0.2556	0.1699	0.1315	0.1091	0.0957	0.0823	0.0750	0.0697	0.0654
1925	--	0.4917	0.2307	0.1516	0.1150	0.0942	0.0800	0.0694	0.0619	0.0573	0.0529
1975	--	0.4784	0.2252	0.1487	0.1123	0.0917	0.0782	0.0676	0.0604	0.0547	0.0507
The harmonics are maximum values from all phases											

Higher frequencies											
Active power P/Pn[%]	0	10	20	30	40	50	60	70	80	90	100
Frequency [kHz]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]	I[%]
2.1	--	1.2039	0.6147	0.3722	0.2419	0.1996	0.1757	0.1617	0.1547	0.1458	0.1397
2.3	--	0.9727	0.4135	0.2494	0.1858	0.1557	0.1282	0.1125	0.1075	0.1017	0.0951
2.5	--	0.8075	0.3641	0.2418	0.1762	0.1449	0.1214	0.1067	0.0985	0.0923	0.0870
2.7	--	0.6944	0.3346	0.2262	0.1641	0.1260	0.1087	0.1047	0.0901	0.0842	0.0765
2.9	--	1.0131	0.4854	0.3444	0.2505	0.1843	0.1445	0.1241	0.1045	0.0921	0.0826
3.1	--	1.1334	0.5378	0.3217	0.2171	0.1845	0.1595	0.1284	0.1108	0.0910	0.0767
3.3	--	1.1319	0.5744	0.3788	0.2633	0.2146	0.1676	0.1366	0.1137	0.0917	0.0689
3.5	--	1.0422	0.4690	0.2440	0.1837	0.1556	0.1204	0.1017	0.0873	0.0756	0.0628
3.7	--	0.9976	0.4949	0.3296	0.2286	0.1615	0.1308	0.1015	0.0832	0.0689	0.0604
3.9	--	0.8414	0.3723	0.2187	0.1721	0.1379	0.1024	0.0837	0.0693	0.0597	0.0523
4.1	--	0.6685	0.3051	0.1975	0.1536	0.1191	0.0954	0.0826	0.0704	0.0626	0.0547
4.3	--	0.6365	0.3000	0.1813	0.1465	0.1175	0.0897	0.0800	0.0668	0.0593	0.0527
4.5	--	0.6616	0.3143	0.1754	0.1396	0.1114	0.0881	0.0735	0.0617	0.0555	0.0462
4.7	--	0.6187	0.2923	0.1818	0.1364	0.1090	0.0865	0.0724	0.0628	0.0574	0.0524
4.9	--	0.5625	0.2721	0.1693	0.1227	0.0989	0.0832	0.0723	0.0645	0.0562	0.0493
5.1	--	0.4688	0.2315	0.1318	0.1011	0.0811	0.0645	0.0556	0.0480	0.0420	0.0371
5.3	--	0.4231	0.1940	0.1292	0.0979	0.0753	0.0627	0.0518	0.0456	0.0407	0.0366
5.5	--	0.4177	0.2075	0.1252	0.0945	0.0756	0.0624	0.0519	0.0450	0.0398	0.0362
5.7	--	0.3825	0.1890	0.1168	0.0861	0.0677	0.0557	0.0469	0.0408	0.0358	0.0320
5.9	--	0.3698	0.1776	0.1169	0.0877	0.0683	0.0561	0.0463	0.0397	0.0356	0.0319
6.1	--	0.3513	0.1762	0.1139	0.0847	0.0663	0.0544	0.0458	0.0396	0.0348	0.0313
6.3	--	0.3579	0.1820	0.1084	0.0814	0.0658	0.0552	0.0461	0.0391	0.0342	0.0304
6.5	--	0.4889	0.2648	0.1813	0.1410	0.1139	0.0958	0.0828	0.0717	0.0637	0.0581

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6.7	--	0.4258	0.1983	0.1357	0.1013	0.0808	0.0668	0.0572	0.0502	0.0440	0.0385
6.9	--	0.3459	0.1768	0.1131	0.0843	0.0666	0.0547	0.0466	0.0393	0.0333	0.0301
7.1	--	0.3192	0.1513	0.1004	0.0745	0.0594	0.0496	0.0418	0.0363	0.0321	0.0287
7.3	--	0.3850	0.1818	0.1249	0.0914	0.0721	0.0588	0.0502	0.0433	0.0385	0.0351
7.5	--	0.4075	0.1948	0.1267	0.0948	0.0750	0.0609	0.0501	0.0425	0.0365	0.0308
7.7	--	0.3308	0.1646	0.1111	0.0830	0.0659	0.0527	0.0443	0.0381	0.0330	0.0284
7.9	--	0.3299	0.1637	0.1088	0.0818	0.0661	0.0544	0.0465	0.0408	0.0356	0.0329
8.1	--	0.3087	0.1485	0.0980	0.0737	0.0592	0.0498	0.0429	0.0385	0.0359	0.0331
8.3	--	0.2960	0.1451	0.0944	0.0731	0.0581	0.0481	0.0412	0.0359	0.0309	0.0270
8.5	--	0.3796	0.1921	0.1258	0.0913	0.0717	0.0580	0.0492	0.0412	0.0347	0.0290
8.7	--	0.4041	0.1834	0.1192	0.0888	0.0698	0.0571	0.0480	0.0397	0.0332	0.0275
8.9	--	0.5439	0.2748	0.1785	0.1310	0.1023	0.0824	0.0694	0.0592	0.0496	0.0400
The harmonics are maximum values from all phases											

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A.2 Requirements to the Test Report on the NS Protection (DIN V VDE V 0124-100)
F.4 Requirements for the test report for the NS protection (VDE-AR-N 4105)

Extract from the test report for the NS protection "Determination of electric properties" — No. YYYY-nnnn (consecutive number) **Engineering sample**

☐ **NS Protection as central NS Protection**

Type of NS protection:	Other manufacturer's data
Software version:	
Manufacturer:	

Measuring period: From YYYY-MM-DD to YYYY-MM-DD

Protective function	Setting value	Tripping value	Tripping time NS protection[a]
Voltage drop protection $U<$	0.8 * U_n	* U_n	ms
Rise-in-voltage protection $U>$	1.1 * U_n	* U_n	ms
Rise-in-voltage protection $U>>$	1.15 * U_n	* U_n	ms
Frequency decrease protection $f<$	47.5Hz	Hz	ms
Frequency increase protection $f>$	51.5Hz	Hz	ms

[a] The tripping time comprises the period before limit value $U|f$ until tripping signal to interface switch.

During planning of power generation system the proper time of interface switch shall be added to the highest value of time determined above. The break time (sum of tripping time NS protection plus proper time of interface switch) shall not exceed 200 ms.

■ **NS protection as integrated NS protection**

Type of NS protection:	**Integrated NS protection**	Other manufacturer's data
Software version:	**Master CPU: V00.01.02.06** **Slave CPU: S0.01**	
Manufacturer:	**Delta Electronics, Ltd.**	Assigned to generator unit DDP-260AB-1 XX Integrated coupling switches and reinforced insulation provided Type of switching arrangement Mfr. Xiamen Hongfa, type HF140FF, 250Vac, 10A

Measuring period: From 2013-04-08 to 2013-05-28

Protective function	Setting value	Tripping value	Tripping time NS protection[a]
Voltage drop protection $U<$	0.8 * U_n	0.8* U_n	**126.5ms**
Rise-in-voltage protection $U>$	1.1 * U_n	--* $U_{n\ a)}$	**310s**
Rise-in-voltage protection $U>>$	1.15 * U_n	1.15 * U_n	**74.5ms**
Frequency decrease protection $f<$	47.5Hz	47.45Hz	**47.43ms**
Frequency increase protection $f>$	51.5Hz	51.65Hz	**25.25ms**
Proper time of interface switch:			**15 ms**

a) Longest tripping time of voltage Increase Protection as Gliding 10 min Average Value.
The break time (sum of tripping time NS protection plus proper time of interface switch) shall not exceed 200 ms.
The verification of the full functional chain "NS protection – Interface switch" has yield to intended disconnection.

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3.5.3 String Inverter

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

5000 Watt solar inverters

Technical data SOLIVIA 5.0 TR

INPUT (DC)	SOLIVIA 5.0 EU G4 TR
Max. recommended PV power	6000 W_P (5320 W_P DE / 5250 W_P BE)
Nominal power	5500 W (4850 W DE / BE)
Voltage range	125 ... 600 V
Full power MPP range	150 ... 480 V
Nominal current	15.7 A @ 350 V
Max. current	36.6 A

OUTPUT (AC)	
Nominal apparent power	5000 VA [1), 2), 3)]
Voltage range	184 ... 264 V [4)]
Nominal current	22 A
Nominal frequency	50 Hz
Frequency range	45 ... 65 Hz [4)]
Power factor adjustable	0.8 cap ... 0.8 ind
Total harmonic distortion (THD)	< 5 % @ nominal apparent power

GENERAL SPECIFICATION	
Model name	SOLIVIA 5.0 EU G4 TR
Part number Delta	EOE46010253
Max. efficiency	96.0 %
Efficiency EU	94.7 %
Operating temperature	-25 ... +60 °C
Full power without derating	-25 ... +55 °C
Storage temperature	-25 ... +80 °C
Humidity	0 ... 95 %
Max. operating altitude	2000 m (above sea level)

MECHANICAL DESIGN	
Size (L x W x D)	512 x 410 x 182 mm
Weight	31 kg
Cooling	Convection
AC connector	Wieland RST25i3S
DC connector	2 pairs of Multi-Contact MC4
Communication interfaces	2 x RJ45 / RS485 + 1 x USB A
DC disconnector	Integrated
Display	3 LEDs, 4-line LCD

SAFETY / STANDARDS	SOLIVIA 5.0 EU G4 TR
Protection degree	IP65
Safety class	I
Configurable trip parameters	Yes
Insulation monitoring	Yes
Overload behavior	Current limitation; power limitation
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 [5)]
EMC	EN61000-6-2; EN61000-6-3; EN61000-3-11; EN61000-3-12
Safety	IEC62109-1 / -2; EC conformity

1) Cos Phi = 1 (VA = W)
2) Continuous nominal active power in the range of Cos Phi = 0.9 cap ... 0.9 ind
3) The AC power can be limited at the inverter during commissioning to meet country-specific regulations regarding the maximum permissible grid load.
4) AC voltage and frequency range will be programmed according to the individual country requirements.
5) Please check our website at www.solar-inverter.com for the latest country grid list.

United Kingdom
Email: sales.uk@solar-inverter.com
Tel: 0800 051 4280 (Free Call)

International
Email: sales.europe@solar-inverter.com
Tel: +49 7641 455 547

www.solar-inverter.com

DELTA

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..

Bureau Veritas
Consumer Products Services
Germany GmbH
Businesspark A96
86842 Türkheim
Germany
+ 49 (0) 40 740 41 – 0
cps-tuerkheim@de.bureauveritas.com

Certification body of BV CPS GmbH
Accredited according to EN 45011 -
ISO / IEC Guide 65

Certificate of compliance

Applicant:	**Delta Energy Systems (Germany) GmbH** Tscheulinstr. 21 79331 Teningen **Germany**
Product:	**Automatic disconnection device between a generator and the public low-voltage grid**
Model:	**SOLIVIA 5.0EUG3 – EOE46010201**

Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with EN 50438:2007 for photovoltaic systems with a single-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverters.

Applied rules and standards:

EN 50438:2007,
Requirements for the connection of micro-generators in parallel with the public low-voltage distribution networks.

The following parameters according to EN 50438:2007 were applied. The inverter SOLIVIA 5.0EUG3 is designed for >16A per phase. However all requirements of the EN 50438:2007 are fulfilled.
Under voltage limit: 195,5V
Upper voltage limit: 264,5V
Under frequency limit: 47,0Hz
Upper frequency limit: 51,0Hz

At the time of issue of this certificate the safety concept of an aforementioned representative product corresponds to the valid safety specifications for the specified use in accordance with regulations.

Report number:	**07TH0223-EN50438**		
Certificate number:	**U12-0835**		
Date of issue:	**2012-09-18**	**Valid until:**	**2015-09-17**

Certification body

Achim Hänchen

DAkkS
Deutsche Akkreditierungsstelle
D-ZE-12024-01-01

STRUCTURAL CALCULATION REPORT

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 desk.

(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)

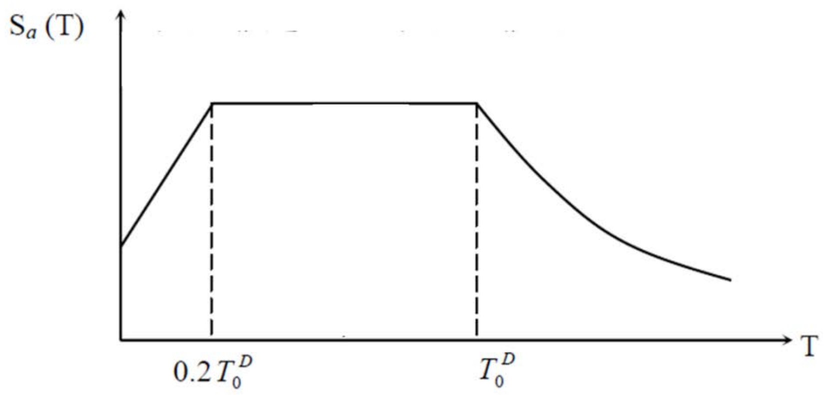
(b) Live Load (LL)

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:



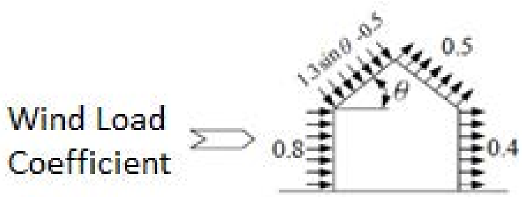
In this report, the structural period for the building located in Hsinchu is 0.358sec and the T_0^D is 0.7sec. Based on the Taiwan Seismic Design Specifications and Commentary of Buildings, the lateral load by earthquake will be

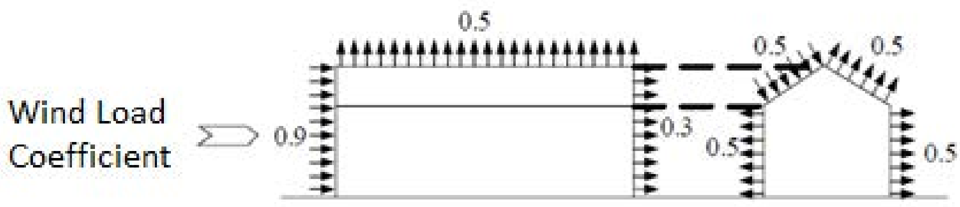
(EL)x = 0.247DL for X-dir

(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)

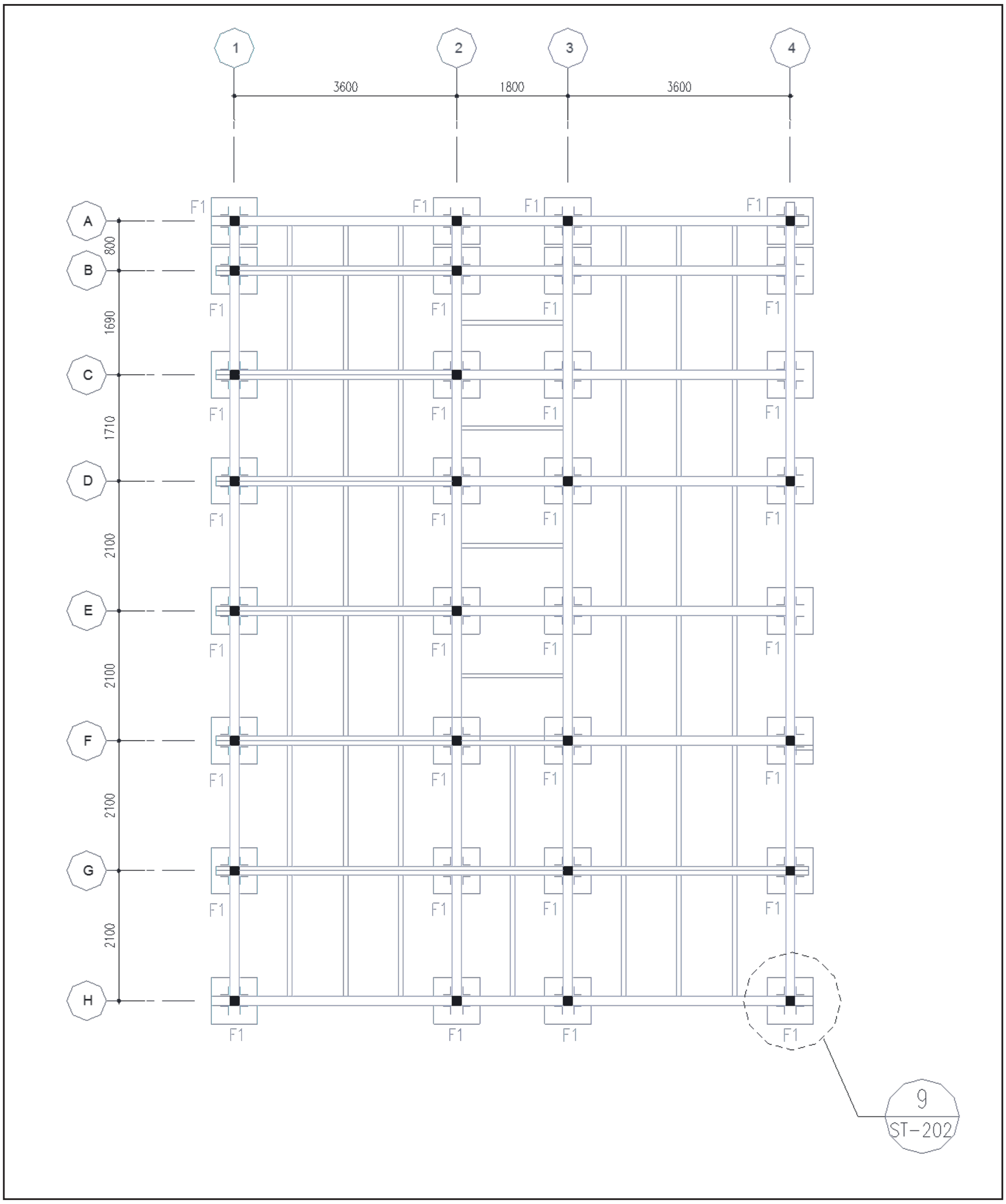
(c) Horizontal Drift of top of the structure: H/200 (for EL)

6. Load Combination

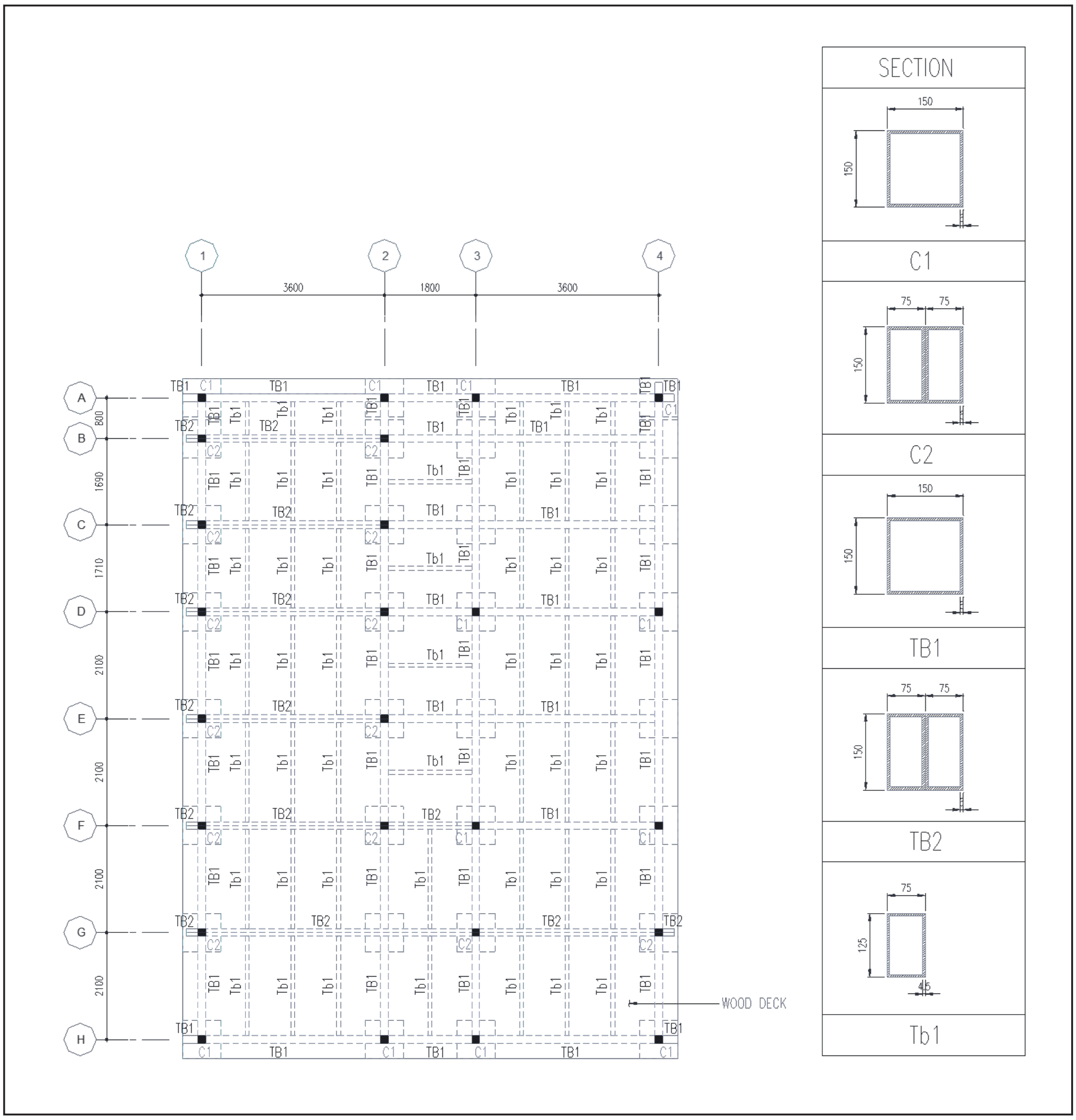
ID	Combination
101	DL+LL
201	DL+0.75(LL+0.8Ex)
202	DL+0.75(LL-0.8Ex)
203	0.7DL+0.8Ex
204	0.7DL-0.8Ex
301	DL+0.75(LL+0.8Ey)
302	DL+0.75(LL-0.8Ey)
303	0.7DL+0.8Ey
304	0.7DL-0.8Ey

7. Structural Layout

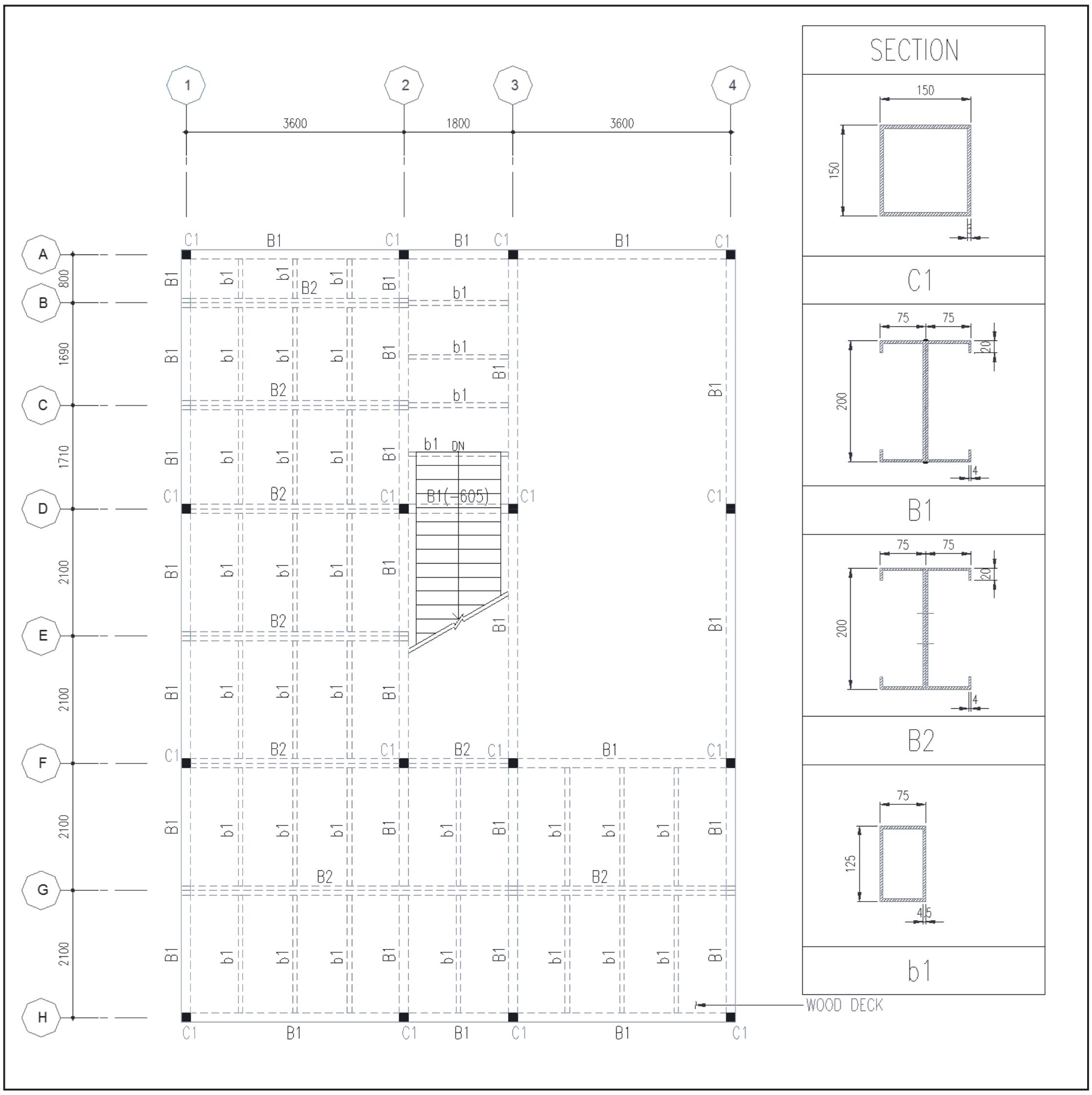
The Structural plan and elevation layout are listed as follows.



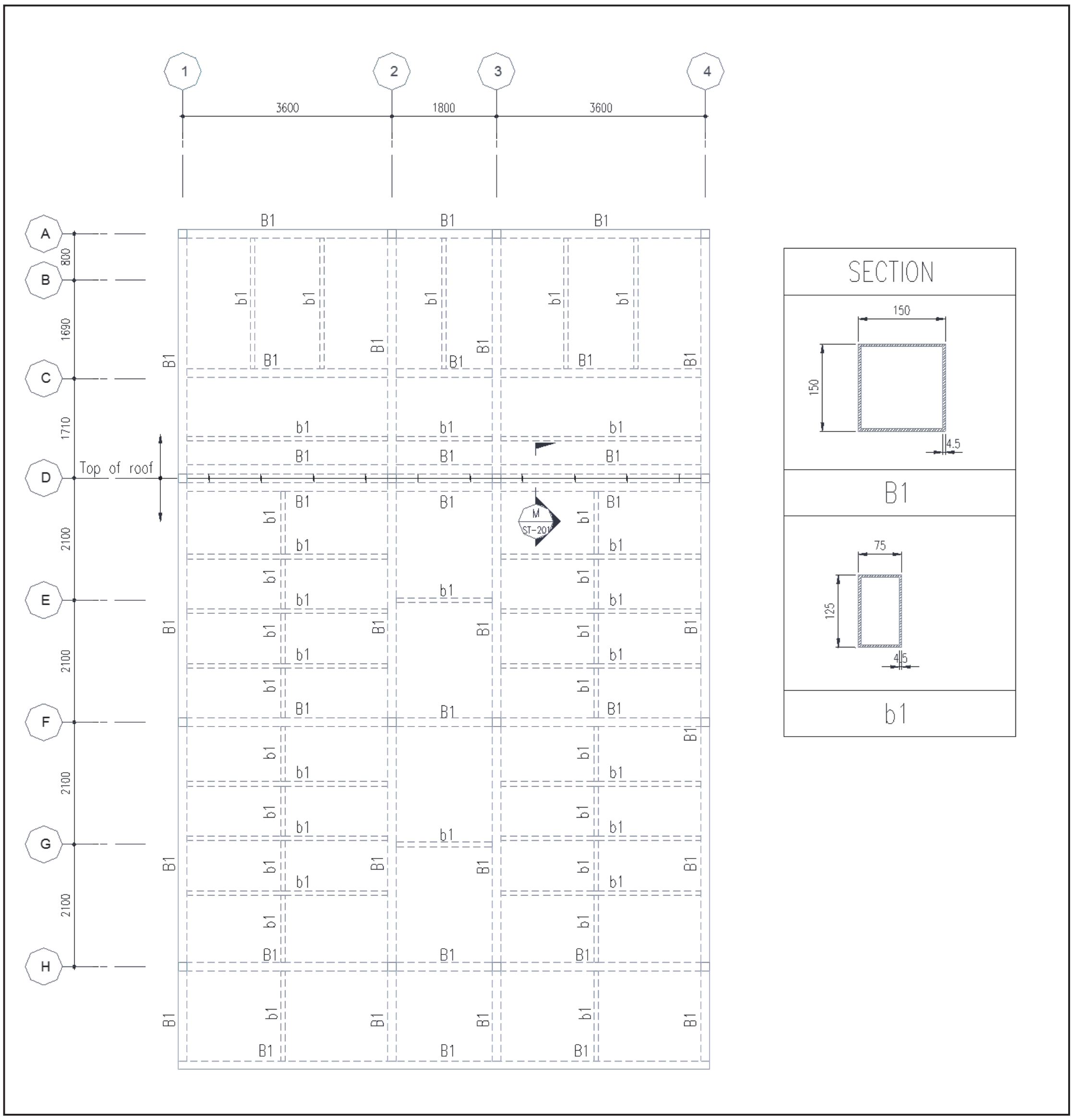
FDN PLAN



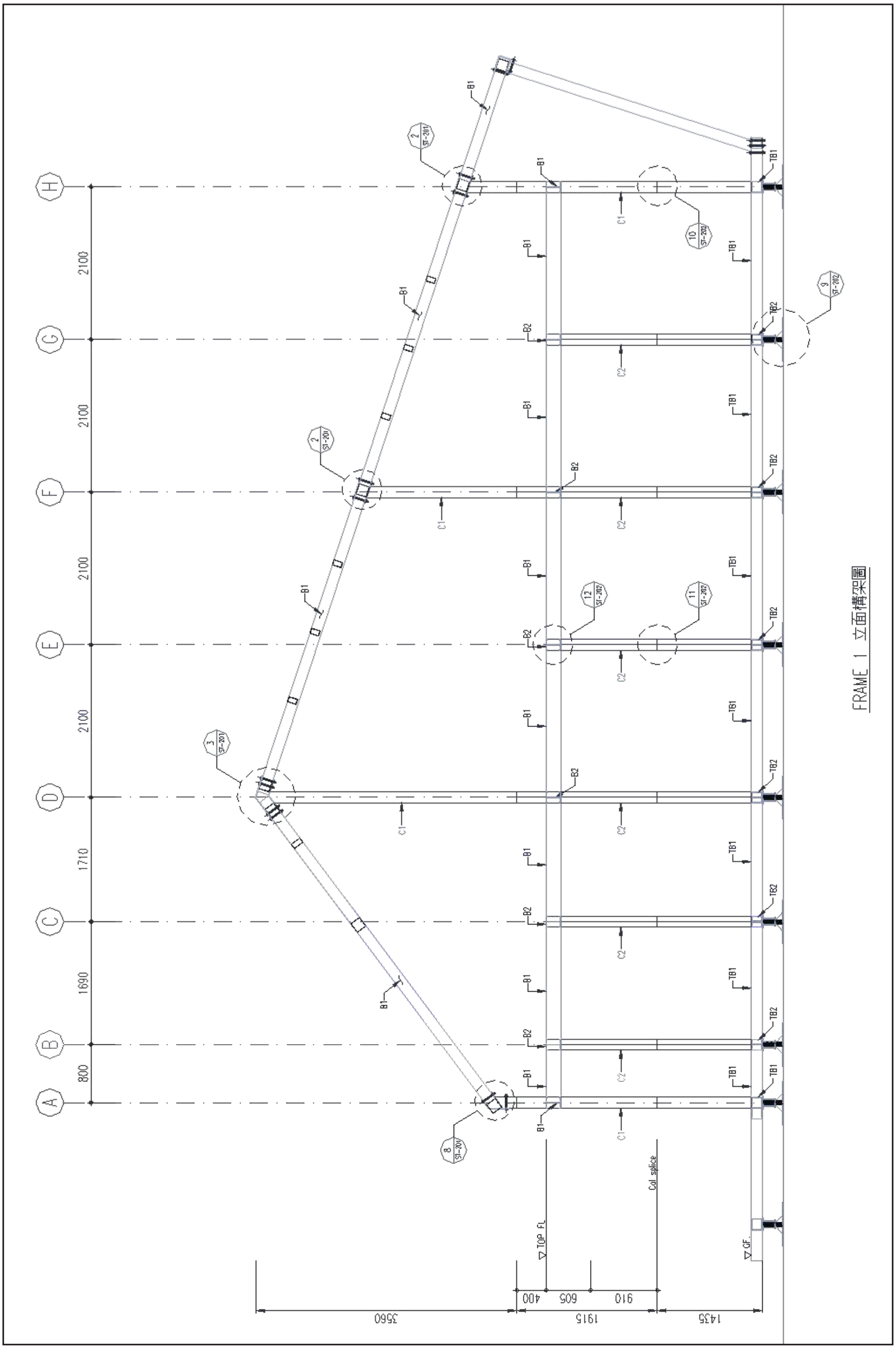
GROUND FLOOR PLAN

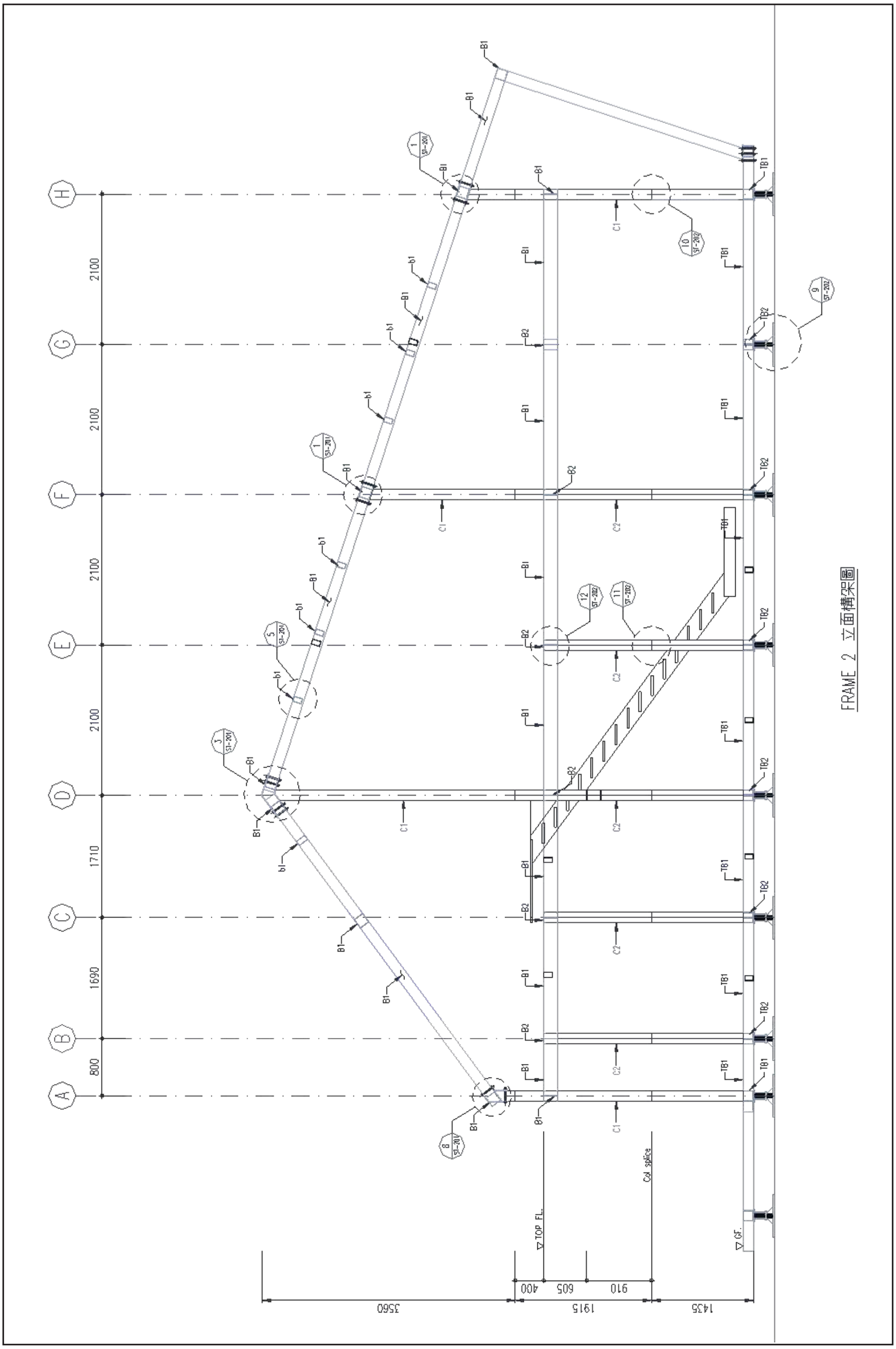


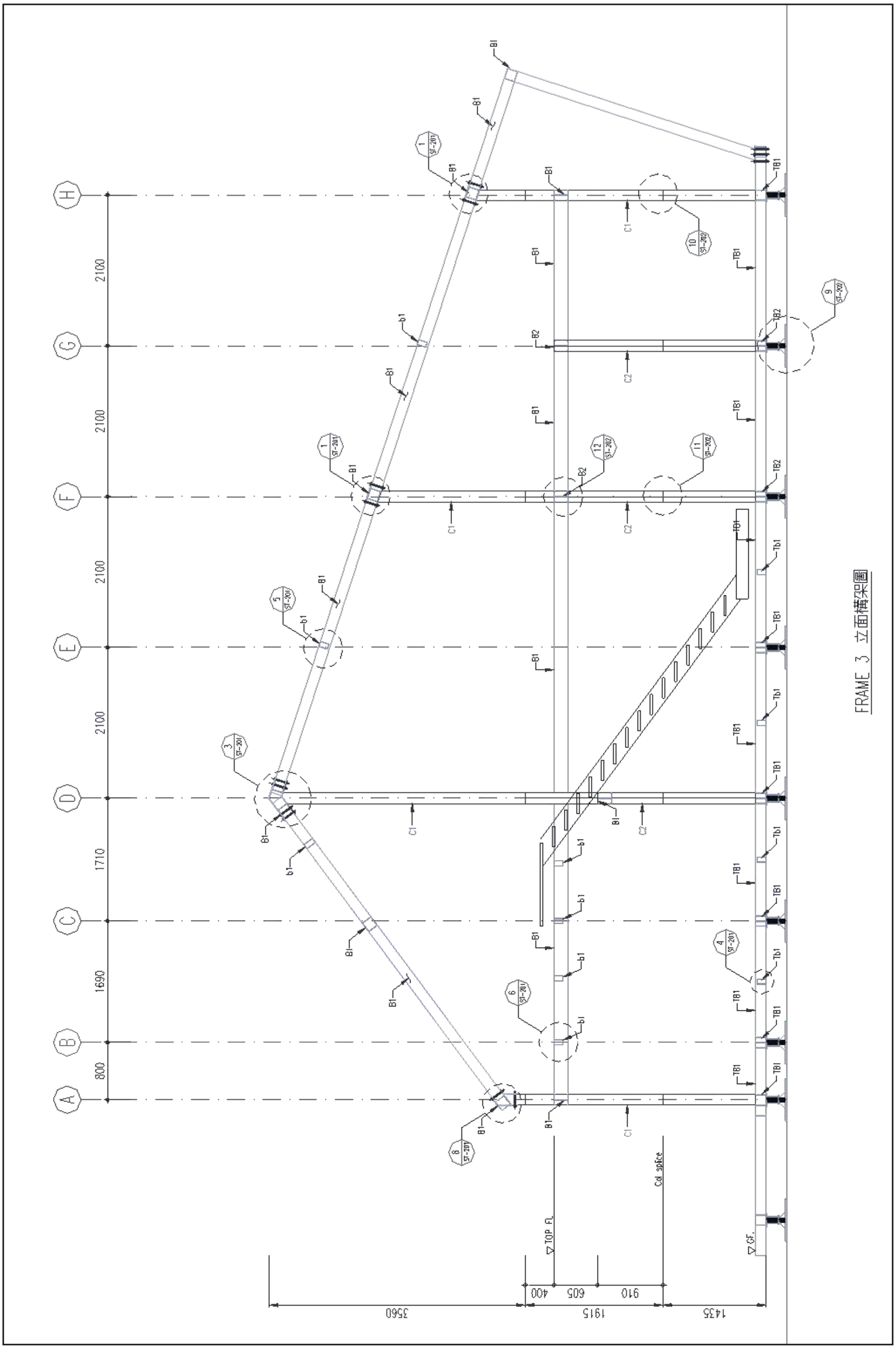
TOP FLOOR PLAN

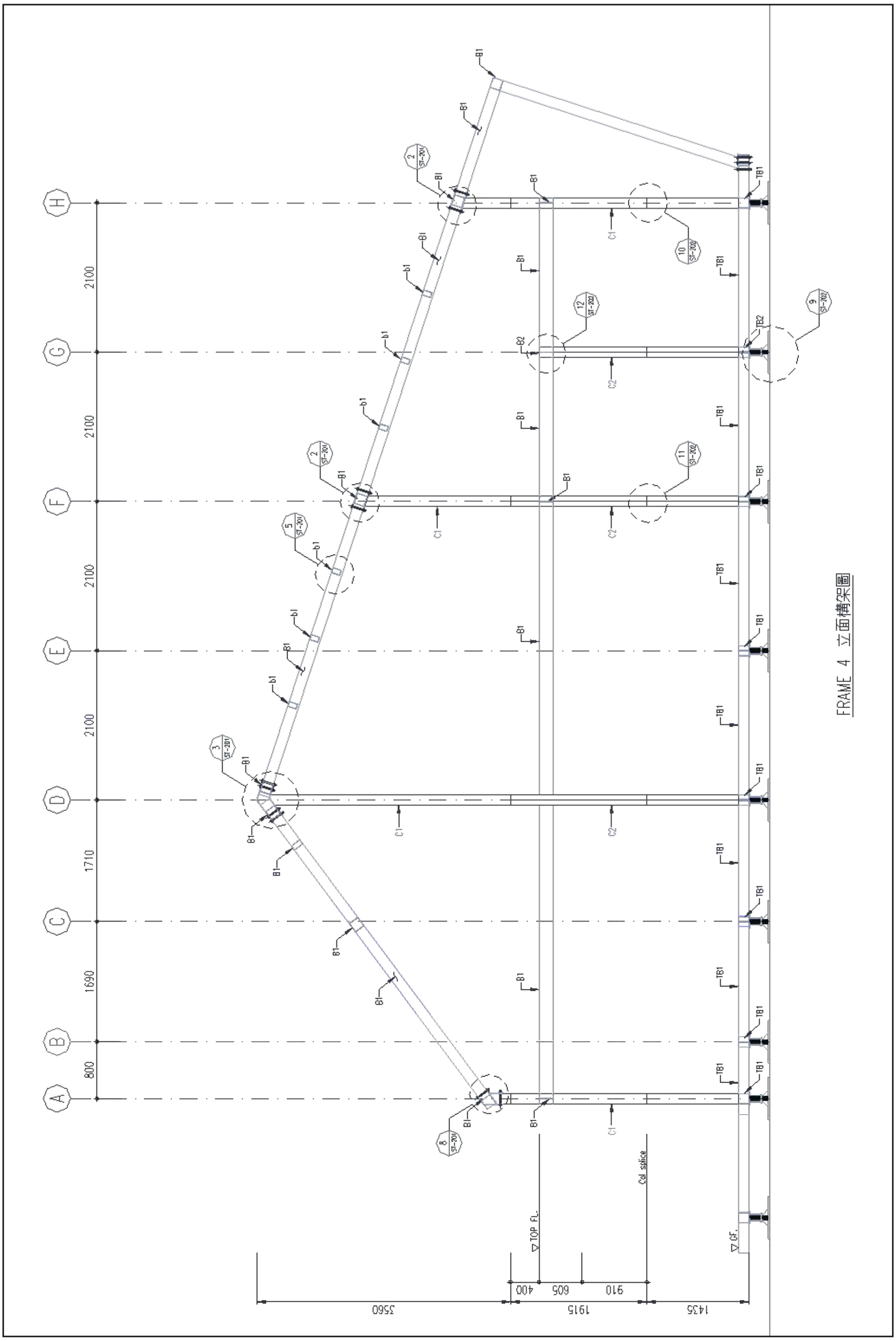

1
2
3
4
3600
1800
3600
A
B
C
D
E
F
G
H
800
1690
1710
2100
2100
2100
2100
Top of roof
B1
b1
M
ST-201
SECTION
150
150
4.5
B1
75
125
4.5
b1

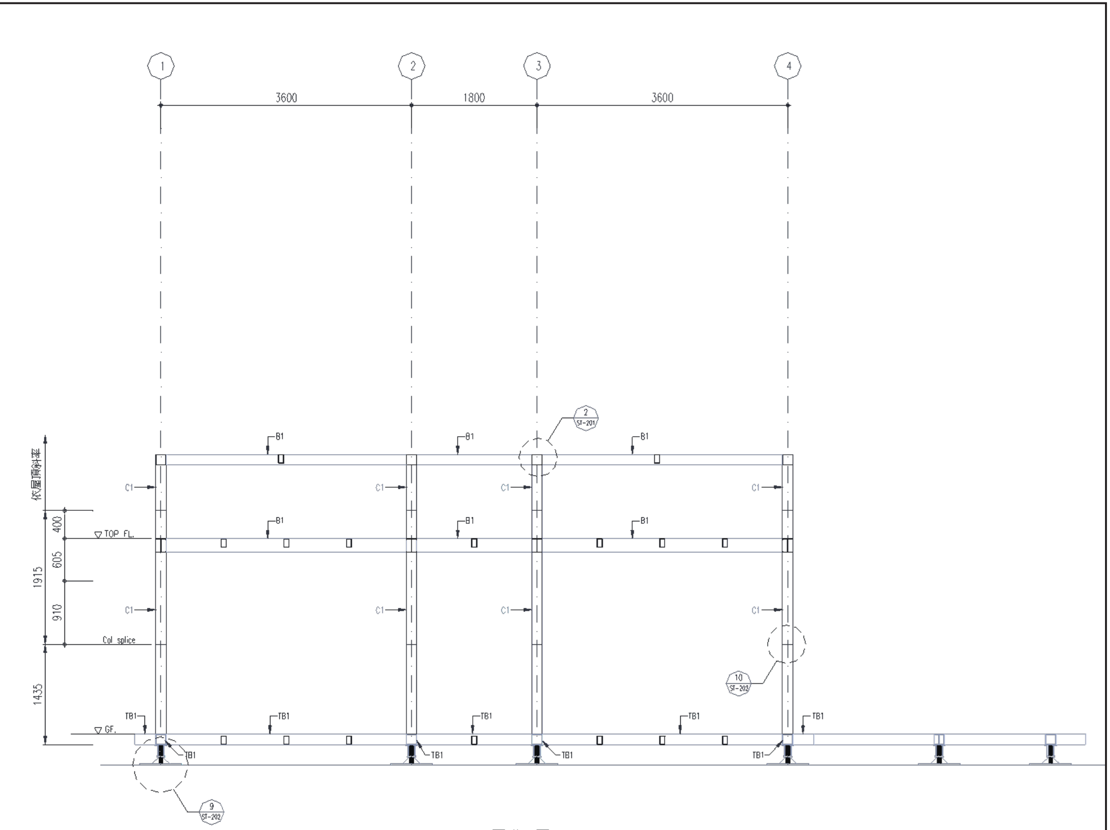
ROOF PLAN


FRAME 1 立面構架圖

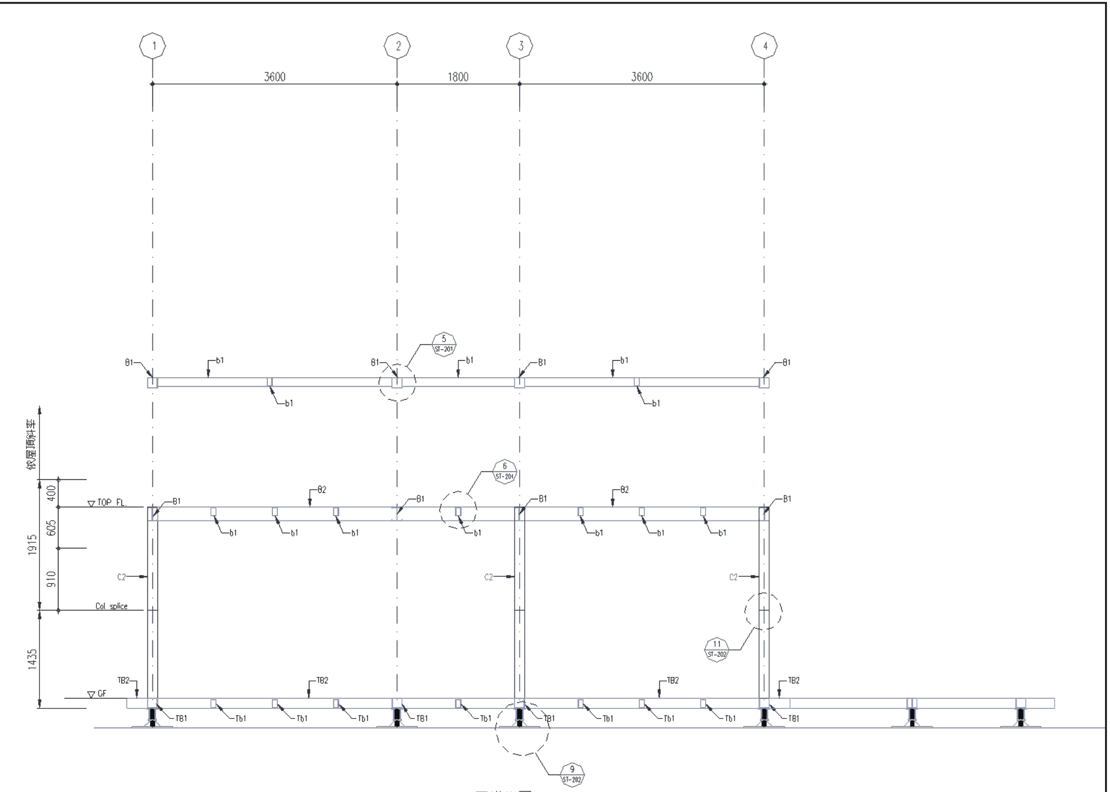

FRAME 2 立面構架圖


FRAME 3 立面構架圖
A
B
C
D
E
F
G
H
800
1690
1710
2100
2100
2100
2100
3560
1915
1435
400
605
910

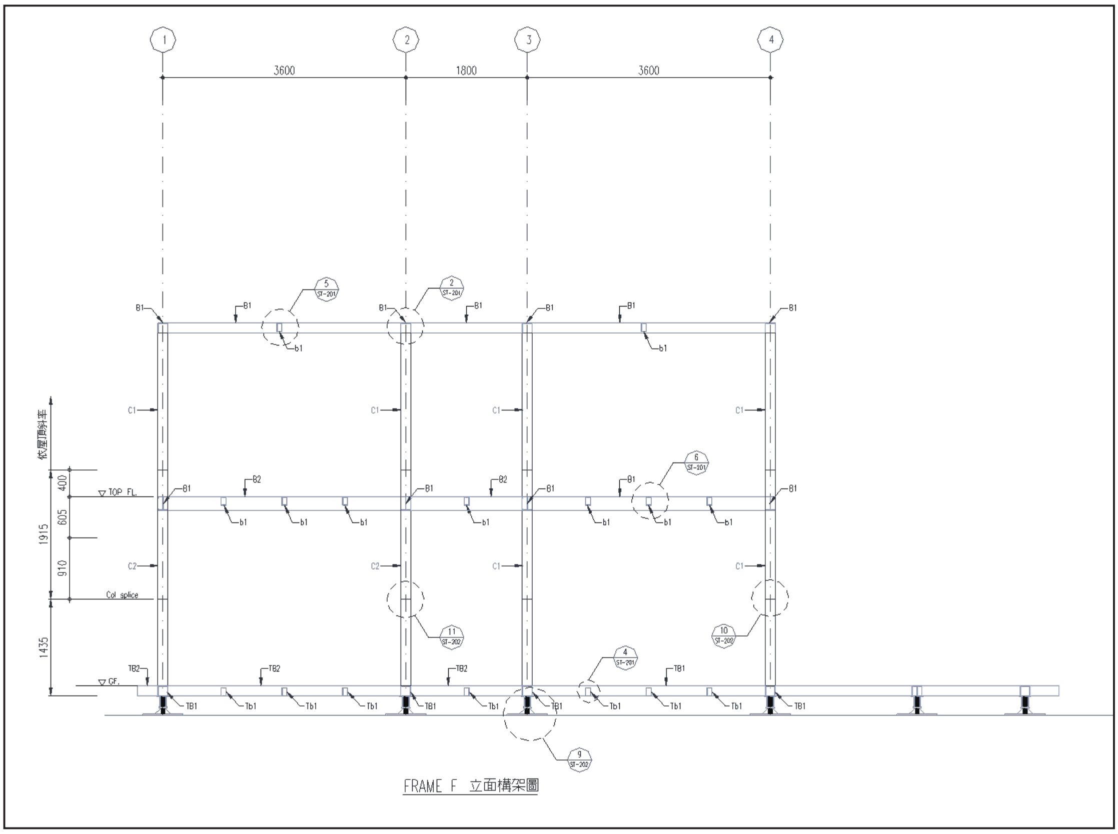

FRAME 4 立面構架圖
A
B
C
D
E
F
G
H
800
1690
1710
2100
2100
2100
2100
2560
1915
1435
400
605
910
TOP FL.
GL.
Col splice

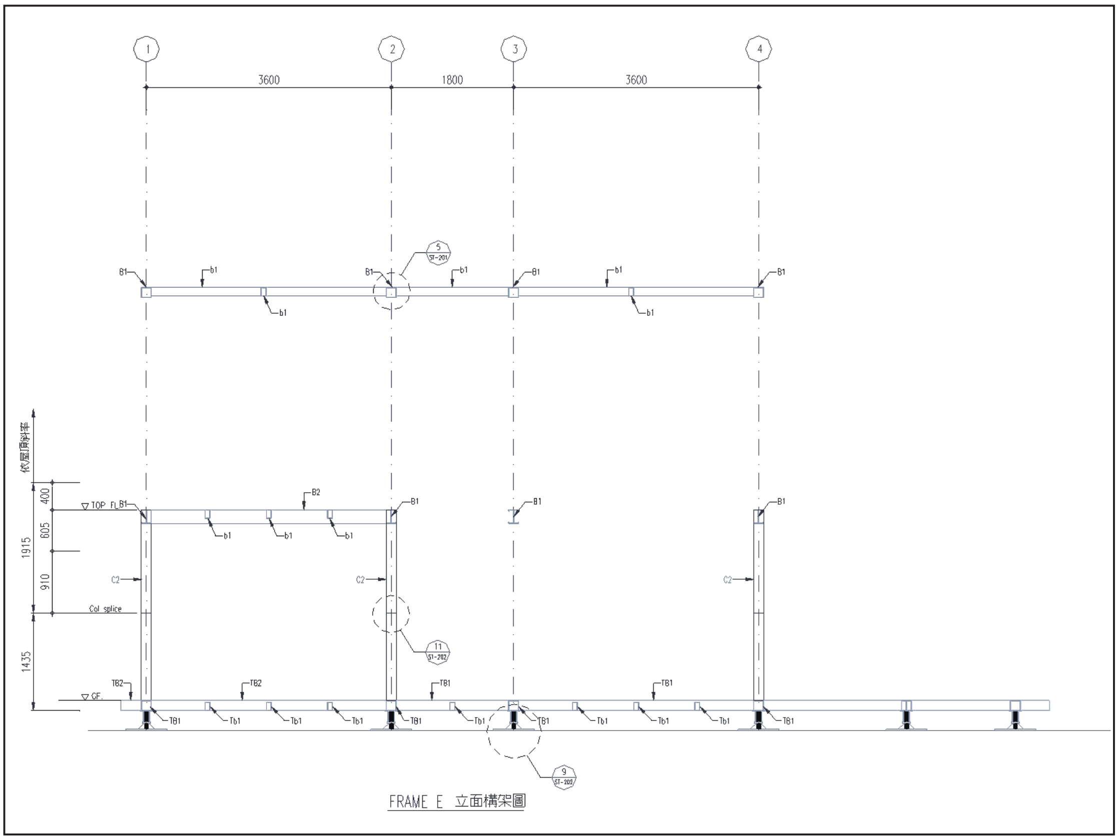


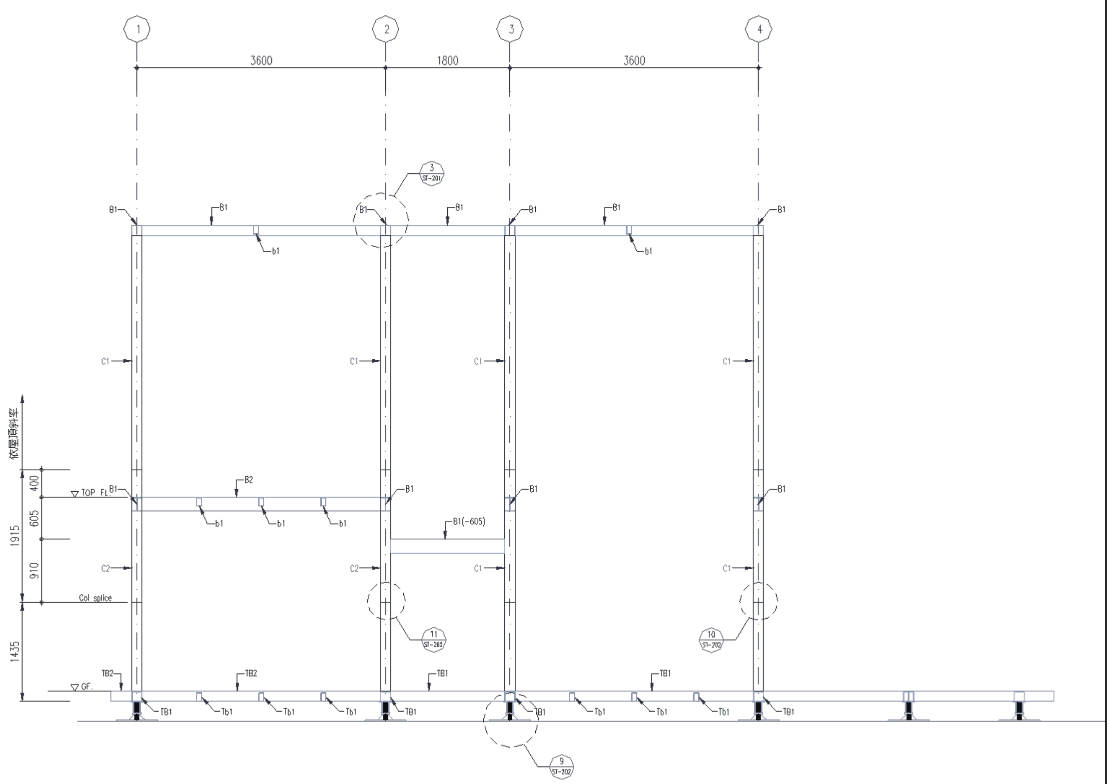
FRAME H 立面構架圖



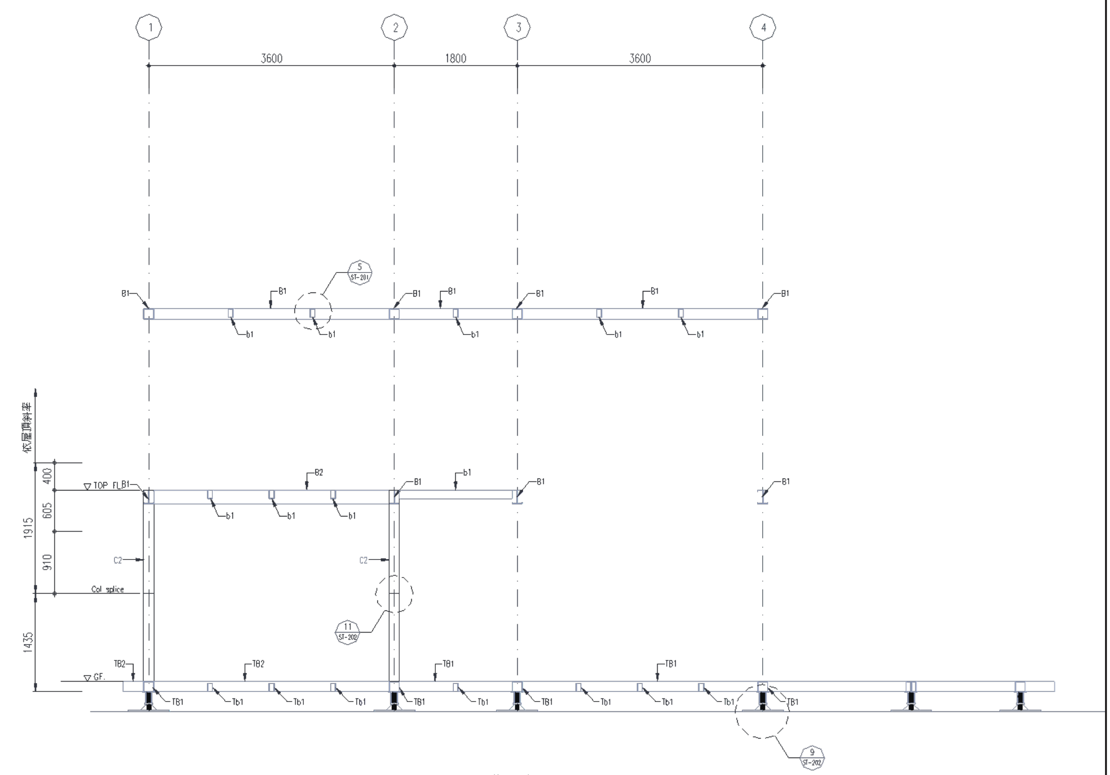
FRAME G 立面構架圖


3600
1800
3600
FRAME F 立面構架圖

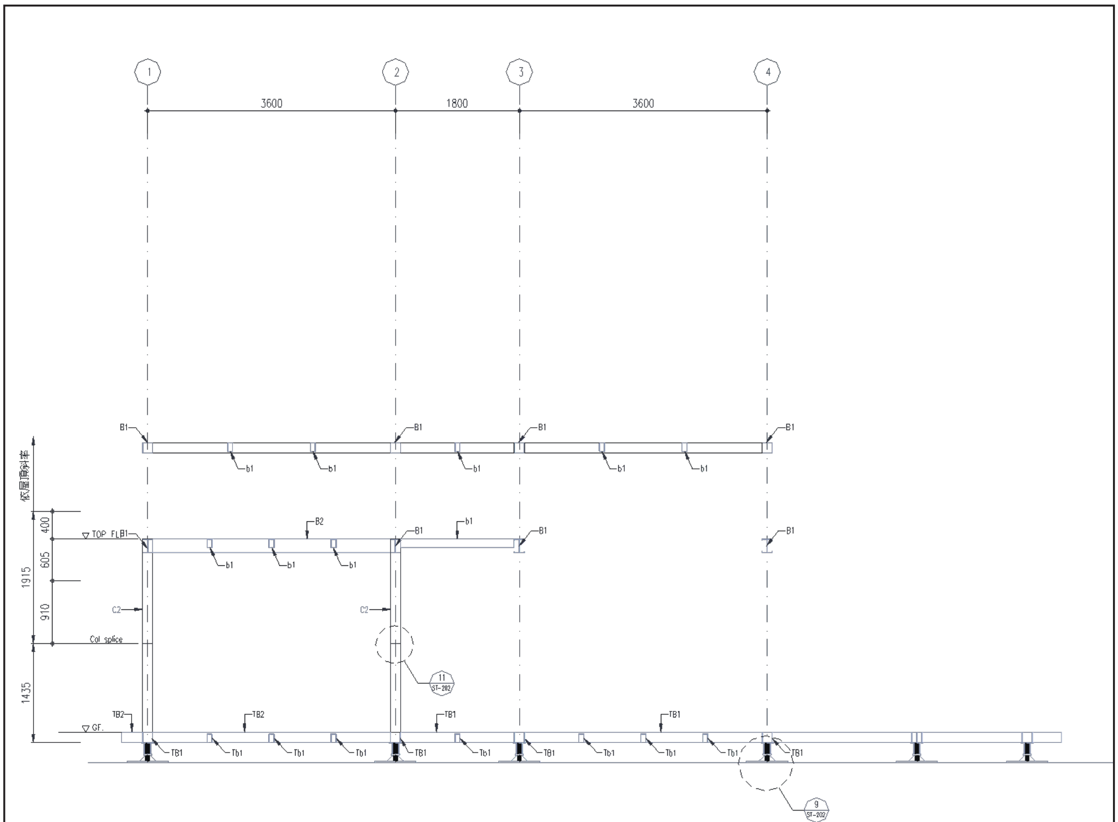

3600
1800
3600
FRAME E 立面構架圖



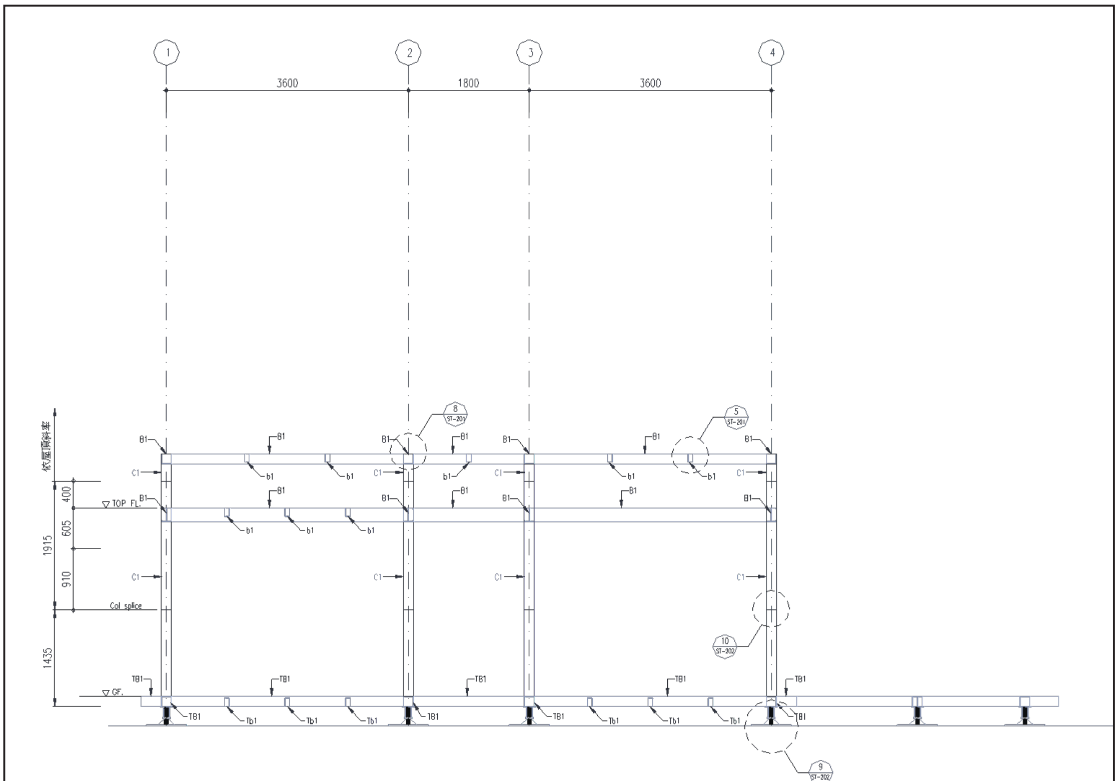
FRAME D 立面構架圖



FRAME C 立面構架圖



FRAME B 立面構架圖

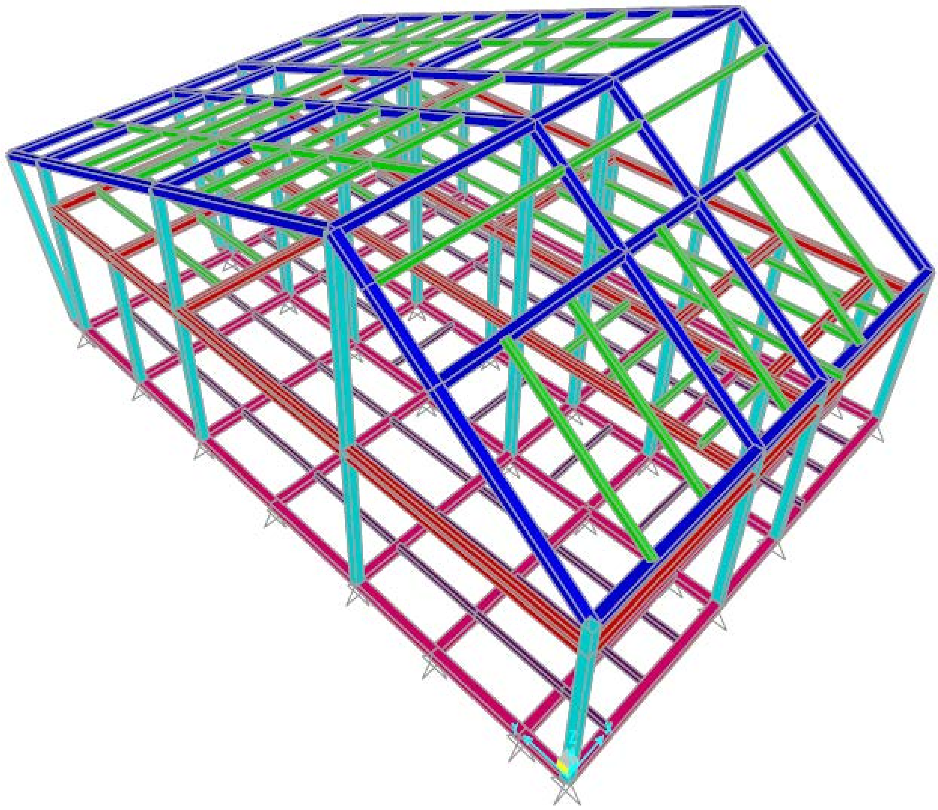


FRAME A 立面構架圖

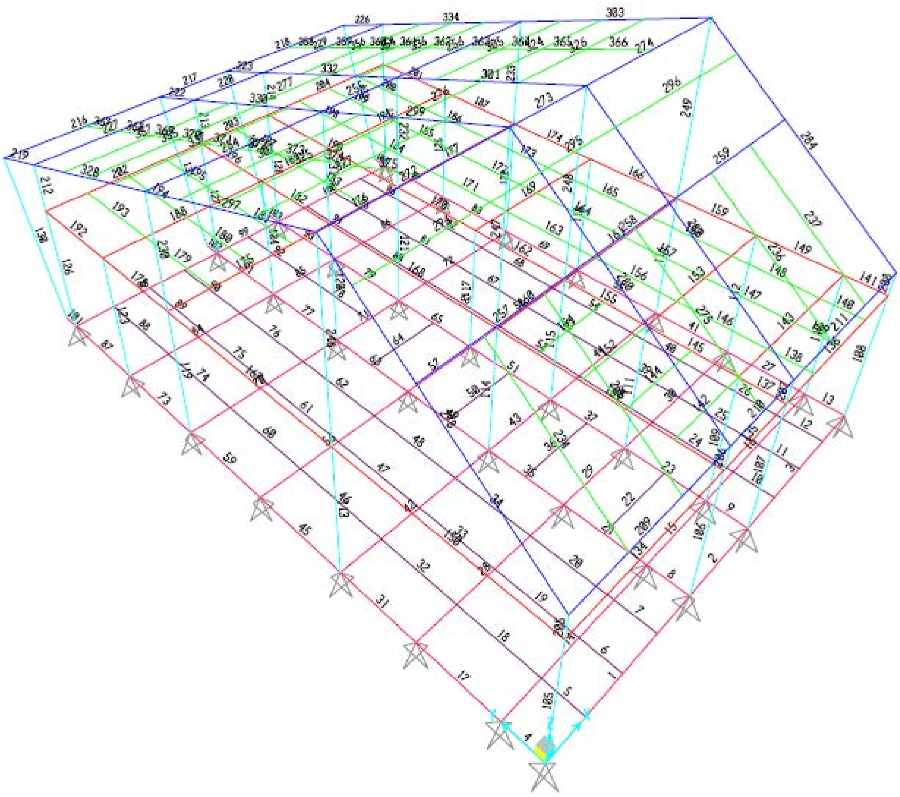
8. Structural Model

The structural model is shown as follows:

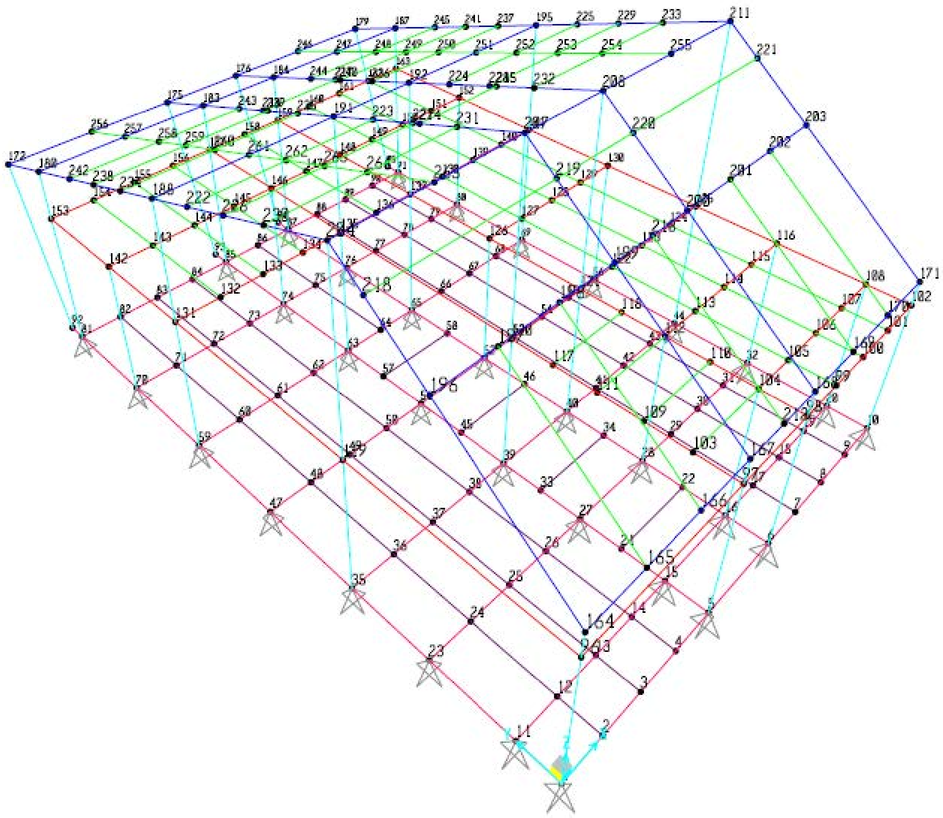
(a) 3D Model



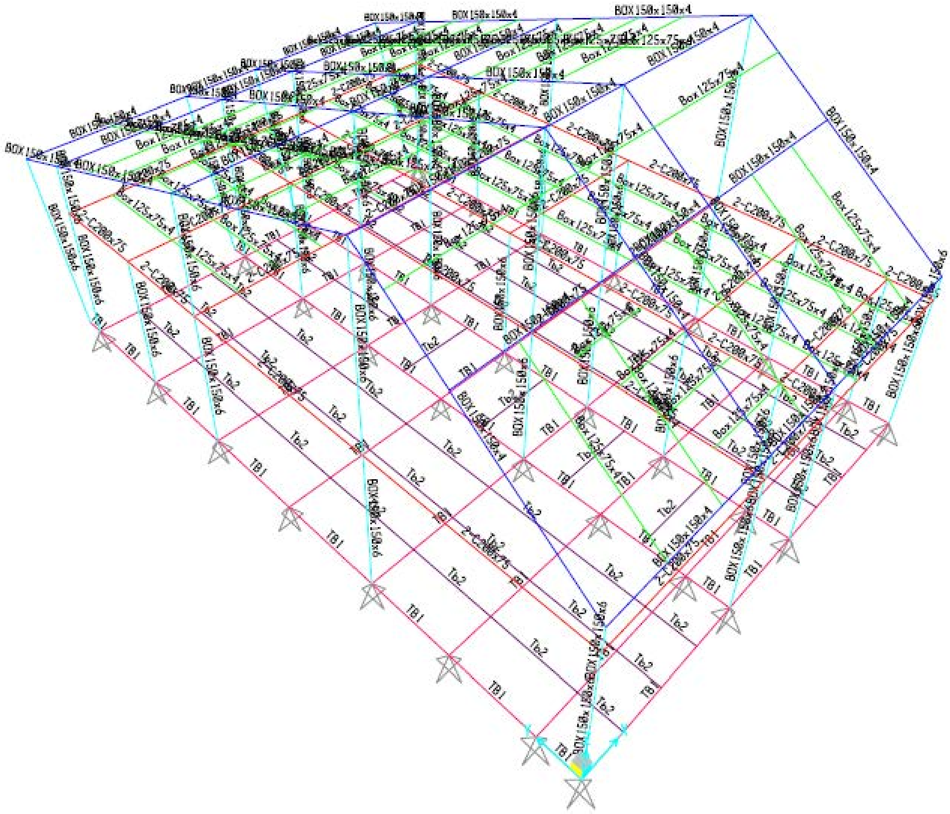
(b) Member ID



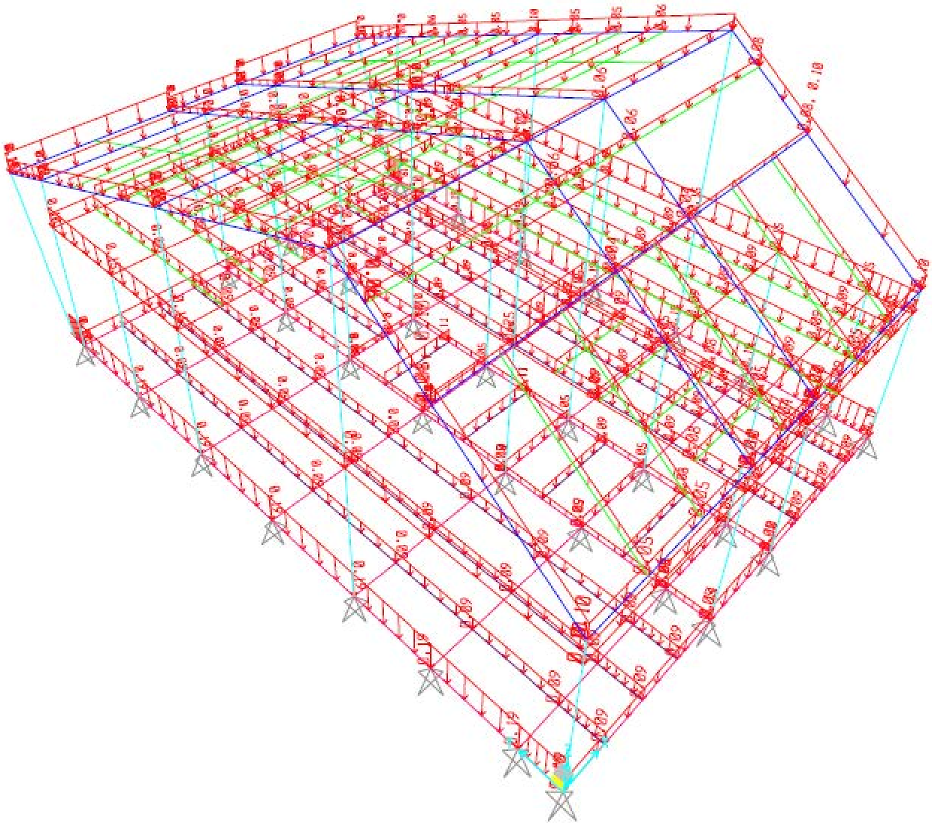
(c) Joint ID



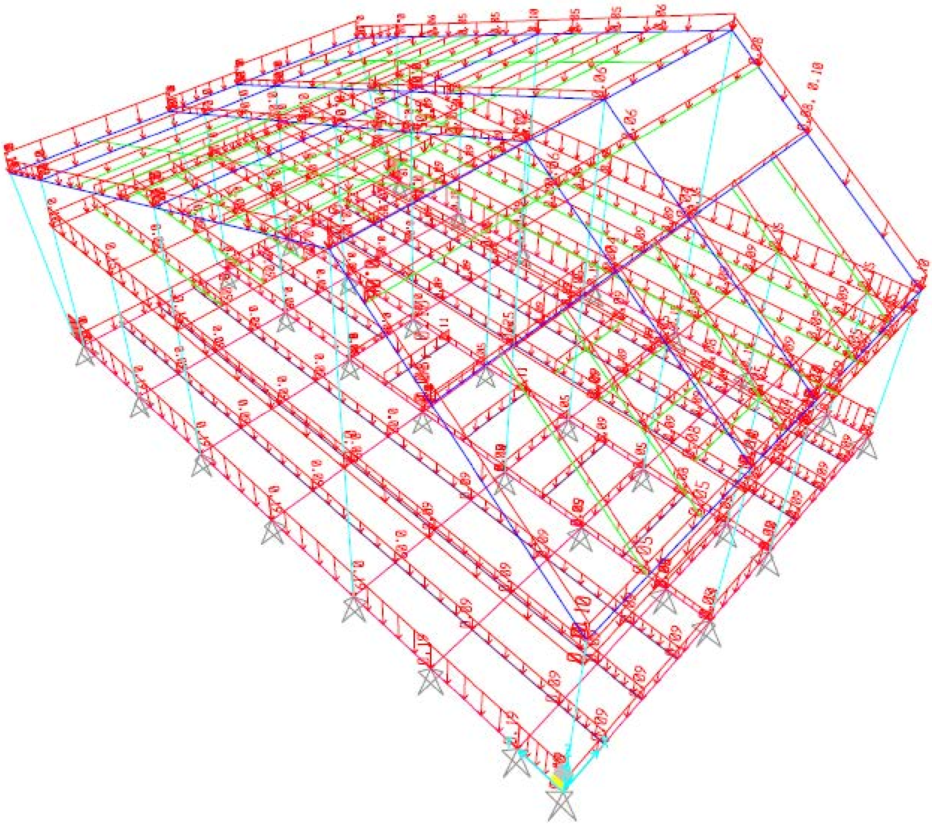
(d) Assigned Section



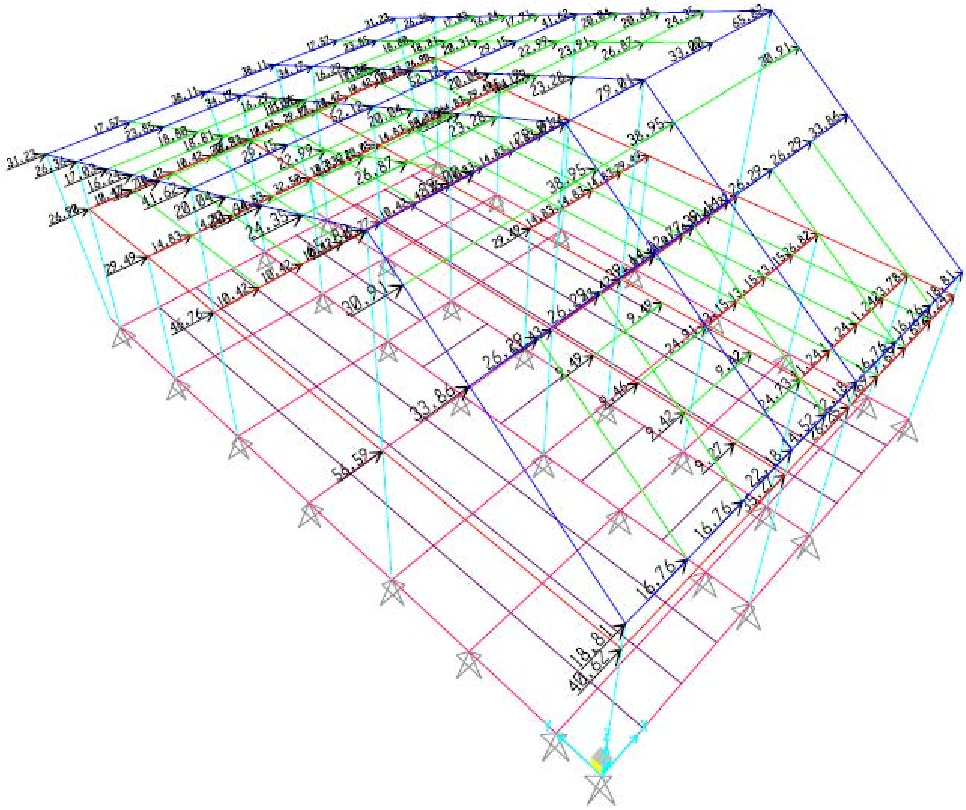
(e) Dead Load



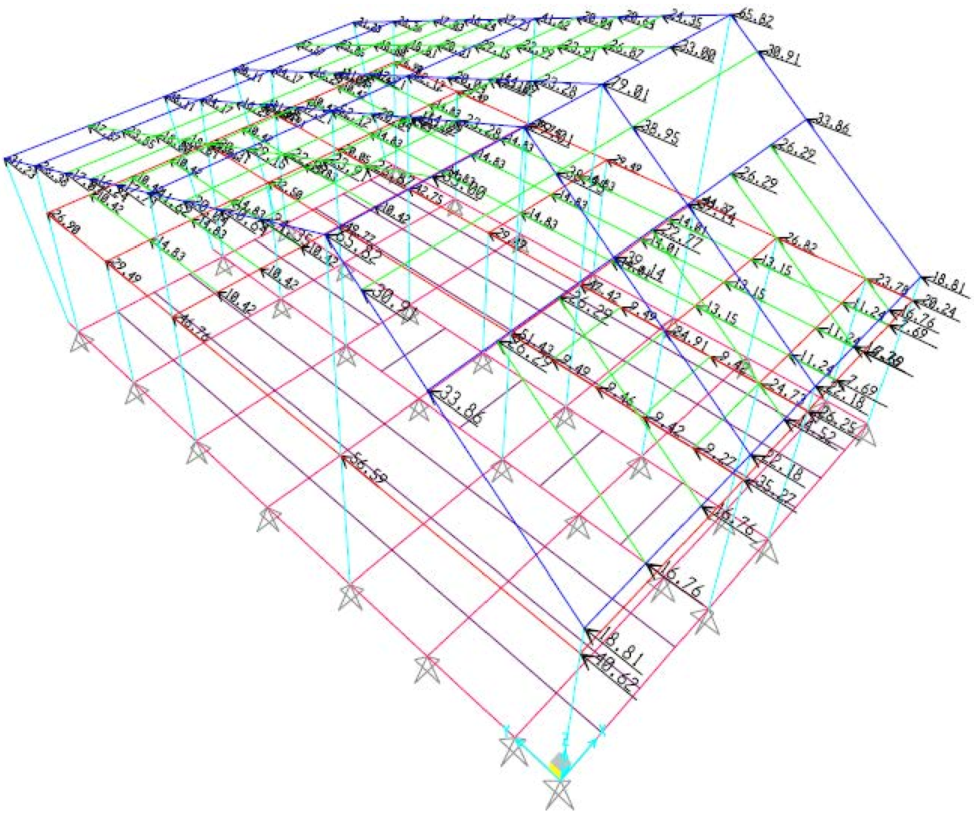
(f) Live Load



(g) Earthquake Load



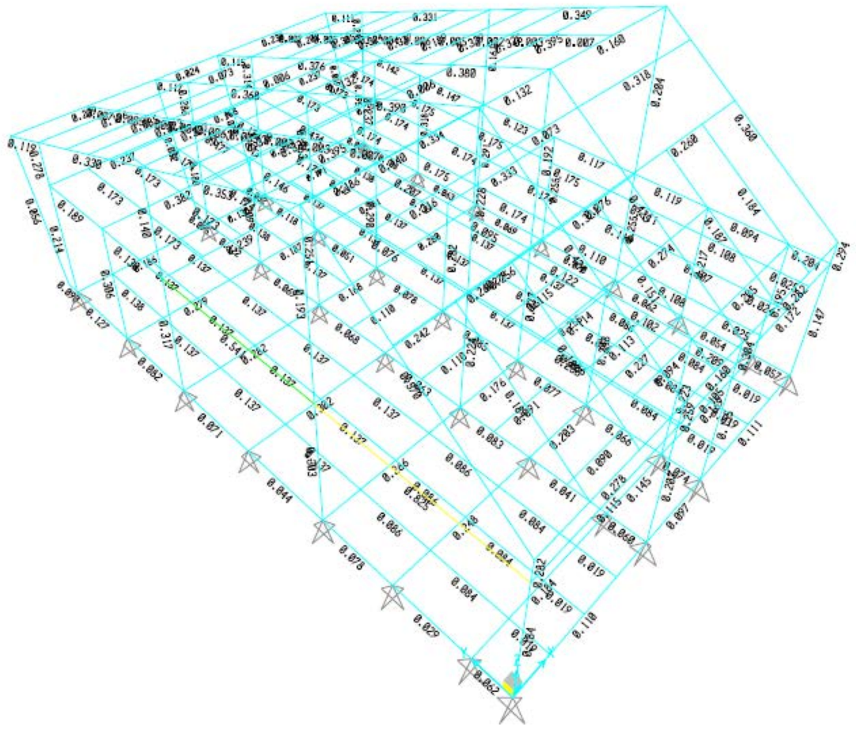
(X-dir)



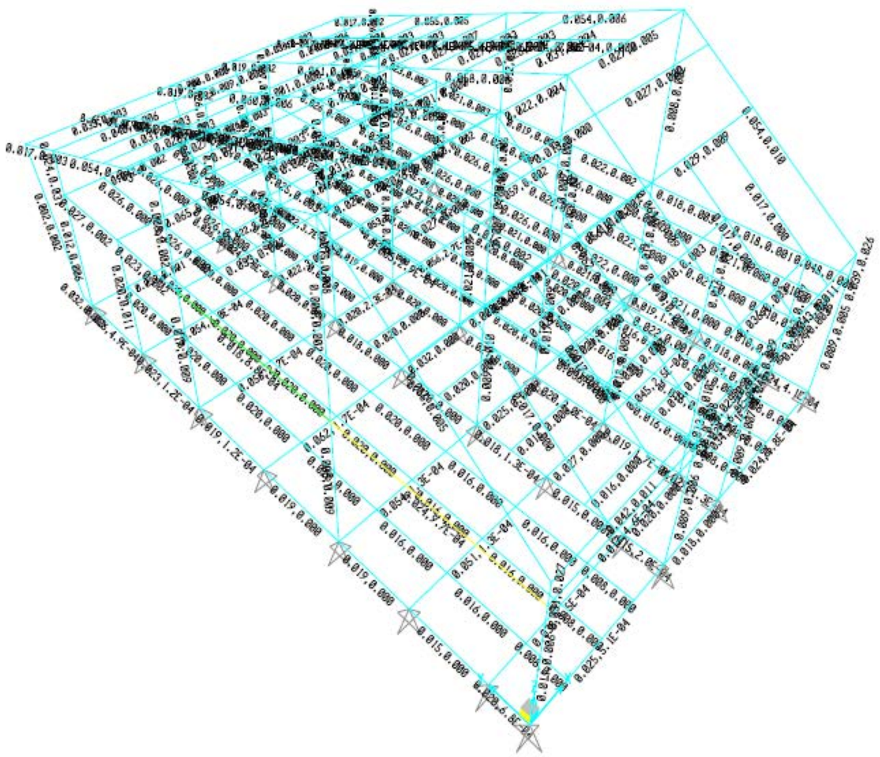
(Y-dir)

9. Structural Member Design

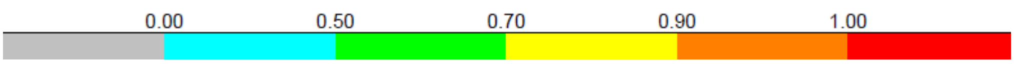
The structural member design and check are shown in the following figure. Detail calculations for column, girder and beam are listed in 9.(1)~9.(5)。



(PMM ratio)



(Shear Ratio)



(1) Steel Column (Box-150x150x6)

TABLE: Steel Column Design - Summary Data									
Frame	DesignSect	DesignType	Status	Ratio	RatioType	Combo	Location	ErrMsg	WarnMsg
Text	Text	Text	Text	Unitless	Text	Text	mm	Text	Text
230	BOX150x150x6	Column	No Messages	0.140	PMM	202	2430	No Messages	No Messages
231	BOX150x150x6	Column	No Messages	0.153	PMM	201	2430	No Messages	No Messages
232	BOX150x150x6	Column	No Messages	0.237	PMM	202	0	No Messages	No Messages
233	BOX150x150x6	Column	No Messages	0.161	PMM	201	0	No Messages	No Messages
109	BOX150x150x6	Column	No Messages	0.223	PMM	301	2950	No Messages	No Messages
110	BOX150x150x6	Column	No Messages	0.195	PMM	301	0	No Messages	No Messages
111	BOX150x150x6	Column	No Messages	0.248	PMM	301	2950	No Messages	No Messages
112	BOX150x150x6	Column	No Messages	0.217	PMM	301	0	No Messages	No Messages
117	BOX150x150x6	Column	No Messages	0.282	PMM	301	2950	No Messages	No Messages
118	BOX150x150x6	Column	No Messages	0.255	PMM	301	0	No Messages	No Messages
123	BOX150x150x6	Column	No Messages	0.306	PMM	301	0	No Messages	No Messages
124	BOX150x150x6	Column	No Messages	0.209	PMM	301	0	No Messages	No Messages
205	BOX150x150x6	Column	No Messages	0.282	PMM	101	500	No Messages	No Messages
206	BOX150x150x6	Column	No Messages	0.259	PMM	101	500	No Messages	No Messages
207	BOX150x150x6	Column	No Messages	0.304	PMM	101	500	No Messages	No Messages
208	BOX150x150x6	Column	No Messages	0.294	PMM	101	500	No Messages	No Messages
246	BOX150x150x6	Column	No Messages	0.193	PMM	202	3810	No Messages	No Messages
247	BOX150x150x6	Column	No Messages	0.228	PMM	202	0	No Messages	No Messages
248	BOX150x150x6	Column	No Messages	0.192	PMM	202	3810	No Messages	No Messages
249	BOX150x150x6	Column	No Messages	0.204	PMM	201	0	No Messages	No Messages
212	BOX150x150x6	Column	No Messages	0.278	PMM	101	1050	No Messages	No Messages
213	BOX150x150x6	Column	No Messages	0.286	PMM	101	1050	No Messages	No Messages
214	BOX150x150x6	Column	No Messages	0.314	PMM	101	0	No Messages	No Messages
215	BOX150x150x6	Column	No Messages	0.271	PMM	101	1050	No Messages	No Messages
105	BOX150x150x6	Column	No Messages	0.184	PMM	301	0	No Messages	No Messages
106	BOX150x150x6	Column	No Messages	0.202	PMM	201	2950	No Messages	No Messages
107	BOX150x150x6	Column	No Messages	0.155	PMM	202	0	No Messages	No Messages
108	BOX150x150x6	Column	No Messages	0.147	PMM	201	0	No Messages	No Messages
113	BOX150x150x6	Column	No Messages	0.303	PMM	301	0	No Messages	No Messages
114	BOX150x150x6	Column	No Messages	0.224	PMM	301	0	No Messages	No Messages
115	BOX150x150x6	Column	No Messages	0.277	PMM	301	0	No Messages	No Messages
116	BOX150x150x6	Column	No Messages	0.255	PMM	301	0	No Messages	No Messages
119	BOX150x150x6	Column	No Messages	0.317	PMM	301	0	No Messages	No Messages
120	BOX150x150x6	Column	No Messages	0.251	PMM	201	0	No Messages	No Messages
121	BOX150x150x6	Column	No Messages	0.290	PMM	202	0	No Messages	No Messages
122	BOX150x150x6	Column	No Messages	0.291	PMM	201	0	No Messages	No Messages
126	BOX150x150x6	Column	No Messages	0.214	PMM	301	0	No Messages	No Messages
127	BOX150x150x6	Column	No Messages	0.188	PMM	201	0	No Messages	No Messages
128	BOX150x150x6	Column	No Messages	0.263	PMM	202	2950	No Messages	No Messages
129	BOX150x150x6	Column	No Messages	0.195	PMM	201	0	No Messages	No Messages
125	BOX150x150x6	Column	No Messages	0.318	PMM	101	2950	No Messages	No Messages
			Max Ratio =	0.318					

Calculation Detail

```
Combo   : 101
Units   : Kgf, cm, C



Frame   : 125             Design Sect: BOX150x150x6
X Mid   : 900.000         Design Type: Column
Y Mid   : 1050.000        Frame Type : Ordinary Moment Resisting Frame
Z Mid   : 147.500         Sect Class : Compact
Length  : 295.000         Major Axis : 0.000 degrees counterclockwise from local 3
Loc     : 295.000         RLLF       : 1.000

Area    : 34.560          SMajor : 159.529        rMajor : 5.884         AVMajor: 18.000
IMajor  : 1196.467        SMinor : 159.529        rMinor : 5.884         AVMinor: 18.000
IMinor  : 1196.467        ZMajor : 186.732        E      : 2040000.000
Ixy     : 0.000           ZMinor : 186.732        Fy     : 2500.000


STRESS CHECK FORCES & MOMENTS
    Location               P         M33         M22          V2          V3           T
    295.000        -1643.222  -67065.687   -5791.501     413.976      38.162      -6.040

PMM DEMAND/CAPACITY RATIO
    Governing          Total           P      MMajor      MMinor       Ratio      Status
    Equation           Ratio       Ratio       Ratio       Ratio       Limit       Check
    (H1-3)             0.318   =   0.042   +   0.255   +   0.022       0.950          OK

AXIAL FORCE DESIGN
                           P          fa          Fa          Ft
                       Force      Stress   Allowable   Allowable
    Axial          -1643.222      47.547    1143.279    1500.000

MOMENT DESIGN
                           M          fb          Fb          Fe        Cm         K         L        Cb
                      Moment      Stress   Allowable   Allowable    Factor    Factor    Factor    Factor
    Major Moment  -67065.687     420.398    1650.000    2135.587     0.850     1.399     1.000     2.300
    Minor Moment   -5791.501      36.304    1650.000    3439.792     0.850     1.102     1.000

SHEAR DESIGN
                           V          fv          Fv      Stress      Status           T
                       Force      Stress   Allowable       Ratio       Check     Torsion
    Major Shear      413.976      22.999    1000.000       0.023          OK       0.000
    Minor Shear       38.162       2.120    1000.000       0.002          OK       0.000
```

(2) Steel Girder (2-C200x75x4、Box-150x150x4.5)

TABLE: Steel Girder (Box-150x150x4.5) Design - Summary Data									
Frame	DesignSect	DesignType	Status	Ratio	RatioType	Combo	Location	ErrMsg	WarnMsg
Text	Text	Text	Text	Unitless	Text	Text	mm	Text	Text
227	BOX150x150x4	Beam	No Messages	0.196	PMM	201	3600	No Messages	No Messages
228	BOX150x150x4	Beam	No Messages	0.073	PMM	201	1800	No Messages	No Messages
229	BOX150x150x4	Beam	No Messages	0.202	PMM	202	0	No Messages	No Messages
254	BOX150x150x4	Beam	No Messages	0.179	PMM	201	3600	No Messages	No Messages
255	BOX150x150x4	Beam	No Messages	0.132	PMM	203	1800	No Messages	No Messages
256	BOX150x150x4	Beam	No Messages	0.189	PMM	201	3600	No Messages	No Messages
219	BOX150x150x4	Brace	No Messages	0.119	PMM	301	1517.1	No Messages	No Messages
222	BOX150x150x4	Brace	No Messages	0.117	PMM	301	1517.1	No Messages	No Messages
223	BOX150x150x4	Brace	No Messages	0.115	PMM	101	1517.1	No Messages	No Messages
226	BOX150x150x4	Brace	No Messages	0.111	PMM	301	1517.1	No Messages	No Messages
209	BOX150x150x4	Beam	No Messages	0.278	PMM	201	3600	No Messages	No Messages
210	BOX150x150x4	Beam	No Messages	0.160	PMM	202	0	No Messages	No Messages
211	BOX150x150x4	Beam	No Messages	0.282	PMM	202	0	No Messages	No Messages
272	BOX150x150x4	Beam	No Messages	0.140	PMM	201	3600	No Messages	No Messages
273	BOX150x150x4	Beam	No Messages	0.132	PMM	202	0	No Messages	No Messages
274	BOX150x150x4	Beam	No Messages	0.160	PMM	201	3600	No Messages	No Messages
257	BOX150x150x4	Beam	No Messages	0.260	PMM	101	2000	No Messages	No Messages
258	BOX150x150x4	Beam	No Messages	0.076	PMM	101	900	No Messages	No Messages
259	BOX150x150x4	Beam	No Messages	0.260	PMM	101	1600	No Messages	No Messages
216	BOX150x150x4	Beam	No Messages	0.229	PMM	101	1800	No Messages	No Messages
217	BOX150x150x4	Beam	No Messages	0.024	PMM	101	900	No Messages	No Messages
218	BOX150x150x4	Beam	No Messages	0.230	PMM	101	1800	No Messages	No Messages
278	BOX150x150x4	Brace	No Messages	0.370	PMM	101	5347.53	No Messages	No Messages
280	BOX150x150x4	Brace	No Messages	0.424	PMM	101	5347.53	No Messages	No Messages
282	BOX150x150x4	Brace	No Messages	0.425	PMM	101	5347.53	No Messages	No Messages
284	BOX150x150x4	Brace	No Messages	0.360	PMM	101	5347.53	No Messages	No Messages
297	BOX150x150x4	Brace	No Messages	0.353	PMM	101	0	No Messages	No Messages
299	BOX150x150x4	Brace	No Messages	0.390	PMM	101	0	No Messages	No Messages
301	BOX150x150x4	Brace	No Messages	0.380	PMM	101	4420.9	No Messages	No Messages
303	BOX150x150x4	Brace	No Messages	0.349	PMM	101	0	No Messages	No Messages
328	BOX150x150x4	Brace	No Messages	0.330	PMM	101	4420.9	No Messages	No Messages
330	BOX150x150x4	Brace	No Messages	0.368	PMM	101	4420.9	No Messages	No Messages
332	BOX150x150x4	Brace	No Messages	0.376	PMM	101	4420.9	No Messages	No Messages
334	BOX150x150x4	Brace	No Messages	0.331	PMM	101	4420.9	No Messages	No Messages
			Max Ratio =	0.425					

Calculation Detail

```
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           -60.707 -777741.300    81483.191     818.302    -112.313    2964.019

PMM DEMAND/CAPACITY RATIO
    Governing            Total           P       MMajor       MMinor       Ratio      Status
    Equation             Ratio       Ratio        Ratio        Ratio       Limit       Check
    (H1-3)               0.425   =   0.002   +    0.382   +    0.040       0.950          OK

AXIAL FORCE DESIGN
                             P          fa           Fa           Ft
                         Force      Stress    Allowable    Allowable
    Axial              -60.707       0.023        9.913       15.000

MOMENT DESIGN
                             M          fb           Fb           Fe         Cm          K          L         Cb
                        Moment      Stress    Allowable    Allowable     Factor     Factor     Factor     Factor
    Major Moment -777741.300       6.306       16.500       12.974      0.850      1.000      1.000      1.000
    Minor Moment   81483.191       0.661       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        818.302       0.606       10.000        0.061          OK       0.000
    Minor Shear        112.313       0.083       10.000        0.008          OK       0.000
```

TABLE: Steel Girder (2-C200x75x4) Design - Summary Data									
Frame	DesignSect	DesignType	Status	Ratio	RatioType	Combo	Location	ErrMsg	WarnMsg
Text	Text	Text	Text	Unitless	Text	Text	mm	Text	Text
203	2-C200x75	Beam	No Messages	0.158	PMM	201	1800	No Messages	No Messages
204	2-C200x75	Beam	No Messages	0.237	PMM	201	3600	No Messages	No Messages
150	2-C200x75	Beam	No Messages	0.825	PMM	301	4200	No Messages	No Messages
167	2-C200x75	Beam	No Messages	0.541	PMM	301	4200	No Messages	No Messages
151	2-C200x75	Beam	No Messages	0.236	PMM	301	4200	No Messages	No Messages
168	2-C200x75	Beam	No Messages	0.076	PMM	101	0	No Messages	No Messages
190	2-C200x75	Beam	No Messages	0.434	PMM	101	2100	No Messages	No Messages
134	2-C200x75	Beam	No Messages	0.115	PMM	204	0	No Messages	No Messages
135	2-C200x75	Beam	No Messages	0.105	PMM	201	1800	No Messages	No Messages
136	2-C200x75	Beam	No Messages	0.172	PMM	202	0	No Messages	No Messages
160	2-C200x75	Beam	No Messages	0.256	PMM	201	1800	No Messages	No Messages
161	2-C200x75	Beam	No Messages	0.321	PMM	202	0	No Messages	No Messages
175	2-C200x75	Beam	No Messages	0.239	PMM	201	3600	No Messages	No Messages
176	2-C200x75	Beam	No Messages	0.186	PMM	201	1800	No Messages	No Messages
177	2-C200x75	Beam	No Messages	0.334	PMM	202	0	No Messages	No Messages
202	2-C200x75	Beam	No Messages	0.237	PMM	201	3600	No Messages	No Messages
143	2-C200x75	Beam	No Messages	0.205	PMM	201	3600	No Messages	No Messages
153	2-C200x75	Beam	No Messages	0.274	PMM	202	0	No Messages	No Messages
169	2-C200x75	Beam	No Messages	0.333	PMM	101	1800	No Messages	No Messages
188	2-C200x75	Beam	No Messages	0.382	PMM	101	3600	No Messages	No Messages
189	2-C200x75	Beam	No Messages	0.373	PMM	101	0	No Messages	No Messages
191	2-C200x75	Beam	No Messages	0.358	PMM	101	1800	No Messages	No Messages
159	2-C200x75	Beam	No Messages	0.119	PMM	202	1710	No Messages	No Messages
166	2-C200x75	Beam	No Messages	0.117	PMM	202	2100	No Messages	No Messages
174	2-C200x75	Beam	No Messages	0.123	PMM	201	2100	No Messages	No Messages
187	2-C200x75	Beam	No Messages	0.147	PMM	201	2100	No Messages	No Messages
201	2-C200x75	Beam	No Messages	0.142	PMM	301	2100	No Messages	No Messages
141	2-C200x75	Beam	No Messages	0.204	PMM	301	0	No Messages	No Messages
149	2-C200x75	Beam	No Messages	0.094	PMM	301	1690	No Messages	No Messages
178	2-C200x75	Beam	No Messages	0.130	PMM	201	2100	No Messages	No Messages
192	2-C200x75	Beam	No Messages	0.189	PMM	301	2100	No Messages	No Messages
182	2-C200x75	Beam	No Messages	0.146	PMM	301	2100	No Messages	No Messages
196	2-C200x75	Beam	No Messages	0.177	PMM	301	2100	No Messages	No Messages
137	2-C200x75	Beam	No Messages	0.209	PMM	301	0	No Messages	No Messages
145	2-C200x75	Beam	No Messages	0.102	PMM	301	1690	No Messages	No Messages
155	2-C200x75	Beam	No Messages	0.122	PMM	202	1710	No Messages	No Messages
162	2-C200x75	Beam	No Messages	0.095	PMM	202	2100	No Messages	No Messages
170	2-C200x75	Beam	No Messages	0.207	PMM	201	2100	No Messages	No Messages
			Max Ratio =	0.825					

Calculation Detail

```
Combo  : 301
Units  : Kgf, mm, C



Frame  : 150             Design Sect: 2-C200x75
X Mid  : 0.000           Design Type: Beam
Y Mid  : 2100.000        Frame Type : Ordinary Moment Resisting Frame
Z Mid  : 2950.000        Sect Class : Slender
Length : 4200.000        Major Axis : 0.000 degrees counterclockwise from local 3
Loc    : 4200.000        RLLF       : 1.000

Area   : 2736.000        SMajor : 162449.920      rMajor : 77.055          AVMajor: 1600.000
IMajor : 16244992.000    SMinor : 30109.227       rMinor : 28.729          AVMinor: 1200.000
IMinor : 2258192.000     ZMajor : 191328.000      E      : 20400.000
Ixy    : 0.000           ZMinor : 48072.000       Fy     : 25.000

STRESS CHECK FORCES & MOMENTS
    Location                 P        M33         M22          V2          V3           T
    4200.000           212.315 -381139.186  -19722.008     382.832       8.600     -11.704

PMM DEMAND/CAPACITY RATIO
    Governing            Total           P      MMajor      MMinor       Ratio      Status
    Equation             Ratio       Ratio       Ratio       Ratio       Limit       Check
    (BENDING)            0.825   =   0.000   +   0.779   +   0.046       0.950          OK

AXIAL FORCE DESIGN
                             P          fa          Fa          Ft
                         Force      Stress   Allowable   Allowable
    Axial              212.315       0.078       1.229      15.000

MOMENT DESIGN
                             M          fb          Fb          Fe        Cm         K         L        Cb
                        Moment      Stress   Allowable   Allowable    Factor    Factor    Factor    Factor
    Major Moment -381139.186       2.346       3.013      35.358     1.000     1.000     1.000     1.000
    Minor Moment  -19722.008       0.655      14.213       1.229     1.000     1.000     2.000

SHEAR DESIGN
                             V          fv          Fv      Stress      Status           T
                         Force      Stress   Allowable       Ratio       Check     Torsion
    Major Shear        382.832       0.239      10.000       0.024          OK       0.000
    Minor Shear          8.600       0.007      10.000       0.001          OK       0.000
```

(3) Steel Beam (Box-125x75x4.5)

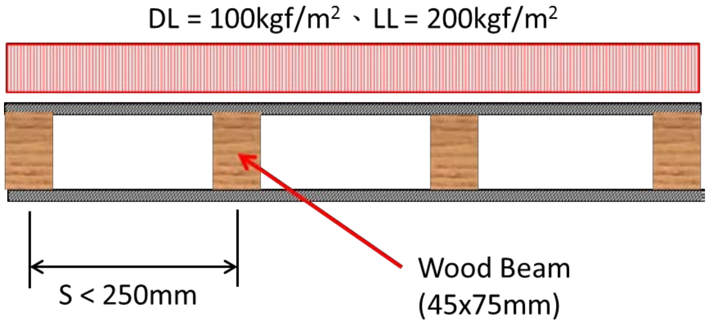
TABLE: Steel Beam (Box-125x75x4.5) Design - Summary Data									
Frame	DesignSect	DesignType	Status	Ratio	RatioType	Combo	Location	ErrMsg	WarnMsg
Text	Text	Text	Text	Unitless	Text	Text	mm	Text	Text
152	Box125x75x4	Beam	No Messages	0.113803	PMM	101	900	No Messages	No Messages
138	Box125x75x4	Beam	No Messages	0.025195	PMM	101	400	No Messages	No Messages
139	Box125x75x4	Beam	No Messages	0.024421	PMM	101	400	No Messages	No Messages
140	Box125x75x4	Beam	No Messages	0.024844	PMM	101	400	No Messages	No Messages
146	Box125x75x4	Beam	No Messages	0.107647	PMM	101	845	No Messages	No Messages
147	Box125x75x4	Beam	No Messages	0.107013	PMM	101	845	No Messages	No Messages
148	Box125x75x4	Beam	No Messages	0.10785	PMM	101	845	No Messages	No Messages
156	Box125x75x4	Beam	No Messages	0.109898	PMM	101	855	No Messages	No Messages
157	Box125x75x4	Beam	No Messages	0.109693	PMM	101	855	No Messages	No Messages
158	Box125x75x4	Beam	No Messages	0.111105	PMM	101	855	No Messages	No Messages
163	Box125x75x4	Beam	No Messages	0.174293	PMM	101	840	No Messages	No Messages
164	Box125x75x4	Beam	No Messages	0.174075	PMM	101	840	No Messages	No Messages
165	Box125x75x4	Beam	No Messages	0.17528	PMM	101	840	No Messages	No Messages
171	Box125x75x4	Beam	No Messages	0.174772	PMM	101	840	No Messages	No Messages
172	Box125x75x4	Beam	No Messages	0.174057	PMM	101	840	No Messages	No Messages
173	Box125x75x4	Beam	No Messages	0.174651	PMM	101	840	No Messages	No Messages
184	Box125x75x4	Beam	No Messages	0.174226	PMM	101	840	No Messages	No Messages
185	Box125x75x4	Beam	No Messages	0.173946	PMM	101	840	No Messages	No Messages
186	Box125x75x4	Beam	No Messages	0.17479	PMM	101	840	No Messages	No Messages
198	Box125x75x4	Beam	No Messages	0.173465	PMM	101	840	No Messages	No Messages
199	Box125x75x4	Beam	No Messages	0.173498	PMM	101	840	No Messages	No Messages
200	Box125x75x4	Beam	No Messages	0.174205	PMM	101	840	No Messages	No Messages
179	Box125x75x4	Beam	No Messages	0.173475	PMM	101	840	No Messages	No Messages
180	Box125x75x4	Beam	No Messages	0.172828	PMM	101	840	No Messages	No Messages
181	Box125x75x4	Beam	No Messages	0.173519	PMM	101	840	No Messages	No Messages
193	Box125x75x4	Beam	No Messages	0.173134	PMM	101	840	No Messages	No Messages
194	Box125x75x4	Beam	No Messages	0.172947	PMM	101	840	No Messages	No Messages
195	Box125x75x4	Beam	No Messages	0.173638	PMM	101	840	No Messages	No Messages
197	Box125x75x4	Beam	No Messages	0.17377	PMM	101	840	No Messages	No Messages
183	Box125x75x4	Beam	No Messages	0.173772	PMM	101	840	No Messages	No Messages
154	Box125x75x4	Beam	No Messages	0.11462	PMM	101	900	No Messages	No Messages
144	Box125x75x4	Beam	No Messages	0.113348	PMM	101	900	No Messages	No Messages
142	Box125x75x4	Beam	No Messages	0.093735	PMM	101	900	No Messages	No Messages
234	Box125x75x4	Brace	No Messages	0.184252	PMM	101	1585.16	No Messages	No Messages
235	Box125x75x4	Brace	No Messages	0.187223	PMM	101	1585.16	No Messages	No Messages
236	Box125x75x4	Brace	No Messages	0.18729	PMM	101	1585.16	No Messages	No Messages
237	Box125x75x4	Brace	No Messages	0.183815	PMM	101	1585.16	No Messages	No Messages
275	Box125x75x4	Brace	No Messages	0.150577	PMM	101	1585.16	No Messages	No Messages
276	Box125x75x4	Beam	No Messages	0.006344	PMM	201	900	No Messages	No Messages
277	Box125x75x4	Beam	No Messages	0.006091	PMM	101	900	No Messages	No Messages
294	Box125x75x4	Beam	No Messages	0.316333	PMM	101	1800	No Messages	No Messages
295	Box125x75x4	Beam	No Messages	0.072881	PMM	101	900	No Messages	No Messages
296	Box125x75x4	Beam	No Messages	0.317755	PMM	101	1800	No Messages	No Messages
305	Box125x75x4	Beam	No Messages	0.33854	PMM	101	1800	No Messages	No Messages
307	Box125x75x4	Beam	No Messages	0.338805	PMM	101	1800	No Messages	No Messages
324	Box125x75x4	Beam	No Messages	0.325396	PMM	101	1800	No Messages	No Messages
325	Box125x75x4	Beam	No Messages	0.324803	PMM	101	1800	No Messages	No Messages
326	Box125x75x4	Beam	No Messages	0.394758	PMM	101	1800	No Messages	No Messages
327	Box125x75x4	Beam	No Messages	0.394537	PMM	101	1800	No Messages	No Messages
336	Box125x75x4	Beam	No Messages	0.336914	PMM	101	1800	No Messages	No Messages
337	Box125x75x4	Beam	No Messages	0.337277	PMM	101	1800	No Messages	No Messages
354	Box125x75x4	Beam	No Messages	0.323887	PMM	101	1800	No Messages	No Messages
355	Box125x75x4	Beam	No Messages	0.323276	PMM	101	1800	No Messages	No Messages
356	Box125x75x4	Beam	No Messages	0.385416	PMM	101	1800	No Messages	No Messages
357	Box125x75x4	Beam	No Messages	0.385333	PMM	101	1800	No Messages	No Messages
358	Box125x75x4	Brace	No Messages	0.007384	PMM	101	758.55	No Messages	No Messages
359	Box125x75x4	Brace	No Messages	0.005312	PMM	301	687.95	No Messages	No Messages

TABLE: Steel Beam (Box-125x75x4.5) Design - Summary Data									
Frame	DesignSect	DesignType	Status	Ratio	RatioType	Combo	Location	ErrMsg	WarnMsg
Text	Text	Text	Text	Unitless	Text	Text	mm	Text	Text
360	Box125x75x4	Brace	No Messages	0.002586	PMM	201	495	No Messages	No Messages
361	Box125x75x4	Brace	No Messages	0.003936	PMM	201	495	No Messages	No Messages
362	Box125x75x4	Brace	No Messages	0.00562	PMM	201	532.5	No Messages	No Messages
363	Box125x75x4	Brace	No Messages	0.004697	PMM	301	532.5	No Messages	No Messages
364	Box125x75x4	Brace	No Messages	0.002427	PMM	202	495	No Messages	No Messages
365	Box125x75x4	Brace	No Messages	0.002822	PMM	301	495	No Messages	No Messages
366	Box125x75x4	Brace	No Messages	0.006633	PMM	301	687.95	No Messages	No Messages
367	Box125x75x4	Brace	No Messages	0.007295	PMM	101	758.55	No Messages	No Messages
368	Box125x75x4	Brace	No Messages	0.005453	PMM	301	687.95	No Messages	No Messages
369	Box125x75x4	Brace	No Messages	0.002707	PMM	304	495	No Messages	No Messages
370	Box125x75x4	Brace	No Messages	0.003686	PMM	202	495	No Messages	No Messages
371	Box125x75x4	Brace	No Messages	0.005532	PMM	101	532.5	No Messages	No Messages
372	Box125x75x4	Brace	No Messages	0.004685	PMM	301	532.5	No Messages	No Messages
373	Box125x75x4	Brace	No Messages	0.002392	PMM	301	495	No Messages	No Messages
374	Box125x75x4	Brace	No Messages	0.002773	PMM	201	495	No Messages	No Messages
375	Box125x75x4	Brace	No Messages	0.006548	PMM	301	687.95	No Messages	No Messages
			Max Ratio =	0.395					

Calculation Detail

```
Combo  : 101
Units  : Kgf, mm, C


Frame  : 326             Design Sect: Box125x75x4
X Mid  : 7200.000        Design Type: Beam
Y Mid  : 5507.153        Frame Type : Ordinary Moment Resisting Frame
Z Mid  : 6330.507        Sect Class : Compact
Length : 3600.000        Major Axis : 0.000 degrees counterclockwise from local 3
Loc    : 1800.000        RLLF       : 1.000

Area   : 1719.000        SMajor : 57953.652       rMajor : 45.903         AVMajor: 1125.000
IMajor : 3622103.250     SMinor : 43077.420       rMinor : 30.655         AVMinor: 675.000
IMinor : 1615403.250     ZMajor : 70944.750       E      : 20400.000
Ixy    : 0.000           ZMinor : 49457.250       Fy     : 25.000


STRESS CHECK FORCES & MOMENTS
    Location                  P        M33         M22          V2          V3           T
    1800.000             58.887 314088.604   45497.467       0.325     -25.276       0.000

PMM DEMAND/CAPACITY RATIO
    Governing             Total          P      MMajor      MMinor       Ratio      Status
    Equation              Ratio      Ratio       Ratio       Ratio       Limit       Check
    (H2-1)                0.395   =  0.002   +   0.328   +   0.064       0.950          OK

AXIAL FORCE DESIGN
                              P         fa          Fa          Ft
                          Force     Stress   Allowable   Allowable
    Axial                58.887      0.034      12.214      15.000

MOMENT DESIGN
                              M         fb          Fb          Fe        Cm          K          L        Cb
                         Moment     Stress   Allowable   Allowable    Factor     Factor     Factor    Factor
    Major Moment     314088.604      5.420      16.500      68.316     1.000      1.000      0.500     1.000
    Minor Moment      45497.467      1.056      16.500      30.468     1.000      1.000      0.500

SHEAR DESIGN
                              V         fv          Fv      Stress      Status           T
                          Force     Stress   Allowable       Ratio       Check     Torsion
    Major Shear           0.325  2.885E-04      10.000   2.885E-05          OK       0.000
    Minor Shear          25.276      0.037      10.000       0.004          OK       0.000
```

(4) Wood Deck Beam



Wood Deck Section

<u>Calculation Detail</u>

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

$$_L fc = 60kgf/cm^2 \quad ; \quad _L ft = 45kgf/cm^2.$$

Because both fc and ft are less than the allowable stresses, the design result is satisfactory.

(5) Bolt Connection Check

The connection between Girder 2-C200x75x4 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 0.318. Therefore, it the bolt connection force can be determined by capacity design concept, that is

$P_{t,col}$ = $(0.6F_y)$ x b_f x t_f x PMM_ratio = 0.6x2.5x15x0.6x0.318 = 4.293 tf

As for Girder Box-150x150x4.5, its maximum PMM ratio (shown in 9.(2)) is 0.425. So, the bolt connection force can be obtained as follows:

$P_{t,girder}$ = $(0.6F_y)$ x b_f x t_f x PMM_ratio = 0.6x2.5x15x0.45x0.425 = 4.303 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 (box-125x75x4.5), its connection to girder is shear connection. The shear ratio of beam is less than 0.1. Use capacity design concept, the connection force can be determined as

V_{BM} = $(0.4F_y)$ x (2 x d_w x t_w) x Shear_ratio = 0.4x2.5x2x12.5x0.45x0.1 = 1.125 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. 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	148.85	31.97	2311.73	0	0	0
1	201	Combination	76.29	28.81	2075.6	0	0	0
1	202	Combination	191.1	33.86	2252.6	0	0	0
1	203	Combination	-14.78	17.23	1086.85	0	0	0
1	204	Combination	138.3	23.97	1322.86	0	0	0
1	301	Combination	135.55	-33.42	1782.99	0	0	0
1	302	Combination	191.1	33.86	2252.6	0	0	0
1	303	Combination	64.23	-65.74	696.71	0	0	0
1	304	Combination	59.29	106.94	1713	0	0	0
5	101	Combination	-61.31	88.4	3399.76	0	0	0
5	201	Combination	-152.42	74.4	2874.04	0	0	0
5	202	Combination	41.19	73.61	3214.27	0	0	0
5	203	Combination	-156.04	22.11	1157.33	0	0	0
5	204	Combination	102.11	21.05	1610.96	0	0	0
5	301	Combination	-49.77	9.5	2664.47	0	0	0
5	302	Combination	41.19	73.61	3214.27	0	0	0
5	303	Combination	-19.17	-64.44	877.9	0	0	0
5	304	Combination	-34.76	107.6	1890.39	0	0	0
6	101	Combination	68.47	-23.79	2564.14	0	0	0
6	201	Combination	-30.73	-24.23	2444.52	0	0	0
6	202	Combination	155.8	-21.34	2146.39	0	0	0
6	203	Combination	-93.04	-15.76	1241.33	0	0	0
6	204	Combination	155.68	-11.91	843.83	0	0	0
6	301	Combination	67.85	-101.49	1381.67	0	0	0
6	302	Combination	155.8	-21.34	2146.39	0	0	0
6	303	Combination	38.41	-118.78	-175.79	0	0	0
6	304	Combination	24.23	91.1	2260.96	0	0	0
10	101	Combination	-114.52	-4.94	1918.04	0	0	0
10	201	Combination	-160.47	-4.36	1856.69	0	0	0
10	202	Combination	-46.66	-5.29	1663.16	0	0	0
10	203	Combination	-125.36	-2.52	1028.91	0	0	0
10	204	Combination	26.38	-3.76	770.87	0	0	0
10	301	Combination	-95.27	-62.91	1044.75	0	0	0
10	302	Combination	-46.66	-5.29	1663.16	0	0	0
10	303	Combination	-38.43	-80.58	-53.68	0	0	0
10	304	Combination	-60.55	74.3	1853.45	0	0	0
11	101	Combination	-6.64	-0.05611	940.35	0	0	0
11	201	Combination	-12.98	1.7	825.16	0	0	0
11	202	Combination	2.07	-1.96	845.77	0	0	0
11	203	Combination	-11.35	2.2	350.82	0	0	0
11	204	Combination	8.7	-2.69	378.3	0	0	0
11	301	Combination	-4.31	-0.44	1041.83	0	0	0
11	302	Combination	2.07	-1.96	845.77	0	0	0
11	303	Combination	0.2	-0.66	639.72	0	0	0
11	304	Combination	-2.85	0.17	89.4	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	-0.69	-0.68	1367.77	0	0	0
15	201	Combination	-0.25	-1	1146.85	0	0	0
15	202	Combination	-1.43	-0.37	1211.33	0	0	0
15	203	Combination	-0.11	-0.9	386.14	0	0	0
15	204	Combination	-1.69	-0.0661	472.12	0	0	0
15	301	Combination	-2.99	-1.38	1377.65	0	0	0
15	302	Combination	-1.43	-0.37	1211.33	0	0	0
15	303	Combination	-3.77	-1.42	693.88	0	0	0
15	304	Combination	1.96	0.45	164.39	0	0	0
16	101	Combination	197.2	-37.69	2662.24	0	0	0
16	201	Combination	92.86	-37.12	2267.85	0	0	0
16	202	Combination	243.7	-35.58	2363.16	0	0	0
16	203	Combination	-43.49	-23.66	829.17	0	0	0
16	204	Combination	157.62	-21.61	956.24	0	0	0
16	301	Combination	168.21	-150.87	2851.14	0	0	0
16	302	Combination	243.7	-35.58	2363.16	0	0	0
16	303	Combination	56.97	-175.33	1606.89	0	0	0
16	304	Combination	57.16	130.06	178.52	0	0	0
20	101	Combination	-205.09	-27.36	2353.06	0	0	0
20	201	Combination	-236.73	-27.92	2195.79	0	0	0
20	202	Combination	-114.59	-23.27	2002.47	0	0	0
20	203	Combination	-142.58	-17.3	1065.03	0	0	0
20	204	Combination	20.27	-11.11	807.25	0	0	0
20	301	Combination	-179.12	-112.4	2504.01	0	0	0
20	302	Combination	-114.59	-23.27	2002.47	0	0	0
20	303	Combination	-65.76	-129.94	1475.97	0	0	0
20	304	Combination	-56.55	101.53	396.31	0	0	0
23	101	Combination	-0.2	-1.54	1136.88	0	0	0
23	201	Combination	0.9	-0.42	1002.24	0	0	0
23	202	Combination	-1.23	-2.29	1009.72	0	0	0
23	203	Combination	1.38	0.68	424.32	0	0	0
23	204	Combination	-1.46	-1.8	434.29	0	0	0
23	301	Combination	-0.09403	-1.42	912.64	0	0	0
23	302	Combination	-1.23	-2.29	1009.72	0	0	0
23	303	Combination	0.05843	-0.65	304.84	0	0	0
23	304	Combination	-0.13	-0.48	553.77	0	0	0
27	101	Combination	0.14	-0.56	1887.18	0	0	0
27	201	Combination	0.47	-1.85	1572.99	0	0	0
27	202	Combination	-0.23	0.75	1639.23	0	0	0
27	203	Combination	0.52	-2.11	489.86	0	0	0
27	204	Combination	-0.42	1.36	578.19	0	0	0
27	301	Combination	0.25	-1.01	1519.76	0	0	0
27	302	Combination	-0.23	0.75	1639.23	0	0	0
27	303	Combination	0.22	-0.99	418.9	0	0	0
27	304	Combination	-0.13	0.24	649.16	0	0	0
28	101	Combination	277.93	-38.91	3006.34	0	0	0
28	201	Combination	155.87	-36.87	2508.67	0	0	0
28	202	Combination	316.56	-36.27	2625.14	0	0	0
28	203	Combination	-29.37	-21.1	796.37	0	0	0
28	204	Combination	184.88	-20.3	951.65	0	0	0
28	301	Combination	237.18	-142.95	2549.05	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
28	302	Combination	316.56	-36.27	2625.14	0	0	0
28	303	Combination	79.05	-162.54	850.2	0	0	0
28	304	Combination	76.47	121.14	897.82	0	0	0
32	101	Combination	-270.14	-28.13	2549.26	0	0	0
32	201	Combination	-294.2	-24.32	2354.69	0	0	0
32	202	Combination	-164.87	-27.82	2141.38	0	0	0
32	203	Combination	-161.63	-11.59	1083.25	0	0	0
32	204	Combination	10.8	-16.25	798.83	0	0	0
32	301	Combination	-228.75	-105.97	2235.99	0	0	0
32	302	Combination	-164.87	-27.82	2141.38	0	0	0
32	303	Combination	-74.37	-120.46	924.99	0	0	0
32	304	Combination	-76.47	92.62	957.1	0	0	0
35	101	Combination	85.25	-43.75	3620.2	0	0	0
35	201	Combination	29.91	-40.78	3172.1	0	0	0
35	202	Combination	115.4	-41.02	3415.6	0	0	0
35	203	Combination	-32.6	-22.5	1458.03	0	0	0
35	204	Combination	81.4	-22.81	1782.71	0	0	0
35	301	Combination	73.3	-142.26	3532.53	0	0	0
35	302	Combination	115.4	-41.02	3415.6	0	0	0
35	303	Combination	25.25	-157.8	1938.61	0	0	0
35	304	Combination	23.54	112.49	1302.13	0	0	0
39	101	Combination	-79.55	-86.93	4966.76	0	0	0
39	201	Combination	-170.86	-76.34	3778.19	0	0	0
39	202	Combination	34.74	-77.84	4773.95	0	0	0
39	203	Combination	-160.57	-32.29	878.95	0	0	0
39	204	Combination	113.57	-34.3	2206.64	0	0	0
39	301	Combination	-67.97	-176.7	4511.81	0	0	0
39	302	Combination	34.74	-77.84	4773.95	0	0	0
39	303	Combination	-23.39	-166.11	1857.12	0	0	0
39	304	Combination	-23.61	99.52	1228.47	0	0	0
40	101	Combination	206.44	-34.67	5713.45	0	0	0
40	201	Combination	53.32	-31.9	5276.29	0	0	0
40	202	Combination	298.06	-33.53	4529.26	0	0	0
40	203	Combination	-104.74	-17.7	2227.56	0	0	0
40	204	Combination	221.57	-19.88	1231.52	0	0	0
40	301	Combination	175.77	-133.71	5198.79	0	0	0
40	302	Combination	298.06	-33.53	4529.26	0	0	0
40	303	Combination	58.51	-153.46	2124.22	0	0	0
40	304	Combination	58.32	115.88	1334.85	0	0	0
44	101	Combination	-233.33	-17.42	4392.81	0	0	0
44	201	Combination	-256.64	-17.38	4140.22	0	0	0
44	202	Combination	-139.71	-15.25	3672.11	0	0	0
44	203	Combination	-142.86	-10.52	2024.42	0	0	0
44	204	Combination	13.05	-7.68	1400.27	0	0	0
44	301	Combination	-198.48	-93.25	4138.97	0	0	0
44	302	Combination	-139.71	-15.25	3672.11	0	0	0
44	303	Combination	-65.31	-111.68	2022.75	0	0	0
44	304	Combination	-64.5	93.48	1401.93	0	0	0
47	101	Combination	-1.04	-2.91	1457.13	0	0	0
47	201	Combination	-2.22	-2.02	1281.1	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	202	Combination	0.42	-3.05	1298.59	0	0	0
47	203	Combination	-2.1	-0.3	539.92	0	0	0
47	204	Combination	1.42	-1.67	563.25	0	0	0
47	301	Combination	-1.15	-2.64	1294.23	0	0	0
47	302	Combination	0.42	-3.05	1298.59	0	0	0
47	303	Combination	-0.67	-1.13	557.43	0	0	0
47	304	Combination	-0.003536	-0.84	545.75	0	0	0
51	101	Combination	-0.18	-1.88	2358.32	0	0	0
51	201	Combination	-0.28	-2.76	1971.1	0	0	0
51	202	Combination	-0.02817	-0.62	2040.83	0	0	0
51	203	Combination	-0.23	-2.2	617.74	0	0	0
51	204	Combination	0.11	0.65	710.71	0	0	0
51	301	Combination	-0.14	-2.21	2008.28	0	0	0
51	302	Combination	-0.02817	-0.62	2040.83	0	0	0
51	303	Combination	-0.04375	-1.47	667.32	0	0	0
51	304	Combination	-0.07736	-0.08228	661.13	0	0	0
52	101	Combination	339.07	-60.53	2928.38	0	0	0
52	201	Combination	199.94	-55.38	2445.25	0	0	0
52	202	Combination	375.28	-54.59	2563.05	0	0	0
52	203	Combination	-23.64	-27.37	783.49	0	0	0
52	204	Combination	210.15	-26.32	940.57	0	0	0
52	301	Combination	287.78	-159.56	2489.18	0	0	0
52	302	Combination	375.28	-54.59	2563.05	0	0	0
52	303	Combination	93.48	-166.29	842.07	0	0	0
52	304	Combination	93.03	112.59	881.99	0	0	0
56	101	Combination	-335.24	-30.36	3171.13	0	0	0
56	201	Combination	-353.63	-28.88	2908.5	0	0	0
56	202	Combination	-215.07	-27.5	2678.59	0	0	0
56	203	Combination	-184.55	-16.1	1315.82	0	0	0
56	204	Combination	0.2	-14.25	1009.27	0	0	0
56	301	Combination	-284.18	-105.5	2789.82	0	0	0
56	302	Combination	-215.07	-27.5	2678.59	0	0	0
56	303	Combination	-91.94	-118.25	1157.58	0	0	0
56	304	Combination	-92.41	87.9	1167.51	0	0	0
59	101	Combination	269.87	-56.18	4514.04	0	0	0
59	201	Combination	146.36	-48.72	3851.35	0	0	0
59	202	Combination	312.34	-58.33	4233.2	0	0	0
59	203	Combination	-35.19	-25.49	1584.32	0	0	0
59	204	Combination	186.11	-38.3	2093.45	0	0	0
59	301	Combination	229.42	-153.9	3882.8	0	0	0
59	302	Combination	312.34	-58.33	4233.2	0	0	0
59	303	Combination	75.55	-165.74	1626.25	0	0	0
59	304	Combination	75.37	101.94	2051.53	0	0	0
63	101	Combination	-152.38	-21.68	4957.99	0	0	0
63	201	Combination	-271.58	-23.05	3970.73	0	0	0
63	202	Combination	13.17	-21.72	4560.42	0	0	0
63	203	Combination	-231.6	-18.03	1138.71	0	0	0
63	204	Combination	148.06	-16.27	1924.96	0	0	0
63	301	Combination	-128.9	-121.49	4117.79	0	0	0
63	302	Combination	13.17	-21.72	4560.42	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
63	303	Combination	-41.37	-149.29	1334.79	0	0	0
63	304	Combination	-42.17	114.99	1728.89	0	0	0
65	101	Combination	219.18	39.95	6429.43	0	0	0
65	201	Combination	42.13	31.8	5800.48	0	0	0
65	202	Combination	329.16	30.02	5219.7	0	0	0
65	203	Combination	-131.82	3.83	2313.63	0	0	0
65	204	Combination	250.88	1.46	1539.25	0	0	0
65	301	Combination	185.89	-60.58	5561.74	0	0	0
65	302	Combination	329.16	30.02	5219.7	0	0	0
65	303	Combination	59.86	-119.34	1995.31	0	0	0
65	304	Combination	59.2	124.63	1857.58	0	0	0
69	101	Combination	-270.27	-31.26	4966.98	0	0	0
69	201	Combination	-309.52	-30.09	4595.22	0	0	0
69	202	Combination	-149.15	-27.22	4209.04	0	0	0
69	203	Combination	-181.48	-16.51	2152.76	0	0	0
69	204	Combination	32.34	-12.69	1637.85	0	0	0
69	301	Combination	-229.47	-102.17	4371.88	0	0	0
69	302	Combination	-149.15	-27.22	4209.04	0	0	0
69	303	Combination	-74.75	-112.61	1854.97	0	0	0
69	304	Combination	-74.39	83.41	1935.64	0	0	0
70	101	Combination	335.22	-73.4	2967.97	0	0	0
70	201	Combination	217.19	-62.32	2499.65	0	0	0
70	202	Combination	351.69	-72.75	2716.2	0	0	0
70	203	Combination	2.81	-28.01	925.09	0	0	0
70	204	Combination	182.14	-41.91	1213.82	0	0	0
70	301	Combination	284.87	-188.33	2543.64	0	0	0
70	302	Combination	351.69	-72.75	2716.2	0	0	0
70	303	Combination	93.05	-196.02	983.74	0	0	0
70	304	Combination	91.9	126.1	1155.17	0	0	0
74	101	Combination	-72.8	-52.41	4244.15	0	0	0
74	201	Combination	-166.68	-50.02	3646.91	0	0	0
74	202	Combination	42.84	-48.35	3569.22	0	0	0
74	203	Combination	-160.17	-28.76	1241.67	0	0	0
74	204	Combination	119.19	-26.54	1138.08	0	0	0
74	301	Combination	-64.98	-169.56	3530.96	0	0	0
74	302	Combination	42.84	-48.35	3569.22	0	0	0
74	303	Combination	-24.57	-188.15	1087.07	0	0	0
74	304	Combination	-16.42	132.84	1292.69	0	0	0
76	101	Combination	-3.11	2.8	1865	0	0	0
76	201	Combination	0.54	4.42	1592.19	0	0	0
76	202	Combination	-5.97	0.57	1570.36	0	0	0
76	203	Combination	3.28	3.67	525.62	0	0	0
76	204	Combination	-5.41	-1.47	496.51	0	0	0
76	301	Combination	-2.32	3.05	1550.5	0	0	0
76	302	Combination	-5.97	0.57	1570.36	0	0	0
76	303	Combination	-0.54	1.85	470.03	0	0	0
76	304	Combination	-1.59	0.36	552.1	0	0	0
80	101	Combination	-403.8	-47.2	3291.26	0	0	0
80	201	Combination	-396.36	-48.5	2947.71	0	0	0
80	202	Combination	-288.6	-37.93	2830.16	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
80	203	Combination	-182.81	-28.93	1255.74	0	0	0
80	204	Combination	-39.11	-14.84	1099	0	0	0
80	301	Combination	-340.25	-125.88	2825.36	0	0	0
80	302	Combination	-288.6	-37.93	2830.16	0	0	0
80	303	Combination	-107.98	-132.11	1092.62	0	0	0
80	304	Combination	-113.94	88.34	1262.13	0	0	0
81	101	Combination	211.61	138.53	4371.02	0	0	0
81	201	Combination	100.17	122.13	3823.06	0	0	0
81	202	Combination	272.63	137.85	4112.94	0	0	0
81	203	Combination	-37.43	62.59	1737.99	0	0	0
81	204	Combination	192.51	83.54	2124.5	0	0	0
81	301	Combination	182.76	41.91	4217.87	0	0	0
81	302	Combination	272.63	137.85	4112.94	0	0	0
81	303	Combination	72.68	-44.38	2264.4	0	0	0
81	304	Combination	82.4	190.51	1598.08	0	0	0
85	101	Combination	-109.21	177.78	5258.27	0	0	0
85	201	Combination	-235.21	164.78	4405.67	0	0	0
85	202	Combination	40.17	168.99	4890.68	0	0	0
85	203	Combination	-227.31	91.14	1649.2	0	0	0
85	204	Combination	139.87	96.75	2295.87	0	0	0
85	301	Combination	-103.53	81.8	4882.46	0	0	0
85	302	Combination	40.17	168.99	4890.68	0	0	0
85	303	Combination	-51.72	-19.51	2284.91	0	0	0
85	304	Combination	-35.71	207.4	1660.16	0	0	0
87	101	Combination	149.25	83.38	5842.79	0	0	0
87	201	Combination	-10.61	88.74	5379.07	0	0	0
87	202	Combination	272.09	86.4	4898.73	0	0	0
87	203	Combination	-135.82	71.65	2439.29	0	0	0
87	204	Combination	241.12	68.53	1798.84	0	0	0
87	301	Combination	125.27	20.68	5260.32	0	0	0
87	302	Combination	272.09	86.4	4898.73	0	0	0
87	303	Combination	45.36	-19.1	2280.96	0	0	0
87	304	Combination	59.94	159.27	1957.17	0	0	0
91	101	Combination	-188.96	161.39	4267.29	0	0	0
91	201	Combination	-253	159.42	4014.53	0	0	0
91	202	Combination	-82.45	141.84	3727.17	0	0	0
91	203	Combination	-186.53	94.56	2068.65	0	0	0
91	204	Combination	40.87	71.12	1685.5	0	0	0
91	301	Combination	-172.44	96.67	4049.53	0	0	0
91	302	Combination	-82.45	141.84	3727.17	0	0	0
91	303	Combination	-79.11	10.89	2115.32	0	0	0
91	304	Combination	-66.54	154.79	1638.83	0	0	0

In the previous list, the maximum vertical force is 6429kgf and uplift force is 176kgf. The uplift force does not include the footing base. After considering the footing weight (near 70kgf), the uplift force is reduced to 106kgf. It is too small and can be ignored. Therefore, we only consider the maximum compressive force 6429kgf 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 20tf/m^2 for long term loading in Hsinchu site. Therefore, the footing 60x60cm is enough because the soil bearing, 6.429/(0.6x0.6)= 17.86 tf/m^2, is less than the allowable soil bearing stress.