PROJECT MANUAL

Deliverable #2
July 1st, 2013

NCTU Architecture
國立交通大學建築研究所

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國立交通大學
National Chiao Tung University

Solar Decathlon Europe 2014 EN FRANCE

Orchid House

SUMMARY OF CHANGES

ITEM	STATUS	DATE
COVER SHEET	UPDATED	JUL 1, 2013
SUMMARY OF CHANGES	UPDATED	JUL 1, 2013
TABLE OF CONTENTS	UPDATED	JUL 1, 2013
RULES AND BUILDING CODE COMPLIANCE CHECKLIST	UPDATED	JUL 1, 2013
CONTEST SUPPORT DOCUMENTS	UPDATED	JUL 1, 2013
Architecture Design Narrative	UPDATED	JUL 1, 2013
Engineering and Construction Design Narrative	UPDATED	JUL 1, 2013
Energy Efficiency Design Narrative	UPDATED	JUL 1, 2013
Communications Plan	UPDATED	JUL 1, 2013
Urban Design, Transportation and Affordability Report	UPDATED	JUL 1, 2013
Innovation Report	UPDATED	JUL 1, 2013
Sustainability Report	UPDATED	JUL 1, 2013
DINNER PARTY MENU	NO CHANGE	APR 1, 2013
COST ESTIMATE AND PROJECT FINANCIAL SUMMARY	NO CHANGE	APR 1, 2013
CONTACT INFORMATION	UPDATED	JUL 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 WORKSPACE)	PM: p.56
4.3 Lot Conditions and attribution	Drawing(s) showing the storage and unloading areas and corresponding load's calculations	N/A
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: SO-201
4.10 Spill and Waste Products	Drawing(s) showing the locations of all equipment, tanks and pipes containing fluids during the event and corresponding specifications	N/A
5.1 Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	PD: AR-101
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 Maximum Architectural Footprint	Drawing(s) showing all information needed by the Rules Officials to digitally measure the architectural footprint	PD: AR-051
6.2 Maximum Architectural Footprint	Drawing(s) showing all the reconfigurable features that may increase the footprint if operated during contest week	PD: AR-041
6.3 Minimum & Maximum Measurable Area	Drawing(s) showing the Minimum & Maximum Measurable Area	PD: AR-052
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 the Solar Village	PD: PT-001
7.3 PV Technology Limitations	Specifications and contractor price quote for photovoltaic components	N/A
7.4 Batteries	Drawing(s) showing the location(s) and quantity of stand-alone, PV-powered devices and corresponding specifications	PD: ME-101 PM: N/A
7.4 Batteries	Drawing(s) showing the location(s) and quantity of hard-wired battery banks components and corresponding specifications	PD: ME-101 PM: N/A
7.6 Thermal Energy Storage	Drawing(s) showing the location of thermal energy storage components and corresponding specifications	PD: AR-211 PM: N/A
7.7 Desiccant Systems	Drawing(s) describing the operation of the desiccant system and corresponding specifications	PD: ME-011
7.8 Humidification systems	Specifications for humidification systems and corresponding certifications of the different elements	N/A
8.1 Containers locations	Drawing(s) showing the location of all the water tanks	PD: ME-011
8.2 Water Delivery	Drawing(s) showing the fill location(s), quantity of water requested at each fill location, tank dimensions, diameter of opening(s) and clearance above the tank(s)	PD: ME-011
8.3 Water Removal	Drawing(s) showing the quantity of water	PD: ME-101

	to be removed from each fill location, tank dimensions, diameter of opening(s) and clearance above the tank(s).	
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	PL-101
8.8 Thermal Mass	Drawing(s) showing the locations of water-based thermal mass systems and corresponding specifications	PD: AR-211 PM: N/A
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-011
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	N/A
11.2 Use of the Solar Decathlon Europe Logo	Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage	PM: p. 31
11.3 Teams' sponsors & Supporting Institutions	Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage	PM: p. 31, 33
11.4 Team Uniforms	Drawing(s) showing the artwork, content and design of the team uniform	N/A
12.4 Public Tour	Drawing(s) showing the public tour route, indicating the dimensions of any difficult point, complying with the accessibility requirements	PT-201
20.0 Contest 6: Drying Method	Drawing(s) showing the drying Method. (ie the place where the clothes wire will be located)	PD: AR-022
20.0 Contest 6: House Functioning	Drawing(s) showing the location of all the appliances and corresponding technical specifications.	PD: AR-021 PM: N/A
36.5 Photovoltaic systems design	Specifications of PV generators, inverters, wiring, cables, protections, earthing systems, interface with the electricity distribution network	PM: P.14-15
36.5 Photovoltaic systems design	Inverters' certificates	N/A
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: p. 14
36.5 Photovoltaic systems design	The corresponding table "design summary" must be filled out	N/A
51.3 Fire Safety	Specifications for Fire Reaction of Constructive elements, extinguishers and fire resistance of the house's structure.	FP-001 FP-002
51.3 Fire Safety	Drawings showing compliance with the evacuation of occupants' requirements and fire extinguishers location	FP-001
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 for uneven flooring, floors with different level, Restricted Areas stairs, Public Areas Staircases, Restricted Areas Ramps and Public Areas Ramps	PT-001
51.4 Safety for avoiding trapping and impact risk	Drawing(s) showing compliance with conditions for avoiding trapping and impact risk	N/A
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	Interior and exterior plans showing the entire accessible tour route	PT-001
51.6 Structural Safety	Specifications for the use of dead loads,	N/A

	live loads, safety factors and load combinations in the structural calculations	
51.7 Electrical and PV Systems	Specifications of the wiring, channels, panels and protections of the electrical installation	N/A
51.7 Electrical and PV Systems	One-line electrical diagram and drawings showing the grounding, execution and paths	EL-501

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Architecture Design Narrative

1.0 Background

Orchid House's architectural design responds to urban redevelopment, the usage of water and the rethinking of energy use. The Orchid House draws inspiration from the tropical Taiwanese orchid to reside in harmony with its surroundings. Wild orchids grow right underneath the canopy level, with good ventilation and no excessive water.

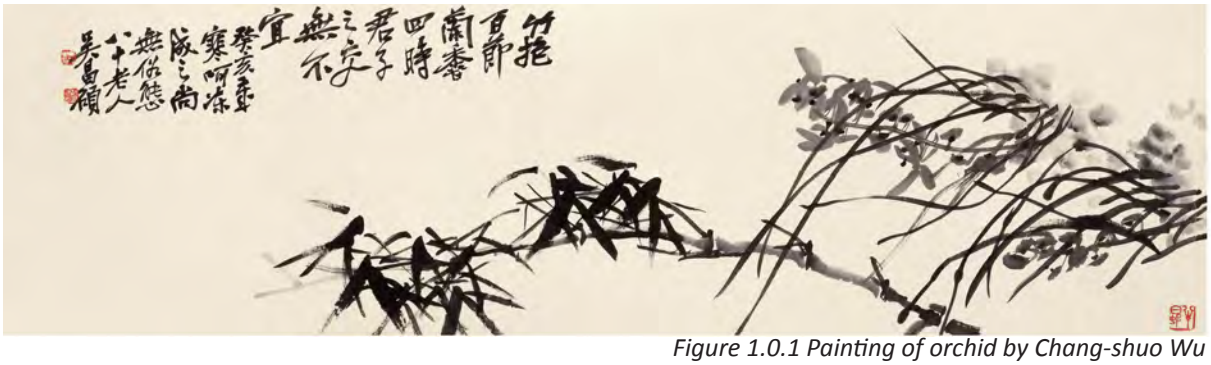


Figure 1.0.1 Painting of orchid by Chang-shuo Wu

Figure 1.0.2 South West View

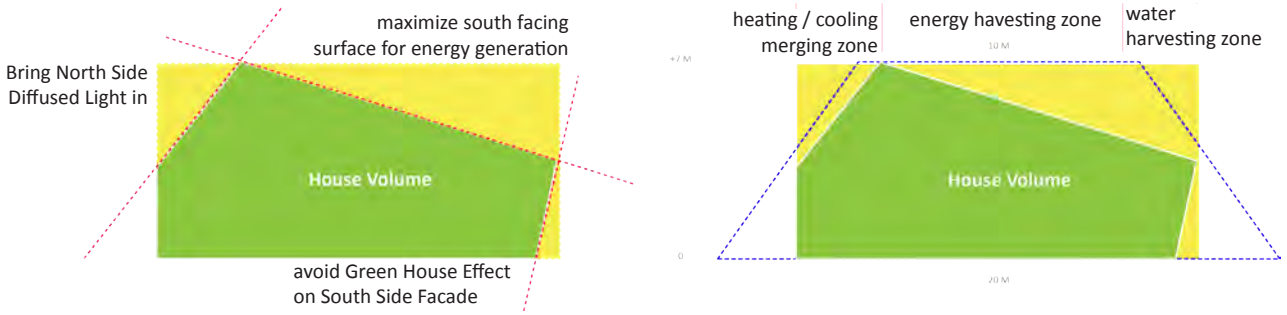
Figure 1.0.3 Terrace View

1.1 Massing Development

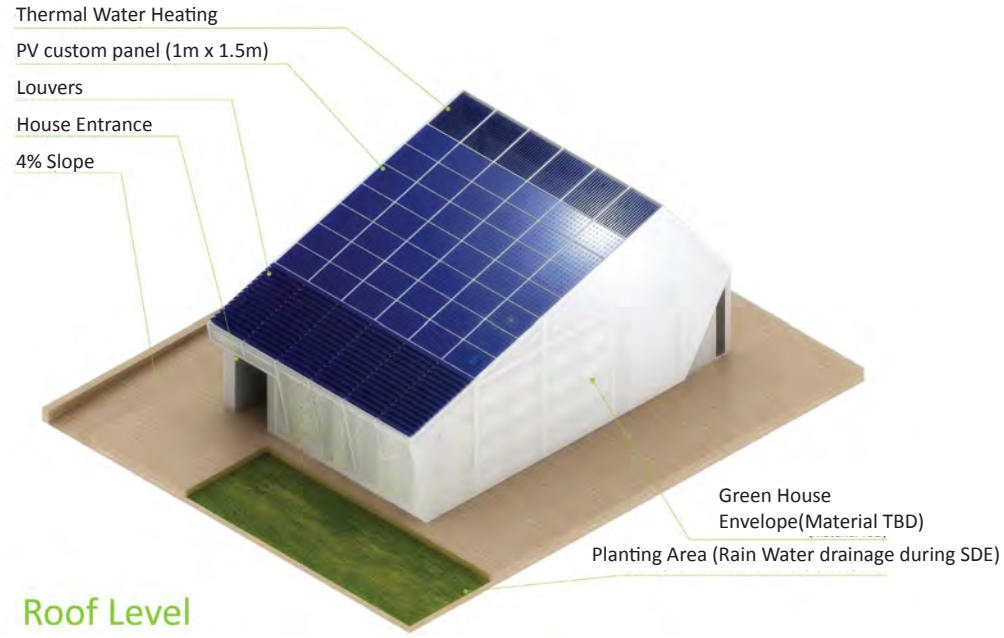
Taiwan suffers from visually unpleasant illegal rooftop structures that are made with metal sheets, and our solar house is an opportunity to solve this problem, along with other social issues and to promote sustainable living. NCTU/UNICODE takes the essence of this natural ecosystem, and regenerates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



1.2 Urban Regeneration Strategies

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.

Figure 1.2.1 Rooftop rendering

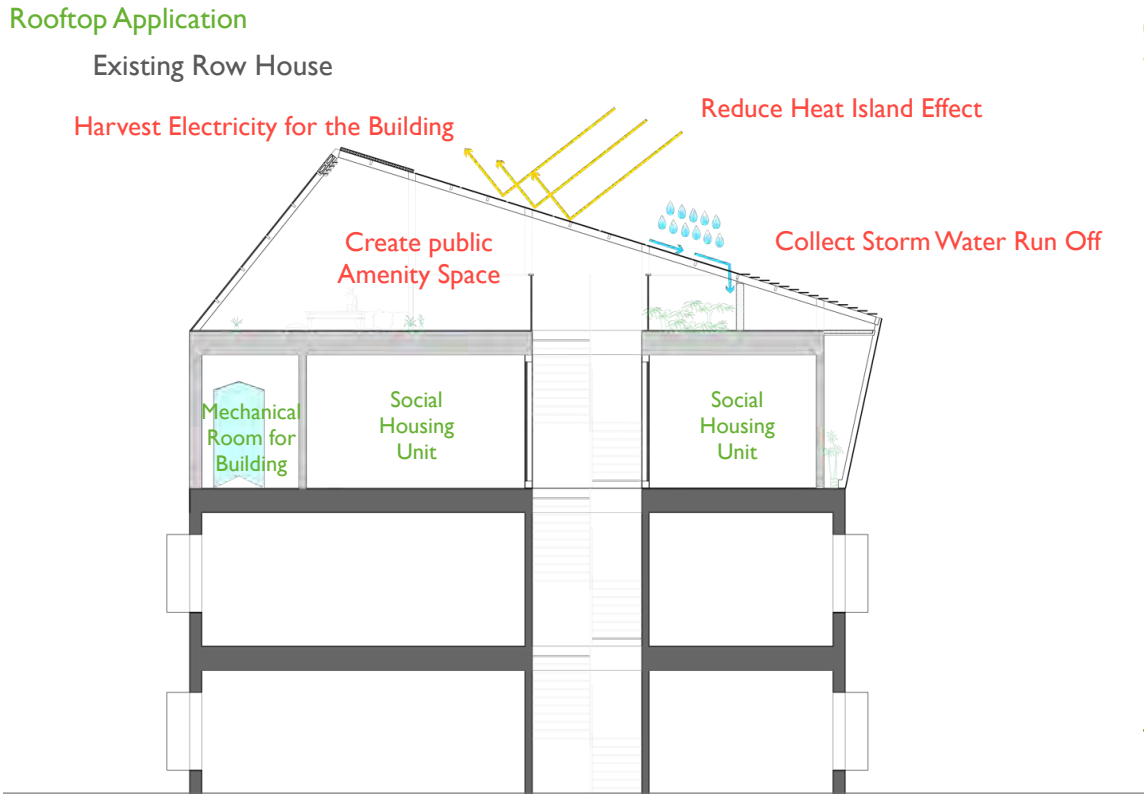


Figure 1.2.2 Rooftop application

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 to house the necessary mechanical features.

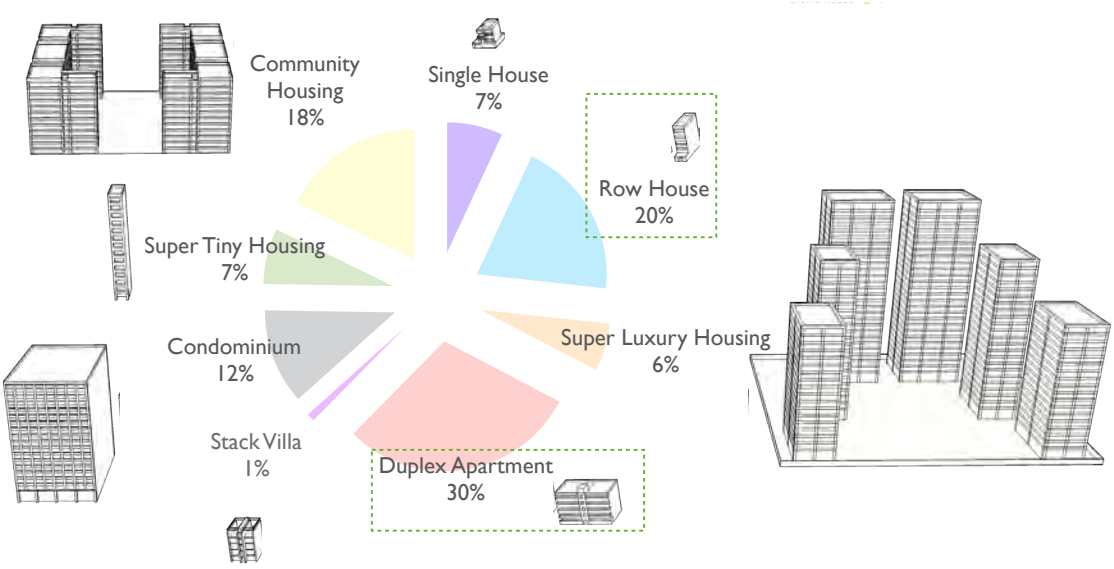


Figure 1.2.3 unit configuration diagram

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.

1.3 Social Housing Application

The solar house competition provides an opportunity to rethink the social issues in a high-density city, such as Taipei, and generate new ideas on how to make it better. At the present moment, Taiwan's social housing situation is in sore need of improvement. As 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 capital of Taiwan, population density in separate districts range from 4,600 to 27,600 – the solution is to build upwards. Many families live in 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, compared to 6.06% in Japan, 6.2% in the USA, and 9.7% in Korea.

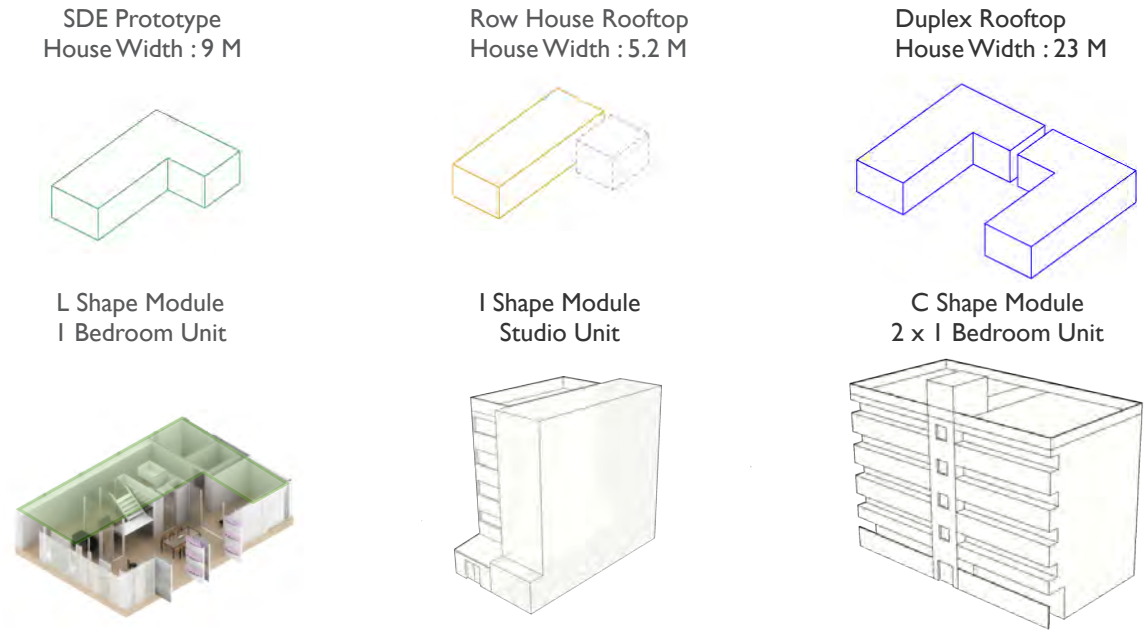


Figure 1.3.1 Diagram of row house and duplex roof top configurations

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. Firstly, 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 electrically self-sustaining through the use of 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.

2.0 Reconfigurable Features

Dining table

The extra large dinner table consists of a tabletop as frame, and dining stools as storage. They all have wheels and can be used separately. The tabletop frame can be expanded during dinner parties and rolled to the center the space, while the storage stools can be opened up as seating.

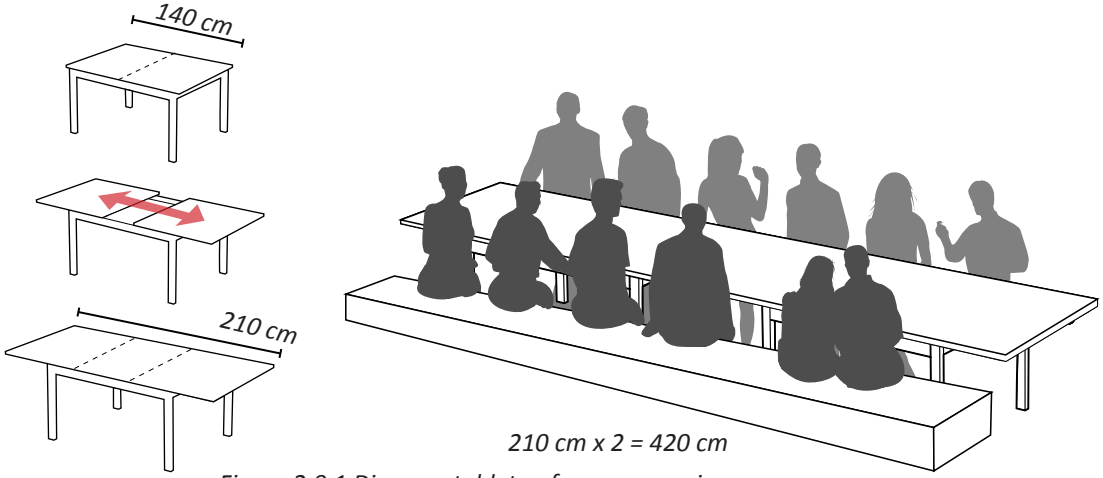


Figure 2.0.1 Diagram tabletop frame expansion

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

3.2 Artificial lighting

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. Lighting analysis will be included in the later deliverables.

LED Lamp	
Model	8W A lamp
Luminous Flus (lm)	480
Input voltage	100-240VAC
CCT (K)	2700
Efficacy (lm/W)	60
Power Factor	0.5
CRI	>80
CAPS	E26/27

Table 3.2.1 LED Lamp

ENGINEERING AND CONSTRUCTION DESIGN NARRATIVE

1.0 Structural Design

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. Also, a box frame can be leveled easily during the competition period. When dealing with real sites such as rooftops, a box frame helps to distribute load evenly without disturbing existing structures.

2.0 Constructive Design

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 acoustic performance of the adopted solutions and estimated indoor reverberation time will be included in the next deliverables.

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 Systems

- Water recycling system: All used water in the house which goes to the removal tank, will be filtered and stored in the rain water tank for vegetation irrigation. This greatly reduces the amount of wasted water.

- Water wall: This innovative evaporation cooling system is inspired by Taiwanese greenhouse technology. To create a negative pressure, the house should be sealed, leaving only the fan to draw hot air out of the house.

3.2 Electrical Systems

- Heating, Ventilation & Air Conditioning Systems (HVAC): With three sets of Hitachi's RAS-22NB/RAC-22NB one to one split-system, all interior areas can be conditioned with little energy used. This air conditioner has also received green certification by the Taiwanese government.

- Heat Reclaim Ventilator (HRV): The Orchid House incorporates Daikin's most advanced heat reclaim ventilator, VAM-GJ, to reduce cooling and heating loads. It exchanges energy and moisture between incoming and outgoing air streams through filters to keep interior temperature constant. The efficiency of the new design reduces at least 31% of cooling loads annually.

3.3 Photovoltaic Systems

Photovoltaic panels(PV): DelSolar's GCG125-6P66FL0 Light-thru BIPV Module provides just about 5kwp power with 50 square meter area. DelSolar's modules, proven by the International Electrotechnical Commission (IEC 61215 and 61730), are defined by its high performance and excellent quality. The modules provide positive and tight power tolerances of 0 to +3%, which offer a stable and high-energy system output. The Orchid House supports 42 pieces of the Light-thru panels.

DelSolar

Light-thru BIPV Module
GCG125-6P66FL0

2 models are available with different junction box positions:

- GCG125-6P66FL0 (Junction box on the right)
- GCG125-6P66FL2 (Junction box in the middle)

MECHANICAL SPECIFICATIONS	
Dimension	1106 (L) x 1061 (W) x 13 (H) mm
Weight	36 kg
Cell type	6" Poly (156*156 mm)
Number of Cells	36
Junction Box	IP65 Tyco with 3 bypass diodes
Cable	Tyco cable with plugs x 1 (2 Meters, 4 mm^2)
Connectors	IP67 Tyco plugs
Front glass	6 mm Saint-Gobain low-iron tempered glass
Encapsulation	EVA (Ethylene-Vinyl-Acetate)
Rear glass	6 mm tempered glass
Transparency	25%

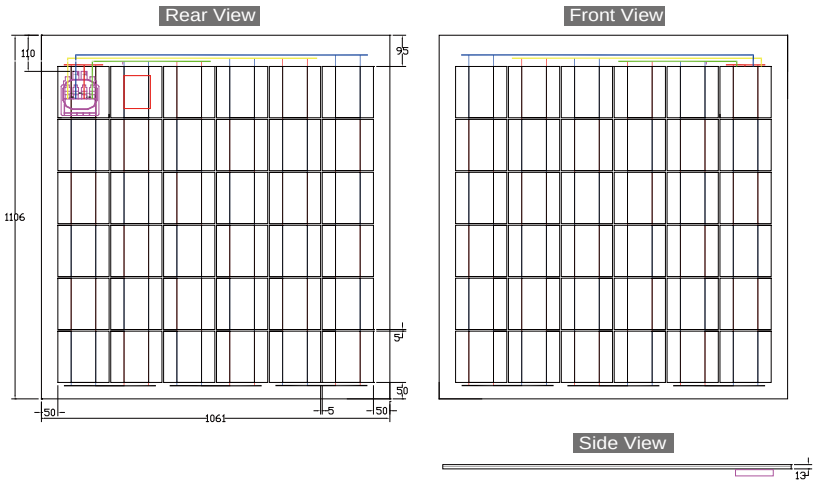
ELECTRICAL SPECIFICATIONS	
Pmax	125 Wp (± 5%)
Voc	21.7 V
Isc	7.82 A
Vmpp	17.21 V
Impp	7.29 A
System Voltage	1000 V
Maximum Over-current Protection	15 A
Module Efficiency	10.7 %

Standard Test Conditions:1,000 W/m^2, AM 1.5, and cell temperature of 25°C

OPERATION CONDITIONS	
Temperature	-40°C to +85°C
Wind load	700 kgf/m^2
Hail impact	⌀2.5cm ice-ball with 23 m/sec
Temperature Coeff. of Voc	-0.0752 V/°C
Temperature Coeff. of Isc	0.004 A/°C

All specifications are subject to change without prior notice

Dimension



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TEL 886-3-578-1999
FAX 886-3-578-1799

http://www.delsolarpv.com

DelSolar

Figure 3.3.1 DelSolar PV data sheet

3.4 Solar Water Heating System (SWH)

The vacuum tube solar water heater is a "pump-circulated" system with the storage tank below the level of the collectors, in the mechanical space. A circulating pump moves water or heat transfer fluid between the tank and the collectors. We also use the hot water generated from the SWH to supply radiant flooring.

Figure 3.4.1 Solar water heater application on rooftop

Figure 3.4.2 Detail of vacuum tube solar water heater

3.5 Control Systems

Smart living control system: This system monitors and collects data from all sensors and automatically responds to make the living environment more pleasant.

4.0 Electrical Energy Balance Simulation

This simulation will be included in the next deliverables after receiving the solar radiation data "PARIS-TMY.cvs" from SDE organization.

5.0 Solar Thermal Design

The analysis will be included in the next deliverables.

6.0 Building Integrated Solar Active Systems

- Aesthetic Integration: Before implementing the Orchid House on existing rooftops, we need to remove the existing parapet and any extruding objects. Instead of having a flat roof with tilted panels, the entire roof the house slopes 17 degrees to maximize solar panel's efficiency. This move makes solar panels part of the structure, and also helps rain water collection and avoid leakage of the roof. The glass laminated PV panels creates a filtered lighting which echoes the natural rainforest canopy

- Constructive Solution: After studying the urban grid carefully, we set the construction module of 90cm and applied it through out the house. It helps to construct the elements in a manageable size and to cohere with the openings of the house.

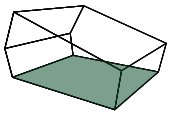
- Maintenance: Orchid House has incorporated Delta's PV panel, which has an incredible power tolerance of 0% to +3%, providing a stable, high-energy system output. The high PV cell shunt resistance enables increased power output in low light conditions and allows low temperature coefficients of power to produce high power output in all weather conditions. The panel has a 5-year guarantee, and the performance warranty is up to 25 years. With the energy generated by the Orchid House, residents can enjoy a return of their investment in as little time as 7 years.

ENERGY EFFICIENCY DESIGN NARRATIVE

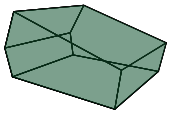
1.0 Technical Project Summary

1.1 Project Dimensions

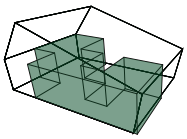
Gross Area



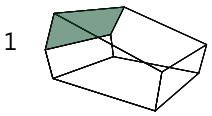
Gross Volume

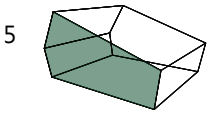


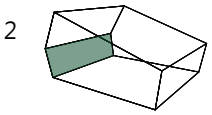
Conditioned Volume

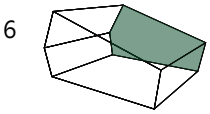


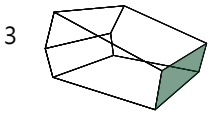
Surface Area

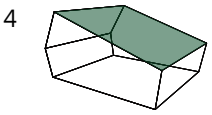










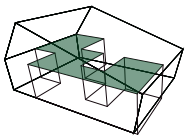


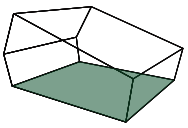
Caculation

Surface	Area
1	43.75
2	29.61
3	32.61
4	107.33
5	73.13
6	73.13
Total	359.55

square meters

Net Floor Area





Caculation

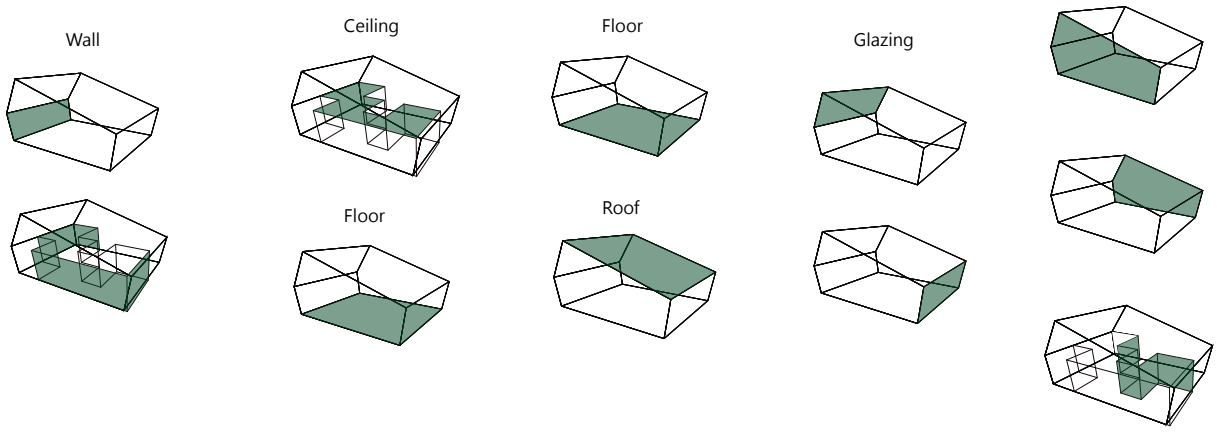
Net Floor Area	
2F	68.33
1F	122.99
Total	191.31

square meters

Project Dimensions		
Gross area	122.99	square meters
Gross Volume	666.17	cubic meters
Surface area	359.55	square meters
Net floor area	191.31	square meters
Conditioned Volume	190.59	cubic meters

Table 1.1.1 Project Dimensions

1.2 House Envelope



	Insulation Type	Thickness (mm)	Area(m2)	Resistance for thickness(m)	Thermal Resistance (m2K/W)	Thermal Transmittance (W/m2K)
Walls	Exterior Insulation Finishing System (EIFS)	180	109.2	-	4.30	0.23
Floor	wood	40	122.99	8	0.32	0.11
	concrete (light weight)	160		1.3	0.21	
	Polystyrene (expanded-based board)	300		28	8.40	
Ceiling	gypsum board	40	68.33	0.1	0.00	0.11
	air zone	20		0.19	0.00	
	Insulation(fiber glass)	400		21	8.40	
	plywood	40		8	0.32	
Roof	Glass	130	107.33	0.09	0.01	85.47
Glazing	Double Glazing w/ Low-E Coating	30	288.93	0.5	0.02	66.67

Table 1.2.1 House envelope surfaces

1.3 HVAC Systems

	Type	Capacity(kw)	COP (Coefficient of performance)
Heating system	Air Conditioner(Single-Split-type)	8.1	3.22
Cooling system	Air Conditioner(Single-Split-type)	6.6	5.46
Refrigerant	R-410a	-	-
Heat Recovery Ventilation	Heat Reclaim Ventilator	0.25	4.16

Table 1.3.1 HVAC calculations

1.4 Domestic Hot Water

Domestic Hot Water - Solar Water Heater

System (Type, capacity)	Integral Collector Storage / 200L
Solar thermal Collectors area (m²)	13.5 sqm
Storage Tanks (capacity)	200L

Solar Thermal Collectors Area

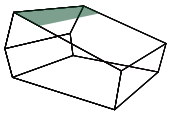
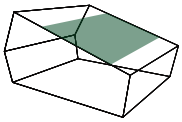


Table 1.4.1 Domestic hot water capacity

1.5 Electrical Energy production

PV Panel Area



Caculation

PV Panel Area 61.9 square meters

PV Modules (Type)	Mono-crystalline Photovoltaic Cell
PV panels area (m²)	61.90
Installed PV power (kWp)	5.00
Estimated energy production (kWh/year)	5848.25
Other systems (Type)	N/A
Other systems installed power (kWp)	N/A

Table 1.5.1 Photovoltaic energy production statistics

1.6 Energy consumption

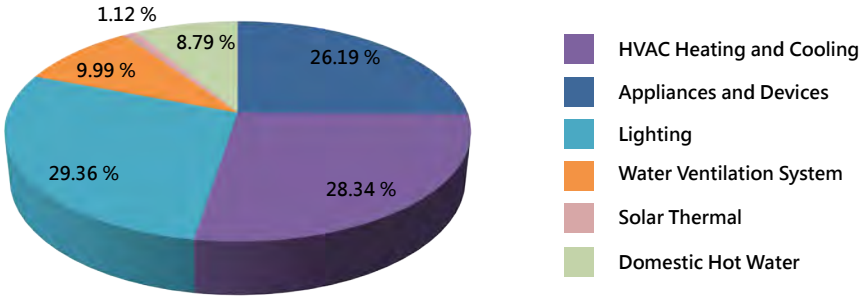


Figure 1.6.1 Annual consumption distribution chart

	End Use Breakdown	Electricity Demand					
		Watt	Hour	Day (KWH)	Year (KWH)	Sub-Total Electricity Year (KWH)	Electricity %
Appliances and Devices	Refrigeration(170) / Freezing(57)	43	24	1.03	376.68	1531.91	26.19%
	Clothes Washer	220	0.5	0.11	40.15		
	Clothes Drying	1470	0.5	0.74	268.275		
	Dishwashing	1050	0.5	0.53	191.625		
	Oven	2250	0	0.00	0		
	Cooking	1700	0.5	0.85	310.25		
	Hood	250	0.5	0.13	45.625		
	TV	70	4	0.28	102.2		
	Notebook (Display)	90	6	0.54	197.1		
HVAC	Cooling and Heating	811	8	4.54	1657.684	1657.68	28.34%
	Heat Reclaim Ventilator	250	8	1.40	511		
Lighting	Lighting (6W*28)	168	28	4.70	1716.96	1716.96	29.36%
Water & Ventilation System	Fan(80W*4)	320	5	1.60	584	584.00	9.99%
	Pump (radiant flooring pipe)	373	0.5	0.19	68.0725		
	Pump (irrigation : grey water - tank)	373	0.5	0.19	68.0725		
	Pump (irrigation : tank - plant)	373	0.5	0.19	68.0725		
	Pump (water wall)	373	0.5	0.19	68.0725		
Solar Thermal	Inverter	20	9	0.18	65.7	65.70	1.12%
Domestic Hot Water	Solar Water Heater (200L)	100	8	0.80	292	292.00	4.99%
			Daily Total Electricity (KWH)	18.17	Annual Total Electricity (KWH)	5848.25	

Table 1.6.2 Energy consumption calculation

1.7 Energy balance

Estimated energy balance (kWh/year)

(A) Estimated Energy:
5KWP*4 hours >>> 20KWH per day
20KWH*365days= 7300 KWH

(B) Estimated Consumption:
5848.25 KWH

Estimated energy balance (KWH/year)
= (A) - (B)
= 1451.75 KWH

Estimated CO2 emissions (Tn/year)

Estimated Consumption 5848.25 KWH
will produce 5844 pounds of CO2 per year,
which equals to 2.6 ton per year.

Source of CO2 emissions caculation:
http://www.epa.gov/climatechange/ghgemissions/individual.html

2.0 Appliances Report

Please refer to Figure 1.6.2

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

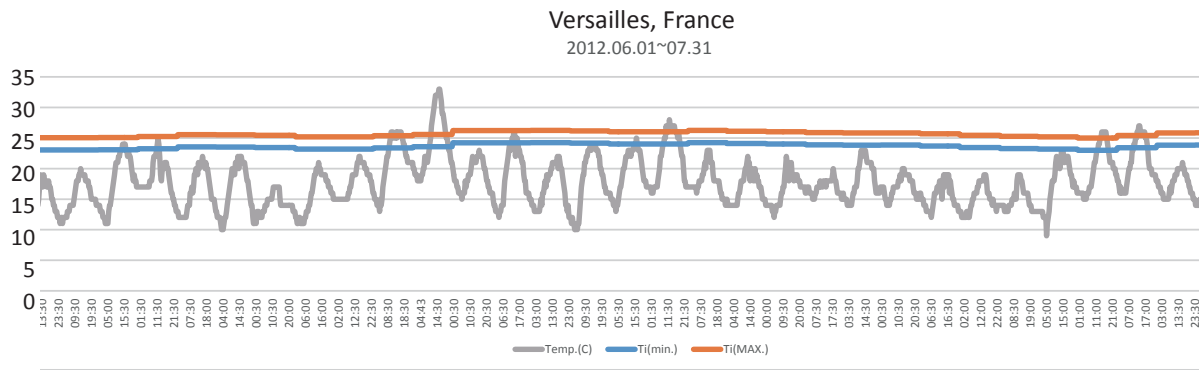


Chart 3.1.3.1 Temparature of Versailles from June to July 2012.

3.1.4 Team Energy Strategy

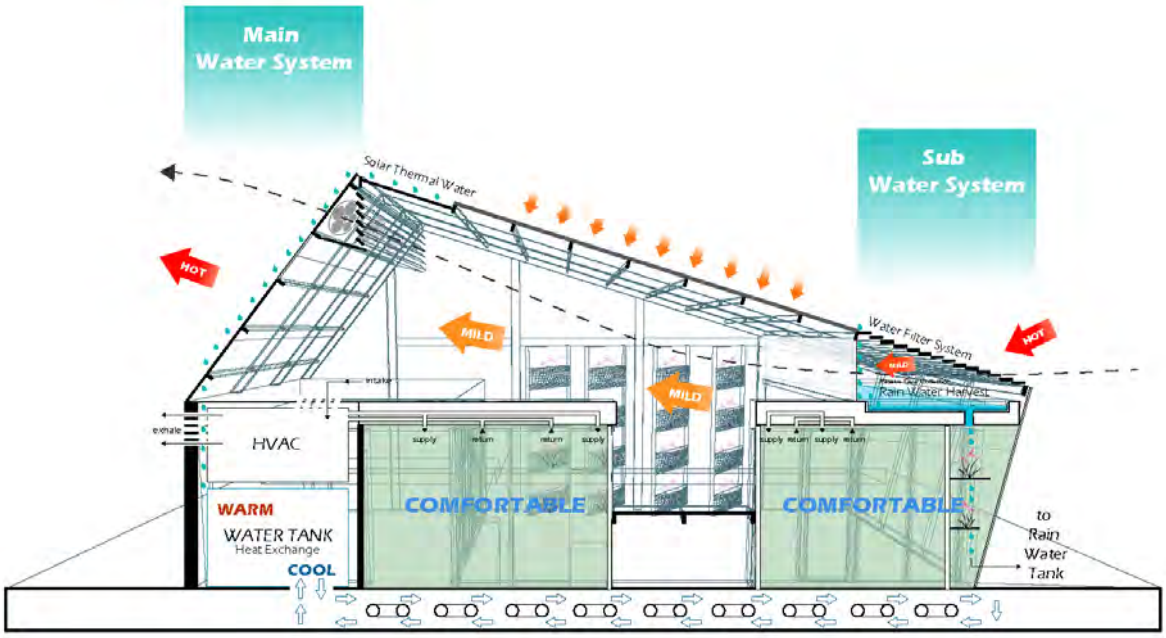


Figure 3.1.4.1 Section Diagram of Energy Strategy in Summer time

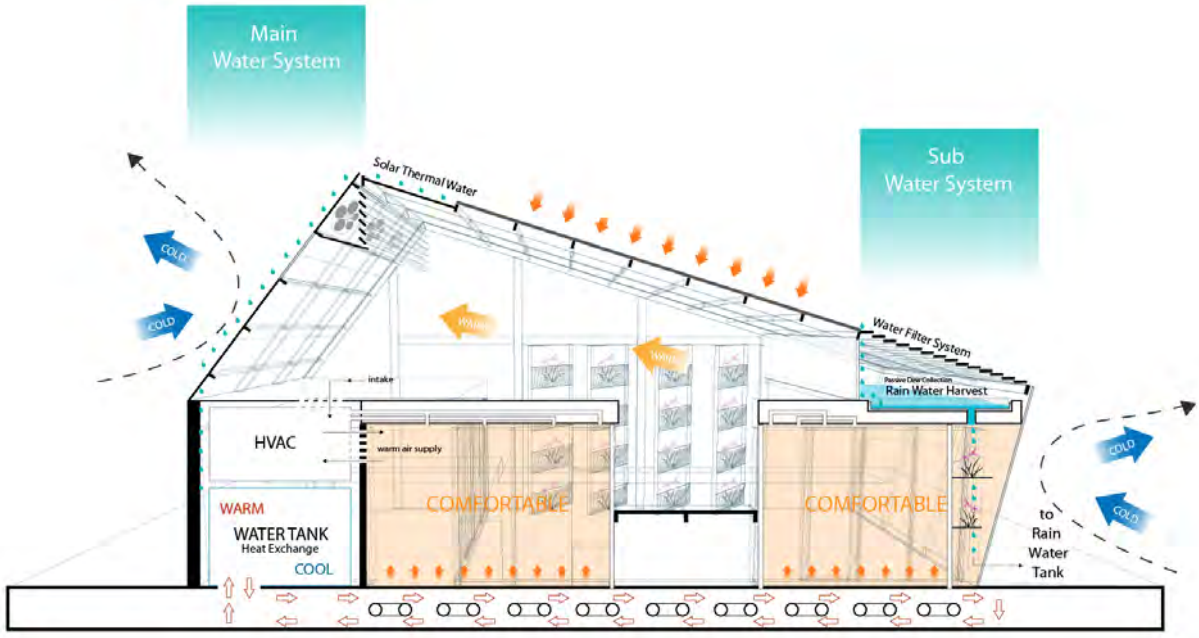


Figure 3.1.4.2 Section Diagram of Energy Strategy in Winter time

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.

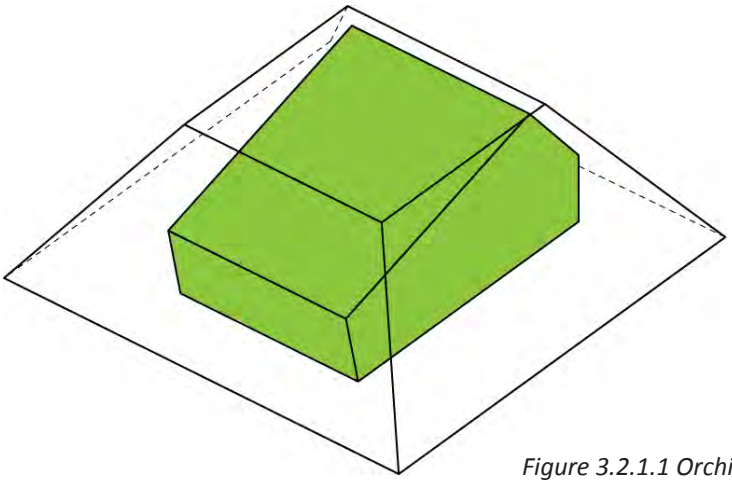


Figure 3.2.1.1 Orchid House volume at SDE site

3.2.2 Passive design strategies

- Thermal mass: In stable interior temperatures, a 30cm thick water wall is placed on the west façade of the house. It absorbs heat in the afternoon and releases heat at night with a 12-hour time lag.
- Solar chimney: To create negative pressure, the house is sealed except for the north side of the roof, which has multiple operable windows to draw out hot air.

The following sections will be developed in the next deliverables.

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

3.3.1 Description
3.3.2 Housing unit modeling
3.3.3 Housing unit energy loads

3.4 Results and Discussions

3.4.1 Energy Performance
3.4.2 Predicted indoor temperatures
3.4.3 HVAC systems
3.4.4 Predicted Heating and cooling loads

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

4.1 Project design optimization
4.2 System optimization

Communications Plan

1.0 Introduction

2.0 Communication Project

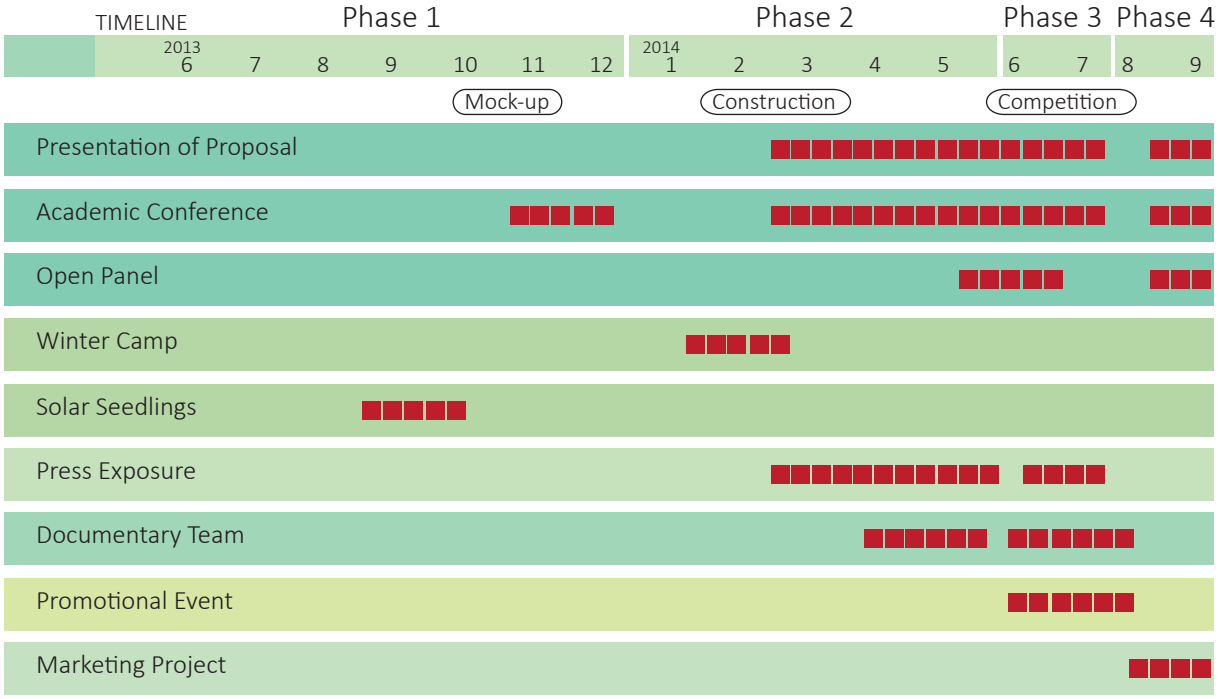
2.1 Abstract

With our integrated marketing and communications plan, NCTU/UNICODE plans to not only generate publicity for our participation in Solar Decathlon Europe (SDE) 2014, but also to spread awareness among the public about the general goal of the Orchid House for a more sustainable future. NCTU/UNICDE will implement this plan in the months leading up to and after SDE 2014.

We divided the coming 18 months into four different phases. Phase 1, extending from July 2013 to December 2013, is also called the Mock-up phase. Phase 2, the Construction, starts in January 2014 and ends in May of the same year. Phase 3, the Competition, is made up of the months before and after SDE – June to August. The last phase takes place after the Competition, with the purpose of encouraging continued interest in sustainable practices in Taiwan. One of the main purposes we hope to accomplish by entering SDE is to convince the government and the public that alternative sources of energy, specifically solar energy, and green technology are highly possible and preferable. To this end, it is essential that we do not stop our PR plan right after the end of the competition, but to continue for several more months to ensure that our hopes and ideas for a better future really take hold in the public imagination.

In general, our Integrated Marketing and Communications Plan is split into six aspects: Awareness Platform, Education Strategy, Strategic Press Exposure, Keep Record, Promotional Events, and Marketing Projects. These aspects can be executed separately, but can also work in synergy to achieve a greater effect. We believe that this overlap is important because multiple messages have more effect and will leave deeper impressions.

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 Definition of the Communication Objective

2.2.1 Awareness Platform

New city aesthetics – Taipei rooftop urban regeneration

The main goal is to promote knowledge and spread information about urban cities, architecture techniques, and green energy. We will use the Orchid House as an example and publicize the information we have come across in our research for the house. We will target three groups: the government, scholars in academia, and the general public interested in green architecture. This will take place 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
- **Action's description / Projects**

i. Presentation of Proposal:

To present the Orchid House project to the government for future applications to Taipei City. The Orchid House is an intersection of academic knowledge, green technology, and urban planning

- Channel: Publication, Exhibition, Workshop, etc.
- Target Audience: Taipei City overment Department of City Development,.etc.
- Exposure Time: Phase 3

ii. Academic Conference:

To gather all the foremost scientists within the nation to share and present new advances in the fields of sustainable energy and green architecture.

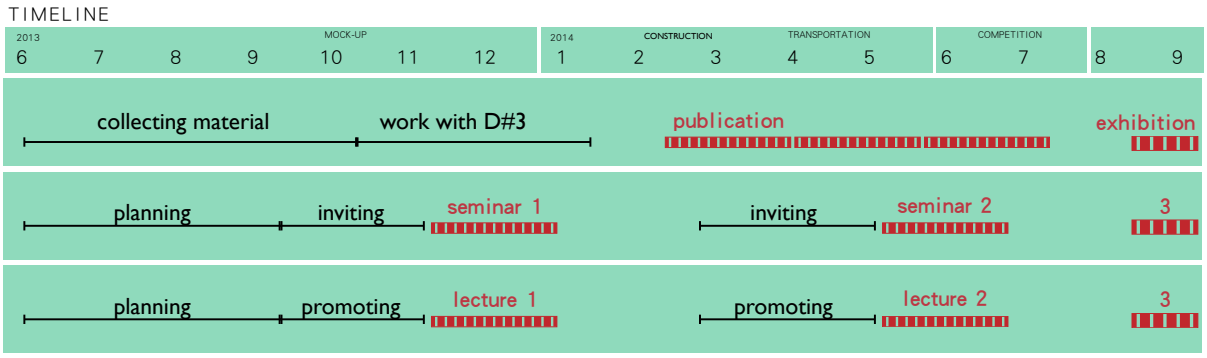
- Channel: Seminar
- Target Audience: Academics in Architecture, Sustainable Research.
- Exposure Time: Phase 2,3

iii. Open Panel – the Orchid House and Current Technology:

To create a channel to expose the general public to the basics of sustainable practices and the Orchid House

- Channel: Seminar
- Target Audience: Academics in Architecture, Sustainable Research.

- **Timetable (based on our 4 phases.)**



2.2.2 Education strategy

Planting the solar seeds (for a better future)

The main goal is to encourage exchange of information and techniques having to do with sustainable practices, and to pass the concepts behind the creation of the Orchid House to the next generation. This aspect will involve resources and ideas from architecture, urban living, sustainability, and renewable energy. The target audience is current and prospective students of National Chiao Tung University (NCTU) and high school students around Taiwan. This plan is set for Phase 2

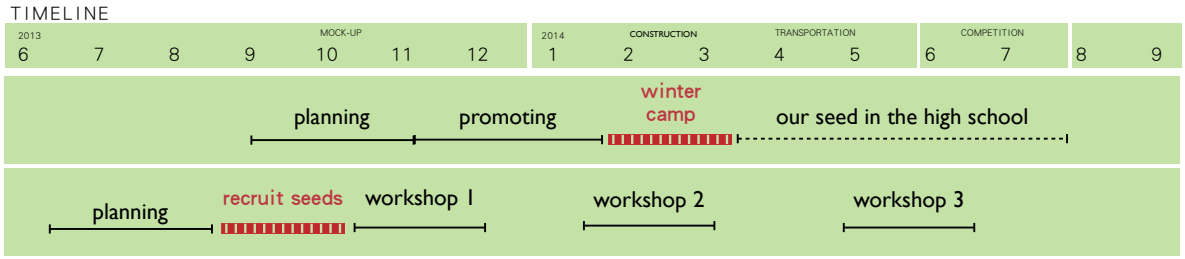
- **Definition of the Communication Objective/ Message**
  Encouraging interchange of knowledge and techniques involved with the creation of the Orchid House
- **Identification of the target group**
  Current and prospective students of NCTU, high school students
- **Action's description/Projects**

i. NCTU Orchid House Winter Camp:

To invite all high school students who express and interest in learning more about sustainable practices and high school science teachers to NCTU for an interactive camp. We hope that NCTU will spark the curiosities of high school students and incite their thirst for more knowledge.

ii. NCTU/UNICODE Orchid House Solar Seedlings Foundation:

To outline an education program for the high school students. Also to invite current NCTU student to participate, and to organize camp leaders and event speakers



2.2.3 Strategic Press Exposure

Revival of solar energy in the anti-nuclear age

The main goal is to control mass media releases in a strategic and orderly way to incite and maintain interest in the project and our goals among the general public. To do this, we will have a number of articles written about current advances in sustainable energy, the SDE competition, and the Orchid House. The team's affiliation with NCTU and location in the Hsinchu Science Park, a prominent technology hub in the global scene, will definitely help in this venture. The target audience is publication subscribers and more broadly, the general public. We will implement this in Phases 2 and 3 leading up to the competition.

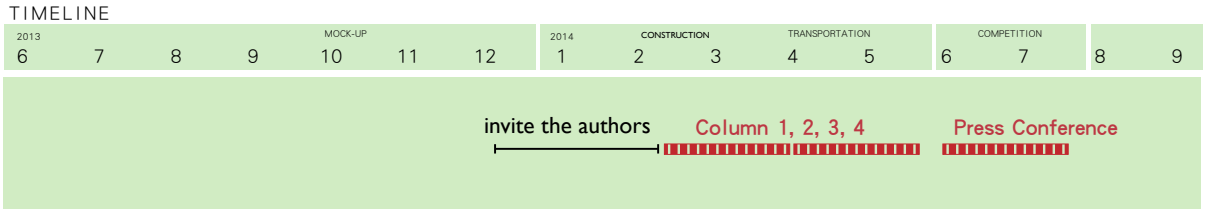
- **Definition of the Communication Objective/ Message**
  Control mass media releases to incite and maintain interest among the general public
- **Identification of the target group:** General public, publication subscribers
- **Action's description/Projects**

i. Magazine Columns

To encourage curiosity and debate about renewable energy through columns written by well-known people

ii. Scientific Magazines
To spark widespread interest in smart living installations and sustainable technology by having features in scientific magazines that include information about the Orchid House

iii. Architecture-related Media
To spread the news of Solar Decathlon Europe 2014 and encourage public excitement over NCTU/UNICODE's participation



2.2.4 Documentary Team (information production team)
Interactive and entertaining documentaries about urban rooftop regeneration

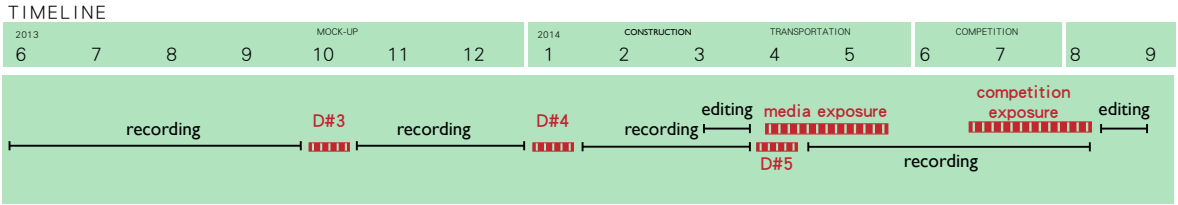
The main goal is to provide textual, photographic, and video records for the PR team. We have been keeping careful records of the progress of our project and the rationale of our design. Additionally, images and videos will be used in the presentation of the Orchid House during the competition. This project has no specific audience and will take place in phase 3.

- **Definition of the Communication Objective/ Message**
  Provide textual, photographic, and video records for the Public Relations team
- **Action's description/Projects**

i. Social Media Management
To manage the official website, Facebook, Instagram, Pinterest, and Twitter accounts.

ii. Print and Images Media Management
The print team will be in charge of official text-based releases and event announcements. The images team will be responsible for the photo documentation of the team's progress, brochures, and the images used at the competition site,

iii. Video Recordings
To document the work, designing, and creation processes; provide material to be shown at the competition site.

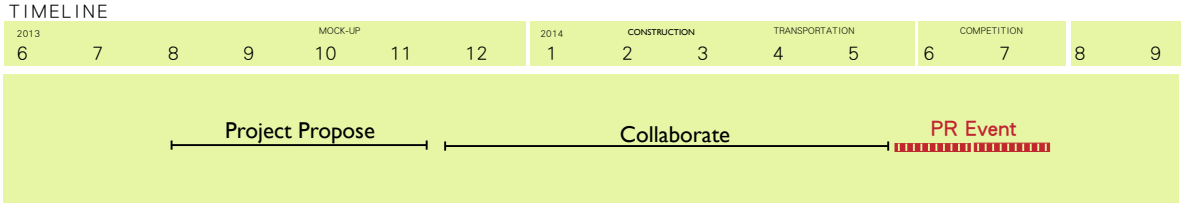


2.2.5 Promotional Events

Solar Flight – an EVA and NCTU collaboration

The main goal is to collaborate with NCTU/UNICODE sponsors and use their company platforms and products to advertise the Orchid House and the SDE competition. The publicity will also benefit the sponsors. This strategy is targeted towards customers and employees of the companies and will take place in Phase 3.

In this project, EVA airline will subsidize the costs of flying the NCTU/UNICODE team to France for the competition. We would like to make this flight into a PR event, calling it the "Solar Flight- EVA x NCTU." On this flight, we may promote sustainable issues with special activities. Additionally, EVA will show the team's documentary and promotional videos on all flights between Taiwan and France during the competition.



2.2.6 Marketing Projects

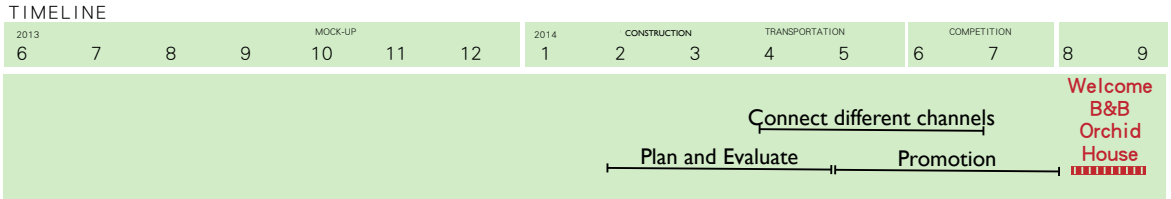
NCTU Bamboo Fox Bed & Breakfast – spending a night in the NCTU Orchid House

The main goal is the maintain emphasis on the importance of sustainable energy, urban renewal, and improved social housing even after the completion of the competition. One plan is to display the Orchid House in NCTU and allow people to live in it. By doing so, we not only show people how convenient a sustainable house is, but will also be able to collect feedback on how well our design works and potential areas to improve. The target for the projects includes high school students, current college students, those interested in architecture, and the general public. The marketing projects will take place in phase 4, after the SDE competition.

- **Definition of the Communication Objective/ Message**
  Maintain emphasis on the importance of sustainable energy, urban renewal, and improved social housing even after the competition.
- **Identification of the target group**
  Travelers, people living in Hsinchu, those interested in architecture
- **Action's description/Projects**

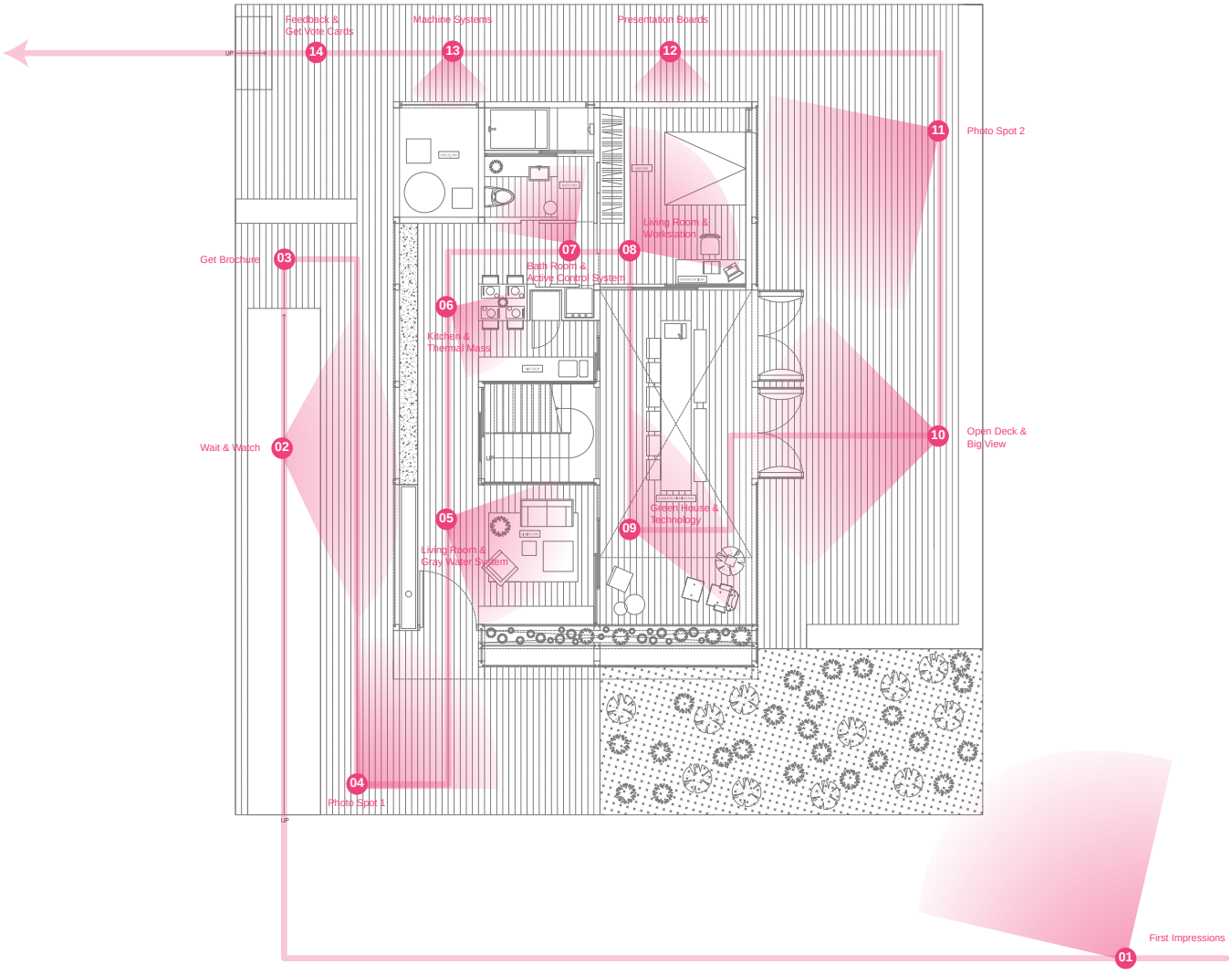
  i. Bamboo Fox Bed & Breakfast:
  We will promote "A free B&B trip in NCTU, Hsinchu" to the public and invite the general public to propose what they would like to do in our Orchid house, what they imagine when they think of the Orchid House, etc, we will choose the most creative proposals an invite those people to live in our Orchid House. This project has three objectives:
  1. To show that a house run on solar energy and other sustainable technology is entirely possible
  2. To lessen the distance between academia and the general public
  3. To collect actual feedback about practical concerns
  - Channel: Official website, Facebook, Hsinchu City Government, Department of City Marketing

  ii. Orchid House – related products:
  To provide souvenirs, which can also be used in the previous five strategies for better PR effect.

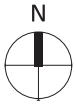


3.0 Public Tour Description

3.1 Drawings showing the route and contouring



01 First Lmpressions
02 Wait & Watch
03 Get Brochures
04 Photo Spot 1
05 Living Room & Gray Water System
06 Kitchen & Thermal Mass
07 Bathroom & Active Control System
08 Living Room & Workstation
09 Green House & Technology
10 Open Deck & Big View
11 Photo Spot with Orchid House
12 Presentation Boards
13 Machine System
14 Get Vote Cards



3.2 Visit Description

NCTU/UNICODE designed the Orchid House not only from the perspective of the architect, with sustainability, aesthetics, and convenience in mind, but also from the viewpoint of a visitor. We designed the house paying special attention to a specific viewing progression. Walking around the Solar Village, visitors will be drawn towards our house by the lush garden outside. Upon rounding the east side of the house towards the ramp on the south front, their interest will be further piqued by the orchid-covered giant swinging doors, which will be open to allow a glimpse into the house.

While waiting in line on the ramp, visitors will be entertained by videos and images that will be projected along the parallel west façade of the Orchid House. At the end of the ramp is a table where an NCTU/UNICODE team member will be waiting to hand out brochures and to recommend the visitors to take photos before entering at the southwest corner of the house, for optimal view. Upon entering the house, visitors will move along a set route that will have team members stationed at certain points to explain and highlight the elements of the house.

- Living Room: Team member will not only show off the living room, but also explain the subunit water tank located above which filters grey water. Member will also give details about how the subunit water tank waters the various plants around the house via drip irrigation and how it keeps the house cool through the evaporative cooling method.

- Kitchen: Team member will explain the function of the mini-counter, which is multifunctional as a kitchen island and as a smaller dining table for informal occasions. Member will also explain describe the thermal mass wall and how it conserves energy and maintains comfortable temperatures day and night.

- Bedroom: Team member will be responsible for showing both the bathroom and the bedroom and to make sure traffic does not become congested by encouraging the visitors to exit the bedroom into the terrace.

- Terrace: With the swinging doors and orchid plants in view, team member will explain the inspiration for the Orchid House. Member will emphasize the natural sun and water conditions of the orchid plant and the importance of its industry in Taiwan. Member will also talk about the team's commitment to using products from Taiwanese companies not only to support the country, but also because the products are top-of-the-line internationally. Goal is to leave a lasting impression of Taiwan and images of the orchid plant.

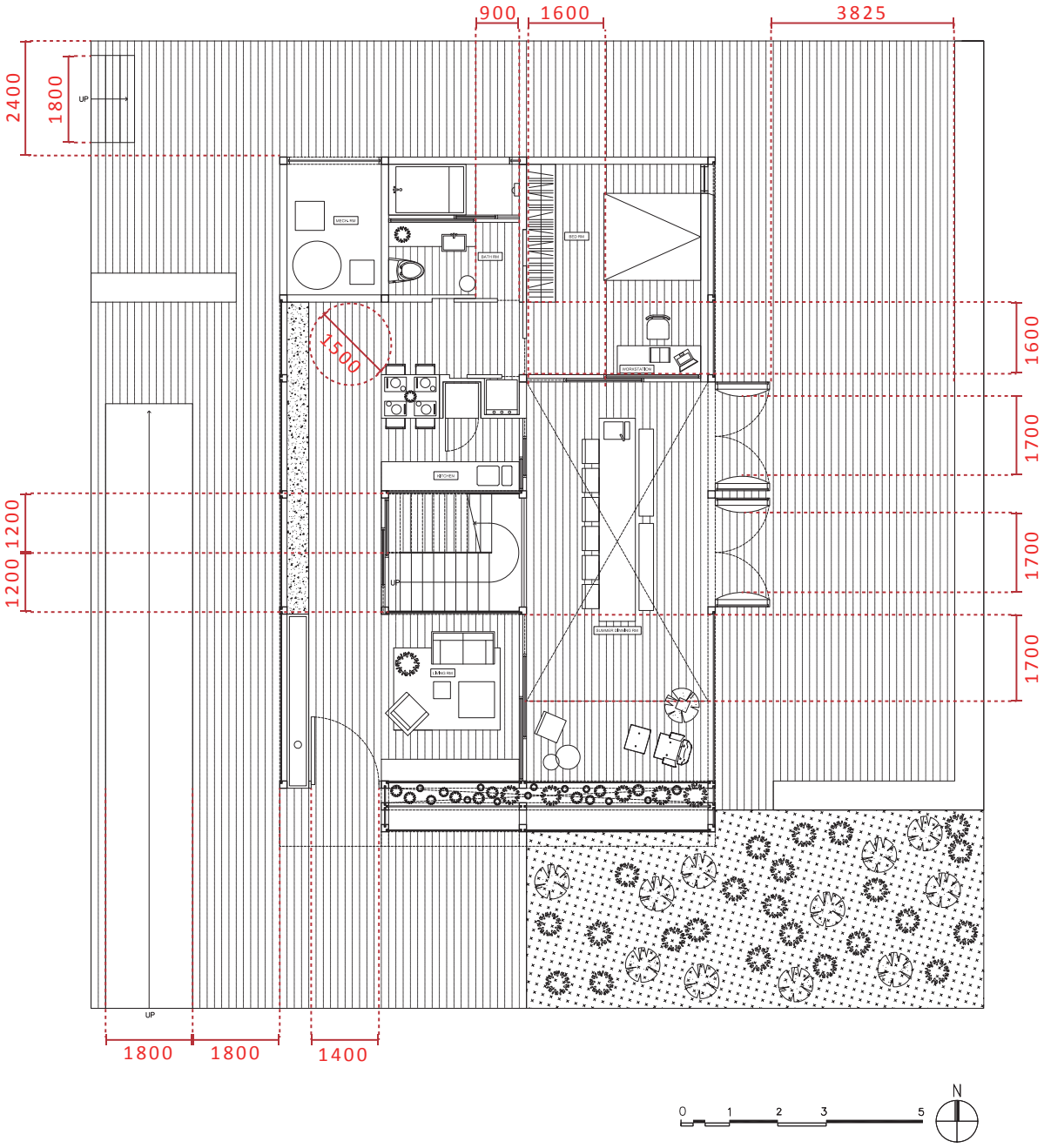
- Mechanical Room: Team member will present the boards placed on the back façade of the house and explain the function of the large fans as part of the evaporative cooling method. Member will emphasize the quietness of the fans and encourage the visitors to return to the open deck to rest and relax.

After touring the house, visitors will be encouraged to wait for other members of their groups out on the open deck. There is an additional opportunity for photos at the northeast corner of the open deck. The deck also offers a ledge for sitting and resting; visitors will be shaded from the sun by the house and they will also receive a memorable view of the Orchid House backlit by sunlight and the swinging doors covered by orchids.

Our team member tour guides will be able to present in both English and Mandarin Chinese, to eight people at a time. The entire tour will take 20 minutes, with four minutes allotted to each station.

VIP: The judges will be shown along the same route as the normal visitors, but between the living room and kitchen stations, they will be invited up to the mezzanine level, where there will be a team member to show them around, with emphasis on the garden plot and the potential for the area as a socializing space.

unit: mm



2.3 Sketches Showing Public Safety Measures for Demonstrations

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

2.4 In-line Entertainment

While visitors are lined up and waiting at the ramp, they will be able to watch the videos and images projected on the west-side wall. The projectors we use will be provided by Delta Electronics and are extremely technologically advanced – able to project clear images under broad daylight and can be linked so that three projectors show three separate sections of an image that can be joined seamlessly.

One of the videos we will show is “Four Seasons,” a film that captures beautiful scenes unique to Taiwan and emphasizes the need for sustainability.

4.0Team Visual Identity Manual:

4.1 Name of Team and House

The team chose the name NCTU/UNICODE to signify that the team is a representative of National Chiao Tung University and that the team is a gathering of students from multiple disciplines. “UNICODE” also implies a universality that we wish to create with the Orchid House. We see the Orchid House as a universal prototype, modularized so that it can adapt from local conditions to any other setting in the world. The house was named after the team’s inspiration; the design of the Orchid House is deeply influenced by the native orchid plant in its natural habitat and by methods of cultivation in orchid greenhouses. The orchid plant represents the team’s conviction to create a living module that resides in a perfect balance of light and water, without any undue wasting of resources.

4.2 Rules 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

NCTUNICODE

Orchid House

BACK GOTHIC / LIGHT FOR NCTUNICODE
Arial / regular for Orchid house

C: 35	R:182		C: 96	R:43	
M: 4	G:208		M: 99	G:42	
Y: 73	B:98		Y: 38	B:107	
K: 0			K: 4		

4.4 Supporting Institutions and Sponsors’ Logos

Supporting Institution

Solar Decathlon Europe 2014 EN FRANCE
國立交通大學 National Chiao Tung University
NCTU Architecture 國立交通大學建築研究所

Sponsor’s Logos will be shown in the supporting institution and companies’ trackign

4.5 Three Logo Versions

Left: An example of how the SDE, NCTU, GIA, UNICODE, and Orchid House logos can be organized on the backdrop of our Press Release cover.

Center: A monochrome version of how the SDE, NCTU, UNICODE, and Orchid House logos can be placed together on the front side of our Business Card.

Right: The front and back design of our jersey, which includes the SDE, UNICODE, and Orchid House logos.

5.0 Sponsorship Manual

5.1 Supporting institution 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, and bronze. Each category can enjoy the different degree of benefit from the project.

Sponsor Opportunity								
	Title Co-Sponsor	Educational Promotional & Social Event	30-second video demo in solar house	Company product + logo on pamphlet	LOGO inside the SDE House	Logo listing on team gear	Logo listing on website invitations / communications / signage / event publications	Invitation to receptions and events
SDE Partner	O	O	O	O	O	O	O	O
Platinum			O	O	O	O	O	O
Gold				O	O	O	O	O
Silver						O	O	O
Bronze							O	O

(Sponsor title and content is updated on 2012/3/27)

Funding

Delta Electronics Foundation — Donation
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886-2-8797-2088, wim.chang@delta-foundation.org.tw
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Ruentex Group — Donation
Samuel Yin, President
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No. 308 Sec. 2 Bade Rd., Zhongshan District, Taipei 104

Resource

Delta Electronics, Inc., Solutions PV Integration — Solar Panel
Robert Luor, GM, 886-2-8797-2088 #6000
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Autodesk Taiwan — Software
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Evergreen Marine Corp. — Shipping
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biz@evergreen-shipping.com.tw
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Consultant

HKR Engineering Consultants — Structural
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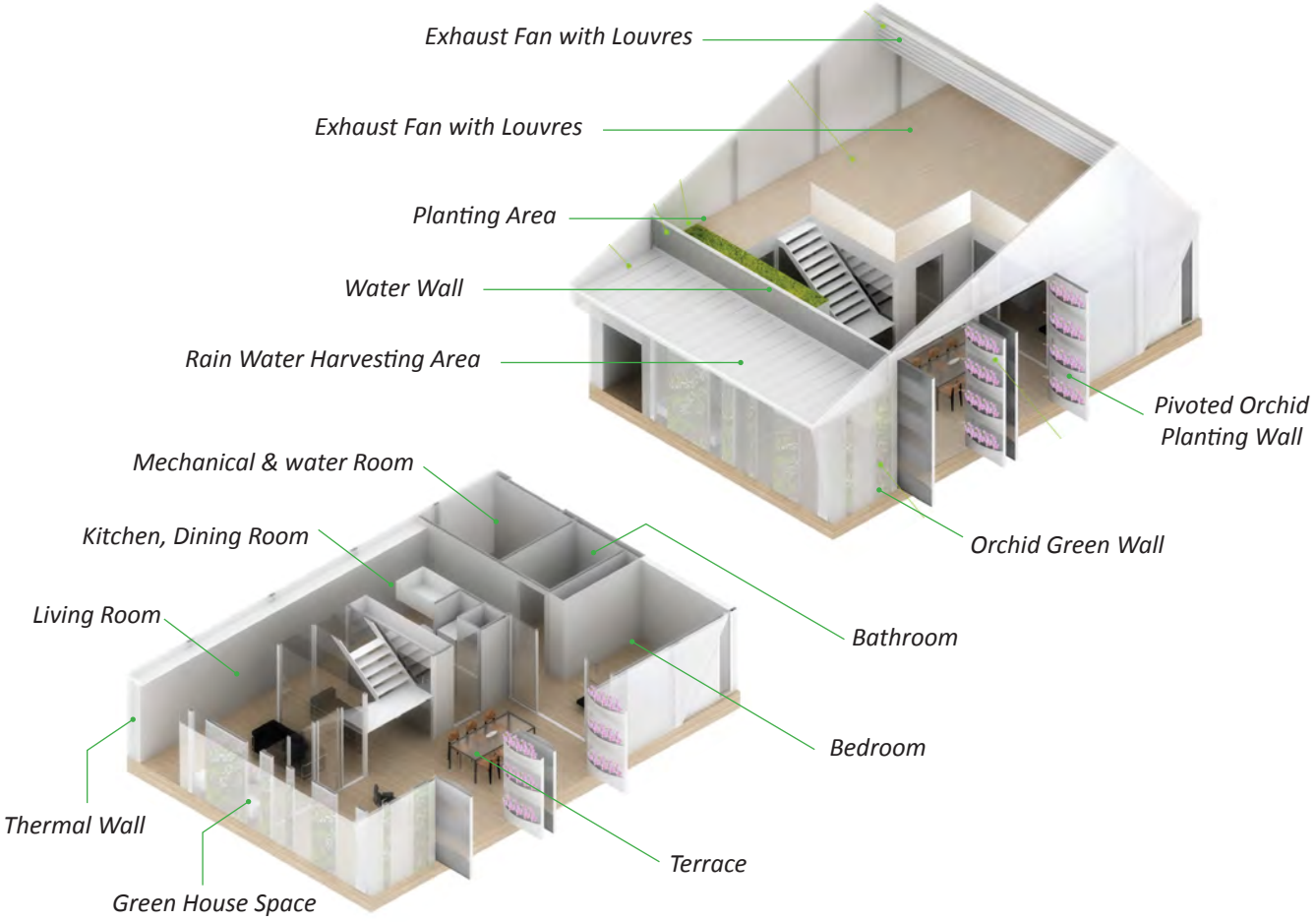
Orchid House
Solar Decathlon Europe 2014
Solar Decathlon
>> 我們成就了什麼?
媒體效應
品牌效應
>> 我們非得要這麼做?
Technology _ WE CREATE
Horticulture _ WE NURTURE
Sustainability _ WE MUST
>> 我們究竟要做什麼?
在凡爾賽宮前蓋一棟綠色住宅!
10天!
十項全能!
>> 我們致勝的亮點是什麼?
glocal / trans-disciplinary
前瞻,創新,跨領域.
Orchid House
>> 我們可以帶來的改變:
SDE 2014 Workshop #1_2013/03/20-21
>> 我們團隊的成員
>> 我們尋求夥伴的理念:
>> 有志一同!
Innovative, Eco-Friendly Energy Systems
「台建陽光小學」於COMPUTEX登場
綠建築節能概念結合最新科技應用
實現智能綠生活理念
1學術提案
2教育計畫
3媒體操作
4影像記錄
5議題事件
6行銷活動
Orchid House
Solar Decathlon Europe 2014

URBAN DESIGN, TRANSPORTATION AND AFFORDABILITY REPORT

1.0 Market Viability of the Product

1.1 Socio-cultural aspects

The Orchid House is designed for a working couple to live and work in the house. It is affordable to the residents in Taiwan due to its efficient in energy and water, 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. We believe these two strategies will expand the market of sustain¬able housing in Taiwan.



The target market identification:

- Geographical market: high density cities such as Taipei, Taichung, and Kaohsiung
- 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

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.

1.2 Economical Aspects

The average annual housing price of Taipei is €6,184 per m², and an average 2 people family will purchase a unit around 50m2. Therefore, each house is about €300,000 in the current market. Orchid house provides a new solution to the overly expensive housing market, with our target of the sales price of €200,000.

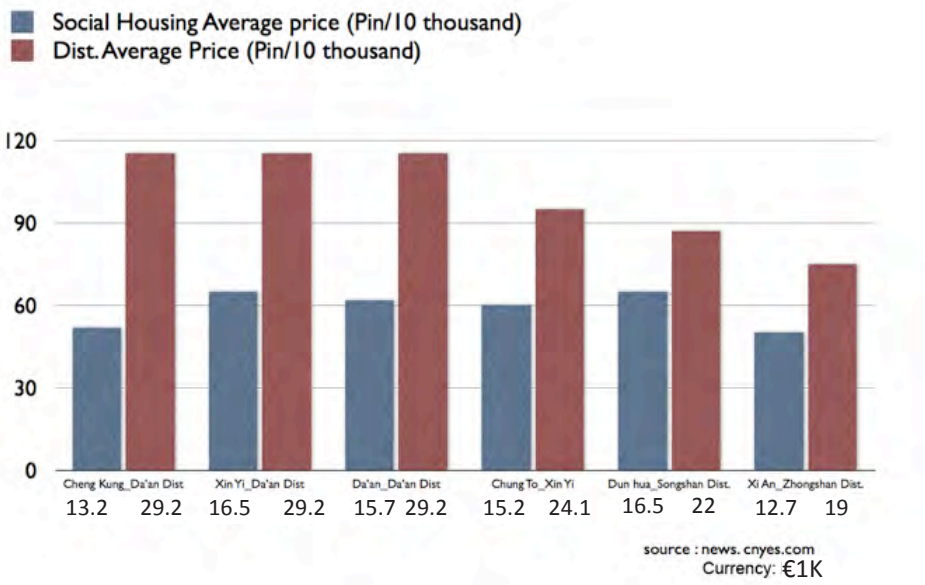


FIGURE: Comparison of Social Housing and Average Housing in different districts in Taipei city per pin (Unit:€1K*)*

1.3 Age

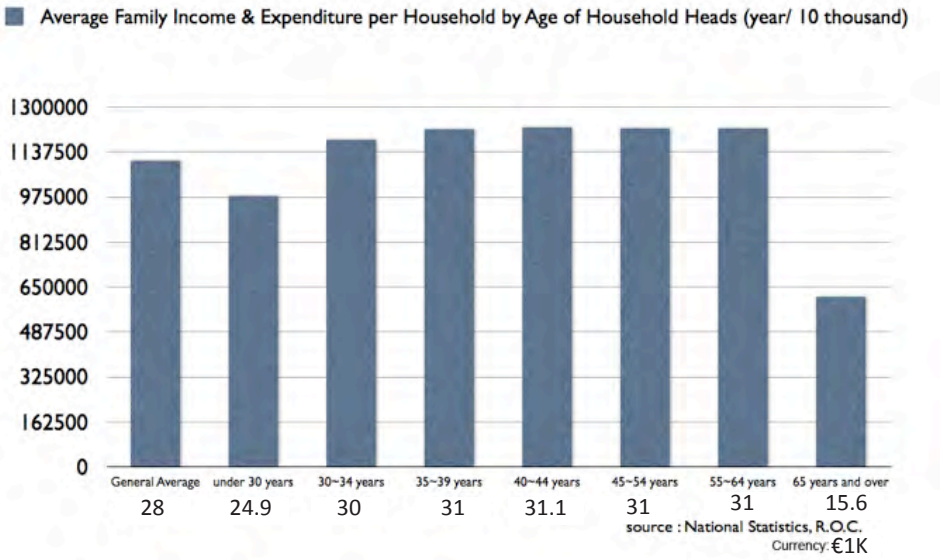


Figure: Average family annual income per household by age of household head (Unit:€1K*)*

This analysis shows that between the age of 30-64, people have the ability to purchase house. We want to promote not only younger generation, but also any generation to have an opportunity to own a property.

2.0 Location related

2.1Background

NCTU Unicode is developing a prototype house that will use progressive greenhouse technology developed in Taiwan for the cultivation of orchids in order to coexist with nature. In addition to emphasizing harmony with nature, NCTU Unicode also strives to create a comfortable living space, which in Taiwan, means dealing with high temperatures and extreme humidity. We believe that using less energy for climate control in the house makes the project more sustainable and more attractive to the market not only in Taiwan but also in other countries as well. We want to devise a solar house solution that is suitable for the local conditions, but can also be applied to a wider range of locations as well.

2.2 Concept

The other key point is that existing rooftops in Taiwan are filled with unpleasant illegal structures that are made with metal panels. 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 rooftops, we plan to generate a considerable amount of energy and rainwater with sustainable technologies.

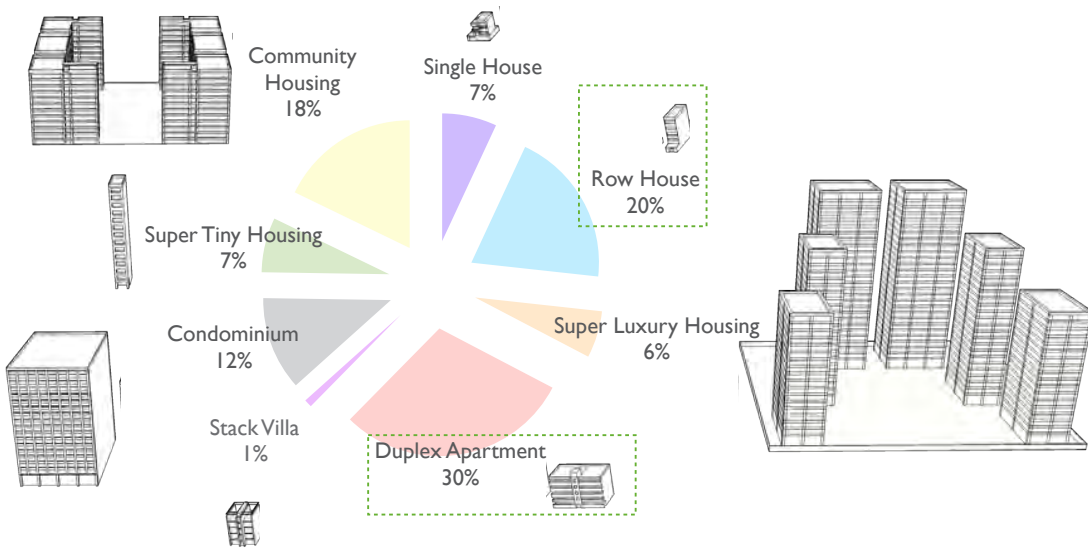


Figure 2.1.1 8 types according to the construction

2.3 Island climate

Taiwan lies on the Tropic of Cancer and has a marine tropical climate. The northern part of the island has a rainy season that lasts from January through late March during the northeast monsoon. The entire island also experiences hot, humid weather from June through September. In order to create a comfortable living space, high temperature and humidity are the biggest issues to solve. In the present day, eco-friendly practices are also of extreme importance, so our design plans to use the lowest amount of energy possible for climate control in the house.

2.4 Building characteristics.

The Orchid House will be implemented on existing rooftops without disturbing the building structure underneath. This is important in Taiwan, especially Taipei, due to the urban density. By building on top, we eliminate using uncultivated land and help to keep the environment green.

Several architectural strategies also forms the building characteristics, including:

- Mezzanine – increase usable area
- Asian-inspired porch – allows natural ventilation and lighting
- Good visibility – glass internal wall connects the interior space with the porch, which makes the space appear larger than it is.

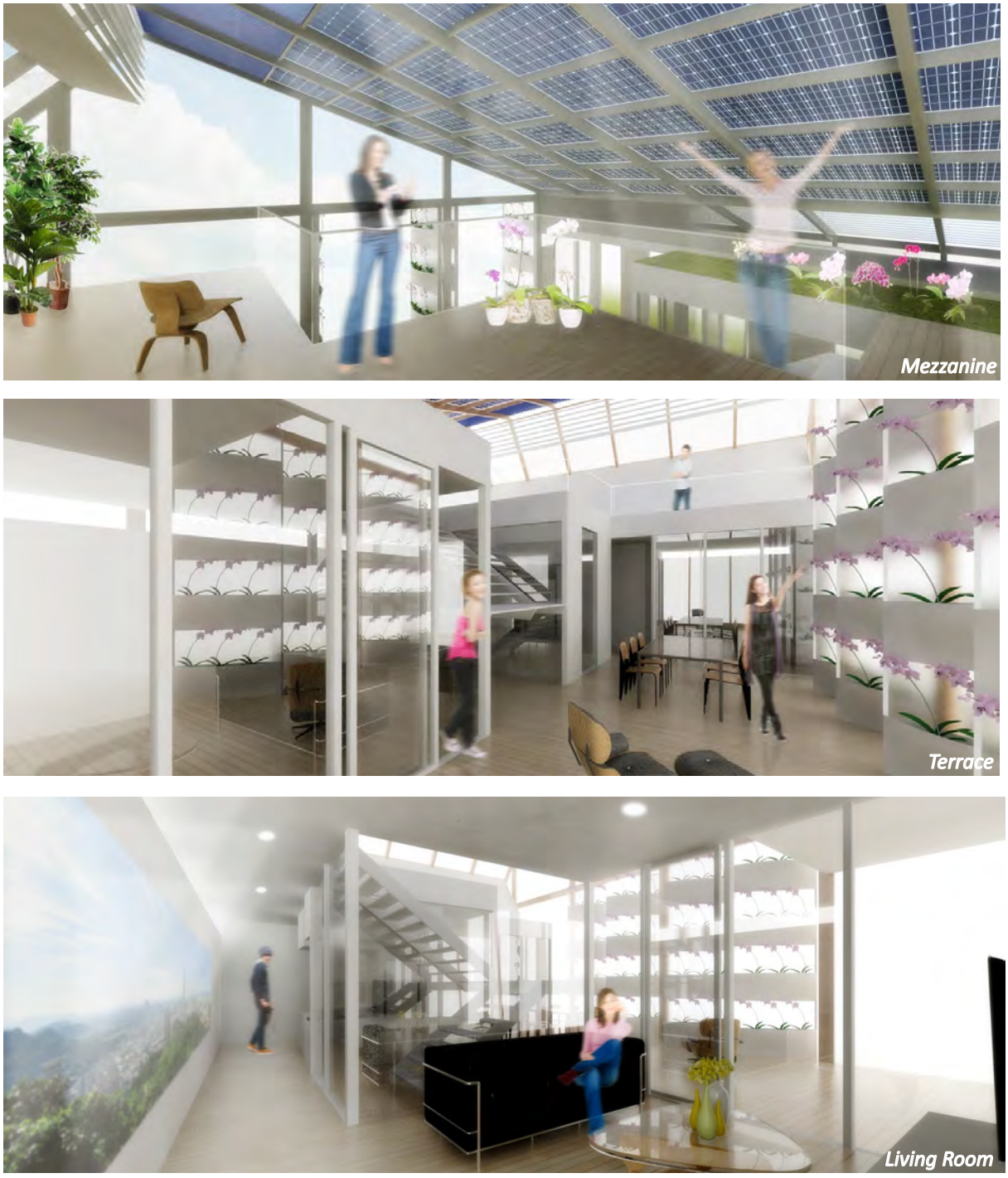


Figure 2.4.1 Mezzanine, Asian-inspired porch, Good visibility form the building characteristics.

2.5 Social housing issues

Social Housing Application

Last but not least, we would like to talk about 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, compared to 6.06% in Japan, 6.2% in the USA, and 9.7% in Korea.

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. Firstly, 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.

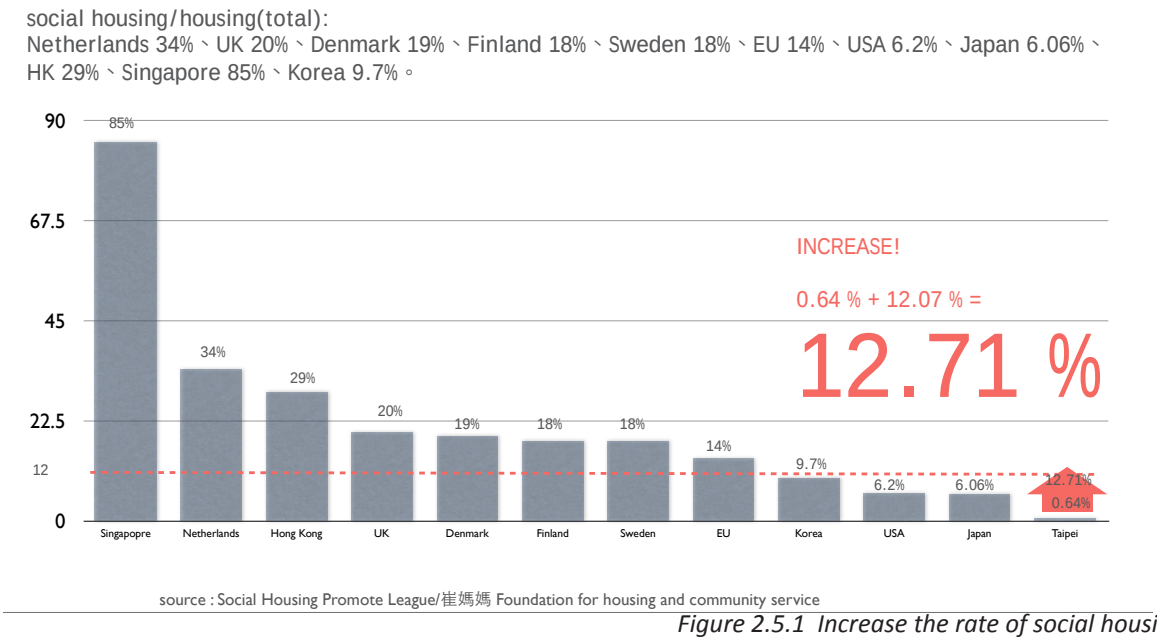


Figure 2.5.1 Increase the rate of social housing

2.6 Industrialization methods

One of the advantages of integrating greenhouse technology into the design of our house is that there already exists an industrialized market in Taiwan, will help lower the construction costs and make the house more affordable.

3.0 Mobility Strategies

To reduce costs and energy impact, most of the structures and building materials will be using the following techniques:

- Pre-fabrication: for faster construction, quality control, low construction cost, and easy assembly.
- Local production: to reduce carbon footprint
- Smaller parts: can fit in the shipping container easily and save space

Orchid House is designed in parts. If the building owner decides to move their prefabricated building, they may hire the construction company that assembled the structure to disassemble and rebuild the structure in a new location.

4.0 Affordability

In a high-density area such as Taipei, fewer and fewer people can afford owning a home, even on a bank loan. 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 sustainable living.
- 40% from ESCO. ESCO is a commercial or non-profit business providing a broad range of comprehensive 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

Orchid House provides a solution to help our target market to acquire property and ease the heavy loan. With implemented renewable energy technologies and high efficiency systems throughout the house, results in the best return on the resident's initial investment.

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: We calculated the angle of our roof 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 contributes 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.

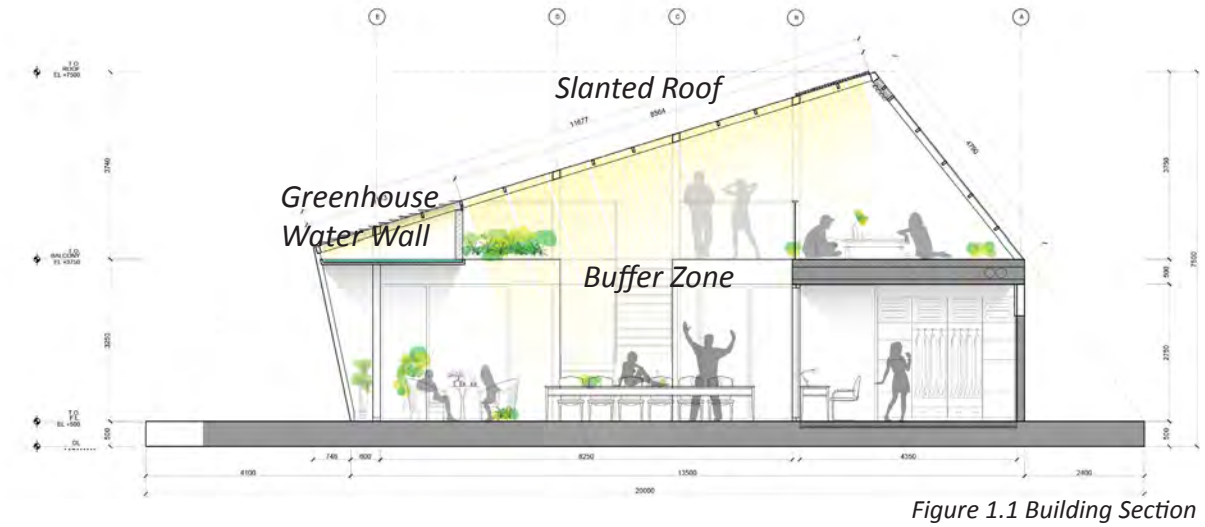
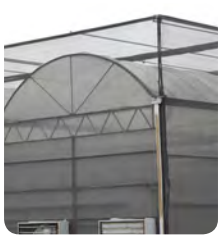


Figure 1.1 Building Section



Green House

DC Fan

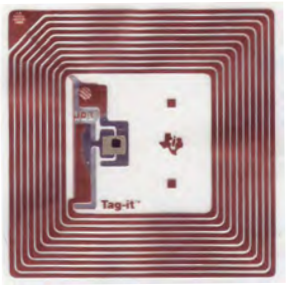
PV Technology

Water Wall

Natural Resource

2.0 Innovation in Engineering and Construction

- RFID with BIM: Building Information Modeling (BIM) is a relatively new technology that allows architects to visualize the properties and functions of their designs digitally, but is not that widely used. Not only will we use BIM to model costs and effects of time along with physical dimensions, we will use it with Radio Frequency Identification (RFID) tags to track the physical components of the house's parts during the construction process. With RFID tags labeling the house parts, we will not have to worry about mixing up house components because the tags will transmit information about where they are supposed to go. This will be beneficial not only during the competition, but also afterwards when the Orchid House is implemented in Taipei as social houses.



RFID

- Delta Photovoltaic Panels: For our Orchid House, we plan to use photovoltaic panels from Delta Electronics. Delta Electronics is extremely innovative and a leader in the field of sustainable electronics. We will be using its photovoltaic panels, which are among the most efficient in the sector.

BIPV Module

3.0 Innovation in Energy Efficiency

- DC-Powered Fans: While most electronics in a house use AC electricity, Delta Electronics has developed fans that are DC powered. These fans, which are essential to circulating air in the house, can be directly connected to the photovoltaic panels. DC-powered fans mean that little to no electricity is wasted through inversion, thus conserving resources and making our house much more sustainable and environmental.

- Delta Electronics Lightbulbs: Delta Electronics has developed LED lightbulbs that are even more efficient and longer-lasting than ordinary LED lightbulbs on the market. During the day, the house is adequately lighted by natural sunlight, but during the night, occupants can turn on these highly economic Delta Electronic lightbulbs. Additionally, 90% of the lightbulb's composition is made of recyclable material, which reduces the strain on the environment.

- Combinations of Active and Passive Solar Strategies: Instead of simply relying on one or the other, we use both active and passive solar heating strategies in combination to reduce the energy load of heating and cooling. The two main techniques are the water wall and radiant heating. The fans that draw out the evaporation-cooled air and encourage air within the house to circulate rely on electricity, but the amount of electricity used is reduced because of DC-powering. The water for radiant heating requires no electricity, and is instead heated by sunlight; the pump that circulates the hot water does, however, require electricity. The tempera-

ture house would not stay in a comfortable range without active solar heating, but we also have passive methods, such as a thermal mass wall and louvers at the north side of the house to draw out air by negative pressure, that reduce the energy load.

- Rainwater Collecting and Dew Harvesting: The design of our house makes use of all resources with as little waste as possible. We specifically designed the roof so that collecting rainwater and harvesting dew happens naturally, without any need for human or mechanical labor. The liquid will be used for our water wall, and for watering the various plants around the house through drip irrigation. Drip irrigation is a relatively new way of watering plants that supplies plants with exactly the amount of water they need, thus preventing unnecessary waste.

4.0 Innovation in Communication and Social Awareness

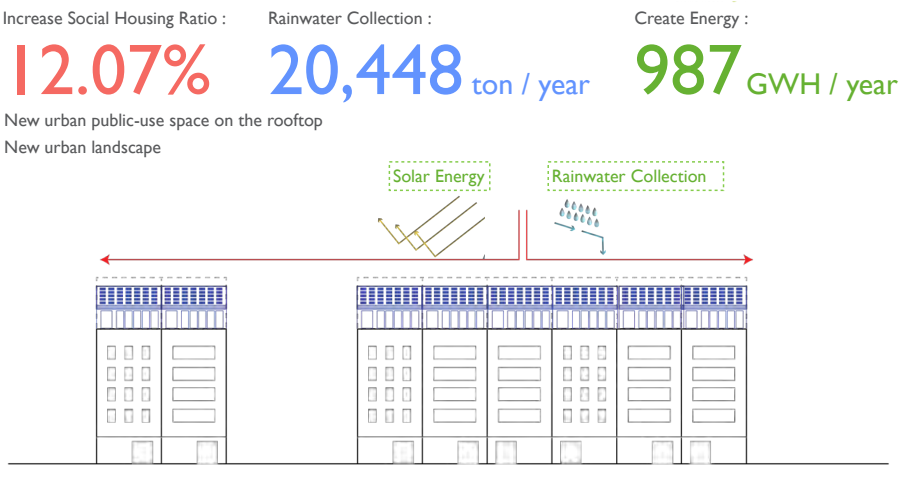
- Bamboo Fox Bed & Breakfast: Instead of letting the hype over the Orchid House die down after the end of the SDE competition, we wish to continue our momentum and push strongly for better recognition of sustainable practices. Before the competition, we will be broadcasting news of the Orchid House through as many channels and to as broad an audience as possible; after the competition, we will allow those interested to stay a night in the actual Orchid House. Through this project, we will be able to convince people that a better future lies in green energy and conserving resources.

- Planting the Solar Seeds: Besides focusing on spreading awareness of green energy and sustainable practices to the public, we also want to target the literal future – the next generation of architects and home-owners. With this communication strategy, we will plant the seeds of environmental awareness in the minds of the primary and secondary school students. All levels of society are important to this project, not just those with low-income who will benefit from the implementation of our project as social housing.

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.

1.0 Objective

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 Introduction: Sustainability Concept applied

We can all learn from Nature. A house is like a plant. The leaves creates de
w drops, and the root absorbs water, then circulate in the stems, and the leaves performs photosynthesis. This cycle creates water and energy, properly stored, then supply to the entire plant. Our house will function the same, as the solar panels absorb light from the sun, converted and stored in the battery, then supply to the rest of the house. We can also harvest water, circulate, recycle and reuse our own water.

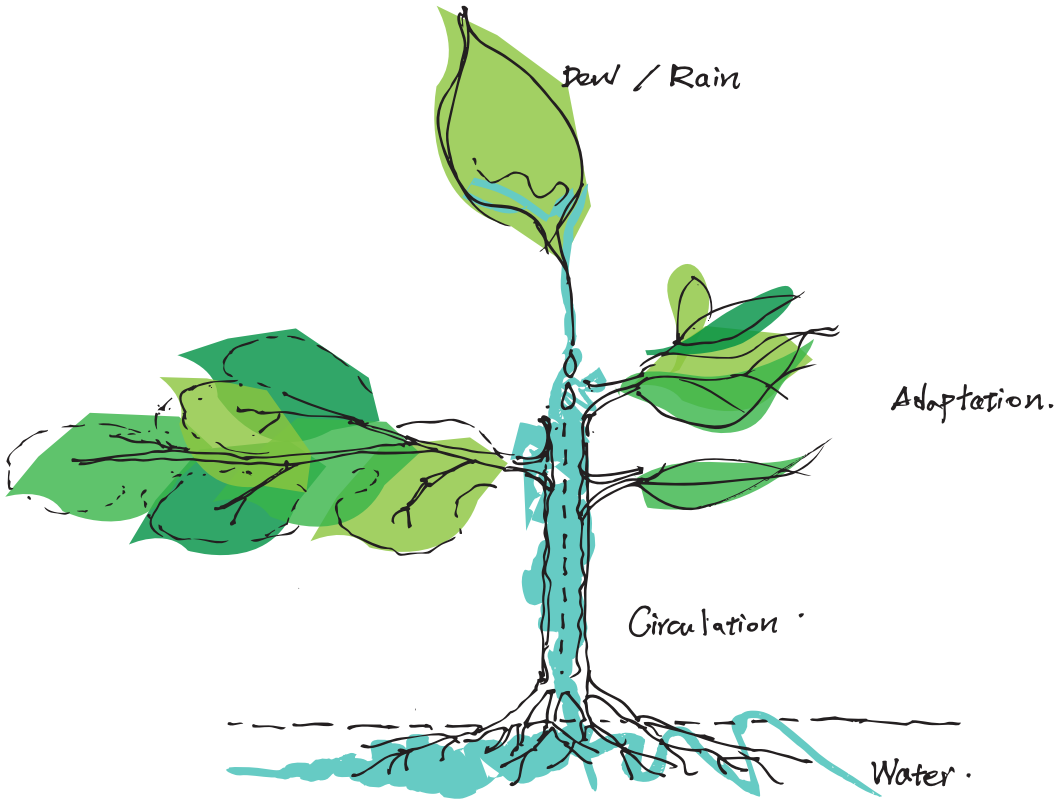


Figure 2.1 Concept Sketch of Living Plant

Our house design concept is based on the Taiwanese local conditions, however, we believe those systems are applicable to any other locations of earth. Here are the sustainable approaches to the house which we have incorporated during the design process:

1. Light weight structure with BIPV (Building Integrated Photovoltaic) system
2. Highly insulated structural panel for living space
3. Solar thermal water device for radiant flooring
4. Humidity and temperature control system develop upon the green house technology
5. Water circulation systems

To create and control a comfortable living environment, we incorporate a special building system at the Orchid House. First we created a skin, which is semi-covered for shading and ventilation purpose. The inside core is the actual living area, where we will have a well-controlled system to keep temperature and humidity levels even.

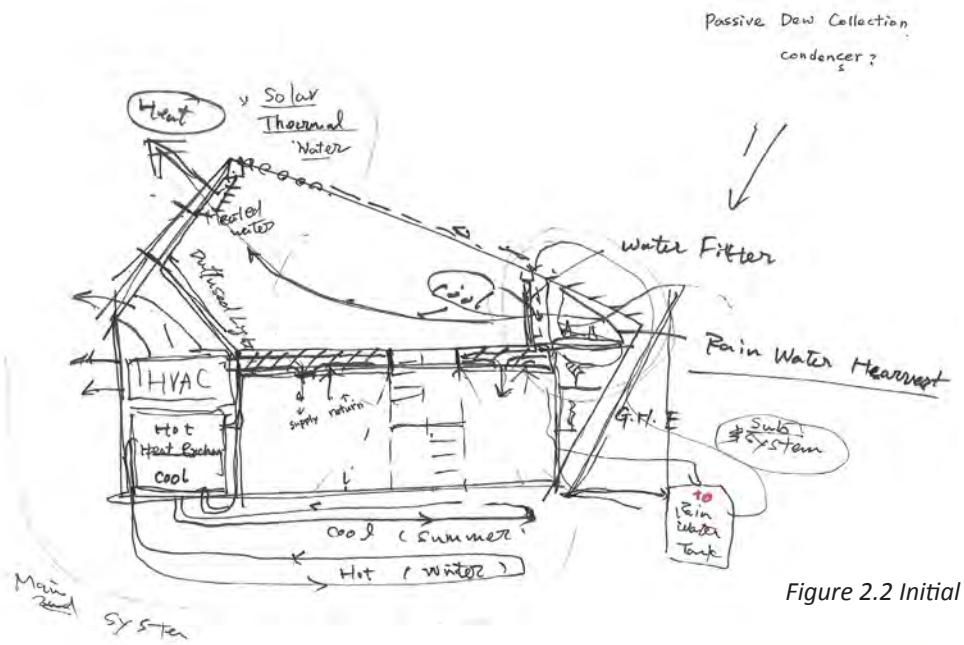


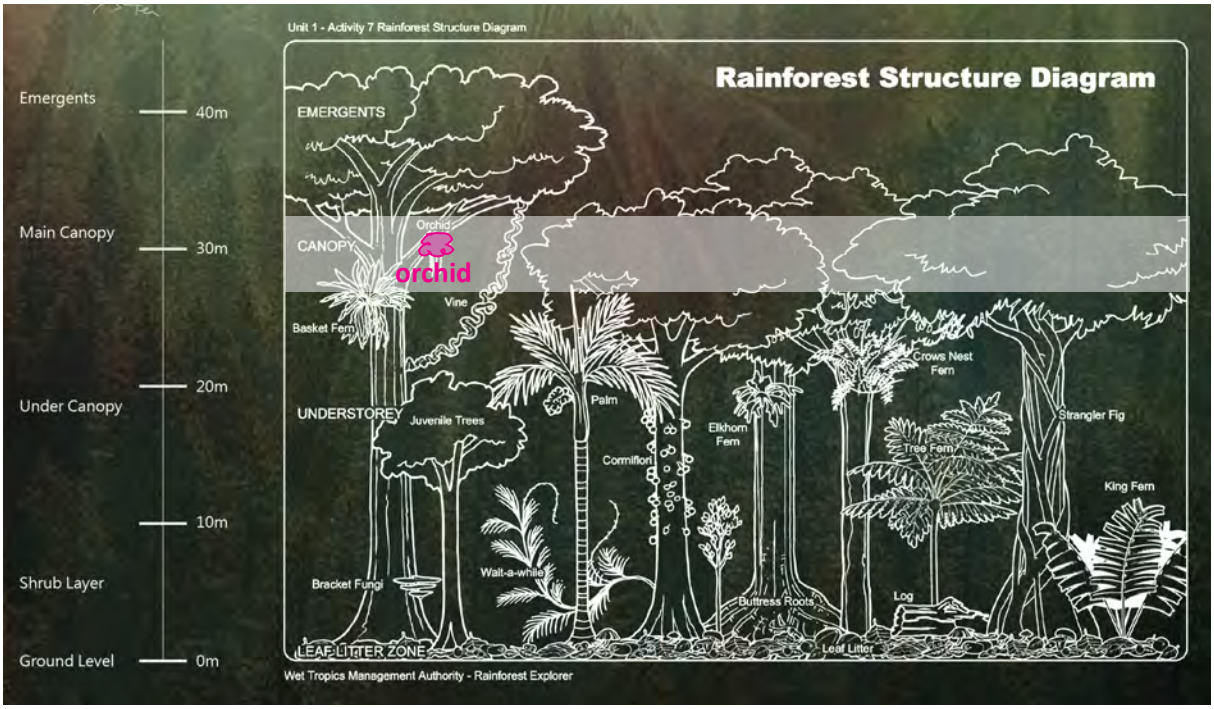
Figure 2.2 Initial Concept Sketch

3.0 Bioclimatic Strategies

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

- No direct 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.



3.1 Water

To make a greater use of water, we have created two water zones in the house and have implemented the following systems:

- Rain water collection
- Dew harvesting
- Grey water recycling

The first water zone in the Orchid House will collect rainwater, which is used for the water wall and for evaporation cooling. The metal sheets in the water zone will create dew drops when due to temperature difference, which we can collect and use as well. The water will then be filtered and used for toilet flushing and irrigation. The second water zone in the back of the house provides clean water, recycles all the used water from house, which is filtered then pumped into the gray water tank for vegetation irrigation.

The combined system does not only help reduce storm water runoff, but also reduces the wasting of potable water. During the competition weeks, we expect to reduce the waste water to nearly 0. In the city of Taipei, we have approximately 10,000,000 m² roof area, which we could expect to harvest more than 20,000 tons of water in a year.

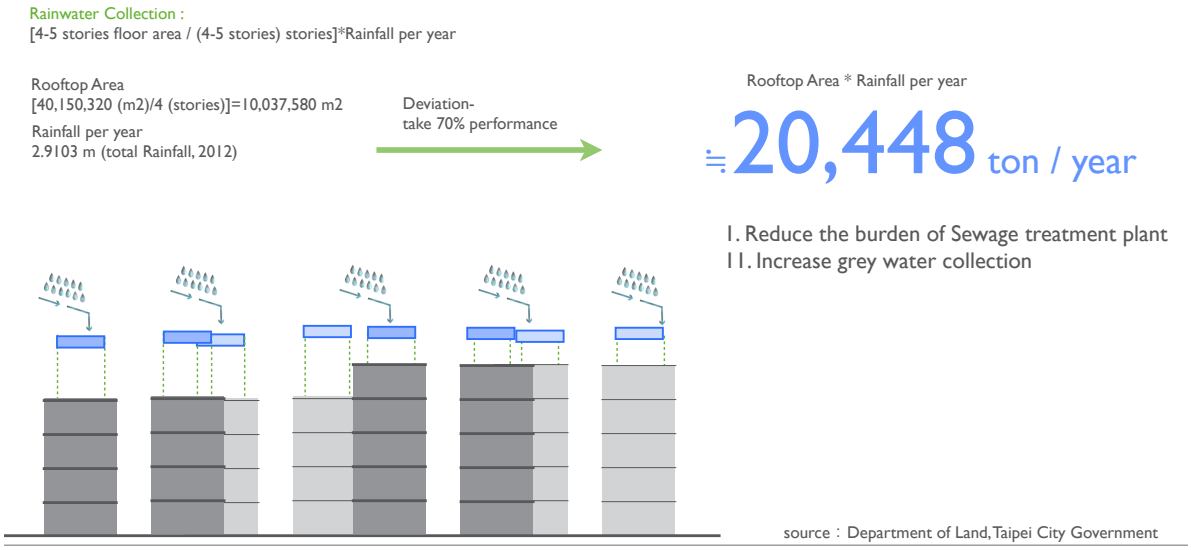


Figure 3.1.1: Expected rain water harvest in Taipei, Taiwan (annual)

3.2 Solid Waste

3.2.1 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.

3.2.2 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.

3.3 Material

3.3.1 Materials selection

The main structure will be steel, which can be recycled an infinite number of times with no loss of product quality. This is incredibly sustainable, and the use of scrap steel, as opposed to virgin ore, has the following estimated environmental impacts:

Figure 3.3.1.1 Steel, Scrap Steel, Glass

- Reducing air pollution by 86%
- Saving energy by 74%
- Reducing water consumption by 40%

Glass is the other one of the few materials that can be recycled infinitely without losing strength, purity or quality. All glazing used in the Orchid House are recycled in the local facility. For every 1,000kg of waste glass recycled into new items saves 314 kilograms of carbon dioxide from being released into atmosphere during the process of making new glass. Therefore, we want to focus on these 2 materials to construct most of the structures of the house.

3.3.2 Enclosure description

The glass laminated PV panel cuts internal gain by 40%, while letting most of the sunlight through the interior space. The 10-meter long thermal mass on the west side is filled with water to create a 12-hour time lag. The beginning point of the tour is strategically placed at the west facade, so visitors can see the panoramic projection on the wall while waiting.

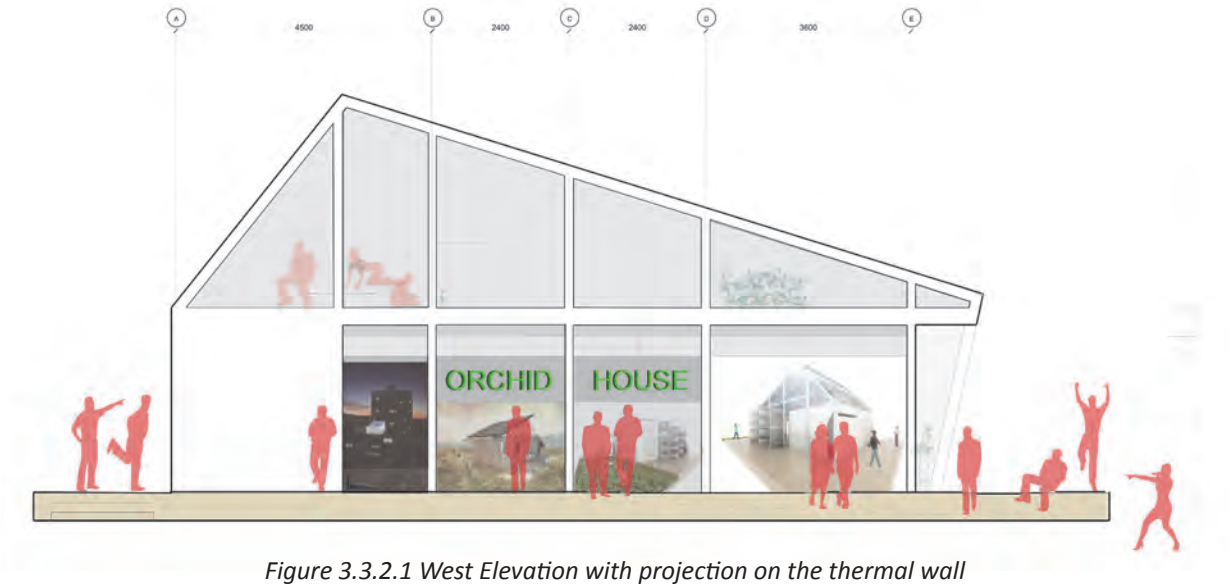


Figure 3.3.2.1 West Elevation with projection on the thermal wall

3.3.3 Maintenance Plan

Since our house is designed to be built in parts, factories can pre-fabricate the parts and ship them to the job site, and maintenance becomes easy and quick. However, since the materials we have used are mainly steel and glass, we do not expect it to need maintenance for at least 10 years.

3.3.4 Incorporated Energy

This calculation will be included in the next deliverables.

3.3.5 Incorporated CO2

This calculation will be included in the next deliverables.

3.4 Solar Facilities

This calculation will be included in the next deliverables.

3.5 Equipment

All the appliances in the house, including washing machine, dryer and oven, etc., will be approved by the Taiwanese government and given a green certification. All lighting will be LED, provided by our sponsor Delta Electronics, Inc., that are 90% recyclable, with extended 90,000 hour life time. HVAC system is combined with a heat reclaim ventilator, to further reduce wasted energy. Radiant flooring that utilizes the hot water from the solar water heater is installed in the main living space. In addition, rain water is recycled and run through the water wall system. Together with DC fan, it becomes another energy and water saving system. Orchid House combines passive and the active systems to create a better solution and to be more sustainable.

Figure 3.5.1 Green Certification

3.6 Transportation

Orchid House relies on the three principles to reduce cost and energy impact:

- Pre-fabrication
- Local production
- Smaller parts

The building materials are pre-fabricated locally to reduce transportation distance, and the smaller part makes shipping with regular size container easier, thus reducing the carbon footprint. The smaller parts can be handled with smaller machines and we can expect a huge saving on labor time and machine power.

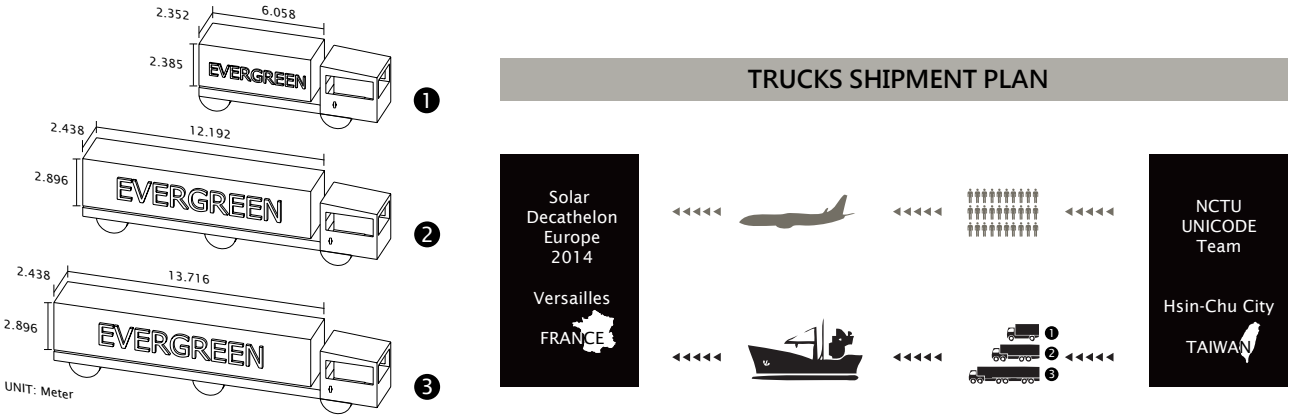


Figure 3.6 Trucks Shipment

Dinner Party Menu

Festival of Taiwan

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.

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.

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.

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.

To conclude our dinner party, we would like to invite our guests to the 2nd floor balcony space. In Taiwan, families and friends often enjoy tea and chitchat after dinner. Our guests will enjoy the Taiwanese high mountain tea with the view from the 2nd floor.

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.

Cost estimate and project finacial summary

Business and Fund-Rasing Plan:

1. Description of overall project

NCTU / UNICODE, team of National Chiao Tung University, is taking Solar Decathlon Europe as the opportunity to develop a prototype house for co-existing with nature by focusing on the green house technology that has been developed for cultivating orchid in Taiwan combining with the research institute here in NCTU. The university's main campus is located at the center of the Hsinchu Science Park, Taiwan's national research center. The area is referred to as the Silicon Valley of Asia. More than 400 technology companies have been established in the park.

2. Project Budget

See the list below

3. Interaction with other departments

In terms of inter-university departmental collaborations, NCTUNICODE tem is base in The Graduate School of Architecture and is in the process of collaborating with the following schools in various aspects related to SDE 2014 project:

NCTU President's Office
1. Administrative and overall support
2. Alumni relations and resource advice
3. School-wide and nation-wide media, communication, and press release

NCTU School of Engineering
1. General engineering solutions and prototyping
2. Database management and technology advice
3. Simulation and specifications

NCTU School of Management
1. Multidisciplinary coordination management
2. Risks management advice
3. Communication planning and strategy

NCTU School of Science
1. Research on various subjects related to horticulture, nursery, and industry
2. Database sourcing related to weather, environment, and other academies

4. Fund-Raising Plan

4.1 Goals and Objectives
4.1.1 To engage the leading industry leaders in each of the key areas of our design as strategic support
4.1.2 To engage the most relevant technology/capacity providers that are capable of extending our research into materialization and commercialization
4.1.3 To engage leaders of sustainability promoters for expanding the public and market awareness of our design

4.2 Strategy
4.2.1 To identify key merits and values in our design and the overall SDE-related activities – by consolidating the driving values inside and out of our design of the solar house project, we will then leverage these key merits for the entire fund-raising activities as our Core Values.
4.2.2 To establish database and contact information - which includes government agencies, private corporations, research-backing institutions, and special interest communities and groups.

4.2.3 To research and engage initial contact – based on internal research of target candidate's creditability, relevance, and likelihood of support, the team will engage initial contact and communication towards a short-list of candidates for in-depth communication and fund-raising activities.
4.2.4 To solicit government or special interest group's endorsement and reference in approaching potential candidates.

4.3 Target Candidates (categorized by sector)
4.3.1 Solar/PV Technology
4.3.2 General Building Construction
4.3.3 General Mechanical, Electric, Environmental Control Provider
4.3.4 Housing Builder
4.3.5 Orchid Horticulture Enabler
4.3.6 Urban Regeneration/Renewal Promoter
4.3.7 Logistics
4.3.8 Alumni Office and Development Office at NCTU
4.3.9 Media, PR Agencies and Advertiser

Cost Estimate:

Project Budget Summary (in €) Date: April, 1, 2013

	ITEMs	COST (est'd)	Remarks
I.	**DIRECT MATERIALS**		
	Landscape	10,000	Earthwork, planting, deck
	Foundation	5,000	
	Structure	23,000	
	Building System	85,000	Wall assembly, metalwork, waterproofing, insulation, etc.
	Roofing	23,000	Including prototyping
	Openings	34,000	Doors & windows
	Finishes	10,000	Interior & Exterior
	Electrical	80,000	Power, storage
	Plumbing	10,000	
	HVAC	23,000	
	Specialty	57,000	Solar PV
	Furnishings	22,000	Including shading device
	Appliances	30,000	Fixtures
	V.A.T.	20,600	@ 5%
	SUBTOTAL	**432,600**	
II.	**MATERIAL OVERHEAD**	43,260	@ 10% of total MATERIALS
	V.A.T.	2,163	@ 5%
	SUBTOTAL	**45,423**	
III.	**DIRECT LABOR**		
	Faculty & Researcher	75,000	5
	Assistant – Admin.	15,000	1
	Assistant – Research	45,000	3
	Granted Students	60,000	4
	Draftsman	15,000	1
	SUBTOTAL	**210,000**	
IV.	**LABOR OVERHEAD**		Including Fringe Benefits
	Granted Students	10,000	
	Laborers	10,000	
	Assistant – Admin.	10,000	
	V.A.T.	1,500	@ 5%
	SUBTOTAL	**31,500**	
V.	**LOWER-SUBCONTRACTORS**		
	Prototyping Phase	2,500	
	1st Construction Phase	3,000	
	2md Construction Phase	4,500	
	V.A.T.	500	@ 5%
	SUBTOTAL	**10,500**	
VI.	**CONSULTANTS**		
	Structural	3,000	
	M/E/P	3,000	
	Life Cycle Analysis	3,000	
	Energy Simulations	3,000	
	Transportation	3,000	
	Site Preparation	3,000	

	Lighting	1,500	
	V.A.T.	975	@ 5%
	SUBTOTAL	**20,475**	
VII.	**OTHER DIRECT COSTS**		
	Professional Photography	500	
	Security	1,000	
	Model	500	
	Communication	2,000	Media, Website
	Publications	2,400	Booklets for various purposes
	Event	4,000	Promotion
	Past Competition Monitoring	10,000	
	V.A.T.	1,020	@ 5%
	SUBTOTAL	**21,420**	
VIII.	**TRAVEL & ONSITE COSTS**		
	Travel Costs	35,000	30 person/trips
	Accommodations	30,000	
	Food	5,000	
	Uniform	5,000	
	Tools & Misc. Expenses	4,000	
	Site Supervision & Security	8,000	
	Shipping and Handling	1,000	
	Allowance	10,000	
	V.A.T.	4,900	@ 5%
	SUBTOTAL	**102,900**	
IX.	**ASSEMBLY/DISASSEMBLY & LOGISTICS**		
	Disassembly in Origin	10,000	
	Transport. & Crane	40,000	
	Assembly Onsite	15,000	
	Disassembly onsite	10,000	
	Transport.	30,000	
	V.A.T.	5,250	@ 5%
	SUBTOTAL	**110,250**	
X.	**INSURANCE**		
	Liability	5,000	
	Transportation	5,000	
	Accident	10,000	
	Medical	10,000	
	V.A.T.	1,500	@ 5%
	SUBTOTAL	**31,500**	
	TOTAL	**1,016,568**	

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