

**Solar
Decathlon
Europe**

2014
EN FRANCE

TEAM
UNICODE
Deliverable #1
Press Release #1

Orchid House

INDEX

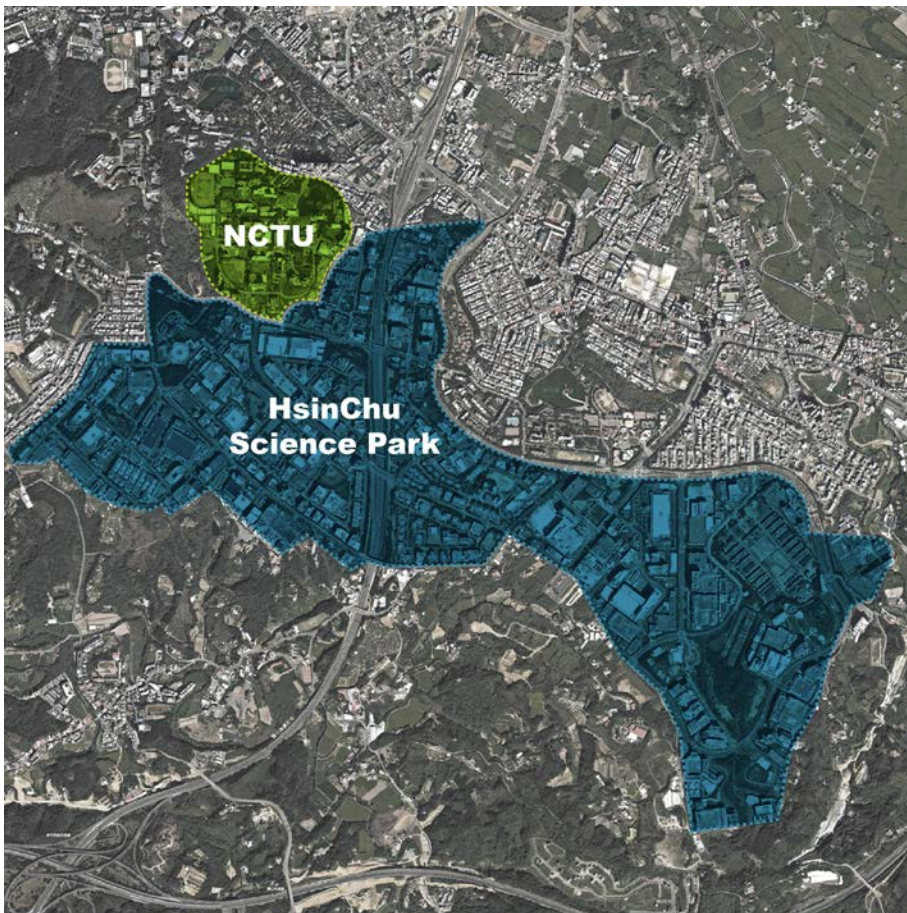
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INTRODUCTION

Taiwan is located on the eastern edge of the Asian continental shelf with complex geological and topographical surroundings where the rivers are short and swift and natural disasters such as typhoons, flooding and earthquakes are a frequent occurrence. In essence, Taiwan is an island whose ecosystem is both vulnerable and isolated. With its high population density and scarce land and natural resources, the rapid development that it has undergone in the past decades has inflicted much damage on its natural environment and posed a great threat to the habitats of its diverse fauna and flora.

Since the limited land resources of an island country constitute an innate limitation on its development, the most important issue for its sustainable development should be to make optimum use of such land resources as it possesses. And that is especially so in Taiwan's case, as two thirds of its land area is mountainous and only one quarter is suitable for agricultural production, which further limits the supply of land that can be used for farming and socio-economic activities apart from forestry, water resources, and mining.

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.



PROJECT

NCTU Unicode concerns that how to develop a prototype house for co-ex-isting with nature by focusing on the green house technology that has been developed for cultivating orchid in Taiwan. In order to create comfort living space, the high temperature and humidity is biggest issue to solve. We believe that less energy usage for climate control in the house bring the project more sustainable development and helps the house to find market not also in Taiwan but other countries as well. We want to find solar house solution with the local condition, but also be able to apply in wider range of locations as well.

Concept

We take the most of design concept for project from the local conditions in Taiwan, such as island climate, available technology, industrialization methods, and social housing issues.

Island climate

Taiwan lies on the Tropic of Cancer, and its climate is marine tropical. The northern part of the island has a rainy season that lasts from January through late March during the northeast monsoon. The entire island experiences hot, humid weather from June through September. In order to create comfort living space, the high temperature and humidity is biggest issue to solve. We believe that less energy usage for climate control in the house bring the project more sustainable development and helps the house to find market in Taiwan.

Green house technology

When we start developing our house concept, we look into the green house technologies that are available in Taiwan, especially for the orchid house. Taiwan is one of the most famous countries for the orchid and holds huge industry for it. We noticed how advance the green house technology is and realized it is ideal for our house to implement them for temperature and humidity control of our inside space.

Social housing issues

We are also aware of the issues in social housing in Taiwan and trying to adopt our house to improve the condition. The housing system in Taiwan has been fully commercialized. Public housing originally fulfilled a social function, but almost every unit has since been sold off and privatized. As a result, public housing policy has been likened to a lottery. The system ignores disadvantaged groups, social justice and low-income housing: rented housing accounts for only 0.08 percent of public housing. We realize that the system we develop for the Solar Decathlon Europe is also applicable for the social housing for the renewable energy to reduce the utility cost as well as the comfortable living space.

Industrialization methods

The advantage of integrating green house technology to our house is the existing industrialized market in Taiwan, which is necessary for lowering the construction cost and market price of the house.

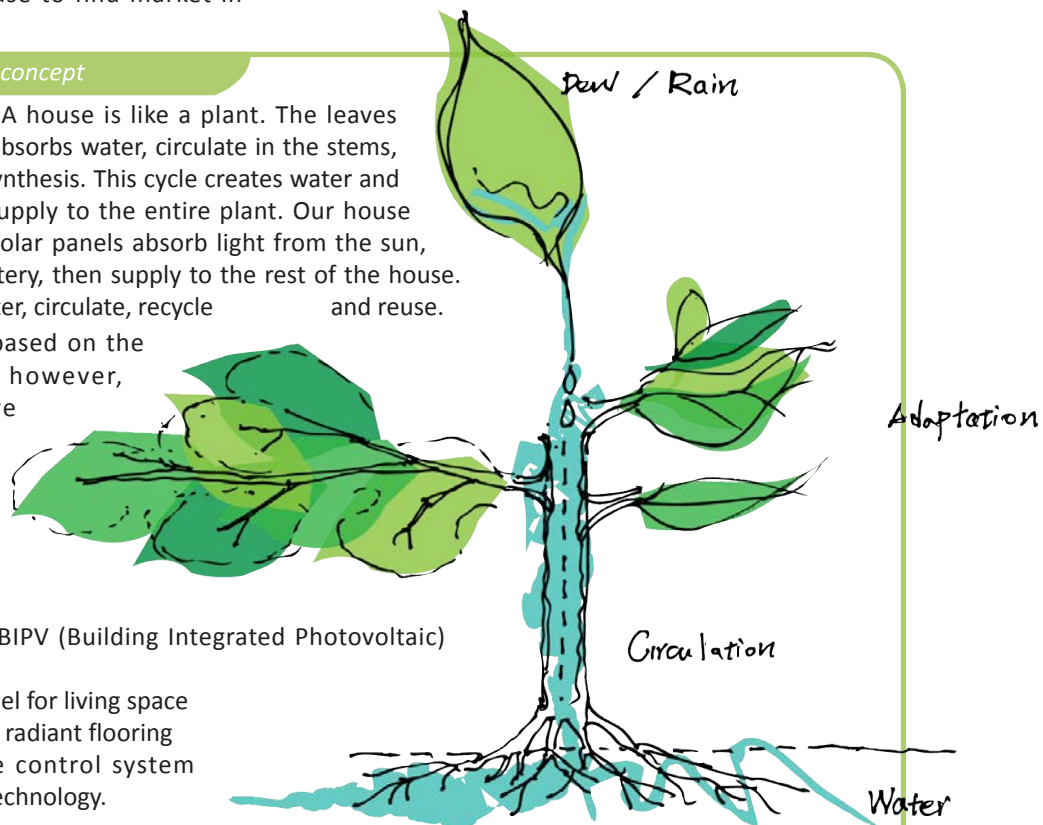
The sketch of the project concept

We can all learn from Nature. A house is like a plant. The leaves create dewdrops, and the root absorbs water, 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 our own water, circulate, recycle and reuse.

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:

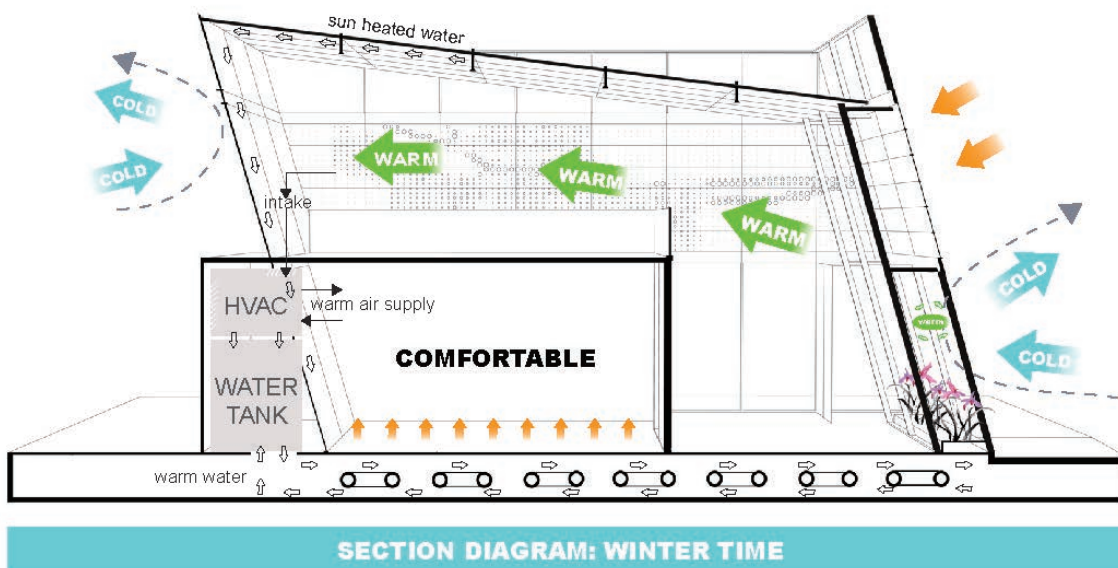
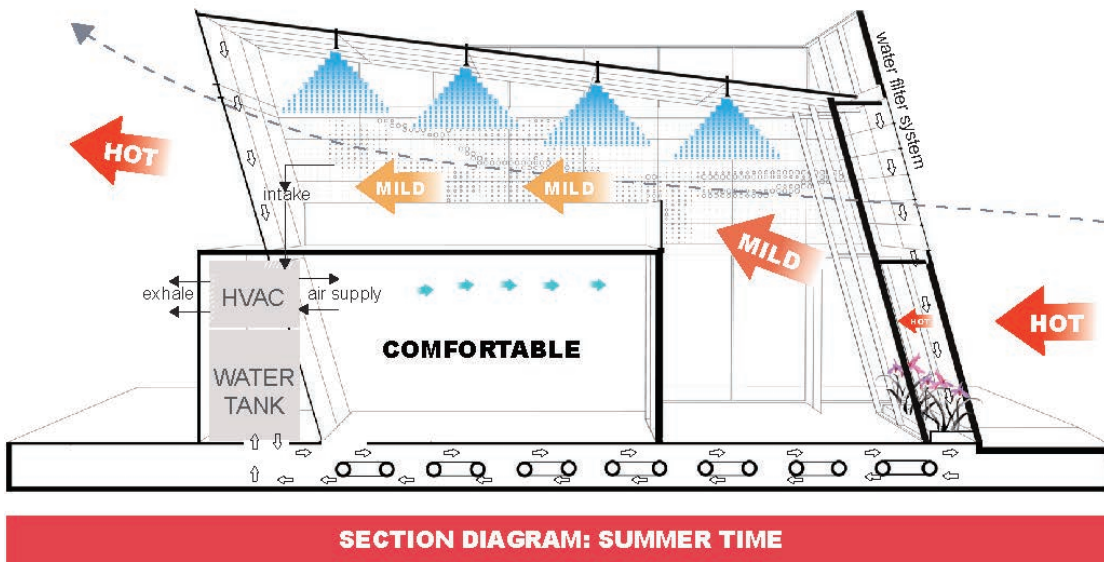
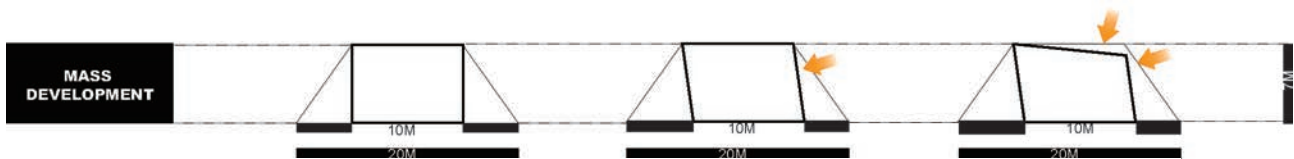
1. Light weight structure with BIPV (Building Integrated Photovoltaic) system
2. Highly insulated structural panel for living space
3. Solar thermal water device for radiant flooring
4. Humidity and temperature control system develop upon the green house technology.
5. Water circulation systems



Design Approach

Our house design concept is based on the Taiwanese local conditions, however, we are confident that those systems are applicable to any other locations of earth. We are expecting much drier climate condition during the Solar Decathlon Europe 2014 in Versailles, France, which is almost opposite climate from one in Taiwan. It will be challenging for us to archive the house to function in the both dry and wet condition well, however, this experience will lead us to market our house in different cities and countries.

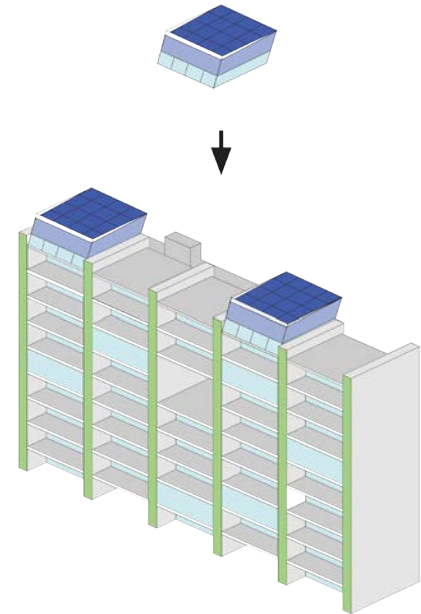
The envelop of house is composed with light weight structure with BIPV (Building Integrated Photovoltaic) system, solar thermal water device, and humidity and temperature control system develop upon the green house technology. The green house space is not only to control indoors temperate and humidity, but also to create semi-outdoor space for comfortable living experience. The key element for this envelop is "WATER" that is circulating within the lightweight structure. The solar thermal system will be heated up the water during the day and stored for shower and radiant floor, while green house system will use the water for cooling the space. The lightweight structure will allow the easy and short time construction, and also low construction budget.



Objectives

Social Housing Application

At last, but not least, we like to talk about the possible development of our solar house to new type of Taiwanese social housing system. Due to the lack of social housing number, the government is eager to solve housing issue in Taiwan. We believe that our industrialization manufacturing process will reduce the load of construction worker and shorten the construction time, which ends up with lowering the construction budget. In order to transform our single dwelling design into multi-floor collective housing, we will introduce the vertical wind tunnel, which also act as main load bearing wall of the building. This wall will incorporate water filtering system as well as thermal water system for the cooling and heating of the units. Even though we will try to run all the electricity from the PV system for the prototype house, the social housing will mainly utilize the harvested electricity for common area and building utilities for not over budgeting the project. The report, which includes the data from Solar Decathlon Europe 2014, will be submitted as a proposal to the housing ministry of Taiwan after the competition of the project.



Rooftop

People owning the top floor in Taiwan would utilize the rooftop space for extending their living space. However, water tanks and the metal roof create an unpleasant visual impression of culture landscape which has been seemed the special characteristic of Taiwan.

In order to change the culture landscape caused by living necessity, NCTU Unicode takes serious consideration to not only make an improvement of the visual part but also make benefit through creating a sustainable system which could increase the energy conservation and cuts down the house utility costs. Since this sustainable roof system could be beneficial for environment, there are more potential possibility and feasibility of marketing in the future Taiwan.

The best and most intension of NCTU Unicode is to create a single dwelling prototype focusing on the environment issue, which is able to reduce the heat island effect and build a feasible drain system as a role of cleaning the city which is the most necessary part in the future Taiwan. We care about the "green rooftop system" and intend to create the passive wind ventilation system; the drain system and the passive solar system to respond energy saving. Thus, these strategies of focusing on the environment may accelerate the speed of reaching the goal of sustainability.



House's Description and Relevant Items

Even though our house will be designed as a single dwelling for Solar Decathlon Europe competition, we also set our goal up for the housing structure to be configured as collective social housing. In order to archive our goal, the structural system has to be extendable to multi-floor building and adopted certain modular units. We will utilize BIM (Building Information Modeling) software for the complex building system and create most efficient but strong structure system. The social housing will be self-sufficient not only for the energy supply, but also food that will be harvested in the green house. The housing complex will be proposed to Taiwanese housing ministry after completing the prototype at Solar Decathlon Europe 2014.

NCTU / UNICODE's "Orchid House" will incorporate all of the high technologies that available in the NCTU research lab, Hsinchu science and technology industrial park, as well as the market in Taiwan, including green house technologies, digital environmental control interfaces, solar thermal collectors, and high efficiency photovoltaic panels. However, if we totally rely on those technologies, the construction cost may exceed the limit of market availability. We aim to lower our house cost by distributing and mixing those technologies, for example incorporating active and passive solar system, and also recycling and harvesting water for radiant flooring and green house wall's water filter system. In order to archive our goal, we have focused our technological research on following topics.

Building envelop and passive solar system

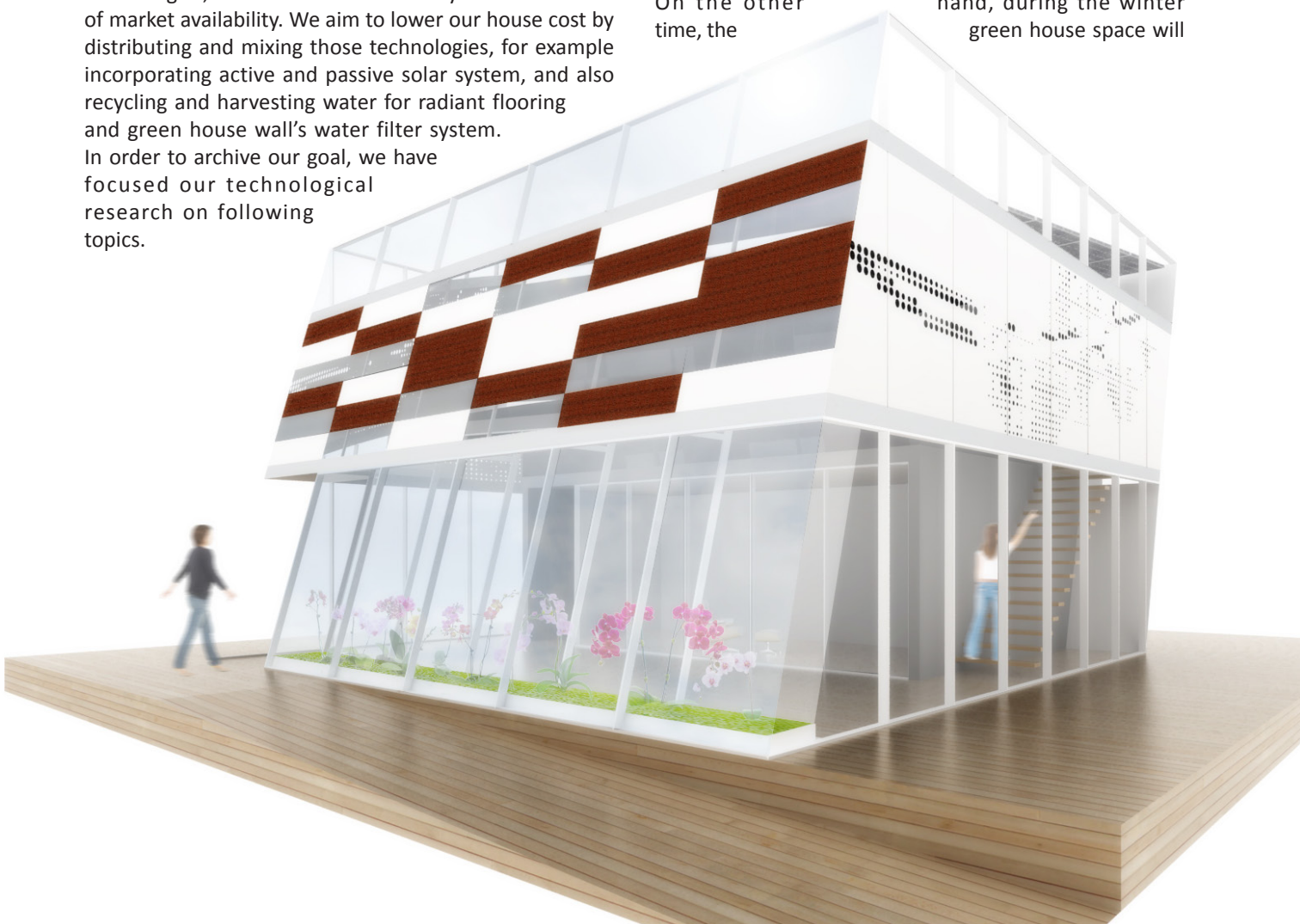
In order to utilize the passive solar system, which uses 90% less energy for heating and cooling compared to existing building and archives 75% overall energy savings, the plan layout of house needs to be considered. We placed living/dining space toward south side and north side of house will host bathroom, kitchen, storage, and machine room to be the layer of protection for thermal lost during the wintertime. The south side living space could be extended to the green house space for the flexible and comfortable living style.

Temperature controlling space

The air temperature will be controlled through the green house space to minimize the energy consumption for cooling and heating the living space. The hot air will travel through the water filter and also the fanning system on ceiling to cool down before going through HVAC system during the summer time.

On the other time, the

hand, during the winter green house space will





stop the over flow of air and heat up with the sun. Also the solar thermal system on the roof will provide hot water for radiate floor. The house will be analysed with solar access calculation software, such as Ecotect from the early development stage to generate environmental feedback.

Lighting system

Lighting design will be an integral element of the house and its energy system. Taiwan is currently one of the largest manufacturers of LED in the world and NCTU research institute is also taking part of the industry. We will use the most efficient light source on the market and integrate all lighting with the house sensor system to monitor the room brightness comfort and temperature. Our electrical lighting will work with the mechanical system to increase system efficiency. All the heat generated by the light source will be paired with the performance of air delivery systems to avoid waste heat by lighting source.

PV system

We have been investigating photovoltaic system for the house, especially from the manufacture in Taiwan. Among many companies, we have paid attention to Neo Solar Power Corporation, the industry leading

PV manufacturer in Taiwan. The highest efficiency panel from Neo Solar Power, Black19+, archives 19.4% efficiency, which allows fewer panels for meeting energy harvesting requirement for the competition. Our design team will work with Neo Solar Power research team closely to develop the most efficient PV system for the house. The PV panels are attached to the building envelop with thermal water tubes behind, which also gives panels air space for avoiding overheat to lose the efficiency of the system. The PV system is not only the prime power generator, but also the key element for the architectural aesthetic.

Control system and Digital fabrication

As one of expertise of Graduate Institute of Architecture, we will apply advanced digital technologies to the house components, especially interactive mechanism and CAD/CAM fabrication. The interactive technology will possibly be a sunshade device of the house or sensory device for the human activities in the house integrated in the house control system. The system will be able to monitor through wireless network within the house and visible in web format to check through personal computer and smart phone devices. Also digital fabrication gives the house interior space to be very unique but constructed with minimum waste of material.

Dissemination Activities and Current Impact

In the past one month, NCTU Unicode team attended several conference, organized several field trip, and introduced itself and the Solar Decathlon Competition on several presentations.

*One day internship in Ruentex Group –
MARCH 20 2013, TAIPEI*



潤泰集團

RUENTEX GROUP

NCTU Unicode team participated in Ruentex Group's internal "Innovation and Technology Committee Meeting", hosted by the chairman Dr. Samuel Yin. As a result, we had a better understanding of on-going projects, cross-functional operations and innovative construction/material development.



Field trip in Grand Biotechnology – MARCH 21 2013, HSINCHU

To gain knowledge of orchid nursery industry, NCTU Unicode team organized a field trip to Grand Biotechnology, a professional orchid grower company, which is involved in the research and development of orchid tissue culture, through the adoption of biotechnology and high tech bio-processes.



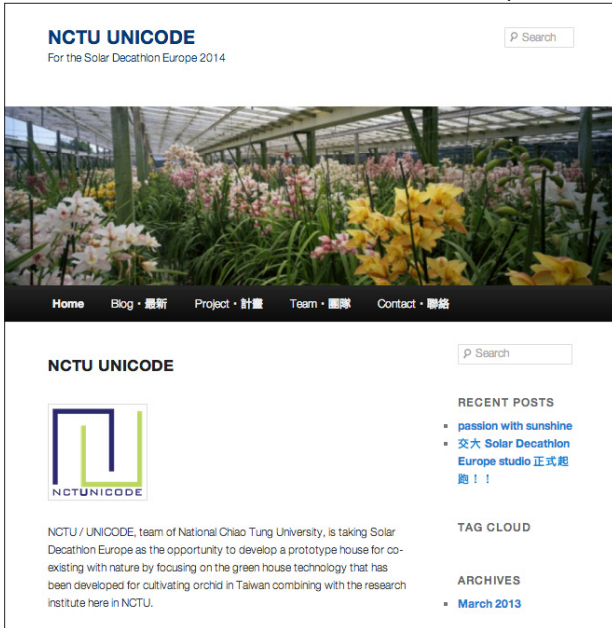
Study Tour of Green Factory – MARCH 20 2013, TAINAN

NCTU Unicode team arranged a study tour to visit Green house as well as Taiwan International Orchid Show 2013 in Tainan. In this tour, we observed the architectural elements of green house, such as shelter, waterproof system, cooling system, fan and artificial lake...etc..



COMMUNICATION INFO

<http://sde.tw>



<http://www.facebook.com/TWSDE>



We set up our Official Web Site in English and Mandarin, please scan the flash code or link to <http://sde.tw> to check out our latest updates. We also have a Facebook fan page to attract more people to be interest in our project.



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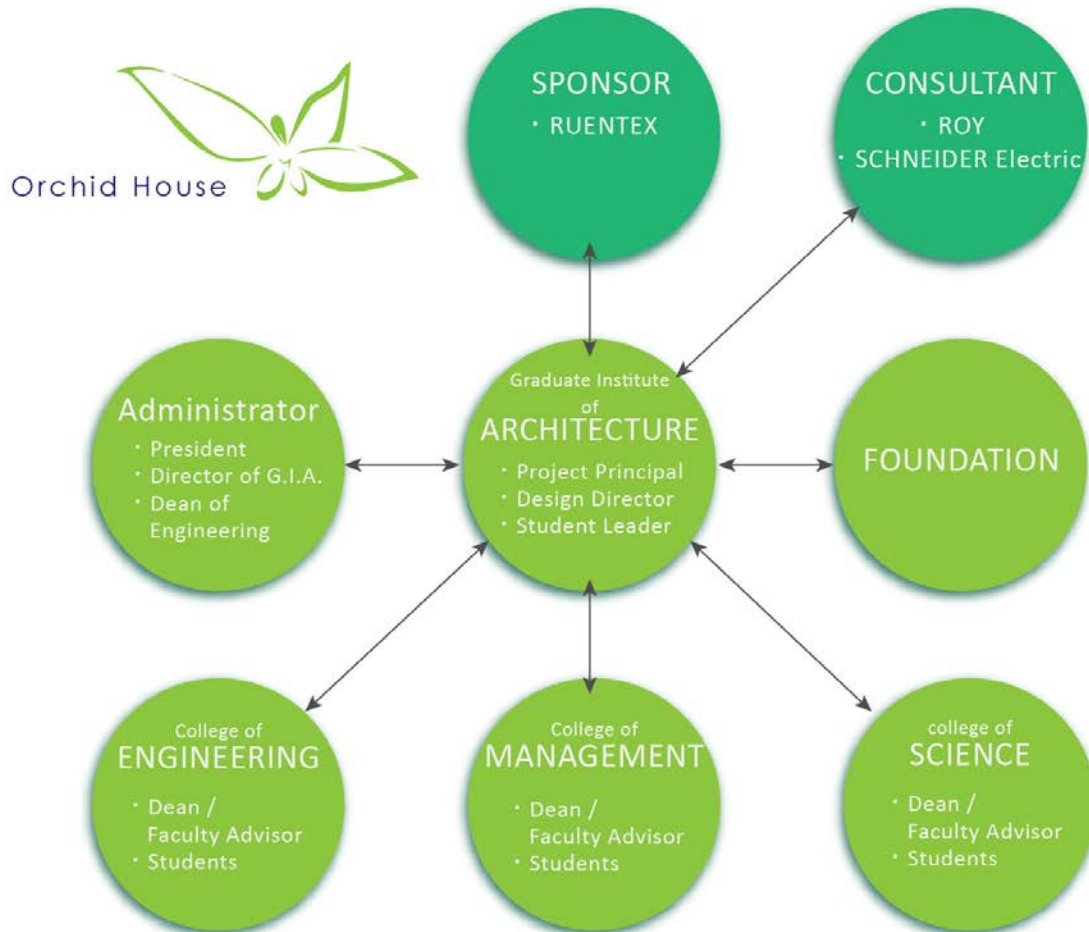
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TEAM

NCTU UNICODE

Since NCTU/UNICODE will be the first Taiwanese team to enter solar decathlon, we compose our team with one of the best skills and knowledge in architecture, engineering, Science and Management in Taiwan.



NCTU/UNICODE includes architects, engineers, scientists, graphic designers, interior designers, product designers and representatives of many other disciplines as one of the best knowledge and skill in Taiwan. This wide range of experience and expertise provides NCTU/UNICODE great opportunity to explore our unlimited possibility of collaborative environment to complete our first Solar House in Taiwan.

The architectural team has experience in design, management, fabrication, and design-build project. Professor Tseng, the project principal, has over 15 years of professional experience at all stage of design and construction with high profile award winning projects. Professor Nagatomo and Jan, the design director, are

specialized translating digital design to fabrications. In addition, architecture team also includes professionals in business development, interactive mechanism, interior design and furniture design.

The engineering team includes experts on variety of interdisciplinary projects in solar cell applications, renewable energy, and solar energy applications. Professor Chang, project research director, is considered as the pioneer of the III-V industry in Taiwan and has developed many important research in various project includes III-V triple junction solar cell applications. There are experts in structural, civil, materials, and construction engineering.

Team Officers



PRESIDENT OF NCTU

Yan-Hwa Wu Lee Ph.D is the president of NCTU. Dr. Lee has received her doctor degree in biochemistry from University of Tennessee and her master and bachelor degree from National Taiwan University. She is the member of The Academy of Sciences for the Developing World since 2007 and also awarded Taiwan Outstanding Women in 2010. Dr. Lee Wu was elected to become an academican of Academia Sinica at Taiwan in 2000, a prestige position for her scientific achievement.



DEAN OF ENGINEERING

Chiun-Hsun Chen Ph.D is the dean and professor of the College of Engineering at National Chiao Tung University. Dr. Chen received his Ph.D and Master degree in Mechanical & Aerospace Engineering from Case Western Reserve University. His area of research is Energy-Thermofluids Engineering / Micro / Nano Engineering.



DIRECTOR OF ARCHITECTURE

Shu-Chang Kung is the director of Graduate Institute of Architecture at NCTU as well as vice professor. Mr. Kung graduated from Architecture Department of Tunghai University, Taiwan in 1986, and received Master of Architecture and Master of Design from Graduate School of Design, Harvard University, U.S.A. He is also licensed architect in Taiwan.



PV SYSTEM DIRECTOR

Chain-Shoo Hsu Ph.D is the vice president of National Chiao Tung University and also chair professor of the college of Science, department of applied chemistry. Dr. Hsu's research area is focused on synthesis of organic materials for optoelectronic applications. Particular examples refer to liquid crystals, liquid crystalline polymers and conjugated polymers.



PROJECT MANGEMENT DIRECTOR

Hsin-Li Chang Ph.D is the dean of the College of Management, also the professor of the Department of Transportation Technology and Management. Dr. Chang received Ph.D from Northwestern University in Transportation System Engineering. He specialized in Transportation Safety, Traffic Engineering and Control, Travel Demand and Behaviour, and Railway Engineering and Operation.



INNOVATION DIRECTOR

Yuan-Pern Lee Ph.D is the Chair Professor of the department of Applied Chemistry at NCTU. Dr Lee received PhD from University of California, Berkeley in Chemistry. His research is specialized in physical chemistry, Laser chemistry and Spectroscopy. He is the fellow of the Academy of Sciences for the Developing World and also elected the Academician from Academia Sinica in 2008.

Graduate Institute of Architecture, G.I.A.



PROJECT PRINCIPAL

C. David Tseng is the professor of Graduate Institute of Architecture as well as vice dean of College of Humanity and Social Science at NCTU. Mr Tseng received his Master degree from Graduate School of Design, Harvard University. He is former dean of architecture Department of Tunghai University in Taiwan and also Architecture/Landscape Architecture Evaluation Board member of Ministry of Education.



DESIGN ADVISOR

Chi-Yi Chang is the professor of G.I.A. at NCTU. He has received Master in Design Studies from Harvard University and the Ohio State University. Mr. Chang has won many design awards and competition projects, and has major contribution to the academic field. He is a member of council at Urban Design Institute of Taiwan.



BUSINESS DEVELOPMENT ADVISOR

Eric Chuang AIA is the assistant professor of G.I.A.. Mr. Chuang received his Master of Architecture degree from University of Pennsylvania (USA) in 1988 and a Bachelor of Architecture from Tunghai University (Taiwan) in 1985. He registered in the State of Massachusetts. Mr. Chuang is also the Managing Director of Chenco Holding Company, LLC, an investment management corporation with its investment portfolios in real estate, information technology, bio-technology and media in the USA, Taiwan and China.



TECHNOLOGY ADVISOR

June-Hao Hou Ph.D is the assistant professor of the Graduate Institute of Architecture at NCTU and also the program director of Master of Science and PhD program. Dr. Hou received Doctor of Design and Master of Design Studies from Graduate School of Design, Harvard University. He is the Director of A Learning and Design Environment for Parametric Modeling in VR CAVE, National Science Council of Taiwan.



TECHNOLOGY ADVISOR

Pei-Hsien Hsu Ph.D is the assistant professor of Graduate Institute of Architecture at NCTU. Dr.Hsu holds PhD in Architecture, Digital Research Studio, from University of Cambridge. His research was funded by National Science Council aimed to investigate the use and the design of mobile augmented reality system to assist collaborative urban design.



DESIGN DIRECTOR

Minnie Jan (the left) is the assistant professor at Graduate Institute of Architecture. Ms. Jan graduated from Columbia University Graduate School of Architecture, Planning and Preservation. She is the selected researcher for Solar Decathlon Europe 2010 of Institute for Advanced Architecture of Catalonia. Ms. Jan is also USGBC LEED Accredited Professional.

Daisuke Nagatomo (the right) is the assistant professor at Graduate Institute of Architecture. Mr Nagatomo has received his master degree in architecture from Columbia University and bachelor degree from Meiji University. He also holds the research diploma from Institute for Advanced Architecture of Catalonia specialized in Solar House development program. Mr Nagatomo is also USGBC LEED Accredited Professional.

Graduate Institute of Architecture, G.I.A.



STUDENT LEADER

Chih-Ming Chien is a Ph.D student at the National Chiao Tung University. He had received his bachelor degree from the National Taipei University of Technology, and master degree from National Taiwan University of Science and Technology. Chien is the founder of “Volunteer Architect” program, which is a special group that gathers student volunteers to build projects at remote locations.



CORE STUDENTS

These 5 Students are the core students in the team, which are all in the third year of Master of Architecture I.

Sheng-Kai Sky Tseng (Left 1)
Sharon Shih (Left 2)
Claire Huang (Middle)
Green Chen (Right 2)
Yating Wu (Right 1)



COLLABORATING INSTITUTIONS AND SPONSORING COMPANIES

organizer



Sponsor



Ruentex Engineering & Construction Co.

Ruentex Engineering & Construction Co. is mainly engaged in construction operations, civil engineering contracting, equipment installation and project planning and consulting business. The company also manufactures and sells building materials.



Autodesk Inc.

Autodesk, Inc., is a leader in 3D design, engineering and entertainment software. Customers across the manufacturing, architecture, building, construction, and media and entertainment industries. From blockbuster visual effects and buildings that create their own energy to electric cars and the batteries that power them, the work of our 3D software customers is everywhere.