CIB World Building Congress 2019
Hong Kong SAR, China
17 – 21 June 2019

Rural Micro Creation Based on Bamboo Construction

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Abstract

Under the background of building a beautiful countryside in China, more and more college teachers and students join the countryside and participate in local rural construction activities. The purpose of which is to excavate local culture, design local architecture, and lead the rural revitalization. College teachers and students go out of classes to face the rural reality, discuss the design theory from the academic perspective and then experience the whole construction process.

Bamboo, a traditional building material, can bring back the essence of architecture,and the architecture made of bamboo can reflect the essence of architectural culture and place spirit. The paper analyzes the micro-creation process of the works, witnesses and records the whole construction through participating in the International University Construction Competition and based on the team's bamboo architectural work Skylark.

Keywords: Skylark, building, bamboo, node

1. Overview of Construction Activities

In August 2016, "the first International University Construction Competition" opened in Runa Village, Dingxiao Town, Yilong Experimental District, Guizhou Province. The contest invited 23 construction institutions to carry out rural field construction with a construction period of 20 days. The theme of the contest is “camping installation”, which met the functional requirements of 2-3 campers to work, eat and rest. At the same time, bamboo was required to be used as the design and construction material, so that participants could have a deeper perception and understanding of the materials, form, space and structure produce in the process from design to construction, which is a typical rural micro-creation.

Our team's work －the lark, has witnessed and recorded the entire construction.

Figure 1:Skylark shape

2. Project Profile and Display of Competition

As the whole construction activity is divided into several stages from March to September 2016, the construction is made into the form below (Figure2) for the better description of the origin of the construction, process and result. We believe that the chart will be a great convenience for knowing about the tasks, strategies and achievements of each stage in comprtition.

<table>
<tr><td rowspan="2">1 Team formation stage</td><td colspan="4">指导老师：王崴 Tutor: Wang Wei
实践团队：苏勤、刘沛峰、宋倩、张竹林、刘洋、石凯、毛一淑、格日勒 、刘璐
Practice team : SuQin、LiuPeifeng、SongQian、ZhangZhulin、LiuYang、ShiKai、MaoYishu、GeRile 、LiuLu
  </td></tr>
<tr><td>Task</td><td>Group formation: The team was set up consisted of a tutor,5 graduate students and 4 undergraduates by comparing the design and practice ability of them in our school.</td><td>strategy</td><td>Registration, Selection and Assessment</td></tr>
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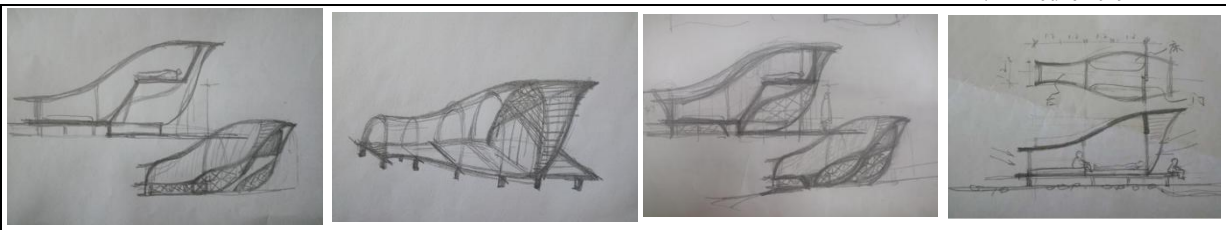
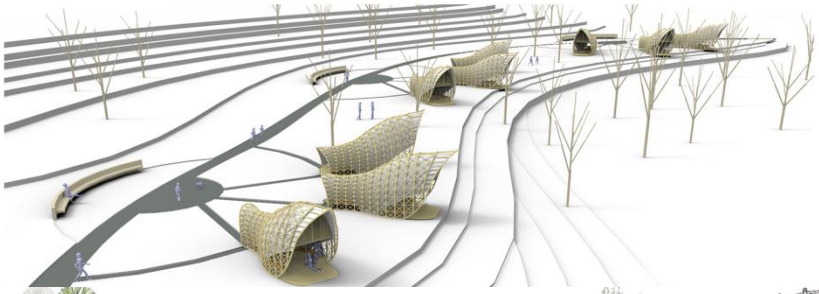
<tr><td rowspan="2">2 Conceptual phase</td><td colspan="4">  </td></tr>
<tr><td>Task</td><td>**Plan Conception:** The saddle shape is formed by discussing with whole member and forming from the task book. We choose the form which is common in saddles in Inner Mongolia and it will be great helpful to regional representativeness in more than 20 colleges from all over the world. The shape is more efficient in structural stress and character of space.</td><td>strategy</td><td>Group discussion, review of project conception, sketching plan.</td></tr>
<tr><td rowspan="2">3 design phase</td><td colspan="4"> 
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 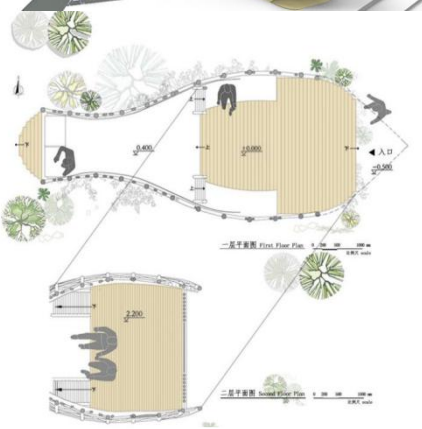
Plan
 
Section
 
elevation</td></tr>
<tr><td>Task</td><td>**Scheme design:** We made the design more actual by modelling in computer with Sketch up and experiencing scale of space from a normal perspective. After the modelling, we drew the plan and façade of the scheme. A detailed scale model would be made using Rhino last.</td><td>strategy</td><td>1. Division and cooperation:everyone is responsible for part of the content;
2. Validating the three-dimensional model of design scheme;
3. Using software: AutoCAD \Adobe Photoshop\ SketchUp \ Rhino;</td></tr>
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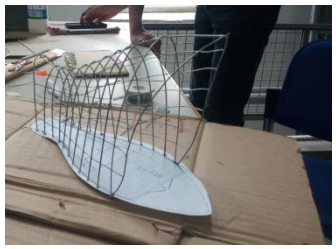
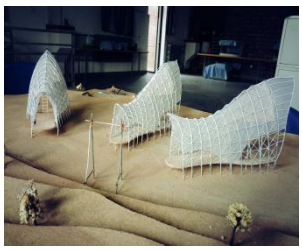
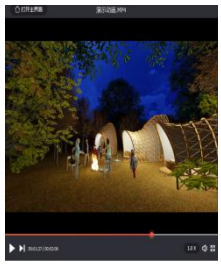
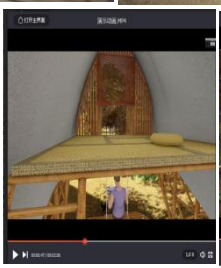
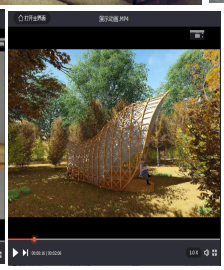
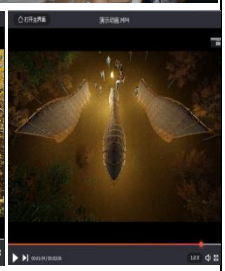
4 Verification Phase of scheme

Task	**Scheme Verification:** The team made manual model for validating the rationality of the structure and achievable in each stage when the plan was going to be built in practice. Experiencing from different perspectives in demo animation can give us a intuitive appreciation.	**strategy**	Manual model: Use iron wire instead of bendable bamboo, sulfuric acid paper instead of canvas. Using Software: Software Lumion Animation Production

5 Field construction phase of the scheme






Task	**Field Construction:** The project was constructed on-the-spot with local bamboo as the main material, In Louna Village, Dingxian Town, Yilong Experimental Zone, Guizhou Province, China, in 20 days.	**strategy**	Technical proposal of construction: The proposal was made aming at the material, construction and node, main frame, tie rod, skin, etc.

6 Selection stage





	Task	**Result selection:** The organizer invited a jury composed of 20 well-known university scholars and relevant experts to conduct on-site scoring evaluation.	**strategy**	The evaluation site should pay attention to the construction of the surrounding environment of the building and render the overall environment atmosphere using landscape sketches.

Figure 2:Stage Chart of

The first stage to the third stage is the design and research stage (theoretical stage) and the fourth stage to the sixth stage is the construction stage (practical stage) in the above table. The author makes a distinction between the two colors. The whole construction contest is a very meaningful teaching activity for it is different from the teaching contents and methods which is made previously and the competition is a complete process in which students can combine theory with practice to verify theory. Although the final result is physical construction, the whole generation process from scratch is full of many hypotheses, establishment, verification, overthrow and reconstruction. Due to the limited length of the article, the paper focuses on the generation process of the construction stage (practice stage).

3. Embryonic Form of the Lark

3.1 Scheme Concepts-the Entry Point of Saddle Shape

Teams were asked to use locally grown bamboo as the main material to build campsites for locals or hikers. In two-week project creation stage, nine team members were greatly inspired to form several versions of different architectural plans. After discussion and comparison, it was found that, on the one hand, the architectural form did not fully show the characteristics of bamboo's emptiness and penetrability, on the other hand, the structural system did not give full play to the mechanical properties of bamboo, the departure of space, form and material make us look for a new entry point. Occasionally, a classmate who participated in the Harvest Construction Festival mentioned the saddle shape scheme of the herdsmen which made the team members see new hope. Then, in two weeks' time, the saddle shape was subjected to local scale scrutiny and software simulation experience. The skeleton was braided by bamboo strips and bamboo pieces in the shape of "米", finally forming the hollow bamboo body and singing posture of the lark.(Figure 1)

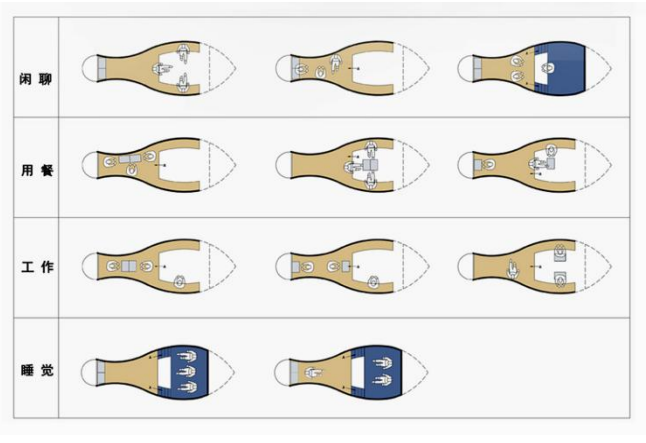


Figure 3:Plane function

3.2 Spatial Function-Free Space Activities

In terms of spatial function, the team hoped that the camping space could make the hikers feel

the natural vitality blended with the outdoor environment, at the same time, the indoor space also possessed the random functional experience. The device was divided vertically into upper, middle and lower three floors, the bottom layer provided the open space with cool and picnics function, the middle layer was used for dining, work and leisure, and the upper layer provided the rest function of private space. Although it is a vertical three-storey space, horizontal direction still allowed the hikers to have an adequate space to do activities.(Figure 3)

3.3 Construction Process-Braided Bamboo Strips

The team finally determined the design process of lark construction: (1) Push the zinc-plated steel pipe into the soil layer to form the inside circle and outside circle, the outside circle was used to support the vertical arch, and the inside circle was used to support the overhead floor. (2)The inside and outside circle are welded horizontally by flat steel to form a bottom outline, laid the circular bamboo on the flat steel in turn and fixed them by drilling screws to form an overhead floor. (3) Each arc vertical arch was made on the flat ground then inserted it into the outside steel pipe to form a vertical skeleton. (4)The steel columns on both sides of the inner circle were inserted into four bamboo columns respectively, and then the horizontal circular bamboo columns were clamped on both sides to form a horizontal bamboo beam. It was used to support the second layer of bamboo bed board. (5) The circular bamboo bed board was covered with two layers of bamboo. (6) The horizontal bamboo strip was bounded outside with the vertical arch to form a transverse skeleton. (7) The bamboo strip was diagonally compiled between the horizontal and longitudinal skeletons to form the bamboo strip. (8) The inside of “米”—frame would be bounded with a rope to bind the tarpaulins. (9) Furniture making and landscape layout then forming the final complete camping installation.

After more than a month of discussion, design and modification of the project, when the 3D animation was finally presented on the screen, the team seemed to see themselves overlooking the sky, the cyan, the peaks, the forest, the yellow and green fields, and the villages locating in it. The river was bent and coiled, not far away a white lark rested quietly.(Figure 4)

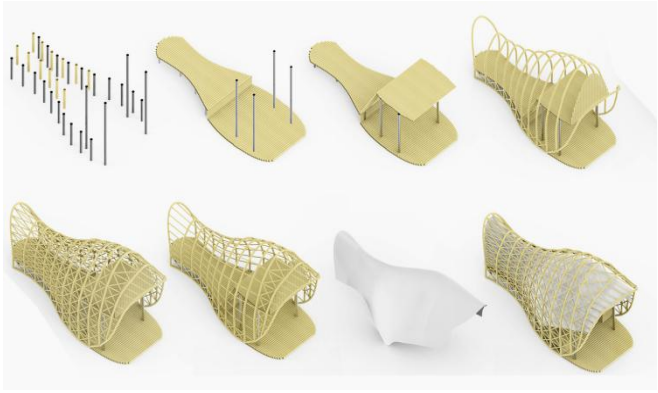


Figure 4:Construction process and exploded view

4. Construction Notes of the Lark

4.1 Complete Idea

The biggest confusion in actual construction was the capsizing of the lark foundation form and head out. During the design period, the members proposed that the foundation should be

in the form of brick or concrete foundation, however，because of the short construction period, the foundation form did not need to be maintained. To be light, simple and effective, the team denied the above form, the entry point fell in what basic form is reasonable and convenient to connect the upper main arch. The scheme of steel pipe socket raised spontaneously, the steel pipe buried underground, the upper part of the pipe was connected with each vertical arch, and the steel pipe that supports the head is buried deeply. So far，the foundation problem, joining problem and resisting overturning problem and infrastructure programs were recognized by faculty members.

With careful consideration of the plan and careful preparation of organizers during the site construction, our team was the only construction team entering with basic materials, naturally became the first team to start.

When the team began building，we fortunately found that the site was based on a deserted paddy field with soft soil, and the steel pipe could quickly reached the required buried depth through manual hammer which improved our construction efficiency.(Figure 5)

Figure 5:Building on the ground

4.2 Tweaking Bamboo

During the construction process, in order to facilitate various teams, the organizers set up a bamboo processing zone at the site, where there are professional teachers working on the bamboo. In the process of processing, members learned that each section of circular bamboo should be shaped by baking and cooling at a rate of cooling. The circular bamboo needed to be baked each section to form a beautiful curve, and the bamboo slice was split ed with knife in master's hands. Bamboo here had undergone a magical change, bamboo's flexibility and toughness in the hands of the masters were drenched to the best of the performance! Students were often heard to produce of the sound of amazement in the processing zone because of the excellent processing skills, in order to thank the bamboo masters in the processing of bamboo processing technical support. From the discussion of the construction plan to the treatment of building detail nodes, we have a new understanding of bamboo, which provides quality assurance for the team to achieve high-quality solutions.

4.3 Bamboo Scrap and Wooden Block

The construction of joints was the main restriction factor for the development of original bamboo buildings. In the process of construction, the most difficult problem for the team was the technical problem of joint connection. Most teams were breaking through the connection between steel and bamboo, bamboo and wood, bamboo and bamboo，as well as the quick installation of batches nodes and subtilizing nodes，etc. For example, when we lay bottom floor, we firstly welded the flat steel with the top of the arranged steel pile to form a closed and stable foundation, and then consider how the foundation connects the upper bamboo. We use screws on one side of the base flat steel to fix the small wooden side, and then use the wood side to connect with the bamboo on the bottom plate, so that the bamboo can easily be connected with the wood side through the screw to solve the problem of the installation of the bottom plate, and at this node connection, small wooden square plays a very good function of conversion. In addition, bamboo is easy to be corroded by rain which can result in the reduction of lifespan. During the construction process, taking the longevity and safety of the camping device into consideration，we built it with bamboo treated with cooking and anti-corrosion. At the same time, we did the anti-rust treatment to the steel column which is

Figure 6:Field construction flow chart

easy to be exposed in rain and anti-slip treatment to the bamboo ladder. They were all wrapped with hemp rope. 40 of the base steel columns were inserted into the columns. Because rain will flow along the column into the steel column which will lead to corrosion, we punched holes in the root of the steel column drainage to solve the problem of corrosion. In the face of this jubilant lark, team members at every stage of the construction will be diligent in thinking, looking for more appropriate technical measures to build the most solid foundation for subsequent construction.

The construction sequence of the site is as follows: (Figure 6)

5. The Revelation of the Lark

Today, the construction competition has a very good significance; most teams were participating in the challenging competition for the first time, the first time from designing to the landing of the project, the first time to participate in the whole process, the first time to experience the hardships and joy of building their own works(Figure 7) .It is a group event with plans, steps, and temperature; we were often moved by the selfless work of the teachers and students.

Although the construction competition was to build small camping installation, it opens up a new model of rural construction, it allows more college teachers and students to enter the beautiful countryside, enjoy the natural environment, excavate local culture and understand the culture of local people! Providing opportunities for exploring and learning, experiencing rural construction firsthand, expanding students' creative ability and design vision.

On this basis, I firmly agree with the idea of building a village in line with the concept of managing the village. To build a house, we should manage it meticulously. If we build a good area, we will drive a region. Villagers are the main body of rural construction. Let the villagers take part in the building and arouse the enthusiasm of the villagers. I hope the beautiful countryside goes farther and gets better and better.

The happy rural building, dare to practise!

What objects are the fountains of thy happy strain?
What fields, or waves, or mountains?
What shapes of sky or plain?
What love of thine own kind? what ignorance of pain?
—To a Skylark By Percy Bysshe Shelley

Figure 7:Night view of the skylark

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