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‘COCOON’ a bamboo building with integration of digital design and low-tech construction

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ABSTRACT: COCOON I is an architectural case study, with the purpose of investigating the possibilities of merging contemporary digital design technology with local low-tech building handcraft on a sustainable level. The investigation is mainly empirical and performed on a cross-cultural basis to benefit from a mutual learning process.

COCOON I is a climate responsive building in South India for agricultural teaching. It is constructed out of local materials; bamboo, palm bark, burnt bricks and granite. The unique design approach of the building shows that the use of digital design tools enables the investigation of new qualities in the understanding of local materials. In this case the focus is on development of arbitrary double curved shapes of a bamboo construction and the formation of local burned bricks. The building was designed in a collaboration between Danish and South Korean teachers and students and constructed with CARE School of Architecture and local workers in South India

EXTENDED ABSTRACT

The idea of the project was developed at Studio CONTEXT at the Aarhus School of Architecture in Denmark. Studio CONTEXT deals with research and teaching in the field of cross-cultural architecture with an emphasize on mutual learning and an experimental approach to architectural projects in 1:1 on the basis of a broad contextual understanding of local conditions.

The COCOON I project started after several years of teaching and research in India (Hansen & Hilberth, 2013). The idea was to develop new design strategies across borders combining South Korean and Danish knowledge in cooperation with a local community in India. A cooperation started in 2014 with professor Byoung Soo Cho and architect Sara Kim from South Korea and the location of the project was decided under guidance by the CARE School of Architecture in South India. The decision of the project site fell on the ‘Krishi Vigyan Kendra’, which is a NGO research and education centre for agriculture situated 20 km southwest of Trichi in South India. The NGO needed a new alternative space for education.

The designed building COCOON I is a new training building to facilitate agricultural education for children and existing local farmers. The area of the building is 9 x 17 m. It is build up by a series of plinths, which form the foundation for the elements of the building. It consists of an organic shaped split bamboo construction for alternative teaching, with the dimensions 7 x 11 m and with a max. height of 3.8 m covered by palm bark shingles; a central ‘plaza’ in red burned bricks for casual meetings and relaxation in close contact with the surrounding nature; and an ecological toilet with a water purifying bed. Together the elements create a floating and dynamic space for alternative learning.

The design process of the project was highly supported by the use of computer programs as a tool to control the curved forms and the elements of the construction. The use of computer programs developed a freedom to generate double curved forms along with more conventional shapes. For this purpose, the program Rhino was used in combination with the plug-in T-spline,

which enabled to change the shape of the surfaces quite rapidly to make fast decisions with the right flow in the working process. Parallel to the process of combining double curved forms and orthogonal compositions, the studio made a research into the use of appropriate materials for the building (Brodo, 2014, Conrad & Otto, 1965, Greenberg & Henrikson, 2006, Minke, 2012, Roland, 1965). The starting point for this investigation was to use materials for the building, which could be found and manufactured within the neighborhood of the construction site.

To enable the control of design, quantity and cost of the construction, the design was then put into the program of Revit to give a first estimate of the consequences of the design decisions. Revit was also used to calculate the dimensions of the bamboo construction, which was originally digitally built up in Rhino on a donut shape strategy. The construction of the split bamboo building with an aesthetic constructive cross weaving for stabilization found its inspiration through scale model tests in the design studio and from studies of constructions designed by Auwi Stübbe (Minke, 2012) and Frei Otto (Otto, 1972). Later during the building process no sections or elevations were drawn, but 3D spatial points in a coordinate grid were the decisive factors in defining the positions of the multi curved bamboo splits in the construction. The process exposes a creative potential of using the combination of modern digital technology, natural, sustainable materials and handcrafts in a local environment.

The actual construction of the building in South India had some major challenges. These challenges were basically founded in the different cultural backgrounds and language groups represented on the site. In spite of this, working with the final building proved to be a fruitful mutual learning experience among the participating people.

The result shows a unique approach to construction with bamboo and local materials, where it is possible to merge new digital techniques with a craftsman's understanding of materials. The building proves it is possible to investigate the potentials of local materials and arbitrary double curved forms in climate responsive bamboo constructions in the future for new sustainable architectural solutions.

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Figure 1. Exterior and interior view of COCOON I