

Lightweight Construction Seminar: Folded Umbrella Structure - Design to Prototype

Folded surface structures (FSS) offer a fascinating variety of structural and formal choices which are characterized by efficient use of lightweight materials such as thin flat cardboard, plywood, plastic sheet, or sheet metal for loadbearing structures. FSS are particularly suitable for intelligent low-cost buildings - such uses include exhibitions, major events, as well as emergency operations.

Research and development of FFS mainly took place during the 60s 70s and 80s of the last century. In recent times, however, architects and engineers have shown an increased interest in new applications of FFS.

Necessary new research has commenced on the key issues of possible folded geometries and their regularities, novel materials that enable in-surface connections without additional connecting means as well as their economy compared to other lightweight structures. The necessary preliminary investigations into these issues formed the scientific focus of the seminar.

The aim of the course

The task of the seminar was to develop, analyze and document technically superior lightweight structures and their constructive and formal characteristics: application, form, support structure, material design, and finally execution.

Pedagogical focus for the execution of complex structures was the necessary discipline and ability for synergistic teamwork and responsibility for the individual scientific contribution of each participant.

Process and progress

The seminar took place as a team work between March and late May 2009.

After a formal introduction to the geometric and structural foundations participants worked on an introductory project of a folded geometry model.

Then a large team was assembled and the following subtopics were allocated to smaller subteams (2-3 students): students worked on a structural design based on a series of scale models and finally constructed a prototype, the entire work process was finally documented and a seminar report produced:

- Literature review and implementation of data into the project database
- Form investigation and determination of antiprismatic folded surfaces
- Structural analysis and construction materials investigations
- Model construction, design, planning and execution of the prototype

Investigation into economy, organization, sponsorship and coordination of the overall documentation.

Regular team meetings and interim presentation took place of the individual works as well as a final presentation before an invited audience.

Outcome

Progress and outcome of key aspects of the seminar are shown in the enclosed Powerpoint presentation.

In summary

The stated goals of the course have been met:

in individual work, the participants documented their ability for scientific work and in the final realization of the prototype their basic ability to work together in teams.

Although the outcome was very positive the path towards the final goal was not always easy. Since the implementation of studies and designs into built reality requires considerably more investment of time, material and finances than originally anticipated by the participants - and for most of them this was a first experience in actual construction - different motivation resulted in varying workloads for the participants during construction of the prototype.

The work done by each of the participants as well as the supervisors went far beyond the usual extent of seminars but was justified by the valuable experience gained and by the successful outcome.

In particular, the financial support by the Institute for Structures and Timber Engineering and the sponsors Duropack, Tesa, Frischeis Timber and Sefra as well as accommodation for the seminar group at Object 210 at Arsenal, including use of special workshops, interior and external spaces must be mentioned here - without these the prototype could not have been built.

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