11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
E. Oñate, J. Oliver and A. Huerta(Eds)

NUMERICAL SIMULATION OF STRUCTURAL BEHAVIOUR OF MEMBRANE RESTRAINED ELASTIC GRIDSHELLS

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Key Words: *Elastic gridshells, Bracing membrane, Hybrid structure, Active-bending, Finite-element-methods.*

Abstract. Developable elastic gridshells are cost-effective lightweight structures making use of a rapid construction process, in which the geometry of the gridshell is obtained by bending an initially flat grid. This particular shaping process saves time during the erection of the structure, as the grid rods must not be bent individually but the grid can be shaped as a whole. Moreover, the assembly of the connections between the superposed rod layers of the grid can be done on the ground on a flat geometry, which is easier than connecting single elements in the air. Nevertheless, in order to introduce shear stiffness to the initially unstable grid lattice, an additional layer of beam elements or diagonal cables must be added. The assembling of this bracing layer is usually time-consuming and requires additional supplies such as cherry-pickers or movable scaffolds. In this manner one of the great advantages - the rapid deployability of elastic gridshells - is clearly reduced. In order to accelerate the construction process of deployable elastic gridshells, we propose to use tensile membranes as restraining in addition to cladding elements. In this paper, the structural behaviour of a membrane restrained elastic hemispheric gridshell with different connection configurations between membrane and grid has been analysed by means of finite-element-methods and compared to that of a 1:1-prototype. The results show the capacity of the membrane to reduce the structure's deviations under asymmetric load. Furthermore, some constructive aspects observed during the construction of the prototype and having an influence on the bearing behaviour of the gridshell are presented.