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"A REVIEW PAPER ON BEHAVIOR OF GRIDSHELL STRUCTURE"

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Abstract - *Gridshell is a structure that gets its strength from its dual curvature (in the same way that a fabric structure gets its strength from dual curvature), but it's made of a grid. The primary rationale for choosing a gridshell design is not only for performance, efficiency, or cost, but also for architectural shape. Based on a grid shell one can create magnificent designs and distinctive buildings. In count you have got the spatial aspects, which plays vital role for the use of the building. A self-bearing structure of gridshell offers flexibility in the inner portion. The meshes in a rigid gridshell are initially investigated in the research to examine the overall behavior of the structure. The mesh technique is a pivotal time in gridshell design because it gives the designer more control over the structural response.*

Key Words: Gridshell Structure, Seismic Analysis, Time-History Analysis, Staad-Pro, Triangular Grid, Square Grid.

1. INTRODUCTION

For free-form architecture, gridshells are the ideal answer. Shells are structures that have a curved surface, frequently a doubly curved surface that differentiates them. However, their application has so far been limited to innovative pavilions and a few deserving large-scale permanent structures. Gridshells, also known as lattice shells or open circulatory shells, are structures that have "the shape and strength of a double-curvature shell, but are composed of a grid instead of a solid surface." The kinematic Construction process is one way of creating gridshells.

1.1 What is a Gridshell?

Shell is a form of architecture that transfers loads using membrane forces or in-plane stresses rather than bending and shear forces. A concrete shell is an uniform surface, whereas a gridshell is separated into smaller parts.

Fig -1: What is Gridshell?

The kinematic building process is one method for creating gridshells. It comprises stretching a rectangular or quadratic grid and then deforming it into shape by drawing together or lifting sections of the grid. Because of its good bending properties, wood is an ideal material. A timber gridshell made of straight components is quite simple and clear to build.

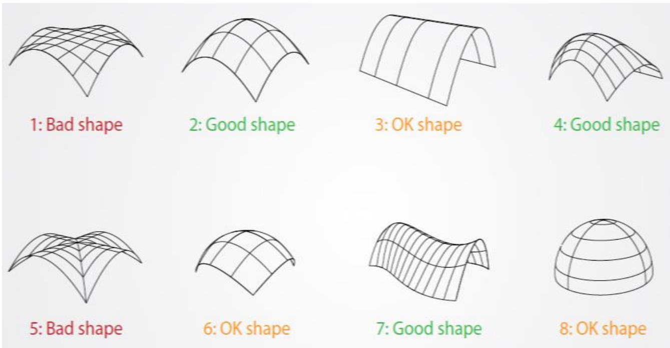

Fig -2: Classification of Gridshell as per Shapes

2. LITERATURE REVIEWS

Ricardo M. AVELINO*, Olivier BAVERELa (2017)- This article presents a new fundamental key for the design and erection of rigid and elastic gridshells with specific meshes. For interlaces with uniqueness are shaped based on the exceptional geometry of a previous successful project designed in 2011 by the Navier Laboratory of the École des Points et Chaussées. The behavior of rigid gridshell is firstly investigated. A FEM structural analysis is done to result proves that the gridshell structure with singularities are stiffer than the original configuration.

B. D'Amico , A. Kermani, H. Zhang, P. Shepherd, C. J. K. Williams (2015)- Bending as a self-forming process enables the comprehension of shape-resistant systems like grid shell structures. This paper introduces a computational approach for optimising the cross-section of dynamically bent structures. The optimization goal for a given load distribution is to normalized the bending stresses over the whole structure to a specific value. Strength and geometric compatibility requirements are also taken into consideration. Numerical examples are used to show the approach. Furthermore, a co-rotational Finite Element formulation is adopted and modified to account for the changes in stiffness that occur during the forming process of active bending systems in order to handle the large displacements involved.

Dragoș Naicu, Richard Harris, Chris Williams (2014) - The procedures for designing and building timber gridshells are described in this article. The advantages of timber gridshells are highlighted using the authors' experience with such projects. Relevant constructed examples are shown, together with discussion of their form-finding and analysis methodologies. A recently completed project in Cluj-Napoca, Romania, demonstrates the utility of the timber gridshell approach by building on past expertise and applying current computational tools available to both architects and engineers.

R. Harris, Steven A. Haskins, J. Roynon (Published 2008) - The roof and supporting components of the Savill Building are described in detail in this publication. A timber gridshell construction is used, which has been detailed in detail in earlier papers1, 2. The Savill Building was constructed using wood gathered from the nearby forest. The roof's shape was developed from a simple geometric shape, and the Eurocode was used for analysis and design reviews. The construction procedure and details, which evolved from techniques used on previous structures, are discussed.

Gonçalo Castro Henriques, Juarez Moara Franco (2020) - The design and construction of flexible gridshell buildings is gaining popularity. Gridshells have been present since the 1960s, but their applicability has been limited due to a lack of material resources, technical, and mathematical understanding. Digital design, manufacturing, and building processes provide us new avenues for addressing these issues and deepening the conversation between form, material, and structural performance. This article describes empirical and theoretical research on these structures that aims to gradually combine the formal and informal processes of Form Finding, taking structural behaviour into account from the beginning of the design process.

Romain Mesnil, John Ochsendorf and Cyril Douthe (2015) - The findings of the pre-stress caused by the erection technique of elastic grid shells on their buckling capability are presented in this research. The research of a pre buckled arch begins with the numerical methods and their validation. Then, using a form-finding approach based on low-speed dynamics, a family of elastic grid shells is generated automatically, and their buckling capacity is compared to that of grid shells with the same geometry but no pre-stress. Finally, the article shows that pre-stress reduces the buckling capacity of elastic grid shells by a few percent.

3. OBJECTIVE

The Main objective of project was to analyzing the Geometric Compatibility of Gridshell Structures under dynamic loadings. The results for the gridshells were compared for Bending Moments, Deflection, Displacement, Shear, Stiffness, Time history analysis etc. The objective of the project is as explained _

1) The Rigid gridshell & Elastic gridshell along with the different lattice patterns were. Compared under the Dynamic loadings (i.e. Seismic loading).
2) To analyze and design the Gridshells using Staad-Pro Connect Edition Software.
3) To increase the Stiffness of gridshell by diagonal stiffness, which can be modelled and achieved in various ways such as_
   a. Making the nodes stiffer by making them moment resistant.
   b. Adding diagonal bracing, either by adding cable elements or struts.
   c. Smearing a continuous shear stiff covering onto the grid.
4) To compare the cost of the structures.

4. METHODOLOGY

1) In the primary step modelling of Gridshell structure along with different Grid Patterns (Diagonal, Orthogonal, etc.) are generated in Staad software.
2) After modelling in design load as per IS 875 and seismic forces as per Indian standard 1893 :(Part-1)-2016 is applied over the structure in Staad-Pro.
3) A FEM analysis is performed to verify the overall behavior of the structure in a rigid Gridshell & elastic gridshell.
4) Relative comparative study is done on the structures to understand its behavior in helping the reduction of lateral forces.
5) All the results obtained from results are plotted in graph using MS word.

5. CONCLUSION

The singularity can boost the stiffness and buckling load of a rigid gridshell, according to the FEM results. By archiving the best outcomes, the singularity is placed at the free-highest form's curvature point. The behavior of materials between grid points may be more precisely modelled. In the case of typically bigger meshes, the form must be planned accurately. Because of the bending constraints imposed by cross-section capacity, they are simpler to bend in double curvature.

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