COMPARISON OF SHELL ELEMENT FORCES OBTAINED THROUGH CLASSICAL ANALYSIS AND COMPUTER SOFTWARE

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Degree of Master of Engineering in Structural Engineering design

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Thesis submitted in partial fulfillment of the requirements for the Master of Engineering in Structural Engineering Design.

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

The "intze" type water tanks are economical for storing large capacities of water. Therefore accurate analysis of these structures is essential.

Modern trend is to use computer software for analysis and design of structures. It is easy and time saving. There are many commercial software available for the structural analysis. However, the accuracy of the output of the software depends on how well the actual structure is modeled. All those software are finite element based. There are many types of finite elements developed for the purpose of structural modeling. These elements have their own advantages and limitations in different situations. Selection of correct type of element and proper fineness of mesh is very important in achieving accurate results.

The aim of this research is to study the proper type of finite element and the optimal fineness of mesh suitable for different types of shells. In this context, the results obtained using different type of finite elements and different fineness of mesh used for analysis of "intze" type water tower were compared with the results obtained through classical analysis.

A 1500m^3 intze type water tank was selected as a structure to analyse and compare the results. First, the structure was analyzed using elastic theory of thin shells with certain approximations. Stress analysis of "intze" tanks is extremely complicated due to many degrees of redundancies.

The computer software "STAAD Pro" was used for the finite element modeling of the tank. Initially 2-noded beam elements and 4-noded plate bending elements were used to model the structure. Many different models were created modifying the initial model until a result which is well comparable with classical results is obtained.

Following models were created in "STAAD Pro",

- Model 1. Beams were modeled as 2-noded beam elements and shells were modeled as 4-noded plate bending elements.
- Model 2. Vertical axis and horizontal axis bending moments were released from the 1st model.
- Model 3. Actual member eccentricities were given for the beams in 2nd model.
- Model 4. Both beams and shells were modeled as 4-noded plate bending elements.

By comparing the results of above 4 models with results obtained through classical analysis, most suitable model was identified. After identifying most suitable model representing the structure, following further studies were carried out.

- Model a) Use of 3-noded shell elements instead of 4-noded shell elements.
- Model b) Changing the fineness of the mesh to study the effect of element size in final results.

The results obtained were studied and made a conclusion on the suitability of different types of finite elements for different types of elements.

It has been found that the STAAD Pro model 3 is the better structural representation of actual structure. STAAD Pro model 3 is the model which has vertical and horizontal axis bending moments released and actual eccentricities were given at the member start node and end node of the ring beam elements. Shells are quadrilateral plate bending element as 4 nodes of the plate in every shell lie on same plane.

It has been also found that the convergence to actual result with increasing fineness of the mesh could not be found due to some of the restrictions in the STAAD Pro software itself.

Finally, comparing the time and tedious calculations in classical analysis which is prone to errors, analysis using computer software is the best way to analyse such structures with the adequate knowledge of structural behavior of the structure.

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