

Finite Element Analysis on Offshore Structures

OIL, GAS AND MINING TECHNICAL DIVISION



reported by
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Engr. Shazlan Rahman is a corporate member with the Institution of Civil Engineers UK (MICE) and a chartered engineer with the Engineering Council UK (CEng). He has more than 10 years of experience in engineering design and project management. He is a committee member of the IEM Marine and Naval Architecture Technical Division (MNATD) and Oil, Gas and Mining Technical Division (OGMTD).



The engineers who attended the talk

The IEM Oil, Gas and Mining Technical Division (OGMTD) organised a two-hour talk titled Finite Element Analysis on Offshore Structures on 28 July 2015. The talk was conducted by Dr Venkatesh Rajagopalan from Aker Solutions and chaired by Engr. Shazlan Rahman from OGMTD. The aim of the talk was to explain the basic principles of finite element analysis (FEA) and how this was used in the offshore structural design. Some 60 IEM members attended this event.

As many engineers are aware, FEM is a mathematical tool used to solve a complicated design by breaking it down into small parts called finite elements. In essence, according to Wikipedia, finite element analysis (FEA) is a mathematical tool used to achieve the following:

- Accurate representation of complex geometry
- Inclusion of dissimilar material properties
- Easy representation of the total solution
- Capture of local effects

In his introduction, Dr Venkatesh explained the fundamental concepts of FEA. In FEA, a structure is cut into several small elements such as rectangles. It then reconnects the elements at "nodes" (as if the nodes are pins that hold the elements together). This process results in a set of simultaneous algebraic equations being developed which can be solved quickly by computer programs.

The presentation continued with a discussion on the advantages and disadvantages of using FEA in structural designs. The main strength is that it can analyse structures with complex geometries and restraints. It can also handle complex loads such as time or frequency dependant loads. On the other hand, FEA has a weakness: It cannot produce a close form solution. In other words, it cannot examine a system response to changes in various parameters.

Dr Venkatesh also covered the procedures for carrying out FEA. There are



Dr Venkatesh giving his presentation

three main stages in FEA: Pre-process, process and post-process.

The first stage, pre-process, involves modelling of the structure and applying associate loads. In the second stage, the FEA programme is used to carry out numerical analysis on the model and to prepare the loading result. The third stage, post-process, involves reviewing the results.

On the analysis of offshore structures, Dr Venkatesh explained the concept of stress concentration on structural joints and how this could affect the fatigue life of a structure. Some of these joints could have complex geometry, so it would be impossible to calculate the stress concentration at these joints by using hand calculations. The only way to do so was by using FEA.

The two-hour talk was followed by an interactive question-answer session. It ended with the chairman, Engr. Shazlan Rahman, presenting a gift and certificate to Dr Venkatesh as a token of appreciation. ■

OBITUARY

With deep regret, we wish to inform that Ir. Hj Dzulkarnain Bin Haji Kamaruzzaman had passed away on 10 October 2015. On behalf of the IEM Council and Management, we wish to convey our deepest condolences to the family.

The IEM Editorial Board