THE AUTOMATION OF BOLTED ASSEMBLIES

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ABSTRACT

Advances in computational technology and computing hardware have made finite element analysis (FEA) a widely accepted part of the engineering design cycle. Typical analyses model assemblies of components and are able to capture complex process physics, such as contact and material failure, and can consist of millions of degrees of freedom. However, despite its wide ranging applicability, from dam construction to stent deployment, often it is used late in the design cycle; sometimes after the first prototypes have been constructed and tested. One of the reasons for the delayed use of FEA tools is that many still believe that finite element analysis is the sole domain of the analysis expert; and there is significant inertia associated with changing this mind set. This paper shows how complex non-linear finite element analyses can be made available to more engineers and used much earlier within the design cycle.

The analysis of bolted structures is considered here to demonstrate how complex FEA analyses can be automated within a design environment. Bolted joints have been around for centuries and are used within all aspects of engineering. However, specifying the correct bolt and understanding its behaviour is critical not only to structural integrity but also, when thousands or tens of thousands of bolts are used, in minimising mass. Analysis of such joints allows engineers to understand the physics of the joint and the process parameters that most influence the response, thereby improving the design on both a local and global scale.

Two techniques are presented, the first packages up the analysis methodology and presents it to the engineer in a familiar environment. The second packages the analysis up within a process automation environment that could be presented to the engineer or used to drive a DOE or optimisation technique. In both, the process physics are accurately captured, modelling and material errors are reduced and the tools or knowledge developed could be deployed across a number of independent engineering programs or projects.

SUGGESTED THEMES

Automation, scripting, abaqus, design technology, isight, process, response, variables