Summary

Nowadays there are two basic approaches regarding crane structural design. The first approach is to require a very stiff structure, with severe stiffness requirements and strict deflection limits, while the second approach requires a flexible supporting structure. The design problem in such a structure is in developing the optimum geometry and stiffness concept. A detailed structural design process is required to minimize the weight and optimize the geometry and sections.

The dynamic behavior of crane structure as a movable flexible structure is different between each type of cranes. Vibrations are a serious problem in crane systems that are required to perform precise motion in the presence of structural flexibility. Not only is the vibration of the crane unacceptable operationally, it may also be unacceptable structurally because of additional fatigue damage. If the dynamic properties of the crane structure are unintentionally tuned to the dynamic properties of the moving loads, unfortunate responses can occur.

In practice, it is very difficult and expensive to do experimental research on a real size crane or even on a scale-model. For this reason, investigations on mathematical models are a necessity, especially during the design stage. Simpler models of cranes enable easier mathematical analysis and give better insight into design. On the other hand, more complex models are necessary to approximate the reality more closely. However, it is impossible to include all the effects of the real life in a mathematical model of the crane.

A validated mathematical model is necessary for conducting a detailed study of the dynamic behavior of the crane. The problem of structural vibrations could be solved either by using an analytical or numerical approach. While analytical solutions are preferred, they are only applicable for very limited models. Therefore, much research has been done on asymptotical methods to solve the equations of motion.

Finite element methods can be used to approximate the natural frequencies and mode shapes of the crane complex mechanical system. A finite element modeling provides a more detailed mathematical description of a mechanical system than an experimental model, and is well suited for structural dynamic studies. FEM models for the crane can be use for analyzing other events concerned with the dynamics of structure such as service operation analysis, stress analysis and fatigue analysis. In addition, beams and girders of such structures can be appropriately modeled with line beam elements. The Timoshenko beam model [1] can, depending on the situation, produce better results than the Euler Bernoulli model.

Crane structures can be failed if the loading applied to it, is increased sufficiently. In cranes it is difficult to give precise estimates of the loading and number of cycles which will occur in service. In the codes an equivalent design loading is specified, based on typical experience. The most common cause of fatigue cracking is either the incorrect designation of weld detail for design purposes. There are several methods to identify the failure of crane structure. As with modes of failure, there are a number of general headings for causes of failure which can be applied, although in most cases there will not be a single cause, but a number of contributory causes.