Application of RFEM to modeling dynamics of lattice boom offshore cranes

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Abstract. Due to the low production of offshore cranes it is important for designers to develop and use models enabling simulations of dynamics of the machines in a rough environment, such as large base (ship or platform) motion caused by wavesand wind. The cranes with lattice booms are often used because they connect two priorities: light weight and high strength. In the paper the rigid finite element method (RFEM) is applied in order to discretize flexible elements of the lattice boom. The model presented allows us to take into account bending, torsional and longitudinal flexibilities of the elements. The computer programme developed on the basis of the models presented enables calculations of dynamics of the cranes. The models and computer package are validated and are used by designers from PROTEA in practice.

Introduction

Cranes used for lifting operations in offshore conditions are characterized by some important features, such as the ability to lift heavy loads in changeable conditions due to base motion, a light bearing structure, large maneuverability and advanced safety systems. The model of the offshore cranes should also take into consideration the possibility of crane base movement, which is caused by the waves acting on the platform or a vessel on which it is installed. Even if there are many general professional packages based on the finite element method, designers are still seeking computer programs adapted to their specific needs. The paper presents the model and computer package applied in design practice.

Result and Discussion

Due to their light weight and high strength parameters, lattice boom cranes are considered as the most efficient solution in many cases. The paper presents a 3D dynamic model of an offshore lattice boom crane used for simulation (Fig. 1). The model is formulated by means of the rigid finite element method [1, 2] used for discretization of the boom's flexible elements. The models which allow to us to analyze the statics of a crane with lattice booms were presented in [3, 4]. The discretization of the boom by means of RFEM allows us to treat load-bearing beams and truss bars as Bernoulli or Timoschenko beams. The model developed is implemented in a Delphi 10.4 environment. The model is validated by comparing our own results with those obtained using commercial FEM software, as well as by experimental measurements carried out on a special stand. Due to the high numerical effectiveness of the model, the computer program developed is used in engineering practice in PROTEA.

Figure 1: Model of the cranes with lattice boom

References

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