

Editorial

Structural Dynamics and Stability of Composite Structures

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In structural applications, past few decades have seen outstanding advances in the use of composite materials including Functionally Graded Materials (FGM). Most structures, whether they are used in civil, marine, or aerospace engineering, are subjected to dynamic loads during their operation. Therefore, Dynamic and Stability Analysis is receiving much attention in academia and industries. Recent advances in Dynamic and Stability Analysis have led to the development of macro-, micro-, and nanolaminated composites and FGM plates.

In M.-S. Park et al.'s paper, the authors investigated the safety evaluation of a hybrid substructure for offshore wind turbine. Towers and rotor-nacelles are being enlarged to respond to the need for higher gross generation of the wind turbines. However, the accompanying enlargement of the substructure supporting these larger offshore wind turbines makes it strongly influenced by the effect of wave forces. In the present study, the hybrid substructure is suggested to reduce the wave forces by composing a multicylinder having different radii near free surface and a gravity substructure at the bottom of the multicylinder. In addition, the reaction forces acting on the substructure due to the very large dead load of the offshore wind turbine require very firm foundations. This implies that the dynamic pile-soil interaction has to be fully considered. Therefore, ENSOFT Group V7.0 is used to calculate the stiffness matrices on the pile-soil interaction conditions. These matrices are then used together with the loads at TP (Transition Piece) obtained from GH-Bladed for the structural analysis of the hybrid substructure by ANSYS ASAS. The structural strength and deformation are

evaluated to derive an ultimate structural safety of the hybrid substructure for various soil conditions and show that the first few natural frequencies of the substructure are heavily influenced by the wind turbine. The modal analysis is carried out through GH-Bladed to examine the resonance between the wind turbine and the hybrid substructure.

The relationship between imperfections and shear buckling resistance of web plates with sectional damage caused by corrosion is studied. To examine the imperfection effect on the shear buckling resistance of a web plate with sectional damage, a series of a nonlinear finite element (FE) analyses were carried out for a web plate with sectional damage, which was assumed as local corrosion damage. For considering imperfections of the web plate in the girder, initial out-of-plane deformation was introduced in the FE analysis model. Using the FE analysis results, the changes in the shear buckling resistance of the web plate with sectional damage were quantitatively examined and summarized according to the aspect ratio, boundary conditions, and height of the damaged section of the web plate. The effects of web imperfections on the shear buckling resistance were evaluated to be little compared to that of the web plate without sectional damage. The shear buckling resistances were shown to significantly change in the high-aspect-ratio web plate. A simple evaluation equation for the shear buckling resistance of a web plate with sectional damage was modified for use in the practical maintenance of a web plate in corrosive environments.

The rapid advances in high tech industries and the increased demand for high precision and reliability of their production environments call for larger structures and higher

vertical vibration performance for high technology facilities. Therefore, there is an urgent demand for structural design and vertical vibration evaluation technologies for high tech facility structures. For estimating the microvibration performance for a clean room unit module in high technology facilities, this study performs the scale modeling experiment and analytical validation. First, the 1/2 scale model (width 7500 mm, depth 7500 mm, and height 7250 mm) for a clean room unit module is manufactured based on a mass-based similitude law which does not require additional mass. The dynamic test using an impact hammer is conducted to obtain the transfer function of 1/2 scale model. The transfer function derived from the test is compared with the analytical results to calibrate the analytical model. It is found that, unlike static analyses, the stiffness of embedded reinforcement must be considered for estimating microvibration responses. The similitude law used in this study is validated by comparing the full-scale analytical model and 1/2 scale analytical model for a clean room unit module.

In the present work, the vibration and buckling analysis of Functionally Graded Material (FGM) structures, using a modified 8-node shell element that allows for the effects of transverse shear deformation, was improved. The properties of FGM vary continuously through the thickness direction according to the volume fraction of constituents defined by sigmoid function. The finite element is improved by the combined use of different sets of collocation points for interpolation of the strain components and assumed natural strains. The modified 8-ANS shell element has been employed to study the effect of power law index on dynamic analysis of FGM plates with various boundary conditions and buckling analysis under combined compressive, tensile, and shear loads and interaction curves of FGM plates subjected to combined loading is carried out. To overcome shear and membrane locking problems, the assumed natural strain method is employed. In order to validate and compare the finite element numerical solutions, the reference results of plates based on Navier's method and the series solutions of sigmoid FGM (S-FGM) plates are compared. Results of the present study show good agreement with the reference results. The solutions of vibration and buckling analysis are numerically illustrated in a number of tables and figures to show the influence of power law index, side-to-thickness ratio, aspect ratio, types of loads, and boundary conditions in FGM structures.

Based on the finite element software ABAQUS and graded element method, we developed a dummy node fracture element, wrote the user subroutines UMAT and UEL, and solved the energy release rate component of Functionally Graded Material (FGM) plates with cracks. An interface element tailored for the virtual crack closure technique (VCCT) was applied. Fixed cracks and moving cracks under dynamic loads were simulated. The results were compared to other VCCT-based analyses. With the implementation of a crack speed function within the element, it can be easily expanded to the cases of varying crack velocities, without convergence difficulty for all cases. Neither singular element nor collapsed element was required. Therefore, due to its simplicity, the VCCT interface element is a potential tool for engineers

to conduct dynamic fracture analysis in conjunction with commercial finite element analysis codes.

These papers represent an exciting, insightful observation into the state of the art as well as emerging future topics, in this important interdisciplinary field. We hope that this special issue would attract a major attention of the peers.

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