Mathematical Study on The Petroleum Gasification Individuality In An Entrained Flow Coal Gasifier

Akshay Suryawanshi[1], Abhishek Kumar[2]
[1]Dept of Mechanical Engineering
[2]Assistant Professor, Dept of Mechanical Engineering
[1, 2] KNPCST, Bhopal, M.P., INDIA

Abstract- *Laminated composites have been used in various industries such as aerospace, mechanical, chemical, space craft and other high performance engineering applications. This in turn created the requirement of analysis of these structures/structural components through mathematical, experimental and/or simulation based model for accurate design and subsequent manufacturing. These structures are uncovered to large acoustic, vibration, inertia excitation as well as unlike environmental condition during their service life. The important thermal loading often changes the original geometry of the panel due to excess deformation and the final structural performance affected greatly. The first method of vibration/fundamental frequency is always associated with high amplitude and it causes large tension and/or compression which leads to fatigue of the structural component. Therefore, the vibration analysis of laminated structures made-up of composite and/or hybrid materials becomes important. In general, buckling is the state of geometrical instability of the structure induced by the in-plane thermal/mechanical/thermo-mechanical forces. It is important to talk about that, the geometric strain associated with buckling is always nonlinear in nature. In this study a general mathematical model is developed for laminated composite single/doubly curved (cylindrical/ spherical/ hyperboloid/ elliptical) panel in the framework of higher order shear deformation theory. The geometrical distortions of the plastic-coated panels due to in-plane (thermal/mechanical/thermo-mechanical) load have been incorporated through Green-Lagrange nonlinearity to count the exact flexure. The developed mathematical model has been discretised using suitable finite element steps to obtain the sets of algebraic equations for the domain. The equations are solved through a computer code developed in MATLAB environment to obtain the desired solutions. In addition to this, a simulation model have been developed in ANSYS for all different cases and the responses are checked to show the generality of the present developed model. The effects of thickness ratio, aspect ratio, curvature ratio, modular ratio, stacking sequence, number of layer and support condition and the material properties on the vibration and the buckling responses are studied in detail.*

Keywords- coated panel, HSDT, Green-Lagrange nonlinearity, thickness ratio, aspect ratio, curvature ratio, modular ratio, stacking sequence, FEM, ANSYS, APDL code.

I. INTRODUCTION

These days laminated multiple shells are used in several structural parts of various modern vehicles, buildings, historical and engineering structures. A shell panel can be clear as curved thin/thick outside. It may be made from a only film or multilayer of isotropic or anisotropic resources. The shell panel can be confidential according to the curvatures such as even more curved (both principal curvatures are not the same), cylindrical (one of the principal curving is zero), round (both principal curvatures are equal), pointed (where one of the curvatures is zero and the other changes linearly with the axial length), and flat panel (both curvatures are zero). Coated composite are incredibly lightweight, especially in comparison to conventional resources like concrete, metal, and wood. Complex resources are tremendously strong in particular per unit of volume/weight, low co-efficient of thermal development, brilliant elastic properties and good deterioration dead set beside and highly resistant to chemical. The composite have skill to allow the structural property to be customized according to necessities which add to their adaptability for high presentation engineering application. A adequate quantity of mass can be drop by using composites as compared to conventional resources, viz. the new Boeing 787 (Dream liner), has used 50 percent compound resources plummeting it's in general mass by 12% (approx.) and added power and lower weight agree to the plane to use less fuel [1]. In order to meet the economic challenge in attendance being it is needed to produce the compound structures on the large scale as it effect on the cost and ease of use of the compound structure. It is essential to analyse these mechanism through arithmetical and/or reproduction base representation in advance for design and developed. The outside skins of aircraft/spaceship/automobile are having section type of geometry and complete of the thin laminated composites. As discussed the structural components of high speed aircrafts, rocket and launch vehicles are subjected to intense loading due to the smooth heating throughout their service as a result the structural response such as deformations, buckle and normal frequencies are exaggerated significantly.

Introduction of Finite Element Method and ANSYS

An effective method developed by the Ritz in 1909 this method gives the approximate solution of the problem in deformable solid mechanics. For solving the engineering and mathematical physics problems, finite element method used and this is a numerical method.

Finite element analysis (FEA) is also referred as finite element method. Mass transport, fluid flow, heat transfer, structural analysis is typical problem area of interest. For these problems the analytical solution needs the solution to boundary and limit value problems for partial differential equations.

II. PROPOSED WORK

The laminated compound shell panels are of great concentration to the designer because of well-organized insubstantial structures, due to their modified properties as mention earlier. Greater than before uses of the compound structure particularly in aeronautical/aerospace engineering have shaped the condition of their psychoanalysis. These structural mechanisms are subjected to various types of joint loading and open to the rudiments to elevated thermal/mechanical/thermo- mechanical surroundings during their service, which often change the original geometry of the shell panel. The change in panel geometry and the communication with load condition affect the structural vibration and buckling response very much.

In arrange to attain the light weight structures for rigorous demand of weight drop in the higher engineering structures to conserve energy the plastic-coated composites consisting of manifold layers are extensively in a job and their usage will continue to grow as structural members. It is also significant to mention that, these plastic-coated composite are weak in shear and highly flexible in nature as compared to any other metallic plate/shell. To obtain the accurate prediction of responses of laminated composite, it is necessary and essential requirement that the displacement model must be capable to take care of the effect of shear deformation. In this look upon a higher order shear deformation theory is most attractive. As discussed earlier, the structural components such as flat/curved laminated shell panels are often subjected to intense thermal/mechanical/thermo-mechanical loading and/or large amplitude vibration throughout their service. The geometry of the shell panel alters and stiffness surrounding substance associated with the material are no more linear due to excess deformations and this effects has to be appropriately considered in the analysis. The vibration and buckling of structures have been received a considerable attention not only due to their wide range request, but also the challenging problems by means of interesting behaviour. In most of the literature, the geometry matrix linked in buckling is modeled taking into explanation for the non-linearity in the von-Karman sense. But the nonlinearity in von-Karman sense may not be suitable enough for the realistic forecast of their responses. It is noted that the studies linked buckling behaviour of plastic-coated panel structure under thermo-mechanical load need to be exploited more by using a better arithmetical model for the forecast of exact behaviour of laminated structures. In addition to that the inclusive testing of the preferred responses using commercial finite element box up will be a really add on to the become skilled at.

III. OBJECTIVES AND SCOPE

This thesis aims to expand a general arithmetical representation for plastic-coated compound curved board under standardized high temperature based on the HSDT disarticulation field model. The Green-Lagrange types of strain disarticulation relations are in employment to take care the geometrical bend. A suitable finite element model is proposed and implement for the discretisation of the panel model. It also aims to get hold of the effect of dissimilar types panel geometries (cylindrical, spherical, elliptical, hyperboloid and flat) and other geometrical parameters (aspect ratios, thickness ratios, curvature ratios, modular ratios, support circumstances and lamination schemes) on the free shaking and buckling (thermal, mechanical and thermo- mechanical) response of the plastic-coated composite. A detailed scope of their study is given below:

- As a first step, free vibration performance of laminated composite panels of a variety of geometries (cylindrical, spherical, elliptical, hyperboloid and flat plate) has been studied using the urbanized arithmetical representation.The model is comprehensive, to study the buckling high temperature of laminated curved compound panels subjected to standardized temperature field through breadth by taking the geometric matrix in Green-Lagrange sense.The model is comprehensive, to study the mechanical buckling performance of laminated compound ammunition subjected to uniaxial and/or bi-axial loading.The vibration and buckling (thermal/mechanical) behaviour of plastic-coated panels has been validating using the APDL code in ANSYS 13.0 surroundings. Finally, the parametric study of plastic-coated compound panel have been carried out using finite element analysis software ANSYS and developed HSDT model.

IV. RESULTS AND DISCUSSIONS

In this section, some numerical examples have been solved to obtain the thermal/mechanical/thermo-mechanical buckling load parameter of laminated composite shell panels by taking nonlinear geometry matrix. In order to do so, a finite element based code has been prepared in MATLAB 7.10 using the developed mathematical model. As a first step, the validation and accuracy of the present developed code has been examined by comparing the results with those available in literature and ANSYS model too. In order to demonstrate the efficacy of the present numerical model a detailed parametric study has been carried out for the curved/flat panel and the results obtained are presented and discussed. It is observed that the responses obtained using the mathematical model and the FE tool are in good agreement with the available published literature. The effects of different combinations parameters like the curvature ratio (*R*/*a*), the thickness ratio (*a*/*h*), the modular ratio (*E*1/*E*2), the lay-up scheme and the support condition on the composite shell panel responses are also studied. For the computational purpose, the following composite material properties have been used.

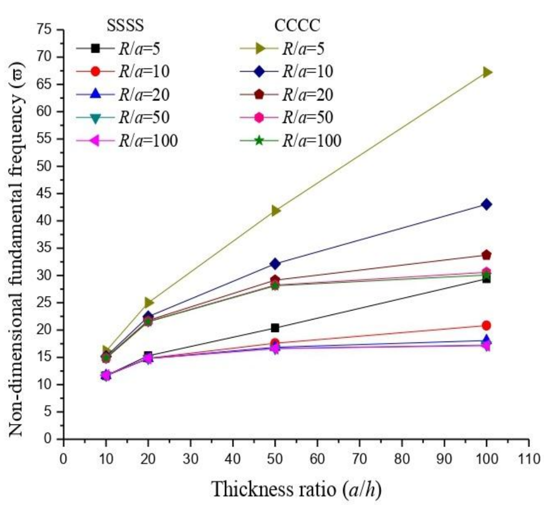

Figure1. Non-dimensional fundamental frequency of cross-ply ($0^0/90^0$)2 laminated composite cylindrical panel

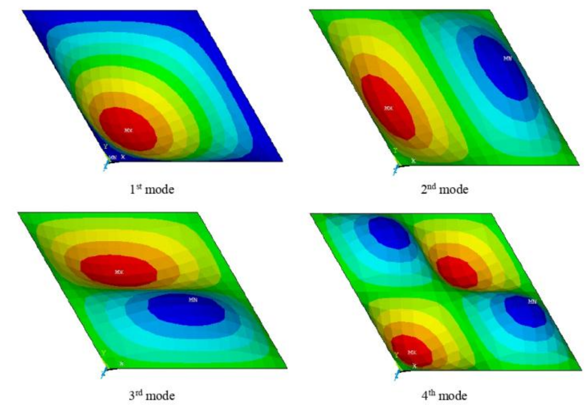

Figure2. Mode shape of simply supported cross-ply ($0^0/90^0$)5 laminated composite flat panel

V. CONCLUSION

Free vibration and buckling (thermal/mechanical/thermo-mechanical) behaviour of laminated composite single/doubly curved panels are computed using higher order mid-plane kinematics. The geometry matrix associated in buckling is evaluated using Green-Lagrange strain displacement relations to evaluate the excess thermal and/or mechanical deformation of plastic-coated panel. A linear finite element is proposed and implemented to discretise the domain and solved numerically to obtain the desired responses by using a nine noded isoparametric Lagrangian constituent having ten degrees of freedom per node. The non- dimensional fundamental frequency and critical buckling load parameters are obtained solving the linear Eigen value problem. The more specific conclusions as a result of the present investigation are stated below:

In this present analysis Green-Lagrange type strain displacement relation is considered for the evaluation of geometric stiffness matrix

VI. FUTURE WORK

The present study has been done by using the linear mathematical model only which can be extended for nonlinear analysis of laminated composite and sandwich structures. The present study can be extended to investigate the nonlinear free/forced vibration and thermo-mechanical post-buckling behavior of laminated composite/sandwich structures by taking temperature dependent material properties based on nonlinear mathematical model.An experimental study on vibration and buckling of laminated composite panels will gives better understanding about the present developed numerical model.By extending the present model, a nonlinear mathematical model can be developed to study the behaviour of laminated composite and sandwich structures in thermal and/or hygro-thermal environment. The smart (piezo, shape memory alloys and magnetostrictive) materials can be incorporated in the nonlinear model to study the effects of material and geometrical parameters. It will be interesting to study the flutter characteristics considering the aerodynamic and acoustic loading that arises frequently in the practical cases.

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