Composite materials are presented as the lightweight design flexibility or tailoring materials for desired demands in the laminate stacking sequence aerospace industries. The benefits of composite materials are to provide high strength and high stiffness regard to the weight, identified fatigue strength, wear, and corrosion resistance provided with the high performance and reliability [1,2]. Buckling analysis is one of the significant behaviour which can reach to the required resistance with constant stiffness (CS) fibre angles through the thickness of each layer in the conventional composites, while via the generation of a new class of composites known as variable stiffness (VS) pointed as laminate tailoring, with embrace the curvilinear fibre paths to the spatially, and hence vary in-plane stiffness, buckling response can manifest significantly betterment [3,4], in compared with CS counterpart. The stiffness variation propose in discrete model such as Patch design or introducing continues fiber path curvilinear which described as VAT laminates [5,6,7,8]. Setoodeh et al. [9] showed that in-plane loads and buckling resistance in the stiff zone with greater satisfied, and not in the critical zone can present higher buckling load adequately in VAT plates based on finite element models [10]. Lopes et al. [11] illustrate the advantages of variable stiffness composite in compressive buckling and failure modes of the first ply by taking advantage of finite element models as the numerical simulation.

Stability analysis of simply-supported rectangular plates under non-uniform uniaxial compression using rigorous and approximate plane stress solutions [12]. Buckling introduced together with the significant failure in the thin-walled structure and thin plates [13,14,15]. A classical finite element cannot grantee continuity and smooths of the variable angle tow fibres with the presumption of them straight. Following by discretization of the fibres, a large number of elements and even higher by using refined mesh size, which may influence on the buckling analysis results by providing a wide variety of error including higher computational time due to higher Degree of Freedom (DOF) [16].

For buckling analysis in an aerospace application, Carrera Unified Formulation can introduce as a capable higher-order beam model (1D) to represent displacement as regards arbitrary unknown over the cross-section by Taylor-like expansion with a generic N-the order which obtained [17,18] or Lagrange-like polynomial expansion by expressing [19] for linear buckling analysis. In anisotropic composite materials, refined 1D CUF beam organise to display as Component-wise [20,21] or layer-wise model \cite{CarreraAIAA1998}, to achieve better solution in contrast with commercial code for classical beam, plates and solid [22].

Lately, the CUF procedure successfully employed to perform free vibration analysis of VAT structures by Viglietti et al. [23,24] and [25].

This chapter present linear buckling and vibration analysis which modelled for variable stiffness composite by 1D CUF beam model, for a thin plate with sixteen layers and then the results will be compared with FEM to show the capability of CUF for decreasing the DOF, computational time with well-presented the continuity of variable stiffness fibre and accurate model.

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