Calculation of the collapse load of laminated composite panels using the effective width method.

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Abstract

The effective width method for approximate analysis of the ultimate buckling load of curved panels with stiffeners was renewed for composites. This method is widely-known for analysis of the isotropic curved panels with stiffeners and was developed in the thirties. Although many of the details of aircraft construction have been changed and new methods of analysis have developed, this method is still valid mainly because of its simplicity. Here an attempt was made to develop this method for composite materials too. Each stiffener with some part of the skin was treated as a laminated composite column.

To find the compression buckling load of a composite curved panel with stiffeners, the compression load acting on the stiffener alone will be first calculated, after it, effective width of sheet $2\,w_e$, based on critical column stress will be determined. The allowable compression load acting on the stiffener plus its effective width of the skin sheet will be calculated again and a new effective width of the sheet will be recalculated. This process will be repeated a few times to receive the stable value of the critical load on the stiffener with a strip of the skin. The effective column area (stiffener plus sheet) will be assumed to carry this critical load. The center of the skin sheet of width $b - 2\,w_e$, where b is the circumferential distance between stiffeners will be assumed to carry the critical buckling stress of a curved plate σ_{cr_c} and the panel sides will be assumed to carry the same critical stresses as the stiffener.

The effect of the Torsional Buckling of stiffeners was investigated too.

To validate this renewed method, a comparison with experimental results of the collapse load of laminated composite panels with stiffeners was made.

For all panels either with straight stiffeners or with "Γ-form" stiffeners good agreement between the method and experiment was found.