STUDY ON LATERAL TORSIONAL BUCKLING OF COMPOSITE THIN WALLED BEAM

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INTRODUCTION

COMPOSITE THIN WALLED STRUCTURES

- combination of different materials that have different physical and chemical properties
- produce different characteristics for the structure
- prone to instability failure-buckling

INTRODUCTION

LATERAL TORSIONAL BUCKLING

is a condition wherein a beam undergoes lateral displacement combined with twisting from its plane.

INTRODUCTION

LATERAL TORSIONAL BUCKLING

PROBLEM STATEMENT

Aircraft components are mainly made from thin walled structures which are easy to buckle. Analysis is needed to determine the critical buckling load.

OBJECTIVES

○To investigate the critical lateral torsional buckling load of thin walled composite beam.

○To investigate the effect of different parameters on lateral torsional buckling of composite beam.

Literature review

METHODOLOGY

METHODOLOGY

ANSYS

COMPARISON

THEORETICAL CALCULATION

PARAMETERS

○ Effect of length to height ratio (L/h)
- L/h = 10 , L/h=20

○ Effect of stacking sequences
- Symmetric
- Cross ply
- Angle ply
- Balanced
- Anti-symmetric

○ Effect of type of loading
- Free end load, mid span load

RECTANGULAR CROSS SECTION BEAM

FIBER REINFORCED PLASTIC (FRP) PROPERTIES:

E11= 142730 MPa
E22= 13790 Mpa
E33= 13790 Mpa
v12= 0.3
v13= 0.028985
v23= 0.028985
G12= 4640 MPa
G13= 4640 Mpa
G23= 3030 MPa

Load at free end of cantilever beam

Load at mid span of cantilever beam

RESULTS

Rectangular cross section beam

Load at free end cantilever beam

Pcr vs Stacking Sequence

Graph of P_{cr} vs Stacking Sequence for Load at Free End with L/h=20

Graph of P_{cr} vs Stacking Sequence for Load at Free End with L/h=10

Graph of P_{cr} vs Stacking Sequence for Load at Free End with L/h=10 and L/h=20

Rectangular cross section beam

Load at mid span cantilever beam

Pcr vs Stacking Sequence

Pcr (N)

- Pcr (N) (Ansys)
- Pcr (N)(Analytical)

Stacking Sequence

Graph of P_{cr} vs Stacking Sequence for Load at Mid Span with L/h=20

Graph of P_{cr} vs Stacking Sequence for Load at Mid Span with L/h=10

Graph of P_{cr} vs Stacking Sequence for Load at Mid Span with L/h=10 and L/h=20

Graph of P_{cr} vs Stacking Sequence for Load at Mid Span and Load at Free End

DISCUSSION

EFFECT OF STACKING SEQUENCES

- *[30/-30/30/-30] -highest value of Pcr*
- *[90/90/90/90] , [0/0/90/90]– lowest values of Pcr*
- *angle increases, Pcr decreases*

EFFECT OF LENGTH TO HEIGHT RATIO

- *L/h increases, Pcr decreases*

EFFECT OF TYPE OF LOADINGS

- *Mid span load- higher Pcr*

CONCLUSION

Pcr can be analyzed using ANSYS

Angle ply laminate is the best among others

Beam with larger height can resist lateral torsional buckling more efficient

Avoid loadings at the free end of the beam