

Correlation of Hand Calculation and FEM for Bending Of Thin Plates

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ABSTRACT

This paper presents a correlation between the hand calculations and the FE analysis of the thin plates subjected to loads. Here thin plates relates to skin panels. For all this, CATIA V5, ANSYS has been taken in use by us.

KEYWORDS

Thin sheets, loads, bending.

1. INTRODUCTION

Generally, a structural component composed of stiffened sheets panels will not fail when buckling of skin panel occurs since the stiffening units continue to carry more loading before they fail. However, that initial buckling of skin panel is required by many design situations. So, a thin sheet supported on its edges and loaded by various types of in plane loads has been considered. All this is done in catia v5 and ansys. Firstly designing is done in catia v5 and, total deformation of thin sheet due to load has been extracted through ANSYS.

Thin plate supports the load by both bending and tension and is primary class encountered in airframe structures

2. PROBLEM DESCRIPTION

Panel size: a = 20 inch long

b = 10 inch width

t = .08 inch thickness

Normal pressure loading: p = 10.55 psi

Material: Aluminium Alloy, E = 10.3 e6 psi

Maximum deflection and total stress needs to be calculated

3. HAND CALCULATIONS

- Panel aspect ratio: $a/b = 20/10 = 2$ and assume four edges are hinged supports
- The pressure load coefficient $pb^4/Et^4 = 250$
- From the figure 1 :

Max. Deflection $\delta = 2.2t = 2.2 \cdot .08 = .175$ inch

Total Stress: $f = 23.6 \cdot (10.3e6) \cdot (.08)^2/10^2$
= 15557 psi

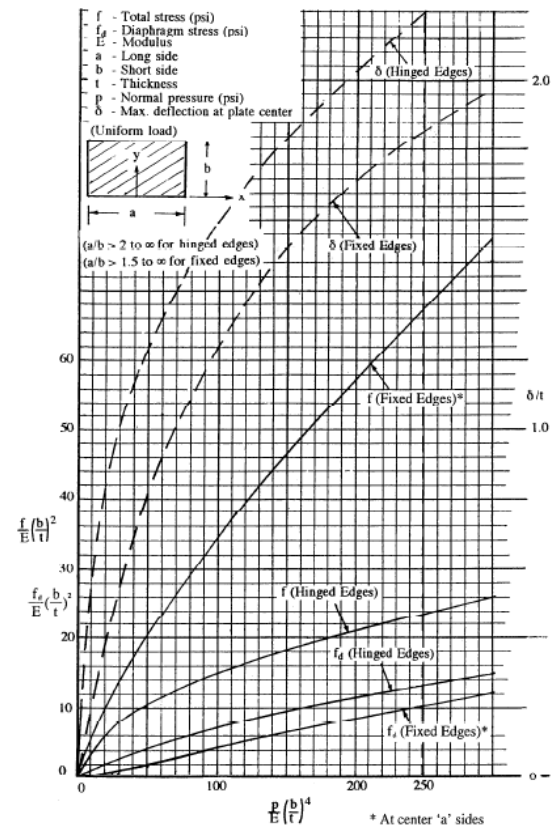
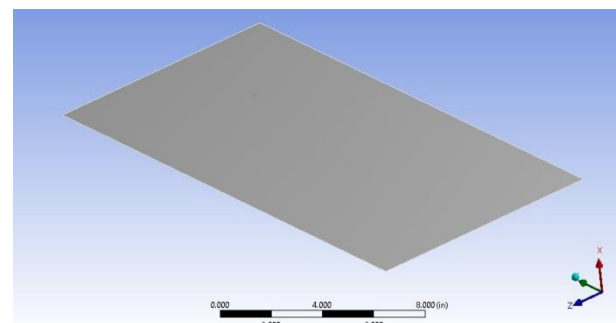


FIG.1 Large deflection of rectangular plates under uniform load

4. FINITE ELEMET ANALYSIS

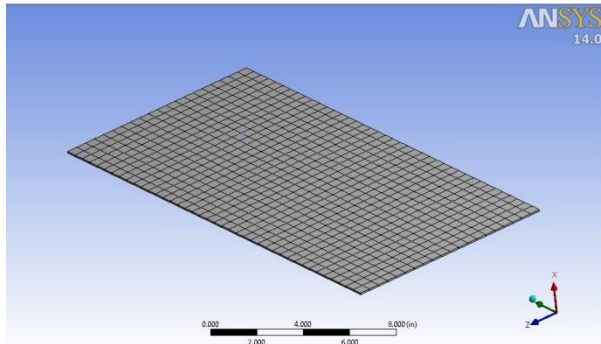
4.1 Thin sheet designed in catia v5

The rectangular pate is modelled in CATIA V5 as per the dimensions



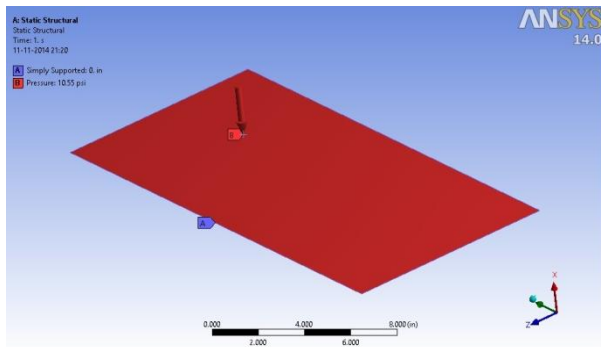
4.2 Meshing

The plate is meshed using Quad elements for better results as shown below



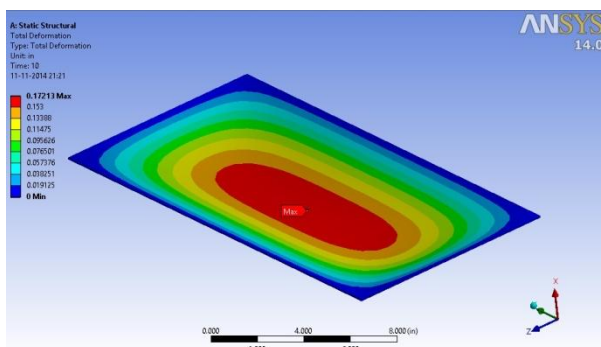
4.3 Boundary conditions

Constant pressure load with a value of 10.55 psi is applied on the plate and the edges are simulated as simply supported as shown below



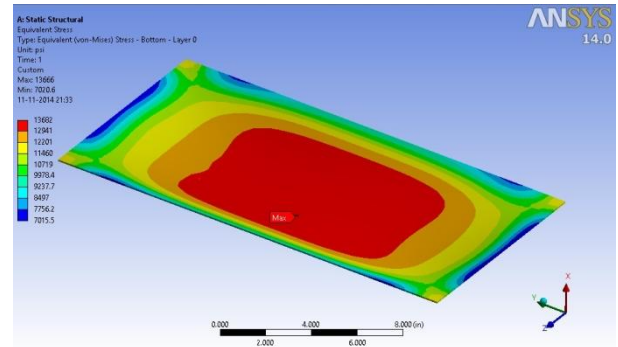
4.4 Maximum deflection of thin sheet

The maximum deflection observed is .172 inch at the centre as shown below



4.5 Total Stress

The total stress observed is 13682 psi as shown below



5. CONCLUSION

From the above hand calculations and FEM results this has been observed that the calculated deflection and total stress are quite close to the FEM results. Hence FEM program can be used to validate the similar kind of structures to save time and better correlation can be established between the hand calculations and finite element analysis.

6. REFERENCES

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