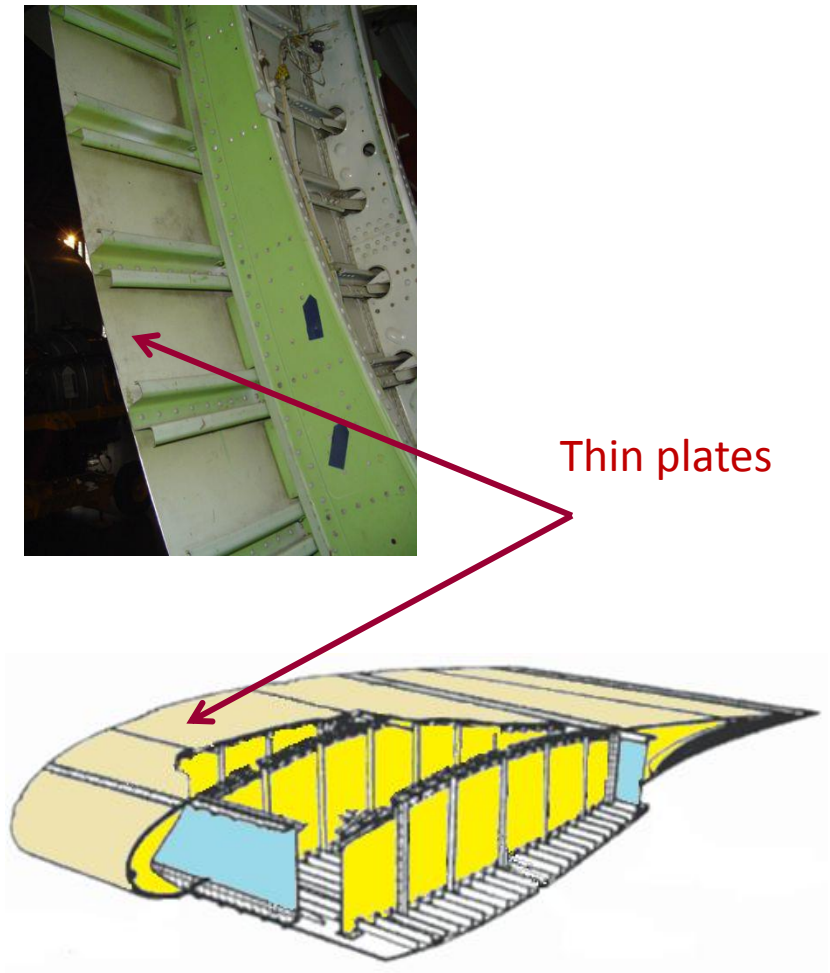
Abstract

The objective of this chapter is to offer the main theoretical background about thin plates and shells. The student will also be provided by tools to apply the theoretical concepts to the solutions of different problems related to the basic theory presented.

1. Introduction

Some basic structural components of an aircraft such as the part of skin located between two adjacent stringers and ribs or frames, depending on whether we consider a wing or a fuselage structure, correspond to a sheet of material whose thickness is small compared with its other dimensions, but which is able to transmit not only membrane forces but also bending moments. These kinds of components are defined as thin plates.



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Chapter 3 presents the basic formulation of thin plates, focusing mainly on rectangular and circular ones, with different support conditions.

In some cases, the structural member with a thickness that is small compared with its other dimensions is a curved surface. This kind of structure is defined as a structural membrane or shell. This chapter also gives some basic ideas on calculating stresses, stains, and displacements of shells which have an axis of revolution.

2. Theoretical contents

The theory of thin plates and shells is divided in three documents.

2.1. Bending of thin plates. This document includes the explanation of the next concepts:
- Equilibrium equations
- Bending equations
- Boundary conditions

2.2. Circular plates. This document includes the explanation of the next concepts:
- Equilibrium equations in polar coordinate system
- Bending equations in polar coordinate system
- Boundary conditions in polar coordinate system

2.3. Shells of revolution. This document includes the explanation of the next concepts:
- Membrane theory
- Basic geometrical relations
- Equilibrium equations for shells of revolution
- Displacement equations for shells of revolution

All these documents are organized following the next structure:
- Index
- Brief introduction
- Theoretical concepts
- Example/s
- References

3. Exercises

Chapter 2 includes seven exercises that cover the main concepts explained on this plates and shells. Conducting exercises by students is essential to understand the main theoretical concepts of the chapter.
The following problems are proposed:

- Exercises 3.1 and 3.2 cover the concepts explained in document 3.1: bending of rectangular thin plates.
- Exercises 3.3, 3.4., and 3.5 cover the concepts explained in document 3.2: bending of circular thin plates.
- Exercises 3.6 and 3.7 cover the concepts explained in document 3.3: Shells of revolution.

4. Auto-evaluation exercise

Finally, chapter 3 includes an auto-evaluation exercise. The students must use this exercise to check if they have a deep understanding of the main concepts of this chapter. This exercise includes different questions that cover basic parts of the theory explained in chapter 3.

5. Suggested readings

T.H.G. Megson. Aircraft Structures for engineering students. Elsevier. 2007

Chapter 7: Bending of thin plates

J. A. Jurado Albarracín-Martinón y S. Hernández Ibáñez, “Análisis estructural de placas y láminas”. Tercera Edición. Andavira editora 2014

Chapter 4: Flexión de placas delgadas en coordenadas polares

Chapter 7: Teoría de membrana en láminas de revolución

Chapter 8: Cálculo de diversos tipos de láminas de revolución