Book Reviews

Mechanics of Aircraft Structures – Second edition

C.T. Sun

John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, UK. 2006. 298pp. Illustrated. £75. ISBN 0-471-69966-7.

This book, by a distinguished academic at Purdue University, is aimed at undergraduate students of Aeronautics, and is based on a one-semester course in structural mechanics and aerospace engineering. In 300 pages its treatment of the mechanics of structures is fairly classical, covering beams, closed and open thin-walled tubes with one or two cells, buckling of struts and plates, and analysis of laminated composites with failure criteria. The book has a slightly old-fashioned look in that boom/pure shear panel idealisations are used extensively to examine non-simple topics such as axial constraints, diffusion and shear lag etc. Although such problems are solved in industry using commercial Finite Element codes, it is still a good idea to obtain simple closed solutions to approximate structures, as opposed to complex numerical solutions to exact structures. The true physics comes out in simple analytical solutions which show for example how rapidly various stress concentrations die away.

All eight chapters have a wealth of really imaginative problems at the end of each chapter, which is invaluable in a teaching text. There are though several details which will confuse a student. For example the beam bending formula and the shear centre of an open tube are simply cited in early chapters, leaving the derivation of the formula to over 100 pages later! Curiously the key proof that shear flow is a constant in thin-walled tubes with no axial stress, takes 4 pages using stress functions rather than the one-liner using equilibrium. Also the use of Airy stress function in 2D elasticity is really old hat, and only one solution is examined.

Students and teachers will probably prefer the book *Aircraft Structures for Engineering Students* by T.H.G. Megson which is better organised, and covers more structural behaviour in 600 pages…..for example Aeroelasticity.

Professor G.A.O. Davies, CEng, FRAeS

Understanding Aircraft Structures – Fourth edition

J. Cutler and J. Liber

Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK. 2006. 213pp. Illustrated. £24.99. ISBN 1-4051-2032-0.

This book was first published in 1981 and is now produced in a revised fourth edition, so clearly has hit its target readership. It is extremely unusual to have a book on aircraft structures, their design and behaviour, without a single equation or formula. To quote the authors "it is primarily aimed at the many people involved in the engineering side of the industry such as draughtsmen and licensed engineers, but not stressmen". The treatment is therefore entirely qualitative, but still achieving a thorough understanding of why aircraft structures are designed and built in that way, and how they have developed over the years. The original author is a consulting engineer, while the revised edition has been compiled by Jeremy Liber, the technical director of Britten-Norman Aircraft Ltd.

In 200 pages there are 13 chapters, with a very helpful review at the conclusion of each chapter. Early chapters cover well the historical evolution of aircraft structures, and the nature of the loads they are designed to resist in an extreme manoeuvre or a gust loading.

The following chapters treat beams and tubes, in bending and torsion, and how they work; all qualitatively without any quantitative analysis or formulae. This means for example that it takes seven paragraphs to say how the depth of a beam affects its performance, knowing that a formula will capture all this in one expression for the second moment of area. Even more difficult is to discuss buckling and post-buckling of struts, plates, and thin tubes. Behaviour in compression, and the design strategies to improve buckling performance therefore receive modest attention. This is unfortunate since over 70% of a modern aircraft structure is designed by compression loading.

Materials, like steel, light aluminium alloys, and titanium, are discussed in terms of their properties of strength and stiffness. They are not also normalised by dividing by density when it would be seen that the three specific strengths are not that dissimilar. In fact the specific properties have to be examined in later chapters on carbon and glass composites when the issue of density is unavoidable. A strange figure has the failure stress of U-D carbon at 1,600MPa but the allowable as 550MPa. Perhaps this harks back to early days when unreliable composites had 'knock-down factors.'

The manufacture of composite structures does not address the key issue of cost reduction, by using automatic tape layers or dry performs and various resin infusers. Even this revised edition claims that no large civil aircraft has gone over to composites for primary structure. The Airbus A400M and Boeing 787 do not get a mention.

There are some very sound and practical chapters on manufacturing metallics, workshops and repair, corrosion and treatment, airworthiness and quality control. There is a chapter on (and not for) stressmen and how they work, including the use of commercial finite element codes. This chapter is a little old fashioned. Statements like "being an aircraft structure it stands a very good chance of being statically indeterminate." In fact the modern structure has to be fail-safe and damage tolerant, which makes it guaranteed to be redundant.

This book, almost uniquely for books on aircraft structures, aims at the general engineer rather than stress analyst. In this aim it is very successful, albeit somewhat old-fashioned.

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Recent Advances in Gossamer Spacecraft. Progress in Astronautics and Aeronautics series Vol 212

Edited by C.H.M. Jenkins

American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Reston, VA 20191-4344, USA. 2006. 341pp. Illustrated. $64.95 (AIAA members); $94.95 (non-members). ISBN 1-56347-777-7.

At first glance you may think this book is about solar sail technology developments, and to a certain extent it is. But it also covers other aspects of gossamer spacecraft technology that might not immediately be associated with the title including membrane mirrors for space telescopes and measurement techniques which are applicable to all membranes.

Essentially a collection of detailed technical papers, it covers the basics as well as recent advances and experiments in related technologies, including:

- Booms and trusses
- Membrane mirrors
- Membrane wrinkling calculation methods
- Materials for smart gossamer spacecraft
- Solar sail technology developments
- Membrane thermal measurement techniques
- Photogrammetry for measuring sail shape and dynamics

The book builds on a previous edition *Gossamer Spacecraft: Membrane and Inflatable Structures Technology for Space Applications* which was published in 2001, (Volume 191 of the same series) and rightly so as there have been many advances in the intervening period. And to the credit of the authors who all come from American institutions, aspects of European developments in the area are also covered.

On a minor note, the quality of some figures is not great and have suffered in conversion from colour to black and white. Overall, the book is an excellent text for anyone interested in membrane technologies and solar sailing who wants to either catch up on recent advances or discover the latest thinking in the area.

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