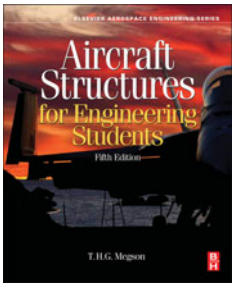
dip into the mathematical underpinnings. Here, especially when describing vision algorithms, more diagrams would be helpful to support the maths. Perhaps the space would be better spent with diagrams to provide intuition into the algorithms rather than exact details – for anyone implementing a vision system this would just be a starting point after all. The final chapters cover the higher-level functionality built on top of a rover system with sample acquisition followed by on-board science autonomy.

As most chapters take the form of literature review style summaries of existing work with excursions into the salient mathematical models or algorithms, it is useful to consider the timeliness of the review. The chapters vary in their recency, such a large work clearly covers several years. The introduction refers to the recent landing of Chang'e-3 on the Moon, an event that occurred late 2013; however, some chapters have information from 2011 presented as recent. It is by no means out of date, however, when considered as an overview reference text rather than state-of-the-art research.

To conclude, I would recommend this book to anyone working or interested in the field requiring a reference to all parts of a rover system. Whilst verbose in places, this is not a significant hindrance dipping in to a chapter, and you are rewarded with a good literature-review style overview with samples of key intuitions and underlying mathematics.

Dr Iain Wallace



Aircraft Structures for Engineering Students – Fifth edition

T. H. G. Megson

Elsevier Butterworth-Heinemann, The Boulevard, Langford Lane, Kidlington, Oxford, OX5 1GB, UK. 2013. 859pp. Illustrated. £49.99. ISBN 978-0-08-096905-3.

When first published by Edward Arnold in 1972, all aspects of the undergraduate course were fully covered in 13 chapters and 485 pages. This fifth edition of 28 chapters and 859 pages is still presented in two parts: 'Fundamentals of Structural Analysis 'and 'Analysis of Aircraft Structures', the main body of text having changed but little over the years. Noted additions include 6 pages on rivet joints, a few more on composite structures and a few more on crack propagation, plus 28 pages devoted to a mini design study. Many new worked examples and exercises including MATLAB demonstrations have also been added.

Chapter 1, 'Basic Elasticity', introduces 3D stress notation, equilibrium and the concept of stress at a point, followed by 2D topics, such as plane stress, stresses on

included planes, principal stresses, Mohr's circle, temperature effects and strain gauge measurement techniques.

Chapter 2, 'Two-Dimensional Problems in Elasticity', provides a substantial introduction to airy stress functions and the inverse/semi-inverse methods. However, the author concedes that 'the obvious disadvantage of the Inverse Method is that we are devising problems to fit assumed solutions, whereas in structural analysis the reverse is the case'.

Notwithstanding the author's valuation (of the inverse method) numerous other examples (of stress functions) attributed to Prandtl and St. Venant are applied to the 'Torsion of Solid Sections' in Chapter 3. The membrane analogy introduced in Section 3.3 is also of interest.

Chapter 4, 'Virtual Work and Energy Methods', paves the way for a more detailed study of energy methods in Chapter 5. The principle of virtual work is described on page 91 as: 'the most fundamental and powerful tool available for the analysis of statically indeterminate structures' and has the advantage of being applicable to problems that lie beyond the elastic range. But only elastic statically determinate problems are considered here.

More useful perhaps, 'Energy Methods' (Chapter 5) demonstrates how complementary energy (described as a purely mathematical device, devoid of physical meaning) and total potential energy (physically real) are concepts widely used in modern structural analysis. The reader should note that the complementary energy concept is used in at least 10 worked examples that follow, whilst total potential energy is discussed later in Sections 5.7 and 5.8. Other, no less important, energy methods include the unit load method, the flexibility method, the principle of superposition and the reciprocal theory. See page 165, where influence coefficients are expressed in matrix form, prior to Chapter 6.

Chapter 6, 'Matrix Methods', explains how matrix algebra enables structural data to be input en masse to a digital computer, capable of performing Millions of Floating Point Operations (MFLOPS) per second, thereby making it possible to resolve problems with tens of thousands of unknowns.

The author makes a modest start by constructing the (2×2) stiffness matrix for a helical spring (representative of a bar loaded in tension or stable compression), thus enabling a (6×6) matrix for a three-bar structure to be assembled. Numerous stiffness matrices for beam elements are then devised before the need to manipulate local and global coordinates, using a transformation matrix, is explained. The final 16 pages introduce elementary aspects of the finite element method, as applied to thin-walled continuum structures, albeit only the basic principles are explained.

The author explains that stressed skin monocoque aircraft structures are divided into a multitude of small rectangular panels, supported by a grid of relatively stiff and stable ribs, frames, quasi-flexible stringers and longerons. The word 'thin' is, of course, a relative term, and the title of Chapter 7 'Bending of Thin Plates' implies that the plates considered are thick enough for bending stresses to be significant. Two approaches are discussed: (1) exact solutions, obtained by solving differential equations (21 pages) and (2) solutions obtained using energy methods (9 pages).

Chapter 8, 'Columns', applies the Euler approach to the elastic buckling of columns where the effect of initial imperfections is examined. Beam columns, those in which transverse and axial loads are applied, and flexural/torsion buckling considerations are also discussed.

The buckling characteristics of truly thin plates are considered under the heading 'Thin Plates'.

In Chapter 9, the instability characteristics of stringer stiffened panels, typical of many forms of aircraft structure, are discussed at an undergraduate level. The predominantly aero-structures problem of tension field beams is also explained. Chapter 10, 'Structural Vibration', covers the basics: that is with the dynamic response of simple flexible beams, loaded by two lumped masses (representative of the dead weight of engines) for which natural (undamped) frequencies and first/second mode forms are determined.

Chapter 11, 'Materials', offers only the most basic coverage of aircraft materials, albeit the general discussion is useful, and there is more than might be expected on low-tech materials testing techniques, with more on structural fabrication in Chapter 12.

Chapter 12, 'Structural Components of Aircraft' is also rudimentary. Sections on the distribution of air loads, structural fabrication and function are clear enough, and the 214-item parts list (page 401) is worthy of study. But the flight-style cutaway diagrams are 25–35 years out of date.

Chapters 13, 14 and 15, entitled 'Airworthiness', 'Airframe Loads' and 'Fatigue', respectively, are a step-up on the two previous chapters. The flight safety (*V-n*) envelope and load factor determination are discussed in the context of structural integrity and uncertainty in Chapter 13, whilst airframe loads generated by inertia reaction to flight manoeuvers and gust loadings are well covered in Chapter 14. Fatigue is further considered in Chapter 15 and covers the traditional (*S-N*) and the newer crack propagation approaches. Safe life and fail safe options are considered and ways of predicting fatigue life determined.

What may be regarded as traditional stress analysis is taken up in Chapters 16–20. Suffice to report that thin-walled open and closed section beams are considered in Chapter 16, shear in beams in Chapter 17, torsion in beams in Chapter 18, and shear flows in combined open and closed tubes in Chapter 19.

Chapter 20, 'Structural Idealization', addresses the need to transform real structures (which have an infinity of redundancies) into simpler idealised forms, which are amenable to the computational power available. The so-called 'little sixth rule', used to simplify the direct load properties of shear webs and shear panels, is explained on page 604, and a 6 boom wing box and fuselage cross section are analysed in idealised form.

The stress analysis of tapered wing spans and tapered wing boxes is studied in greater detail in Chapter 21. The effect of window cut-outs in fuselages is covered in Chapter 22, and multi-cell wings with cut-outs are considered in Chapter 23. Fuselage frames and wing ribs are analysed in Chapter 24.

Chapter 25, 'Laminated Composite Structures', covers the topic from two points of view: (1) the micromechanics approach, used by materials scientists where the Law of Mixtures is invoked to determine properties of various fibre/matrix compositions; ()2 the macro approach, used by practising engineers

to design unilateral laminates and cross ply sandwich lay-ups of various kinds is explained, and the analysis of thin-walled composite beams concludes the chapter.

Section B5, 'Structural and Loading Discontinuities', represents a big step-up from simple engineering theory and provides an excellent introduction to axial constraint, one important observation being that the zero warping axis and the shear centre focus are not one and the same. Shear lag, another form of load diffusion, is also clearly explained.

Readers will know by now that closed tubes are far better suited to carrying torsion than are open section tubes (Is, channels, Zees Tees, etc.). It is, however, important to note that when the ends of short lengths of open tubes are fully built in (as in undercarriage bays), significant torques may be transmitted (see Fig 27.12).

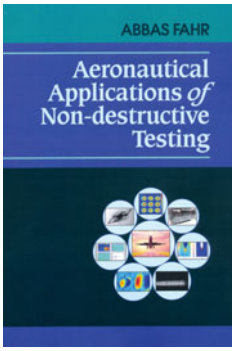
Chapter 28, 'Wing Problems', confirms that the wings of aircraft are not rigid but may flex considerably under aerodynamic loads (due to gusts for example). Problems considered include torsional divergence of a swept wing, control effectiveness, aileron reversal and flutter.

Finally, an Appendix, which describes the design of a section of rear fuselage, brings this fifth edition to a close.

Lecturers who adopt this text may apply to the publishers at: www.textbookselsevier.com, for a full set of solutions and electronic figures.

All who have learned from this iconic book in the past 40 years will surely hold Megson's work in high regard; essential reading for all serious students new to the subject.

Peter C Gasson, CEng, MIMechE, FRAeS



Aeronautical Applications of Non-destructive Testing

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DEStech Publications, Inc, 439 North Duke Street, Lancaster, PA 17602-4967, USA. 2014. 479pp. Illustrated. $179.50. ISBN 978-1-60595-120–1.

Non-destructive Testing (NDT) is well-known as an integral part of the through-life operation of all modern aircraft. Indeed, NDT is also interwoven with current design and manufacturing philosophies. I was, therefore, delighted to see that this extremely important topic is now covered by a 477-page book.

Firstly, the book sets the context in which NDT is used by the aerospace industry and explains design philosophies such as the concepts of damage tolerance and inspection intervals. This is important as it explains why NDT is needed and how it fits into the aerospace industry.

The book then goes on to delve into the core NDT methods, such as ultrasonics, theromography and eddy currents. This is a daunting breadth of subject matter, as NDT