

It is a very clean and efficient account of all the basics, with plenty of illustrative examples.

a Haar measure on a linear Lie group in 4.1.) The only prerequisites are a sound understanding of undergraduate analysis and linear algebra. While this book could be considered too sophisticated for the undergraduate level in an Indian university, an imaginative teacher could fashion several interesting courses out of this book at the M.Sc. level.

On the downside, the index is woefully inadequate for a book of such encyclopaedic reach. In fact, since Sternberg eschews the usual definition-theorem-corollary format of mathematics books, the index needs to be exhaustive. For example, *Poincaré Group*, *spin*

and *angular momentum* do not exist as entries in the index! Another inadequacy is the absence of exercises, which could have been used to provide the sometimes very elementary demonstrations that Sternberg goes through in painstaking detail. There are also more typos than one would expect from such a reputed publisher.

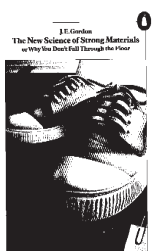
Finally, I hope the author will write a sequel to this book where the Cartan-Weyl theory and classification of groups such as  $Spin$  and  $Spin_c$  and their representations, which are of great interest to physicists, and finally gauge theory are dealt with in greater detail. Meanwhile, happy reading, or for that matter, even browsing!

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## The Strength of Materials

Without Stress or Strain

*Gangan Prathap*



*The New Science of Strong Materials or  
Why you don't fall through the floor*  
J E Gordon  
Reprinted in Penguin Books, 1991.  
pp.287, Rs.195.

Stress and strain are words used to describe the mental condition of human beings. In this sense, the words are used interchangeably to mean the same thing. In science and

engineering, these words are given distinct meanings and the entire science underlying structural engineering rests on these basic distinctions. The structural engineer's craft rests on two pillars: form (or how shape and size and manner of arrangement of structural material provides efficient design) and substance (the nature of material(s) out of which the structure is fashioned). An earlier book by Gordon, 'Structures or Why Things Don't Fall Down' (also available in Penguin edition), dealt with the former aspect; the book reviewed here deals with the latter issue.

"Why do things break?" is the substantial question addressed in this book. "How is this



**“Why do things break?” is the substantial question addressed in this book. “How is this to be interpreted in terms of the physics and chemistry of the material constitution?”**

to be interpreted in terms of the physics and chemistry of the material constitution?” Gordon surveys the field from its historical origins to the most recent advances in materials design (yes, engineering new materials for optimal structural performance) using as little mathematical equipment as possible, meeting Lord Ashby’s criterion of “technological humanism”- “the habit of apprehending a technology in its completeness.”

Chapter one asks awkward questions on the new science of strong materials, which has taken shape only in this half of the century. It sets the stage for what follows.

The remaining ten chapters are arranged into three parts. Part one deals with elasticity theory and the theory of strength, where the engineering definitions of stress and strain (from Galileo to Hooke and then to Young) are clearly spelled out and the manner in which an understanding of the distributions of stress and strain in a structure assists in predicting its structural performance. How strong any given material is and what the causes of weakness are, come next; a fair amount of attention is devoted to the role that cracks and dislocations play and how their growth under adverse conditions of stress

concentrations can certainly lead to distress.

Materials scientists divide themselves into two factions, the metallurgists and the non-mets, not entirely unexpected because the properties of metals and non-metals are evidently so different. This division has “run right through the history of technology” and Gordon very fairly divides the remaining and greater part of the book into these two traditions. Part two discusses how non-metallic materials can be toughened to stop cracks. It deals with such common place materials as timber, cellulose and plywood and proceeds from here to the more recent wonder materials — the world of composites. Part three is an intimate study of iron and steel, which made the industrial revolution possible, and of metals in general. The book ends with some “technological forecasting” , and happily it turns out that chapter 11, “The materials of the future” was supported by a sub-title which Gordon could change from a defensive “or how to guess wrongly” (first edition of the book in 1968) to an optimistic “or how to have second thoughts” when he revised the book in 1976. Most of his prophecies became accomplished facts. “Getting to the moon... was a very expensive

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The end of the book carries two appendices on various kinds of solids and on a simple beam formula. There is a list of books suggested for further study, much in the same way *Resonance* instructs its contributors to end their essays (as this review also dutifully does, borrowing from the same list). A helpful index is also provided.

I found and relished Gordon’s two books much after completing my formal degree in engineering. I couldn’t help feel a sense of regret and incompleteness that my engineering education never did of itself provide a fabric into which technology could

be woven so that I could claim to have been given a liberal education (to paraphrase the long quote from Lord Ashby’s ‘Technology and the Academics’ which Gordon places as a motto at the head of his book). I hope that readers of *Resonance* will get hold of these two books, even if they are not structural engineers or materials scientists, to educate themselves of the “sometimes curious and entertaining ways in which scientists isolate and solve problems.”

### Suggested Reading

**SP Timoshenko. History of the Strength of Materials. McGraw-Hill, 1953.**

**History of Technology. Oxford University Press. 1954.**  
**D’Arcy Thompson. On Growth and Form (abridged edition). Cambridge University Press. 1961.**

**E Torroja. Philosophy of Structures (translated from the Spanish). University of California Press, Berkeley, 1962.**

**B R Schlenken. Introduction to Materials Science, John Wiley, 1974.**

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**“Agata Mendel ... jokes that most contemporary molecular and developmental biologists reason like a child who, because turning the knob on the television set makes the picture appear, concludes that the knob ‘causes’ or ‘programs’ the picture, and then goes the next absurd, step of trying to understand the mechanism of television by chemically analysing the knob” from *Theory and practice of genetic reductionism –from Mendel’s laws to genetic engineering*, an essay by R Hubbard in ‘*Towards a Liberatory biology*’ edited by S Rose.**

