Energy Absorption of Structures and Materials

Description: The prediction of damage to structures caused by accidental collision – whether to automobiles, offshore installations or simply the packaging around an electrical appliance – is a crucial factor in their design. This important new study focuses on the way in which structures and materials can be designed to absorb kinetic energy in a controllable and predictable manner. An investigation into energy absorption requires an understanding of materials engineering, structural mechanics, the theory of plasticity and impact dynamics. Whilst a great deal of research has been undertaken on various aspects of these subjects, this knowledge is diffuse and widely scattered. Based on their extensive research and experience in the field, Guoxing Lu and Tongxi Yu have synthesised the most recent developments and latest research to form a detailed and comprehensive treatment of the subject.

The opening chapter covers the engineering background to energy absorption and the general requirements for impact energy absorbers based on the theory of plasticity and impact dynamics. Chapter 2 sets out the fundamental principles and methodology for analytical studies. Chapter 3 discusses dimensional analysis, the concept of small-scale model tests, and conventional experimental methods. Chapters 4, 5 and 6 explore the energy absorption of many simple structural members under different loading conditions. Chapters 7 and 8 deal with the modelling of local deformation under impact, plastic deformation and tearing. Chapter 9 covers the plastic analysis of the four main deformation processes: tube inversion and tube internal nosing, inversion of a spherical sphere and buckle propagation in pipelines. Chapters 10 and 11 discuss the energy absorption in cellular and composite materials. Chapter 12 presents some fascinating case studies illustrating the application of the principles covered in previous chapters.

- Important new study of energy absorption of engineering structures and materials
- Shows how they can be designed to withstand sudden loading in a safe, controllable and predictable way
- Illuminating case studies back up the theoretical analysis
- Essential reading for structural engineers and materials scientists

This book will be an essential reference for engineers and materials scientists, practising mechanical and structural engineers, as well as researchers concerned with energy absorption prediction and the effective design of structures and materials to counter the effects of impacts and sudden loading.

About the Author

Guoxing Lu is currently Professor at the School of Engineering and Science, Swinburne University of Technology, Melbourne, Australia. He obtained his BEng from Jilin University of Technology, China, in 1984, and his MSc from Cranfield University, UK, in 1986; both in automotive engineering. He obtained his PhD from Cambridge University in 1989 in structural plasticity. He lectured for five years at the School of Mechanical and Production Engineering, Nanyang Technological University, Singapore. He joined Swinburne University of Technology in 1995. His main research interest is energy absorption of structures. He has published over 100 refereed papers in international journals and conference proceedings.

Tongxi Yu is Head and Professor in the Department of Mechanical Engineering, Hong Kong University of Science and Technology. After obtaining his first degree in Solid Mechanics from Peking University in 1964, he worked as an engineer in the machine-building industry in China. Between 1980-83 he conducted research on engineering plasticity at Cambridge University, UK, receiving his PhD in 1983. Between 1984-91, he was a professor at Peking University, China, this was followed by a period as reader at UMIST, UK, until he joined HKUST in 1995. His research interests mainly focus on Impact Dynamics, Engineering Plasticity and Energy Absorption. He has published 7 books and 230 academic papers in refereed journals or as book chapters. He received a Royal Society (UK) Visiting Fellowship in 1991, a China Higher Education Science and Technology
Award (1st class) in 2001. As a recognition of his outstanding contribution to applied mechanics, Cambridge University awarded him ScD (Doctor of Science) in 1995.

Contents:

Introduction

- Vehicle accidents and their consequences
- Applications of energy-absorbing structures/materials
- Design of energy-absorbing structures and selection of energy-absorbing materials

Methodology of analysing energy-absorption capacities

- Idealisation of materials’ behaviour
- Limit analysis and bound theorems
- Effects of large deformation
- Effects of dynamic loading
- Energy method

Rings and ring systems

- Ring compressed by two point loads
- Ring pulled by two point loads
- Built-in semi-circular arch under point loads
- Ring compressed by two flat plates
- Laterally constrained tubes
- One-dimensional ring system under end impact
- Lateral crushing of arrays of circular tubes
- Other ring/tube systems

Thin-walled members under transverse loading

- Circular tube under point loading
- Indentation of a circular tube by a blunt wedge
- Bending collapse of thin-walled members
- Other loading systems and comments

Axial crushing of thin-walled members

- Circular tubes
- Square tubes
- Top-hat and double-hat sections
- Effect of foam filling
- Further remarks

Impact on structures and inertia-sensitivity

- Local deformation of structures due to impact
- Inertia-sensitive energy-absorbing structures

Plastic deformation and ductile tearing

- Measurement of tearing energy
- Axial splitting of circular metal tubes
- Axial splitting of square metal tubes
- Piercing of metal tubes
- Cutting of metal plates by a wedge

Cylindrical and spherical shells

- Tube inversion
- Tube internal nosing
- Inversion of a spherical shell
- Propagating collapse of a submarine pipe
Cellular materials
- Honeycombs
- Foams
- Wood
- Impact response of cellular materials
- Cellular textile composites

Composite materials and structures
- Factors that influence the energy absorption characteristics
- Axial crushing of circular tubes
- Axial crushing of tubes with other geometries
- Tubes under bending
- Comments on the crushing of composite tubes
- Axial crushing of composite wrapped metal tubes
- Composite sandwich panels

Case studies
- Rockfall protective net
- Packaging using plastic foams
- Design of vehicle interior trim
- Corrugated guardrail beams

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