ENGINEERS
AUSTRALIA

TEACHER DEVELOPMENT PROGRAM
BRINGING SCHOOLS AND ENGINEERING TOGETHER

Presentation 1 – Engineering Fundamentals
9 February 2015
Merewether High School

Teacher Development Program

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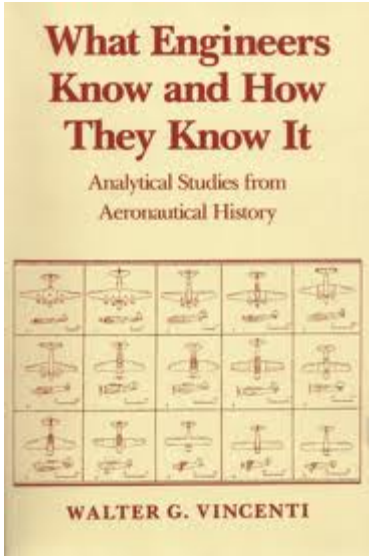
Introduction

Michael van Koeverden - 2015 Newcastle Division President- *BE (Civil), FIE Aust., CPEng, NPER, RPEQ* - Director- BGE Materials Technology



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Introduction

- Background
- Format
- Timetable

Engineering Fundamentals

- Areas of Engineering Practice
- Materials
- Mechanics

Feedback on Previous Exams

Refreshments

Q + A and Networking

Close

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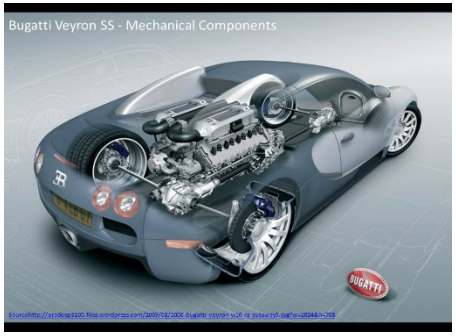
Background

Engineering covers multi disciplines

Civil



Mechanical

Electrical

Chemical

Structural

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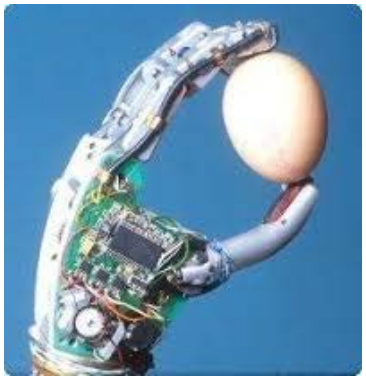
Background

- Engineering covers multi disciplines

Water

Electrical



Bio medical

- Engineering provides essential services to our communities
- Engineering puts ideas into practice
- Engineering is vital to the way we live.
- What engineers do is not well understood by students.
- Engineering as a career path can be exciting for students

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Background (Cont'd)

- These sessions are designed to bring together teaching professionals to collaborate and align teaching with the needs of the engineering profession.

Format

- Short presentation on an area of the HSC Engineering Studies Curriculum with how this links with the Engineering industry
- EA to facilitate question and answer networking session with teachers on how to align teaching with the requirements of the engineering industry

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HSC Engineering Studies Curriculum

Engineering Studies 2015

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Term	Week	Date (week beginning)	Year 11 Preliminary Modules	Year 12 HSC Modules	Venue
1	3	Feb-09	Engineering fundamentals		Merewether High school
	7	Mar-09		Civil structures	HVGS
2	3	May-04	Engineering products		TBA
	7	Jun-01		Personal and public transport	TBA
3	3	Jul-27	Braking systems		TBA
		August	Engineering week	Function Networking witn UON and TAFE	TBA
3	7	Sep-04		Aeronautical engineering	TBA
4	3	Oct-19	Biomedical engineering		TBA
	7	Nov-16		Telecommunications engineering	TBA

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Presentation - Engineering Fundamentals

Areas of engineering Practice.

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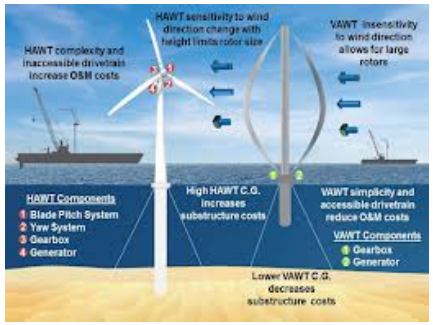
David Sparkes

- Principal Structural Engineer at GHD
- Conjoint Associate Professor of Structural Engineering University of Newcastle



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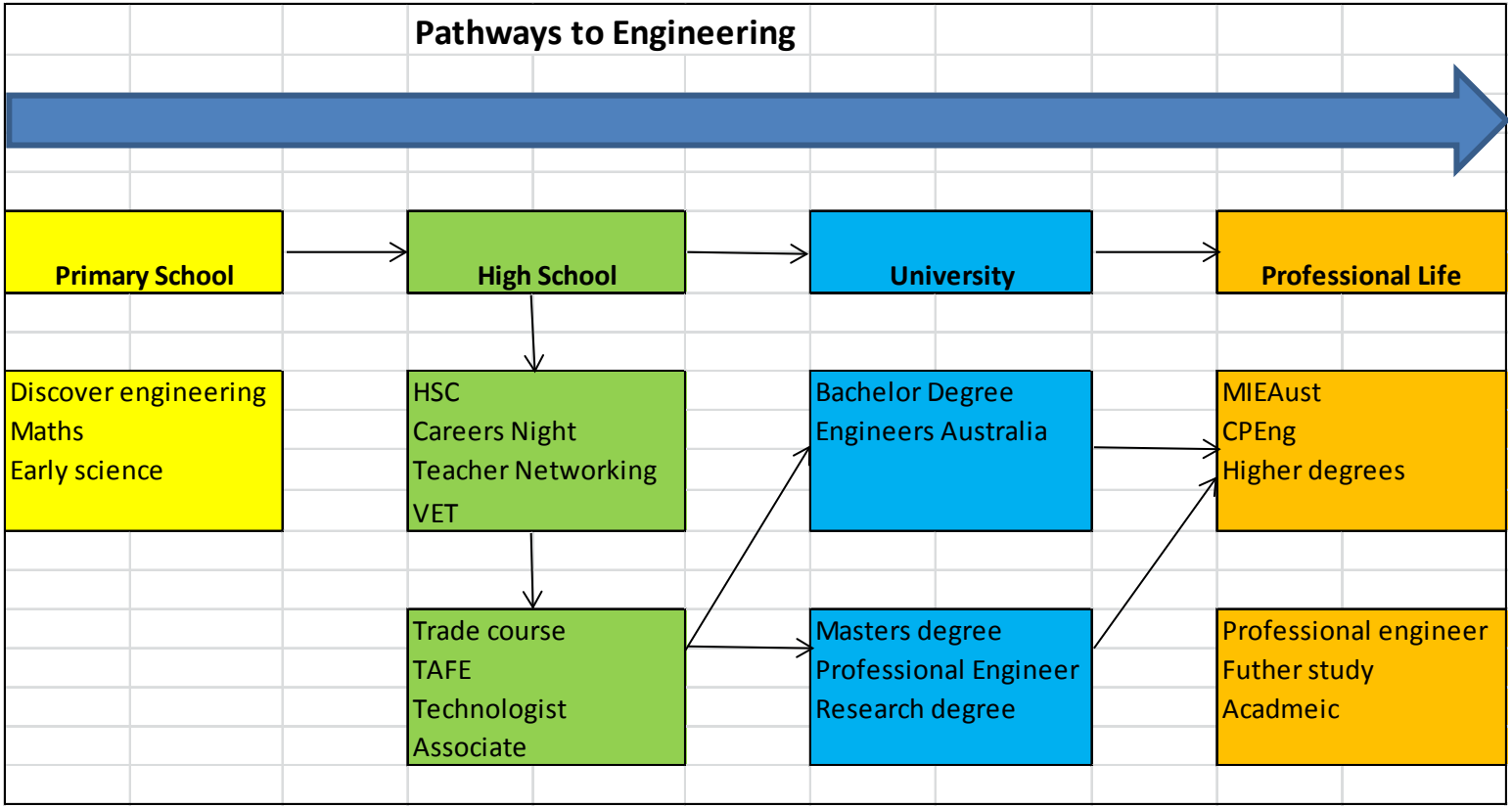
Presentation - Engineering Fundamentals

Areas of engineering Practice



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Presentation - Engineering Fundamentals

Areas of engineering Practice.

Engineers Australia has the following areas for engineering practice.

NPER: ***National Professional Engineers Register***
Aerospace, Biomedical, Building Services, Chemical, Civil Electrical, Environmental, Management, Mechanical, Structural, Naval Architecture, ITEE, Petroleum.

NETR: ***National Engineering Technologists Register***
Aerospace, Biomedical, Building Services, Chemical, Civil Electrical, Environmental, Management, Mechanical, Structural, ITEE.

NEAR: ***National Engineering Associates Register***
Aerospace, Biomedical, Building Services, Chemical, Civil Electrical, Environmental, Management, Mechanical, Structural, ITEE.

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Areas of engineering Practice.

•In response to government and Industry demand there are specialist sub sectors of practice. The current sectors are:

•Pressure equipment design verification
•Fire safety Engineering
•Heritage and conservation engineering
•Subdivision and Geotechnical engineering
•In-service Inspection of amusement rides
•Oil and Gas pipeline engineering

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Presentation - Engineering Fundamentals

Areas of engineering Practice.

Brief History of Engineering in Australia (professional engineers)

- 1800 - 1900 Colonial Era
- 1900 - 1920 Development of cognitive base and formal education
- 1921 – 1980 Professional Recognition Era
- 1981 – 1990 Era of social change
- 1990 – 2006 Changes in Labour force
- 2006 – Present Ongoing changes to the profession and engineers

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Presentation - Engineering Fundamentals

Areas of engineering Practice.

Engineering Innovation

10. Organ transplants
9. Robotics and artificial Intelligence
8. Electronics funds transfer
7. Nuclear power
6. Mobile Phones
5.Space flight (led to fibre technology and integrated circuits)
4.Personal computers
3. Digital Media
2. Genetic engineering
1. Internet.

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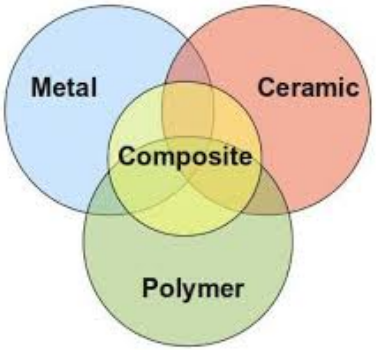
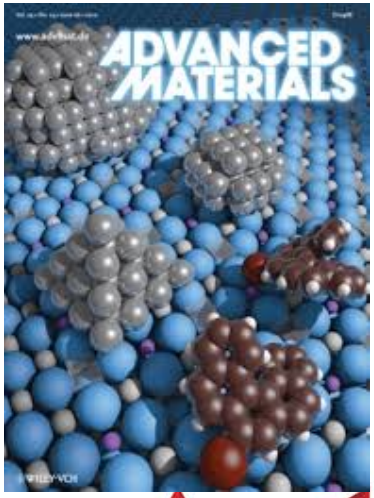
Presentation - Engineering Fundamentals

Materials – Michael van Koeverden





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Presentation - Engineering Fundamentals

Materials.

- Materials are fundamental building blocks of engineering.
- Students of engineering learn about repeatable and reproducible engineering properties that can be applied to solve engineering problems.
- Materials is taught in the second year of an engineering diploma or degree and it is important that those moving into engineering get a solid understanding of this area.
- *The success of any engineering project is only as good as the materials from which they are made and the workmanship to do so.*

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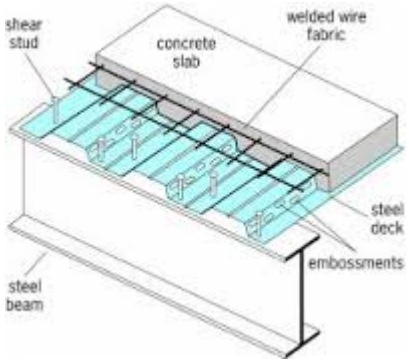
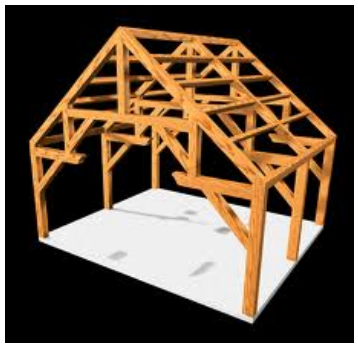
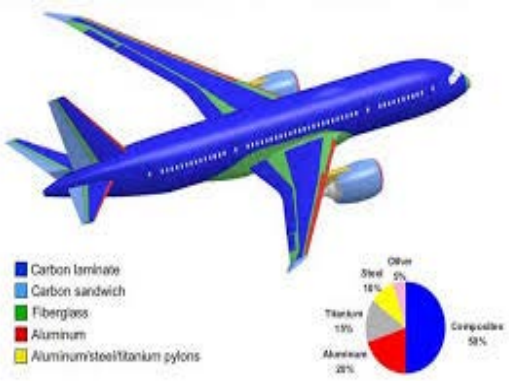
Presentation - Engineering Fundamentals

Materials

Engineering Materials







Steel/Metals

Timber- natural / Engineered

Composites

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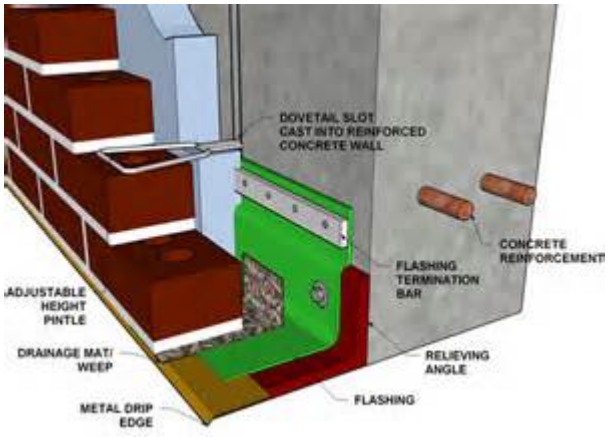
Materials

Engineering Materials

Concrete / Masonry



E.T.C…

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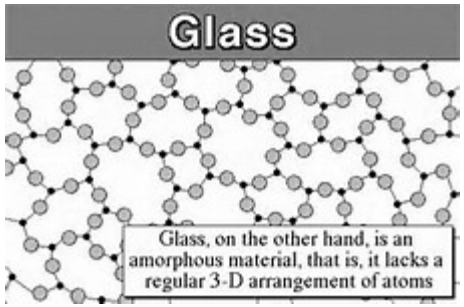
Materials

Classification of materials by:

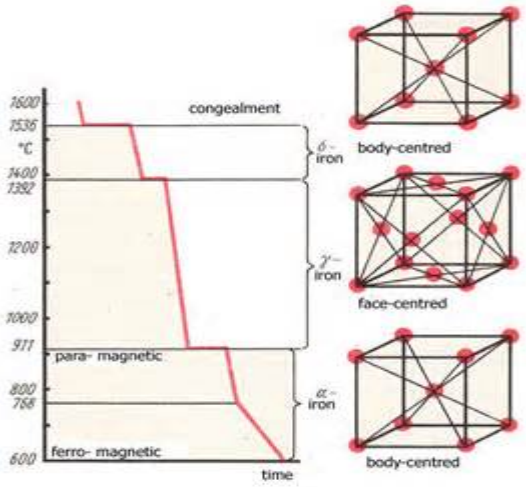
Property- weight (kg), density (T/m3), Strength (MPa, GPa), Stiffness e.t.c…

Structure of Materials-



Amorphous (Glass)

Crystalline (Sand Aggregates)



Lattice (Metals)

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Materials

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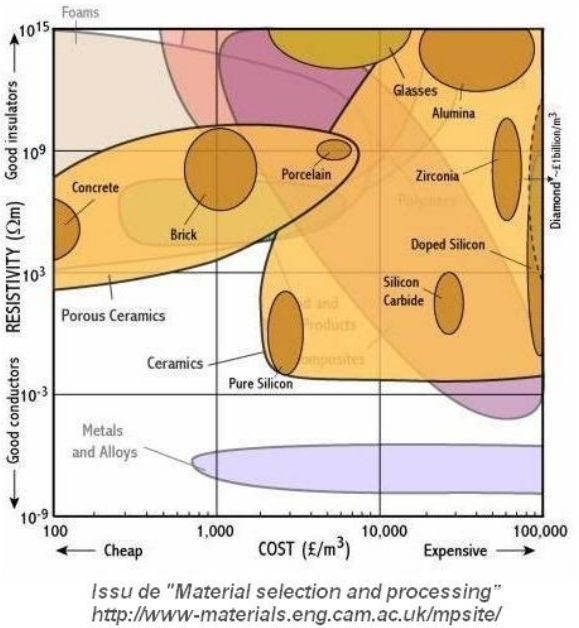
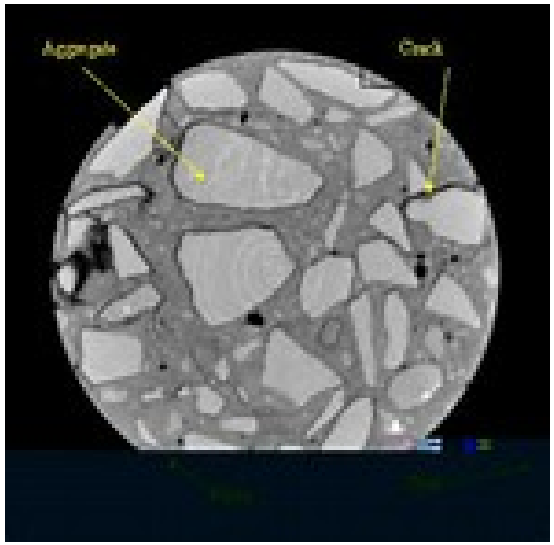
Classification of materials by:

Structure of Materials-



Ceramics (Industrial applications)



Composite (Concrete)

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Presentation - Engineering Fundamentals

Materials

Classification of materials by:

Forming processes

Sprayed Concrete

Hand-Placed Concrete

Slip-formed Concrete

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Materials

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History of materials for engineering applications

Early construction- Physical properties that could be measured

E.g. Simple arch structures common as material tension capacity low.

Later spans increased- reinforcement, PT and new mats

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Materials

Renewable materials and environmental concerns

- Carbon footprint -specific mats may be high to make (E.g. Cement)
- Process improvements to reduce carbon (E.g. Limestone / Cement)
- Use of low carbon materials in construction
- Incentives to reduce carbon- (Green star buildings etc).
- Recycled materials may not have suitable properties vs. virgin mats
- Cost of recycling may be more harmful to environment than virgin mats
- Environmental, social , economic risk to society of mats use or not?
- Waste management from production processes

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Materials

Latest trends in emerging materials

- Lighter stronger materials
- More sustainable materials and processes
- Life cycle of material- whole of life analysis (material-birth to grave)
- Nano-engineered materials- (smaller with customised applications)
- Material optimisation of existing and new products / processes

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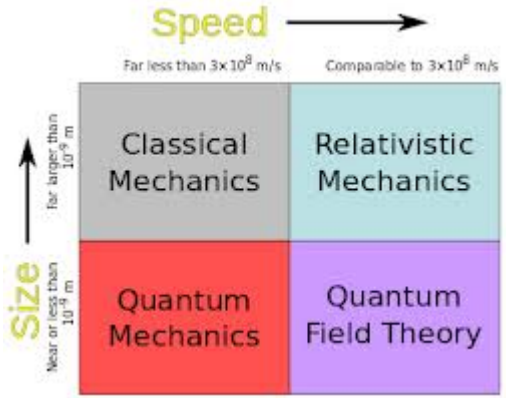
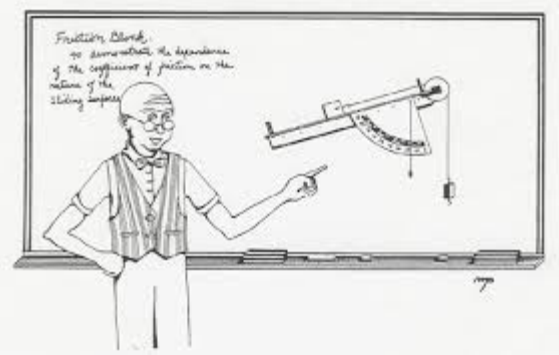
Presentation - Engineering Fundamentals

Mechanics. – David Sparkes





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Presentation - Engineering Fundamentals

Mechanics.

- Mechanics is one of the fundamental areas of mechanical and structural engineering.
- Students of engineering lean to take pure mathematics and physics and apply it to models of the environment to solve engineering problems
- Mechanics is taught in the first year of an engineering diploma or degree and forms the foundation for further study in this area. It is extremely important that those moving into structural or mechanical engineering get a solid understanding of this area of applied maths and physics

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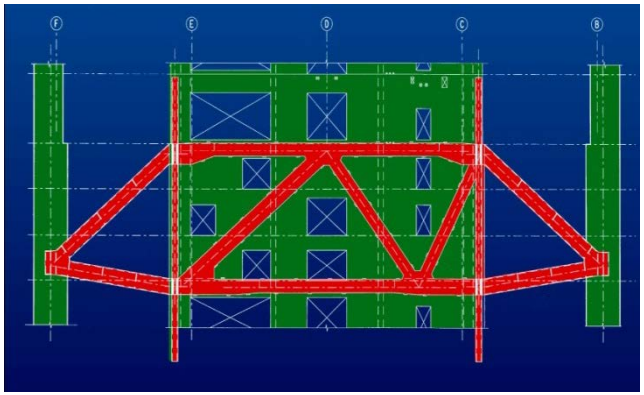
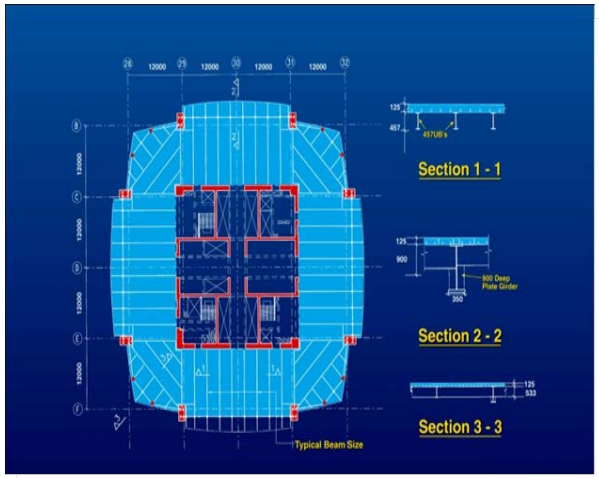
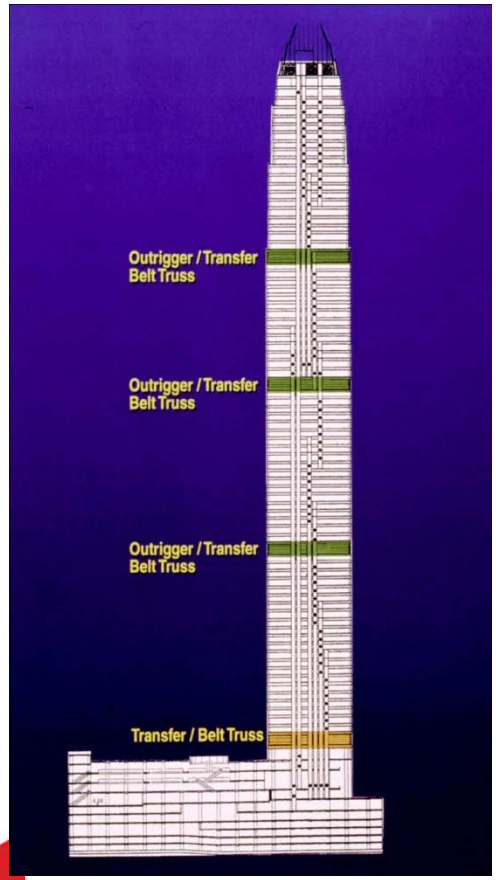
Mechanics.







North East Tower – Hong Kong

- 411m
- 88 Stories – Office
- Concrete Core + Steel Outrigger + Composite Columns

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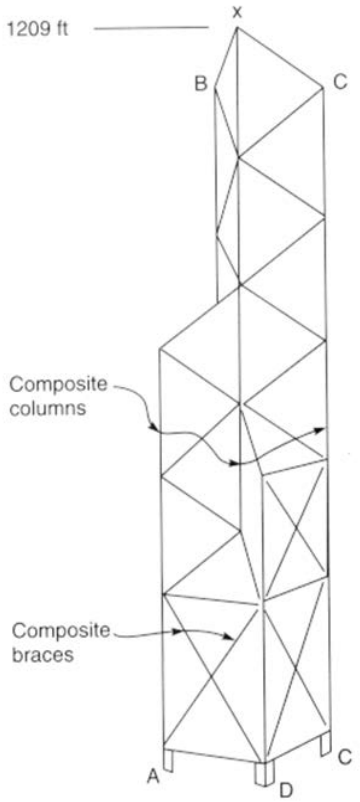
Presentation - Engineering Fundamentals

Mechanics.



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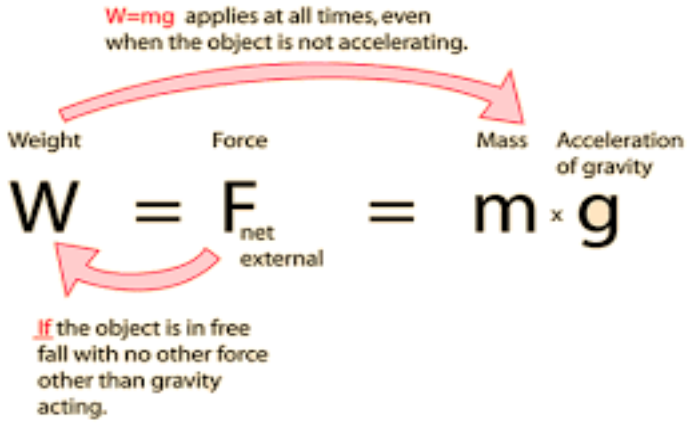
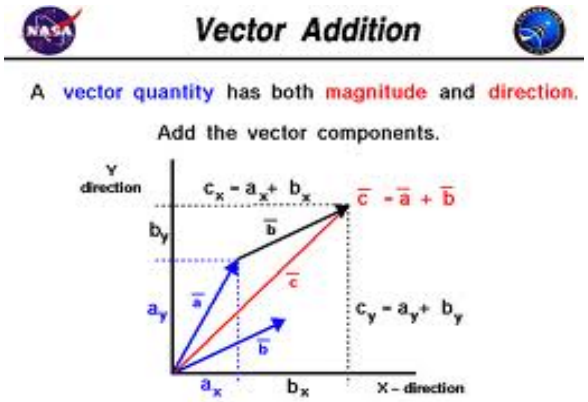
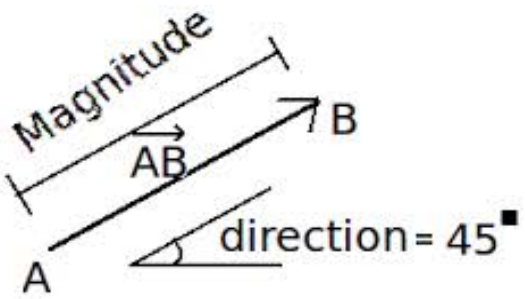
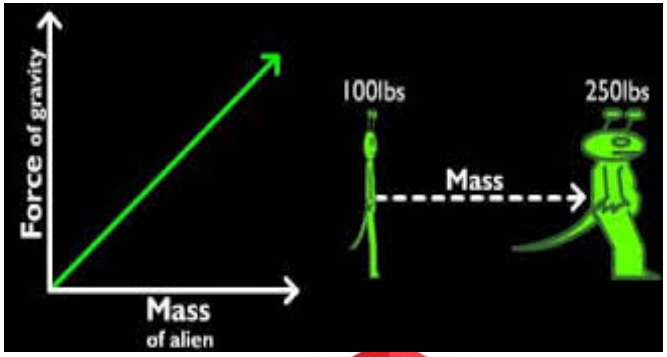
Mechanics.









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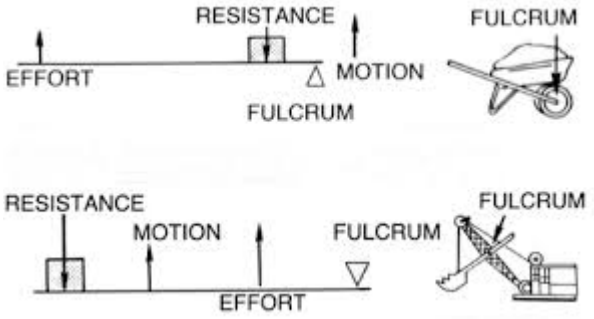
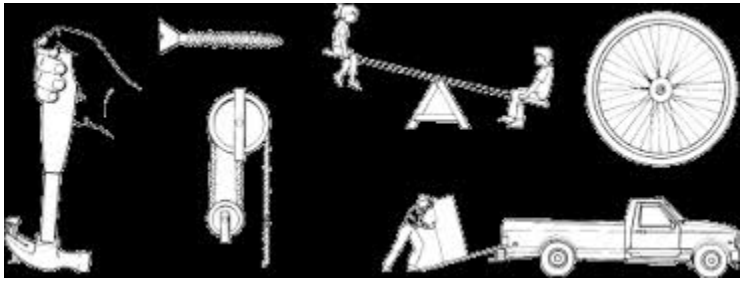
Presentation - Engineering Fundamentals

Mechanics.

Man lifting a stone with a lever





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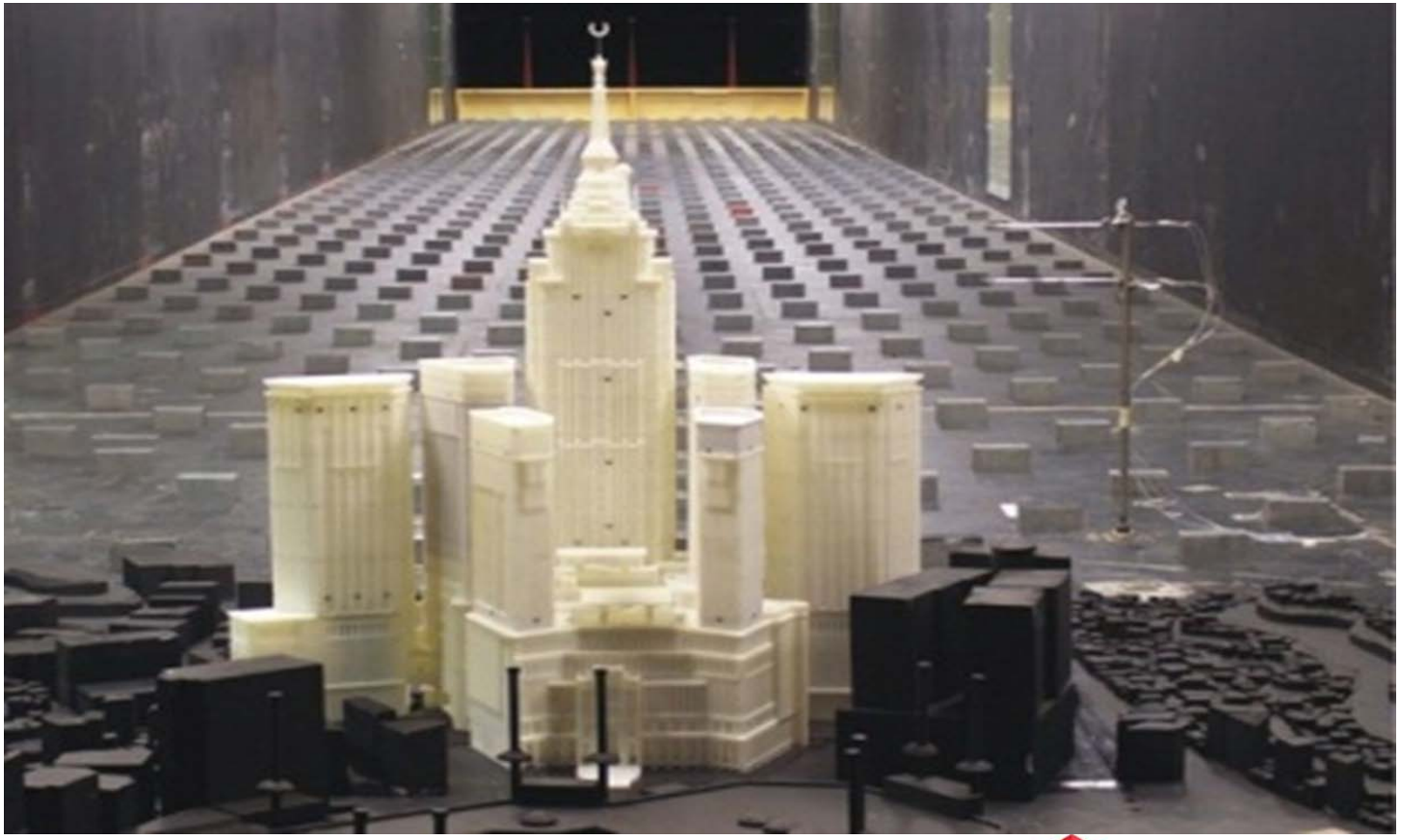
Mechanics.



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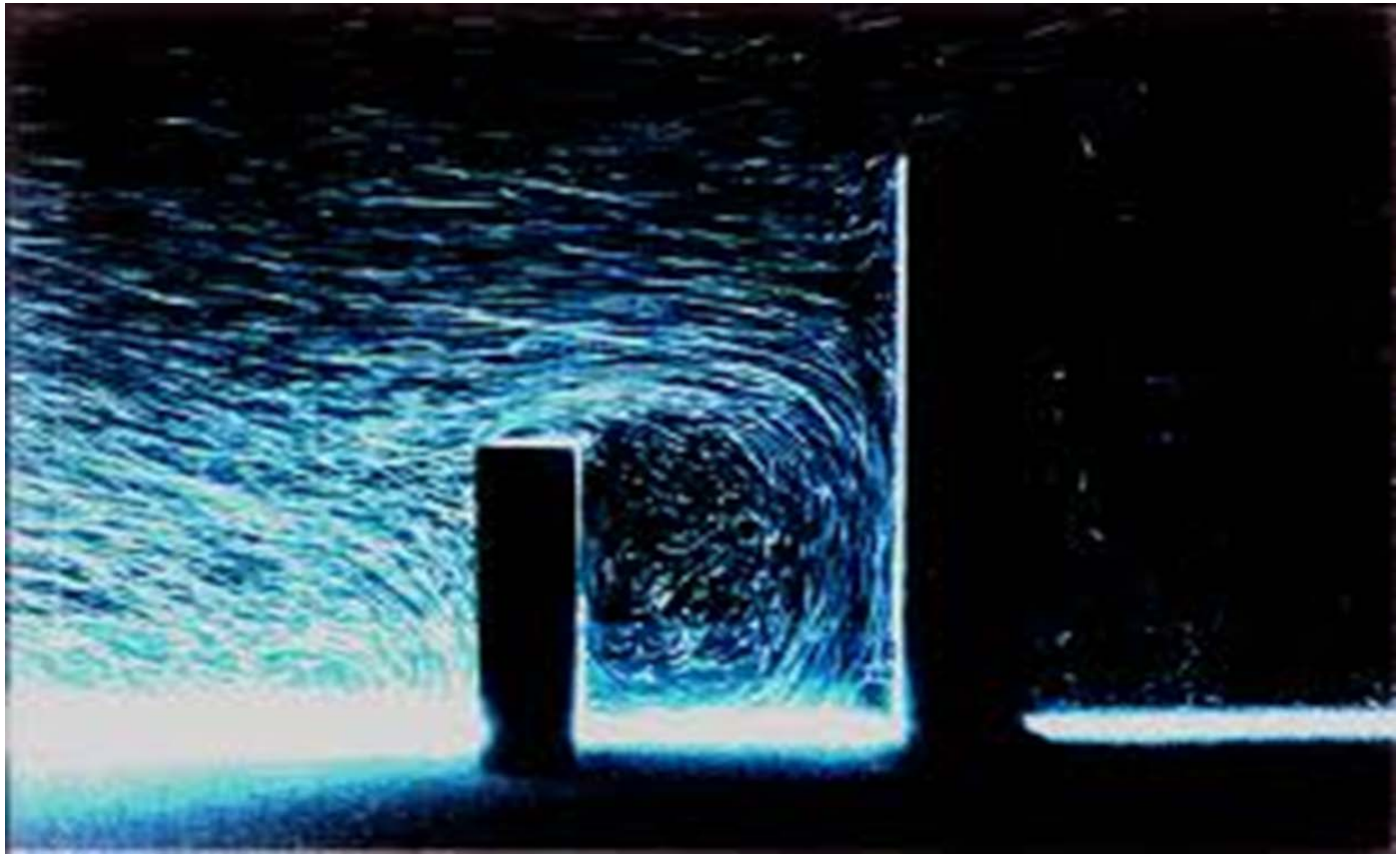
Presentation - Engineering Fundamentals

Mechanics.



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Mechanics.

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Mechanics.

- www.youtube.com/watch?v=rX62Rxx1Shg
- www.youtube.com/watch?v=1nLS5_IK-x8
- www.youtube.com/watch?v=WmWJV6qFfv8
- www.youtube.com/watch?v=PFhIMjwOg3s
- www.youtube.com/watch?v=sV_6E1Lh7yo

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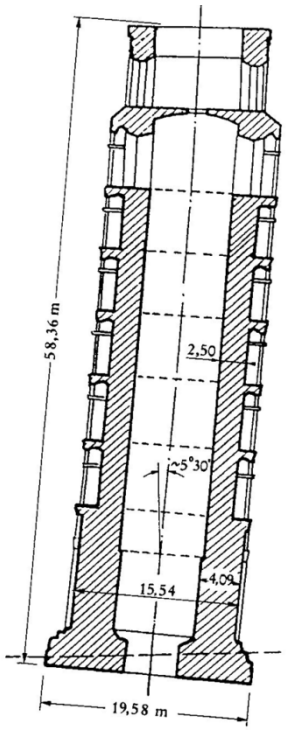
Mechanics.

When we get it wrong



Tilt = 5.5 degrees

Total Weight = 144.5 MN
(14,745 t)

Overturning Moment = 334,000 kNm

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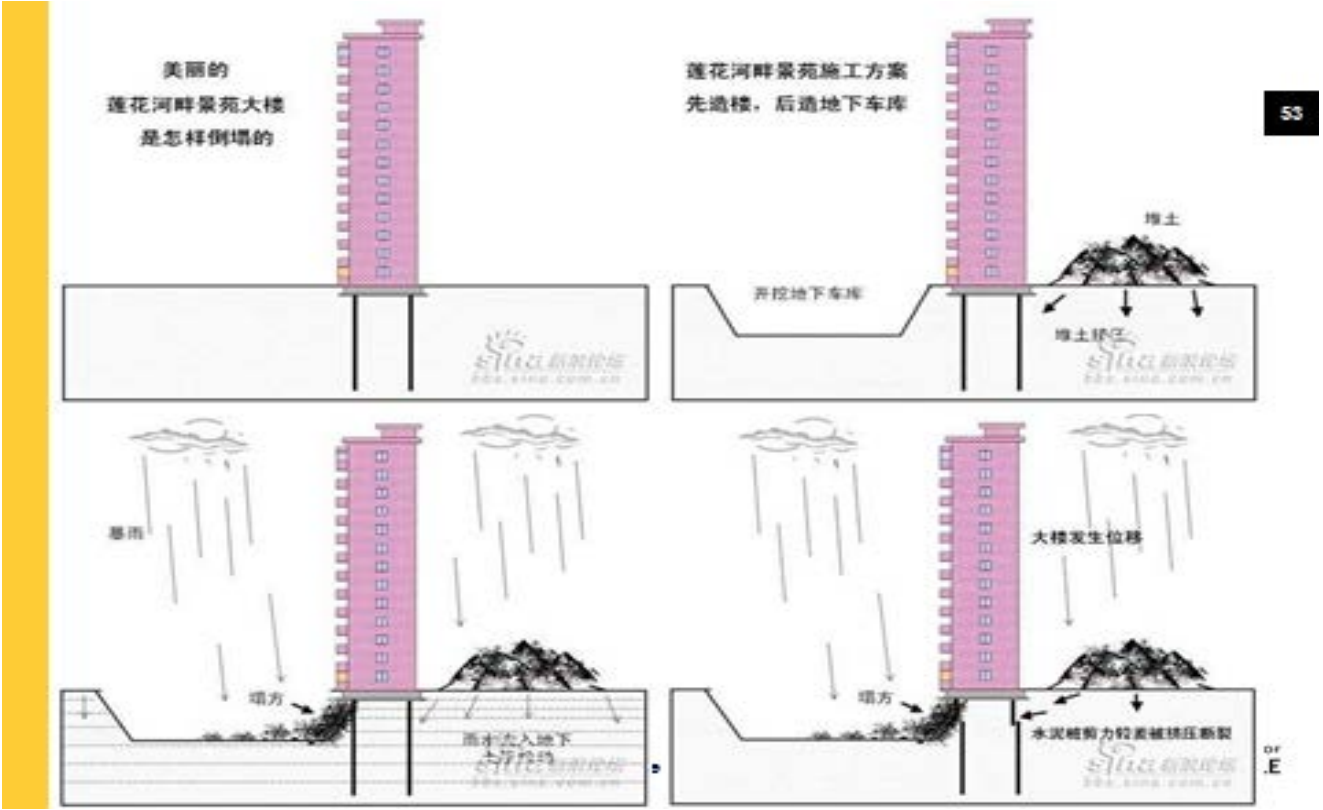
Presentation - Engineering Fundamentals

Mechanics.



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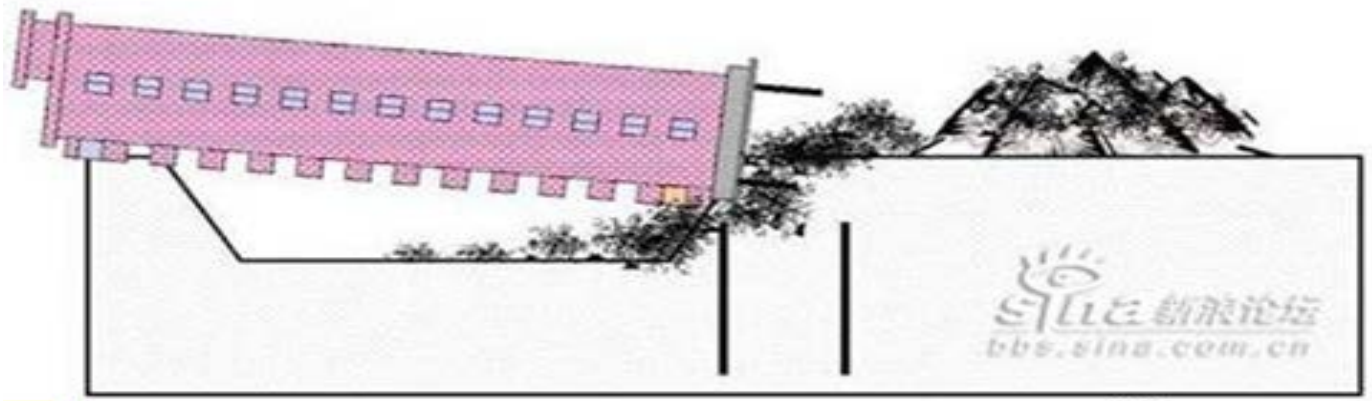
Mechanics.

创造世界房屋倒塌奇迹

54



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Presentation - Engineering Fundamentals

Mechanics.

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Mechanics.

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Mechanics.

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Mechanics.

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Past Exam Q and A

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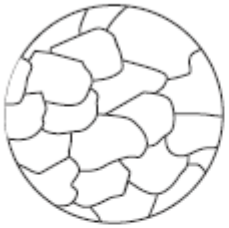
Presentation - Engineering Fundamentals

Past exam Q and A

15 Which of the following plain carbon steel microstructures would be best for the manufacture of gears and shafts?

(A)



(B)

(C)

(D)

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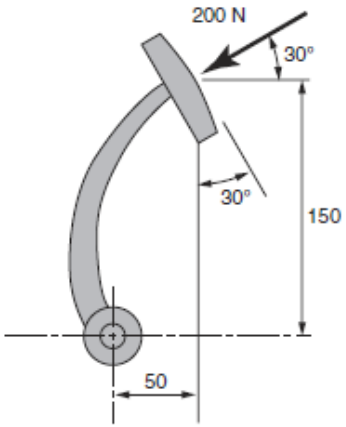
Past exam Q and A

4 A brake pedal is loaded as shown.



What is the moment applied to the pivot?

(A) 21 Nm

(B) 26 Nm

(C) 30 Nm

(D) 31 Nm

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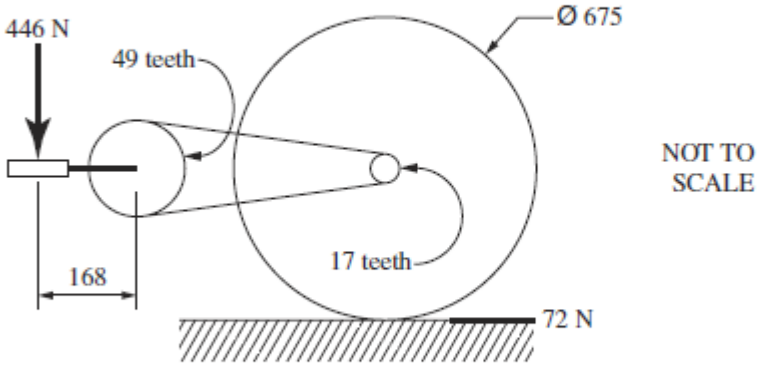
Presentation - Engineering Fundamentals

Past exam Q and A

Question 22 (continued)

(b) The diagram shows the drive mechanism for a bicycle. When the pedal crank is horizontal, a vertical downward force of 446 N just rotates the rear wheel against a resistance of 72 N. **3**



Calculate the efficiency of the drive mechanism.

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Past exam Q and A

(c) Describe the steps involved in the heat treatment of duralumin (an aluminium-copper alloy) to achieve its maximum strength. 3

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Past exam Q and A

8 Which of the following copper alloys, when fully heat-treated and then cold-worked, is the hardest and strongest?

(A) Copper beryllium

(B) Copper tin (bronze)

(C) Copper zinc (brass)

(D) Electrolytic tough pitched copper

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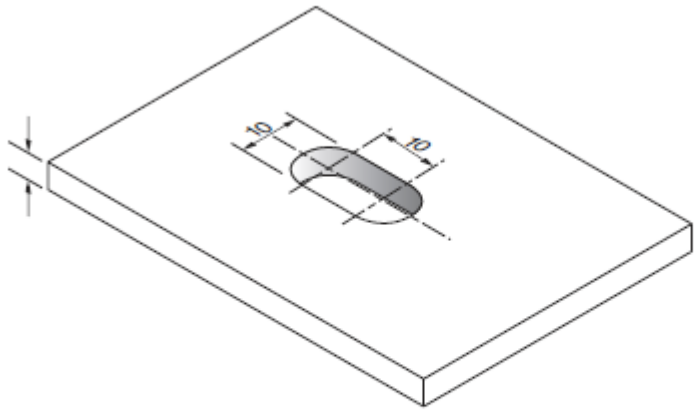
Past exam Q and A

14 A metal plate is 4 mm thick and has an ultimate shear stress of 600 MPa. A hole is punched through the plate as shown.



What is the force required to punch the hole?

(A) 30.8 kN

(B) 48.0 kN

(C) 60.0 kN

(D) 123.4 kN

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Presentation - Engineering Fundamentals

Takeaways/Outcomes from Today

EA to be your link with the Engineering Profession / Industry

These forums provide important networking opportunities with other teaching professionals

We want to assist in providing exciting ways of presenting concepts with real world examples and application

We encourage a link of support with exam assessors

We would like to make clear the pathways to engineering that exist for the student- Professional, Trades, VET

WE AIM TO BE FACILITATOR ONLY supporting you.

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