Materials & Specifications

Introduction

SBEC1822 & SBEQ1822 – MATERIALS & SPECIFICATIONS

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Presentation Overview

- Introduction to materials used in construction
- Evolution & innovation in materials for civil & building engineering
- Sustainability of material
- Health and Safety in Materials Engineering
- Materials management
- Summary

Learning Objectives

By the end of today's lectures you should able to:

- Understand and appreciate the use of construction materials.
- Describe what is construction material and application to construction projects
- Acquire relevant information from various sources

Introduction

- Materials are at the heart of all branches of engineering
- Engineers and builders are better engineers if they understand materials
- Quantity surveyors need to have an appreciation so they can understand the costing issues

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Introduction (cont'd)

- Past understanding of materials came from craft practices
- Today the range is so great, so this method is now impossible
- Science can now provide a framework to understand both new and old materials
- This science is called 'Materials Science'

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Evolution and Innovation in Materials for Civil & Building Engineering

- No branch of engineering can provide such a long history on the significance of materials as civil and building engineering construction.

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- Masonry was the dominant material while timber playing an important part.
- Jointing materials such as gypsum, resins, bitumen's and lime have been used since Egyptian times

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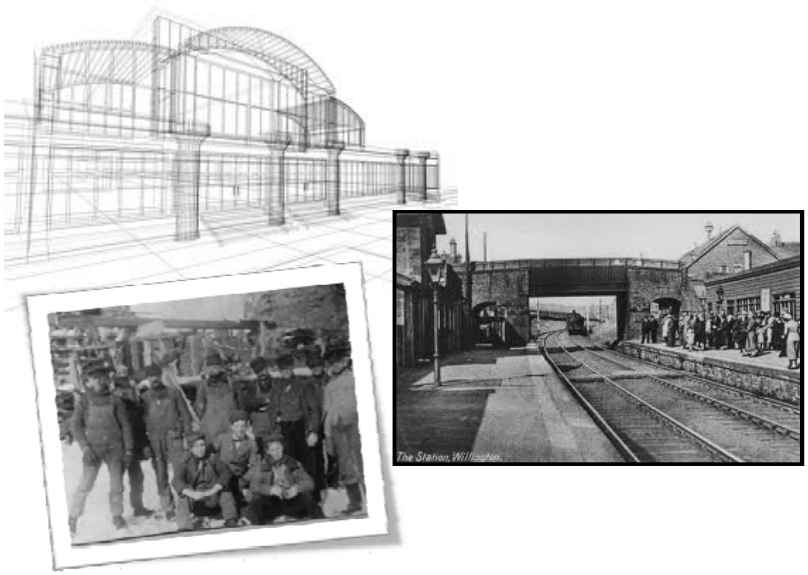
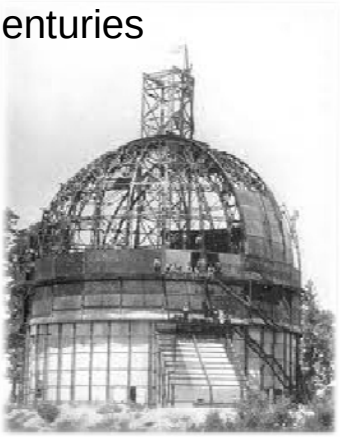


- Metals have been a dominant material throughout engineering and building for the last two centuries

From here……



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To…

Emirates Stadium, UK

- Bend pipes and pipework systems are an essential requirement for most building and civil engineering projects.
- Lead has been used since Roman times as a jointing material
- Fired clay (vitrified or salt glazed to reduce permeability) was the workhorse material throughout the 19th century and well into the 20th

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- Wrought iron pipes and later steel pipes are used long time ago.

Wrought iron pipes

Steel pipes

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- The radical innovation has been in the rapid and general substitution of polymer pipes over the last 20 to 30 years, primarily high density polyethylene (HDPE)
- Naturally occurring polymer-based materials were used in construction activities 2000 and more years ago
- Construction site applications
  - polyesters late 1940s
  - epoxies mid 1940's-1950's
  - polyurethanes 1950's
  - meth acrylates 1960's
  - furanes 1950's-1960's
  - kevlar 1972
  - HDPE 1980s

- Other polymer-based materials may be used such as glass fibre reinforced polyester
- Polypropylene pipes and their couplings complement the use of copper in small diameter plumbing systems

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- The float process for manufacturing sheet glass made flat glass for windows widely available throughout the world
- Before the float process glass of such quality could only be produced by the laborious and costly grinding and polishing of plate glass

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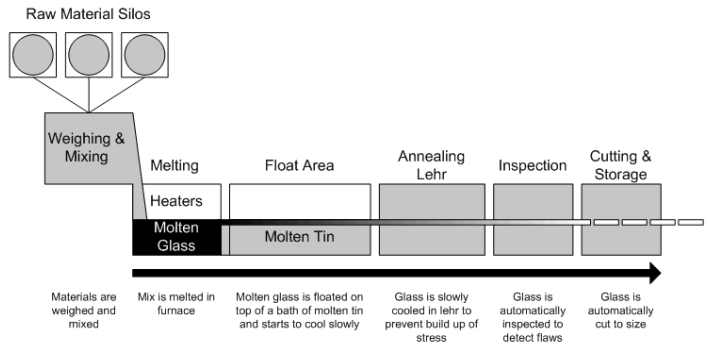
The Basic Float Glass Process



Courtesy of Tangram Technolgy Ltd

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- Because of the widespread use of sheet glass improvements were demanded to combat the deficiencies of the standard material
- e.g. laminated safety glass has been developed by sandwiching one or two layers of a transparent polymer film, between two or three glass sheets

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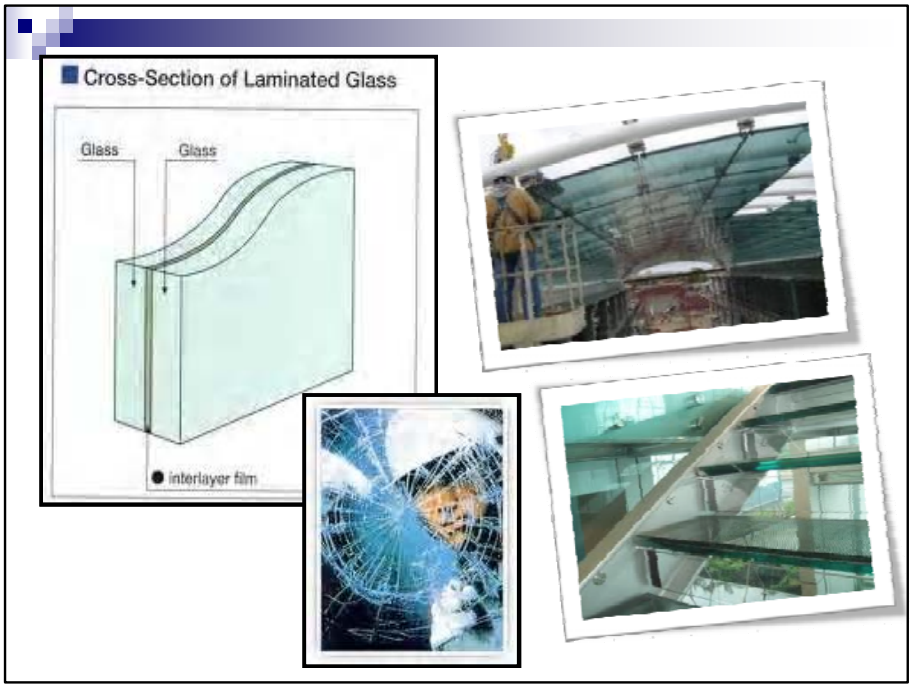

- A further example has been the surface treatment of sheet glass
- In this case extremely thin coatings of transparent materials such as titanium dioxide allow the glass to act as a selective filter for various components of sunlight and thus provide solar control within the building envelope

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Innovation in materials

- It seems unlikely, at least in the near future, that substantially new primary or commodity materials will emerge
- Civil and building engineering benefit in many ways from developments in materials technology which are less apparent group of developments in the structural materials

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Innovation in materials

- Concrete technology has exploited numerous chemical additives which can modify the workability of freshly poured concrete
- We can also use an additive which induces small almost microscopic holes in the concrete, this is called *air-entrainment*

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Innovation in materials

- Other innovations in materials from many fields will eventually find their way to building and civil engineering

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Sustainability of materials

- All materials have their origin in the natural resources of the planet.
- Sustainability means analysing the entire life-cycle costs of a material to provide a basis for rational choices in materials, selection and usage

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Health and Safety in Materials Engineering

- Many materials present hazards to workers at the time of construction and after to the public at large.
- H&S is therefore necessary throughout the life cycle of products and processes

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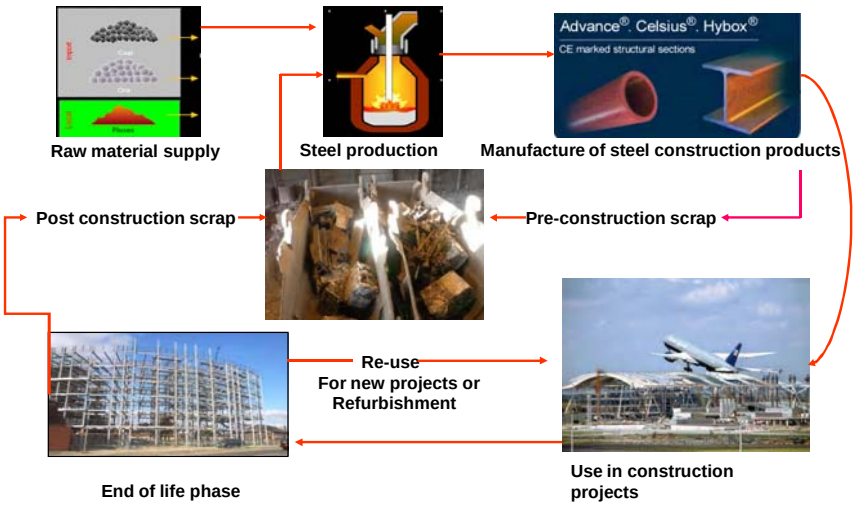
- The Sustainable Loop for Steel-



Health and Safety in Materials Engineering

- Asbestos has caused huge problems because of its industrial use
- Asbestos occurs in several forms, all composed or brittle fibres which, during handling, easily break into minute fibrils
- The hazard arising from asbestos illustrates the dangers associated with fine powders and dust

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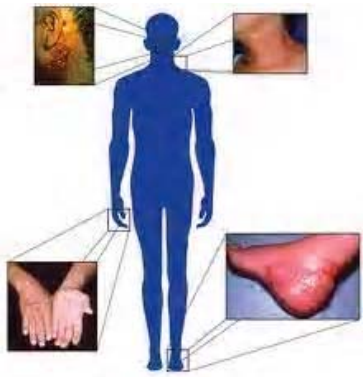
Health and Safety in Materials Engineering

- A second example is the role that trace levels of chromium in cement which can cause allergic contact dermatitis (rash on the skin)



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Material management

- Materials management is a process

  "…it is how a building is designed and how materials are estimated. It is how materials are acquired and even how the packaging is specified. It is how the delivery schedule is designed. It is how contractors plan materials use and how they manage previously used materials and cuts"

- Materials represent a major expense in construction, so minimizing *procurement* or *purchase* costs presents important opportunities for reducing costs.

Material management

- Materials use and materials reuse, reduction and recycling - begins in the planning stages of a project.
- It starts with the architect, proceeds through the engineer, the estimator, the purchaser, the construction manager and finally the contractors.

Table I: Pre-construction people Involved In materials management

Team Member	Role in Materials Management
Architect	Designs for best use of standard sizes, for multiple applications and for their recyclability. Specifies materials with recycled content, responsible packaging and from renewable resources.
Engineer	Ensures appropriate structural component dimensions, quality and spacing for use of standard fasteners and materials for multiple applications and recyclability. Specifies materials with recycled content, responsible packaging and from renewable resources.
Estimator	Uses latest materials takeoff technologies and exercises accuracy in estimates. Reviews actual waste generation data and updates actual waste factors regularly.
Purchaser	Plans purchases and deliveries to reduce surplus and to balance materials maintenance during on-site storage versus transportation energy consumption. Specifies recyclable and returnable packaging.

Reference: *Construction Materials Management Guidelines (1994), American Institute of Architects, Texas*

Table I presents a list of those people typically involved before the materials arrive on site, and the roles they play in effective materials management.

Table II: Construction site people involved in materials Management

Team Member	Role in Materials Management
Site construction management	Applies the materials management plan to the site and oversees its implementation. Takes into consideration physical space available and ensures subcontractors are familiar with and committed to the plan.
Site materials manager	Keeps track of new materials, cuts and used materials; organizes and stores them for availability by the various trades throughout the project in accordance with the materials management plan.
Subcontract management	Communicates with site management and Materials Manager regarding the types of materials they may be able to use for various purposes, even if temporarily. Ensures trades follow the Plan's practices.
Trade workers	Use materials properly, store new materials properly, handle and cut them carefully for maximum use and minimum waste. Consider using cuts before new pieces.

Reference: *Construction Materials Management Guidelines (1994), American Institute of Architects, Texas*

Table II lists those people directly involved in the use of the materials. They may participate in the planning process, since they know first-hand the actual site and working conditions.

Summary

- Materials used in construction are varies
- Civil and building engineering benefit in many ways from developments in materials technology
- Sustainability and Health Safety is an important element in materials engineering throughout the life cycle of products and processes
- Materials management is an important element in project planning and control.

References and further reading

- Marotta, T. W. (2005). Basic construction materials 7th edition. New Jersey: Prentice Hall. Call Number TA403 M26 2005
- Allen, E and Iano, J (2004). Fundamentals of building construction : materials and methods. 4th edition. New Jersey : John Wiley. Call Number TH145 A44 2004 f
- Taylor, G.D. (2000). Materials in construction: an introduction. 3rd edition. Essex : Pearson Higher Limited. Call Number TA403 T396 2000
- Hegger, M. (et al) (2006). Construction materials manual. Basel : Birkhauser. Call Number TA402.5.G3 C66 2006 f
- Spence, W.P. (2006). Construction methods, materials, and techniques. 2nd edition. New York: Thomson Delmar Learning Call Number TH145 S66 2006 f

- *Reliable online sources are also acceptable*

Thank you for listening -

Keep on the right path ...and don't fall off !