Construction Materials

Engineering Materials

- **There are thousands of materials available to the engineer!**
- **Basic construction materiales: concrete, Steel, Clay products & Wood.**

Metals and alloys	Iron and steels Aluminium and its alloys Copper and its alloys Nickel and its alloys Titanium and its alloys
Polymers	Polyethylene (PE) Polymethylmethacrylate (acrylic and PMMA) Nylon, alias polyamide (PA) Polystyrene (PS) Polyurethane (PU) Polyvinylchloride (PVC) Polyethylene terephthalate (PET) Polyethylether ketone (PEEK) Epoxies (EP) Elastomers, such as natural rubber (NR)
Ceramics and glasses*	Alumina (Al_2O_3, emery, sapphire) Magnesia (MgO) Silica (SiO_2) glasses and silicates Silicon carbide (SiC) Silicon nitride (Si_3N_4) Cement and concrete
Composites	Fiberglass (GFRP) Carbon-fiber reinforced polymers (CFRP) Filled polymers Cermets
Natural materials	Wood Leather Cotton/wool/silk Bone

Options in Construction

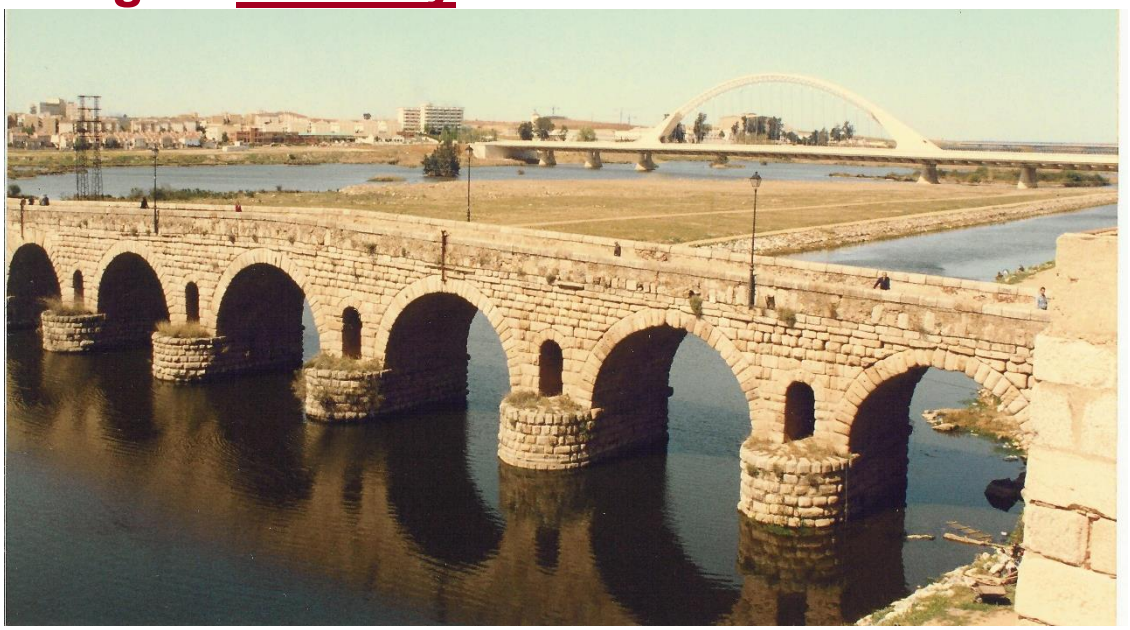
Bridges: Wood

Wooden bridge, Queen's Collage, Cambridge, UK.
Built originally in 1749 (oak), repaired in 1866 & rebuilt in 1905 (teak).

Covered wooden bridge, Lucerne, Switzerland
Built originally in the 1300s, burned down in 1993, was rebuilt

Options in Construction

Bridges: Masonry



Stone arch bridge, Mérida, Spain.

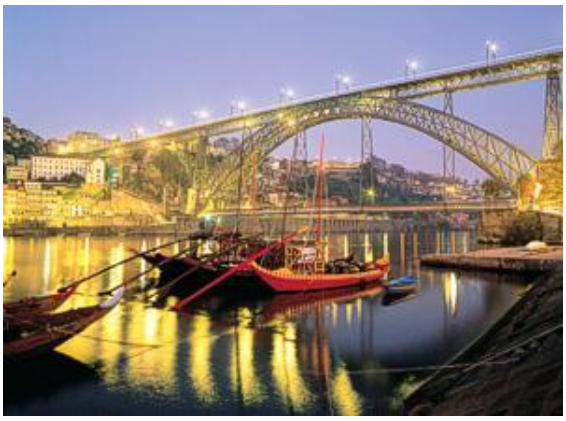
1st century

Brick masonry bridge, Kuldiga, Latvia.
Originally completed in 1874, destroyed in 1915, rebuilt in 1926.

Options in Construction

Bridges: Steel

Luis I bridge, Porto, Portugal.
Completed in 1886.



Howrah bridge, Kolkata.
Completed in 1943, replaced a floating bridge of 1874.

Options in Construction

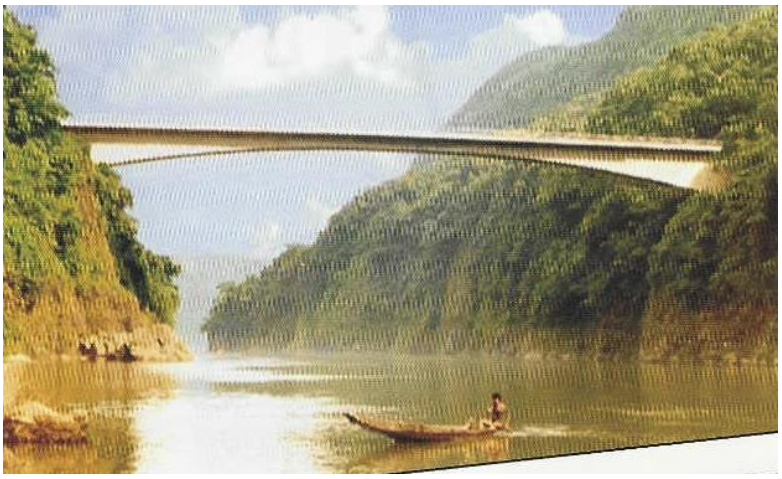
Bridges: Steel

Golden Gate bridge, San Francisco, USA.
Completed in 1937.

Sydney Harbour bridge, Sydney, Australia.
Completed in 1932.

Options in Construction

Bridges: Concrete



Jadukata bridge, Meghalaya.

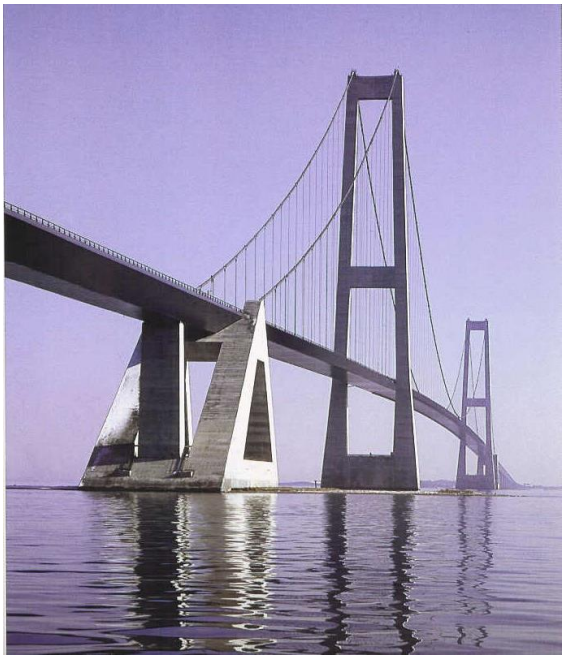
Completed in 1997.

Confederation bridge, Canada.

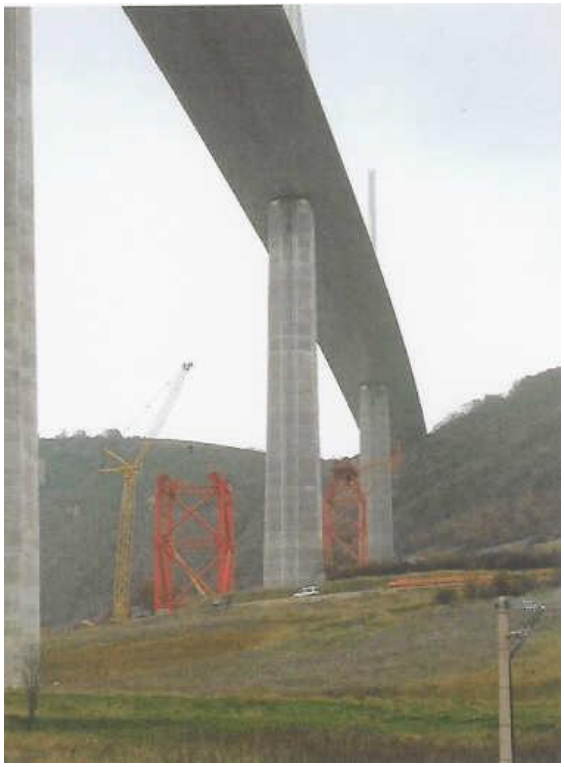
Completed in 1997.

Options in Construction

Bridges: Concrete



Great Belt Link bridge, Denmark/Sweden.
Completed in 1998.



Millau viaduct, France.
Completed in 2004.

Options in Construction

Bridges: Composites

Kings Stormwater Channel bridge, California, USA.
Completed in 2001.

Carbon shells to be filled with lightweight concrete and used as girder

Options in Construction

Buildings: Wood

Norway

Padmanabhapuram Palace, Kerala/Tamilnadu.
17th century.

Options in Construction

Buildings: Brick Masonry

USA
20th century.

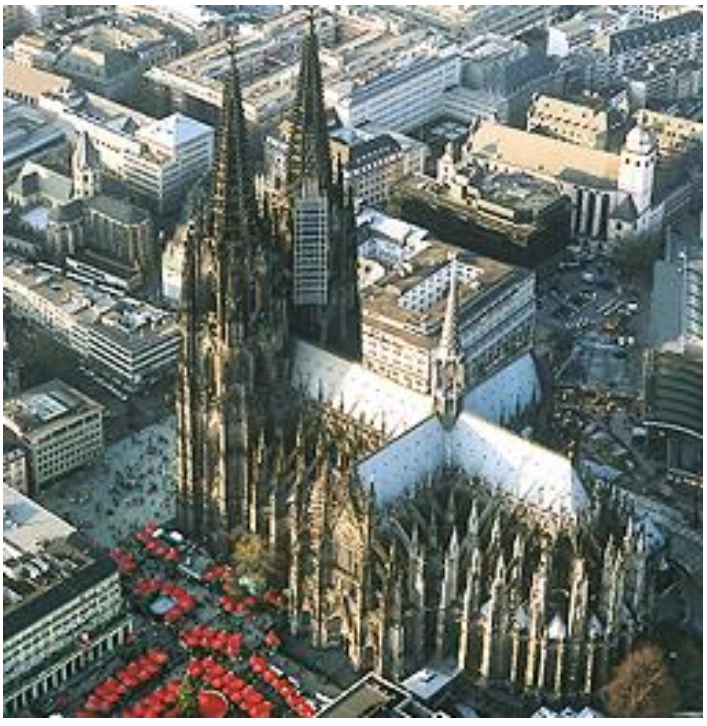
University of Madras, Senate House, Chennai
Completed 1869.

Options in Construction

Buildings: Stone Masonry

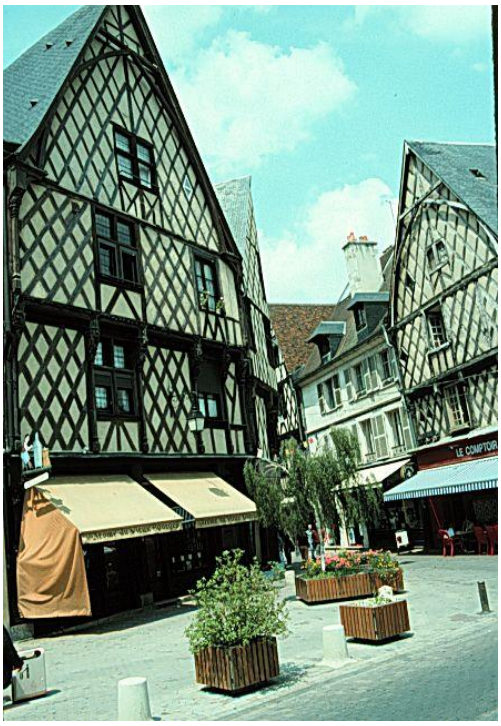
Qutab Minar, Delhi.
Completed in 1230.

Cologne Cathedral, Cologne, Germany
1248-1880, damaged during WW II, repaired.



Options in Construction

Buildings: Wood and Masonry



Bourges, France.
15th century.

Liuheta pagoda, Hangzhou, China
Present form dates to 1152.

Options in Construction

Buildings: Concrete

Marina City, Chicago, USA.
1959

Petronas Towers, Kuala Lumpur, Malaysia
Completed in 1998.

Options in Construction

Buildings: Steel Framed

Sears Tower, Chicago, USA.
1973

Taipei 101, Taipei, Taiwan
Completed in 2004.

Options in Construction

Buildings: Glass and Steel

Apple Computer Store, Soho, New York, USA.
Completed in 2002.

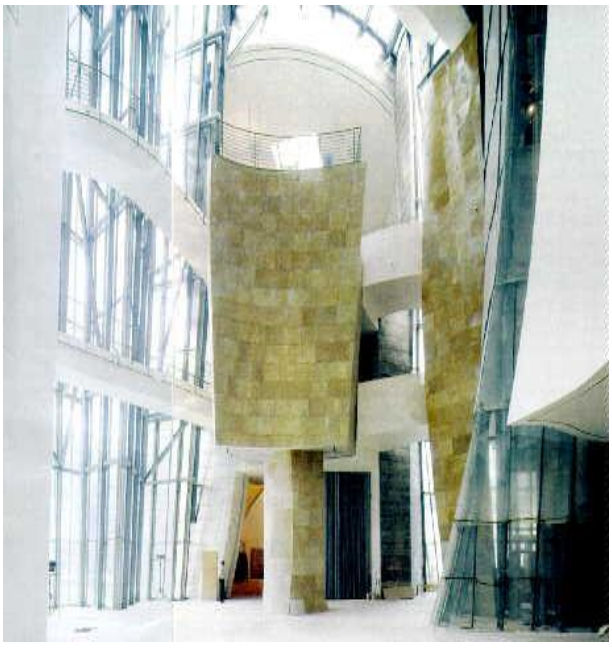
GLA Building, London, UK.
2002

Options in Construction

Buildings: Titanium-clad Steel and Limestone

Guggenhiem Museum, Bilbao, Spain.

1997



Factors Influencing the Choice of Material

- *Type of application*
- *Cost-effectiveness*
- *Availability (geographical location)*
- *Climate*
- *Performance requirements*
- *Aesthetics*
- *Environmental concerns (energy content, raw materials, emissions)*

References

- *Engineering Materials 1: An introduction to properties, applications and design,* M.F. Ashby and D.R.H. Jones, Elsevier, 2005.
- *www.greatbuildings.com*