Historic Timber Structures
Today’s Lecture

1. History of Timber Structures
2. Potential Paper Topics
3. Properties of Timber
4. Case study
Historical Development of Timber Structures

- Roman theatres
- Gothic roof systems
- 16\textsuperscript{th} C bridges – Palladio
- 17\textsuperscript{th} C roof trusses – Wren
- 18\textsuperscript{th} C bridges – Grubenmann
- 19\textsuperscript{th} C bridges – USA
Roman Timber Structures

- Trajan’s column – details of a “trussed” arch bridge
Roman Roof at Orange (France today)

- Timber cantilevers supported a lightweight roof
- Spanned greater than 60 feet (20m)

Research questions?
  - Support conditions
  - Size of timbers
  - Geometry of timber trusses
Gothic Roof systems

- Timber roof systems span above the vaults

- Typical spans of 30-60 ft (10-20 m)

- May have been built prior to the vaults to protect and aid the works
Gothic Roof systems

- Paper topics
  - Comparison of timber roof systems for Gothic cathedrals
  - Analysis of various geometries for roofs
Hammer-Beam Roof systems

- Typical in England
  - Case study next week
  - Used to help span longer distances

- Limit to span for a single beam
  - Diameter of trees
  - Length of elements
  - Consistency of materials
Palladio
Timber Truss Bridge, 1570
Sheldonian Theatre, Oxford
Christopher Wren, 1669
Connection Details
Sheldonian Theatre, Oxford
Christopher Wren, 1669

- Paper topic:
  - Comparison of Wren trusses
    - How much did he understand?
    - How efficient are the truss designs?
18th C covered bridges in Switzerland
Schaffhausen Bridge, 1755
Schaffhausen Bridge, 1755
Craft traditions of timber bridges
“Colossus” over Schuylkill River
in Philadelphia, 1812, 340 ft span
US Covered Bridges
US Covered Bridges
Taftsville Bridge in NH, 1836
US Covered Bridges
Bamboo Suspension Bridges

From Himalaya and China

Spans of 600 feet (200 m)

Longest spans in the world

Barely studied at all

→ great paper topic!
Inca Woven Bridge Construction: An Annual Festival

Day 1: Ropes made from local grass or plant fibers

Day 2: Old bridge is cut and new ropes are installed

Day 3: Roadway and handrails are added and bridge is complete

Rebuilt ever year for 500 years
Microstructure of Wood
Stiffness (E) per unit weight

Source: Biggs (1991)
Properties of Timber

- Cellular structure is very efficient
- Handles both compression and tension well
- Different strengths with and against the grain
- Inhomogeneous material with imperfections
Enemies of Timber

- Fire
- Water
- Insects
Conclusions

- The distance spanned by wood is limited by the size of trees
- Trusses allow for longer spans
- Many subjects of historic timber construction have not been studied
- Apply simple truss analysis in most cases