Telford, Brunel and British Metal Forms

1780’s to 1880’s British Structural Engineering
Iron Bridge - Abraham Darby - 1779
Telford’s Buildwas Br. - 1795
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Darby’s Iron Bridge - 1779
Pont y Cysyllt Aqueduct - 1805
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Tour de France
Telford/Eiffel video
Telford proposal for Menai Straits
DESIGN for the SUSPENDED PANTHERINE for the proposed IRON ARCH over the MEGALITIC TUNY-MOUTH.
Bonar Bridge over the Dornoch Firth.
Craigellachie Bridge - 1814 - 150 feet
Minute “paper”:

- Draw an alternative arrangement of members to connect the deck and arch of the Craigellachie bridge
- Compare your results with your neighbor. Explain why you chose your arrangement
Telford proposal for Runcorn Gap (1000’ span!, developed 1814 to 1818)
Telford’s most famous work: Menai Straits
CROESO I BORTHCAETHWY
WELCOME TO MENAI BRIDGE
Menai Strait Bridge - 1826 - 580 feet
Without calculations or research, what issues in the design do you think would affect the economy of these alternative bridge designs?
Isambard Kingdom Brunel
1806-1859
Britannia Bridge - Stephenson - 1850
circa 1980’s
Brittania today
Saltash Bridge - Brunel - 1859 - 455 feet
Eiffel Tower Structural Study

introduction to statics
Tools and methods for structural analysis

Free body diagrams
Equilibrium
Load path
Free Body Diagrams
gravity
\[ M = Fh \]
\[ P = \text{wl} \]
\[ P = (2.6)(984) \]
\[ P = 2600 \text{ kips} \]

\[ p = 2.6 \text{ k/ft} \]
wind

gravity

reactions
wind reactions \[ T \] M = reactions
WIND FORCE $F$

STRETCHING (TENSION)

SHORTENING (COMPRESSION)
Civil Engineering Units

• Lots of imperial units..
• The kip? kip = kilopound = 1000 lb
• The psf? a pound per square foot
  – say you weigh 150 lb and are standing on a part of the floor which is 1ft x 1ft, you are = 150psf
  – other way – say a constant wind of 40 psf is blowing on a building which is 100ft x 100ft across – the force is 40psf \times 100ft \times 100ft = 40,000 lb
  – 40,000 lb = 40 kips
• Also… psi and ksi, pound/sq. in, and kip/sq. in
  – Materials may be described as having limit stresses in psi or ksi, e.g., typical yield stress of steel = 50 ksi
Equilibrium
\[ \sum M_{\text{section}} = 0 \Rightarrow M - p(H-h)(H-h)/2 = 0 \]
\( \Sigma M_{\text{section}} = 0 \rightarrow M - p(H-h)(H-h)/2 = 0 \)

\[ M = [p(H-h)][(H-h)/2] = P(H-h)/2 \]
\[ P = p(H-h) \]

\[ M = \left[ p(H-h) \right] \left[ \frac{(H-h)}{2} \right] - \frac{P(H-h)}{2} \]

\[ C = -T = \frac{M}{w} \]
bending moment

location

bending moment
\[ M = [p(H-h)][(H-h)/2] = p(H-h)^2/2 \]
Load path

or, how the load travels to the ground
Load Path

All forces or loads must eventually get to the ground. Can we trace the path of tension or compression?
Load Path

All forces or loads must eventually get to the ground. Can we trace the path of tension or compression?
Load Path

All forces or loads must eventually get to the ground. Can we trace the path of tension of compression?

Secondary load path
Assignments

DUE TUESDAY
Read the Burr arch-truss and be prepared to discuss timber covered bridges in the context of structural art.

DUE NEXT THURSDAY
Submit the first calculation homework