

BRIDGES

BBHHS Tech Ed

Mr. Goubeaux

WHAT IS A BRIDGE?

- Bridge -
A structure spanning and providing passage over a river, chasm, road, or the like.



WHO DESIGNS THEM?

- Civil Engineer
- Structural Engineer



THE BASICS

- Why do Bridges work?
 - Because the weight is distributed throughout the structure
- There are six materials used for bridges:
 - Wood, Stone, Iron, Steel, Concrete, Aluminum



BRIEF HISTORY

- First bridges were made of stone or wood.
- Then we moved to iron bridges
- Now bridges are mainly made from steel and concrete





BRECKSVILLE-NORTHFIELD HIGH LEVEL BRIDGE



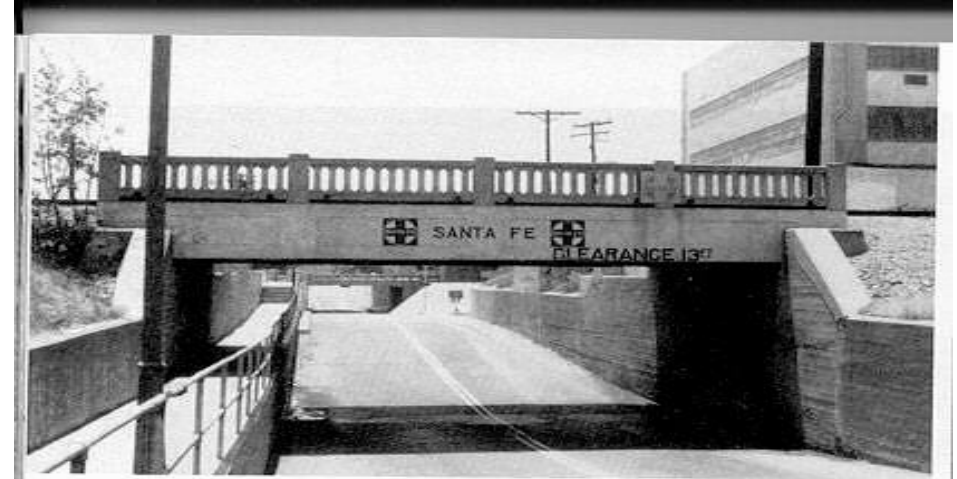


CLEVELAND'S DETROIT SUPERIOR BRIDGE



BRIDGE TERMS

- SPAN
 - The distance between pilings, towers, or abutments.
- Piling
 - The post or beam which supports the span.



BRIDGE TERMS

- Abutment
 - The place where the bridge is attached to the land.
- Cantenary Curve
 - The specific curve used in the suspension bridge



BRIDGE TERMS

- **Truss**
 - **Structure of connected elements forming triangular units. The connected elements (typically straight) may be stressed from tension, compression, or sometimes both in response to dynamic loads..**



BRIDGE TYPES

- There are so many types of bridges and each has a specific purpose.
- 6 main types of bridges
 - Beam
 - Girder
 - Truss
 - Arch
 - Suspension
 - Cable Stayed



BEAM BRIDGE



BEAM PROS AND CONS

- Cheap & easy to manufacture
- Not very beautiful
- Beam needs careful design

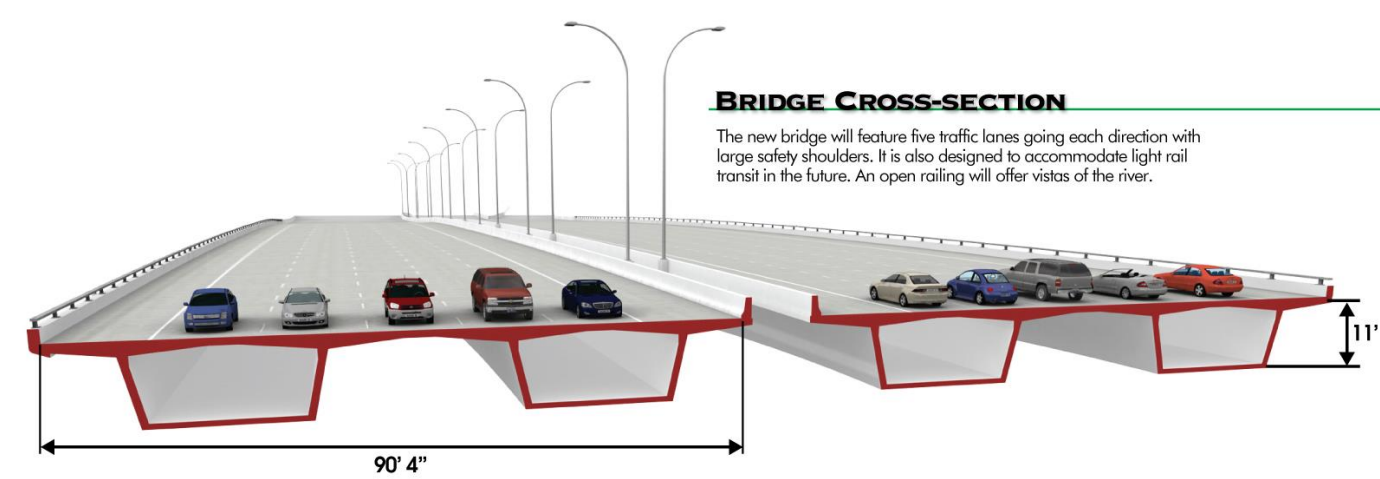


BOX GIRDER BRIDGE



BRIDGE CROSS-SECTION

The new bridge will feature five traffic lanes going each direction with large safety shoulders. It is also designed to accommodate light rail transit in the future. An open railing will offer vistas of the river.



BOX GIRDER PROS AND CONS

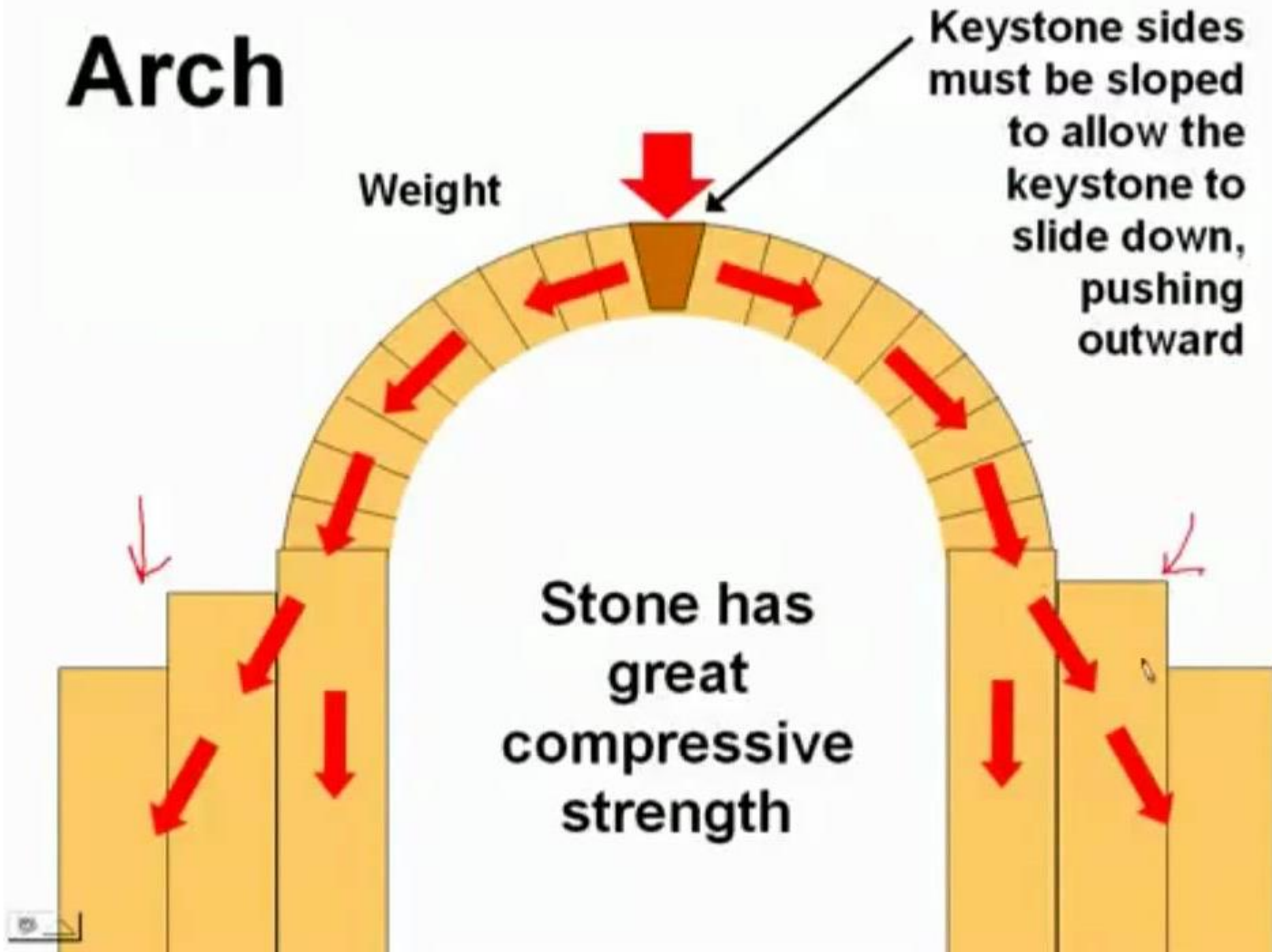
- **Cheap**
- **Easy to manufacture**
- **Not very beautiful**
- **Girder needs careful design**



STONE ARCH BRIDGE



Arch



CONCRETE ARCH BRIDGE



MULTI-SPAN (ARCH) BRIDGE



ARCH PROS AND CONS

- **Very strong if well designed**
- **Can be very beautiful**
- **Tend to be very heavy**
- **Need very strong abutments**



THROUGH TRUSS BRIDGE



UNDER TRUSS BRIDGE

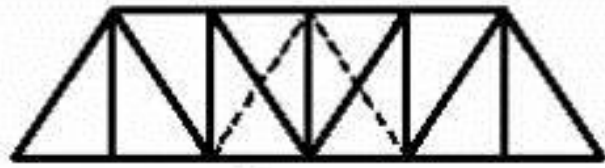


ARCH TROUGH TRUSS BRIDGE



CANTILEVER (TRUSS) BRIDGE

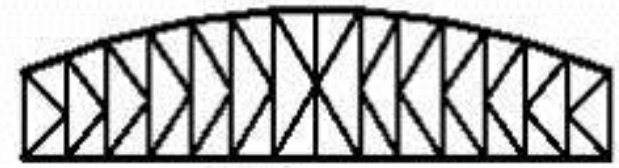




Pratt



Parker



K-Truss



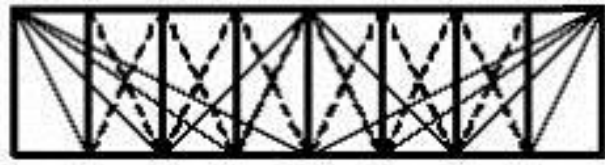
Howe



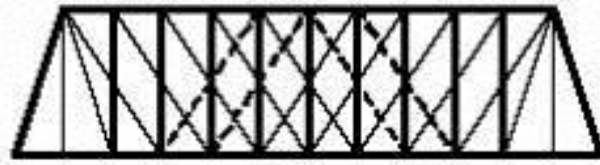
Camelback



Warren



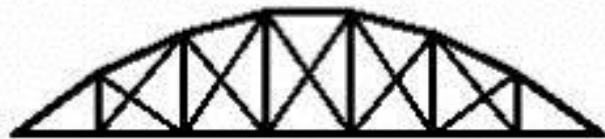
Fink



Double Intersection Pratt



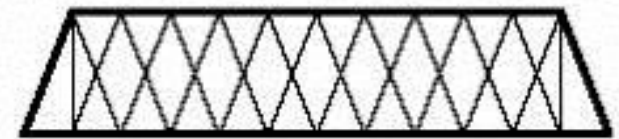
Warren (with Verticals)



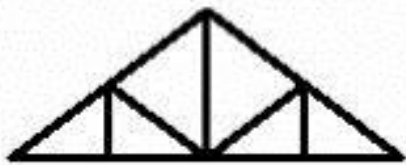
Bowstring



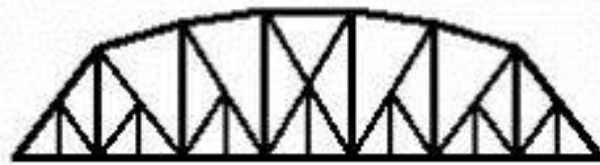
Baltimore



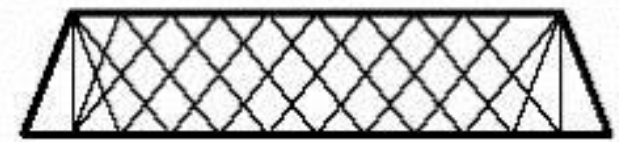
Double Intersection Warren



Waddell "A" Truss



Pennsylvania



Lattice



TRUSS BRIDGE PROS AND CONS

- **Very good strength to weight performance**
- **Possibility of lots of repeated parts reduces manufacturing costs**
- **Can be incorporated into almost any design**
- **Can be very beautiful**
- **Lots of parts to be manufactured**



SUSPENSION BRIDGE



SUSPENSION PROS AND CONS

- **Aesthetic, light and strong**
- **Can span distances far longer than any other kind of bridge**
- **The most expensive bridges to build**
- **Susceptible to “wobble” if poorly designed**



CABLE STAY BRIDGE





CABLE STAY PROS AND CONS

- **Undeniably beautiful**
- Compared to suspension bridges...
 - **Require less cable**
 - **Are easier and faster to build**
- **Need stronger towers**
- **Expensive**



BRIDGES ARE AMAZING











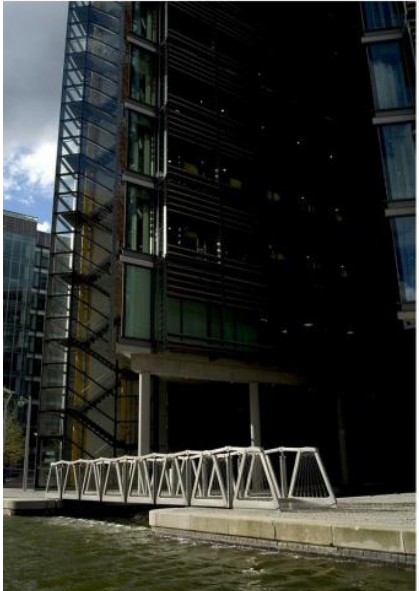
www.graeme-peacock.com

Gateshead Millennium Bridge

























FORCES THAT ACT ON BRIDGES

- **Dead Load**
- **Live Load**
- **Compression**
- **Tension**
- **Bending**
- **Torsion**
- **Thermal Expansion**
- **Shear**
- **Strain**
- **Elastic/Plastic Deformation**



FORCES ACTIVITY

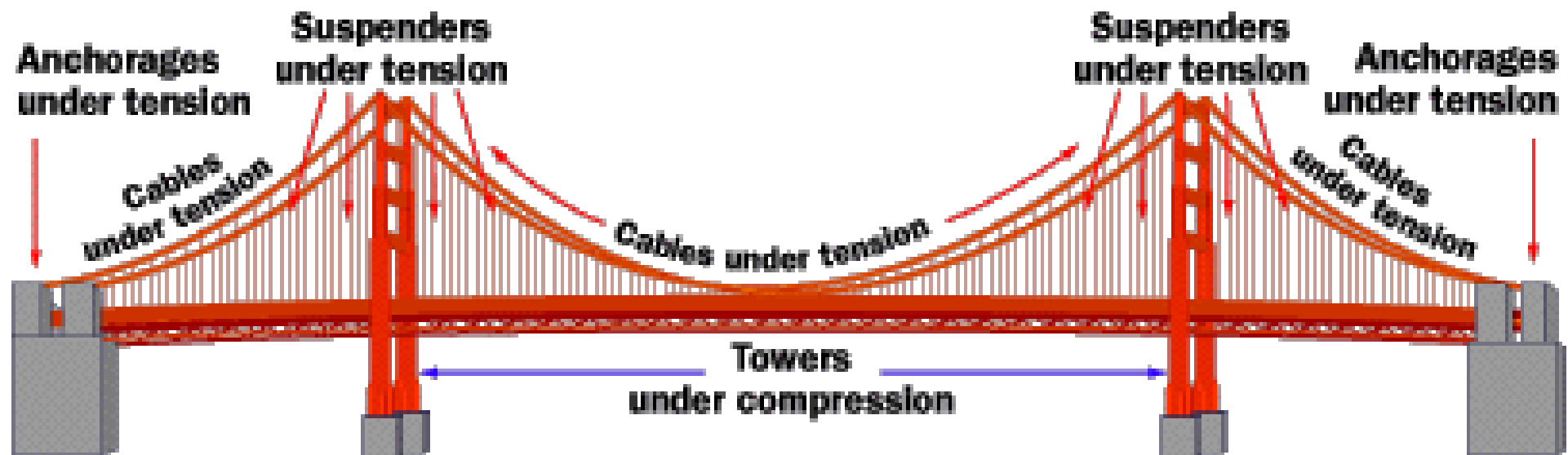
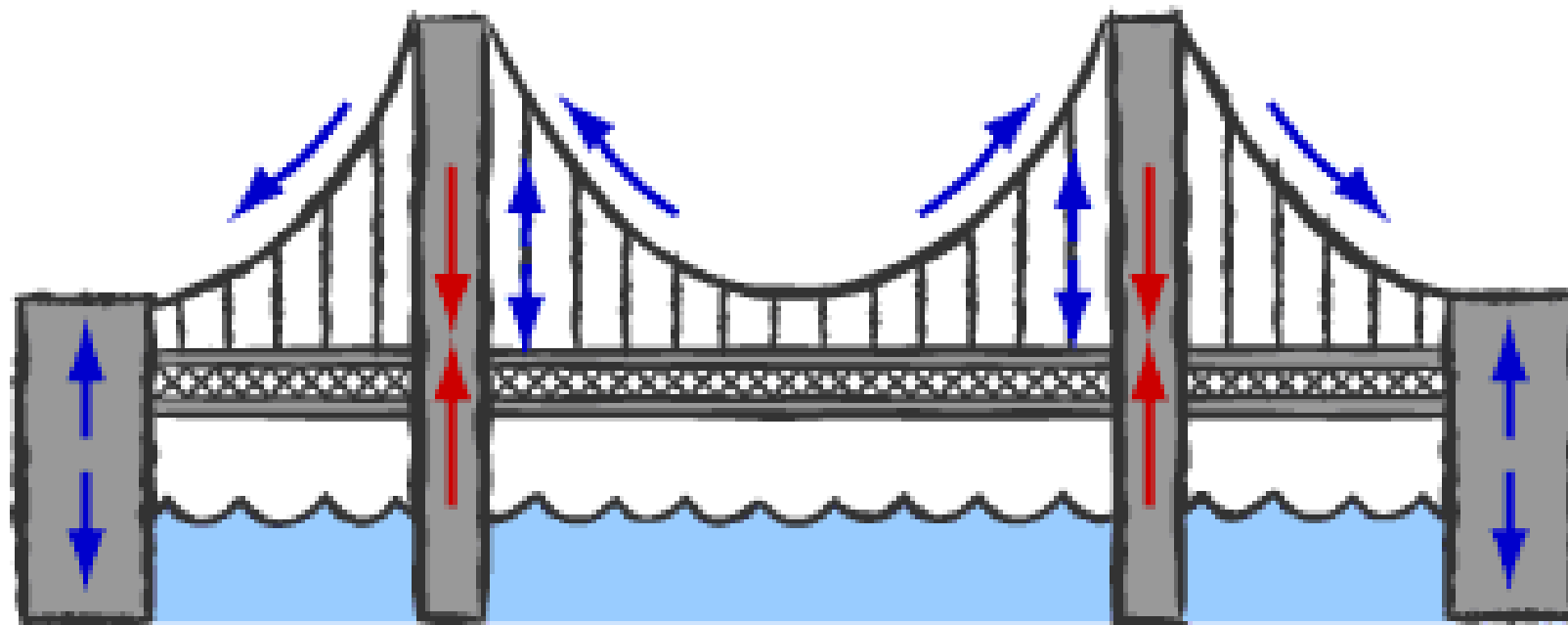
- <http://legacy.mos.org/etf/force.html>



7 LEAPS BRIDGES OVERCAME

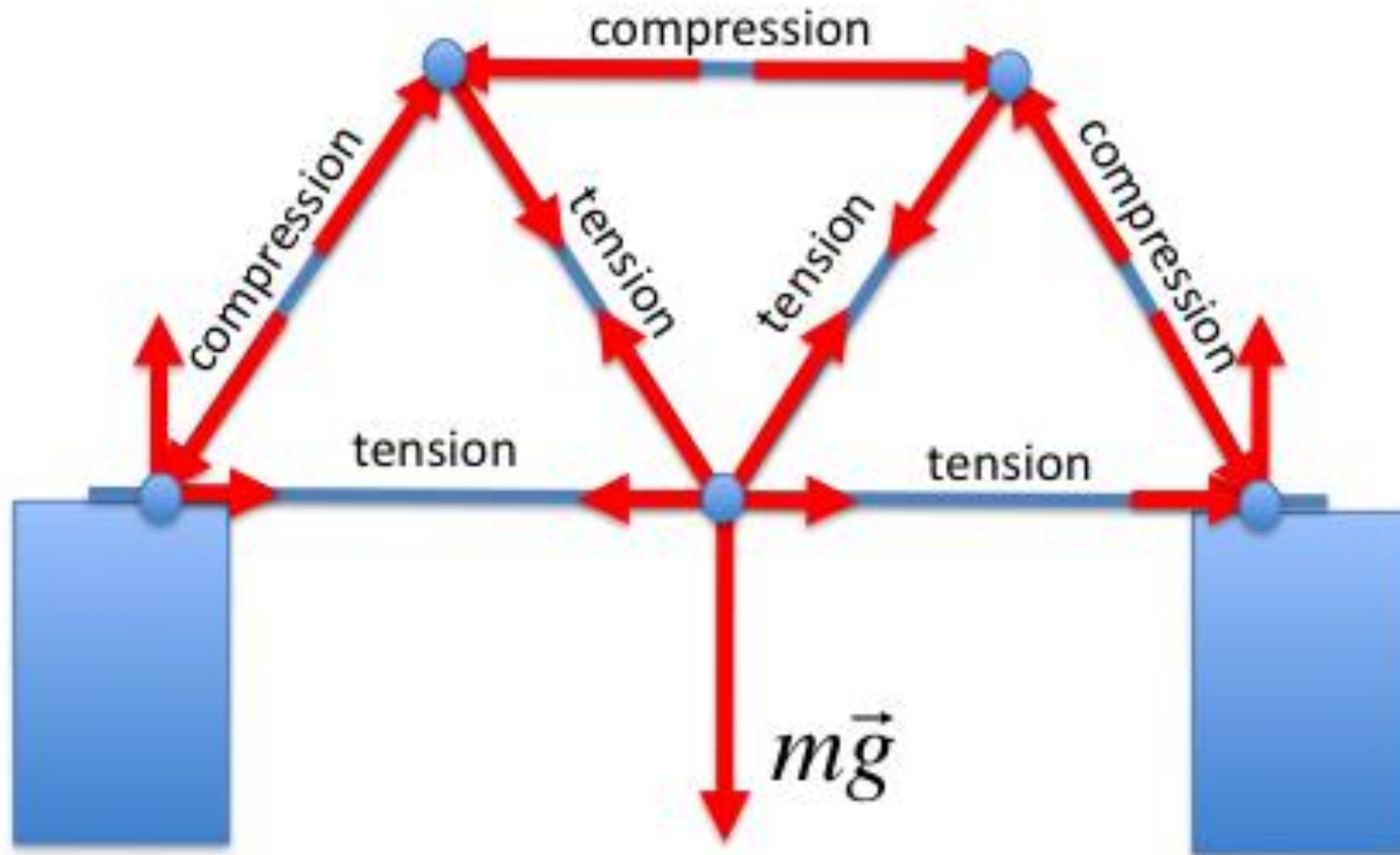
- Materials
 - Iron Bridge 18th Century England
- Distance (Suspension)
 - Menai Bridge 19th Century Wales
- Strength
 - Niagara Bridge 1851
- Building Underwater
 - Brooklyn Bridge 1874
- Height (Taller Towers)
 - Golden Gate Bridge 1933
- Wind
 - Verrazano Narrows Bridge 1940
- Earthquakes
 - Akashi Kaikyo Bridge 1988



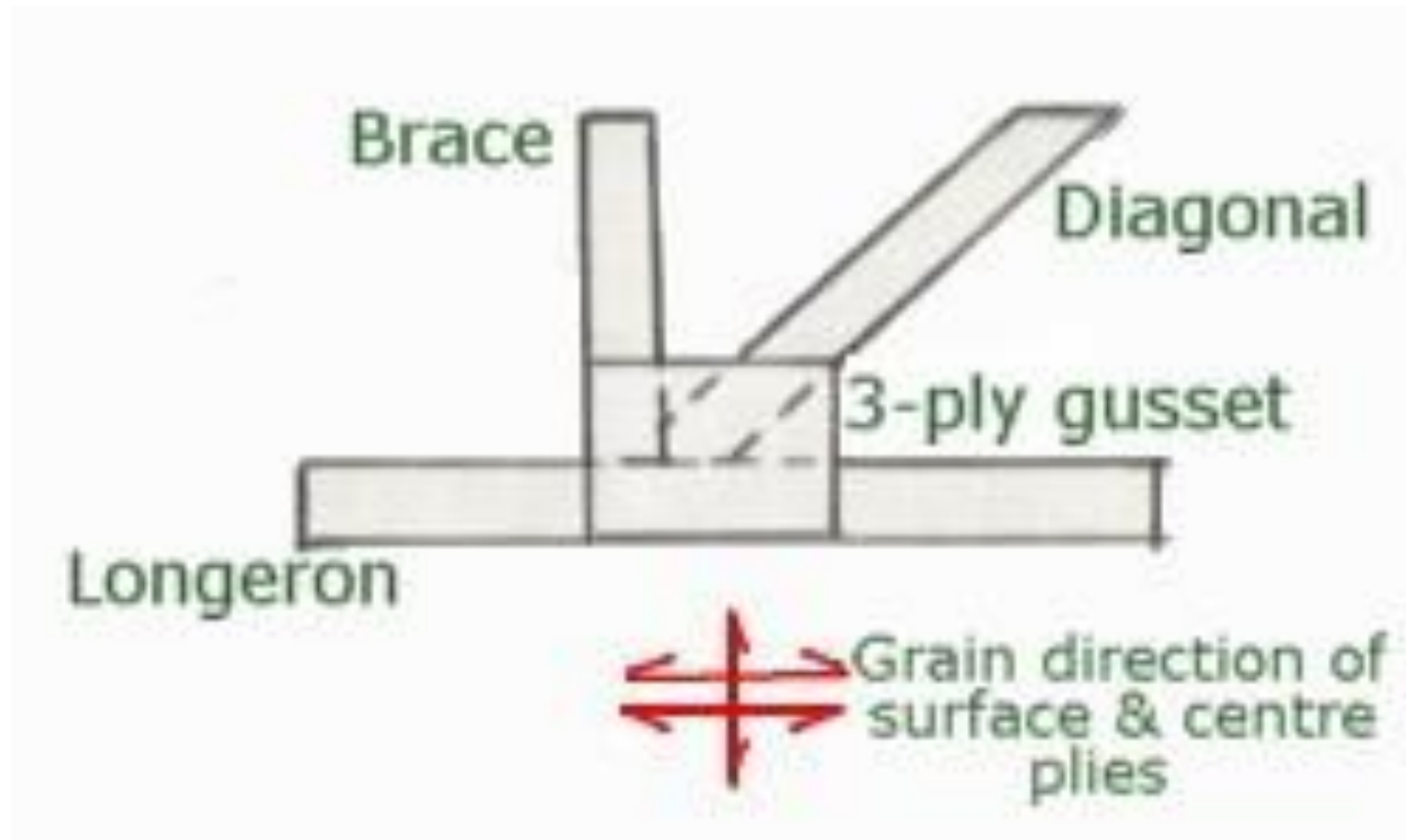


TR

Arrows are forces on **hinges**!



CONSTRUCTION



BRIDGE EFFICIENCY

FORMULA:

Efficiency =

Max. weight held/weight of Bridge

WHAT TYPES OF ENGINEER BUILDS BRIDGES?

CIVIL ENGINEER

STRUCTURAL ENGINEER



FACTORS IN BRIDGE DESIGN

1. What will the load on the bridge be? Live and Dead
2. What is the span bank to bank?
3. What environmental factors will effect the bridge? Wind, Ice, Heat, Cold.
4. What is the budget?
5. What are the soil characteristics of the banks and the river?
6. What is the time frame?
7. How do you want it to look?



