ARCHITECTURAL STRUCTURES:
FORM, BEHAVIOR, AND DESIGN
ARCH 331
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SUMMER 2014

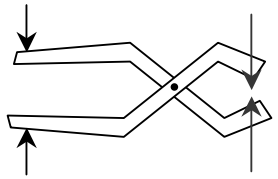
lecture
nine

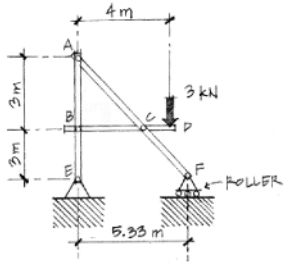
Continental train platform, Grimshaw 1993

other beams & pinned frames

Pinned Frames

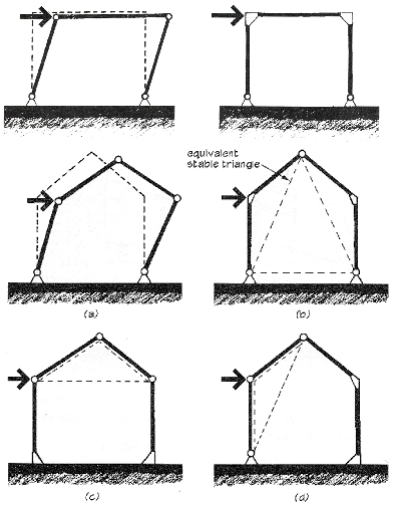
- structures with at least one 3 force body
- connected with pins
- reactions are equal and opposite
  - non-rigid
  - rigid





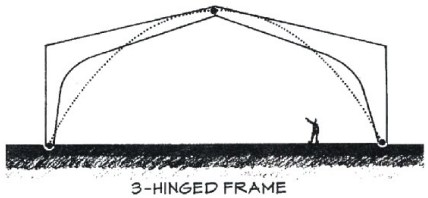
Rigid Frames

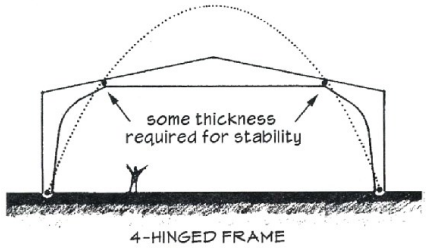
- rigid frames have no pins
- frame is all one body
- typically statically indeterminate
- types
  - portal
  - gable



Rigid Frames with PINS

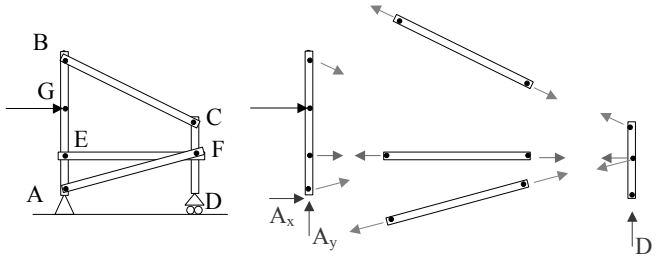
- frame pieces with connecting pins
- not necessarily symmetrical





Internal Pin Connections

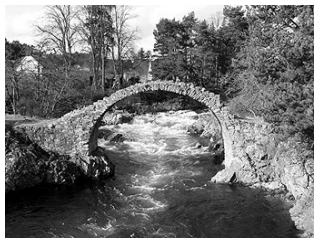
- *statically determinant*
  - *3 equations per body*
  - *2 reactions per pin + support forces*



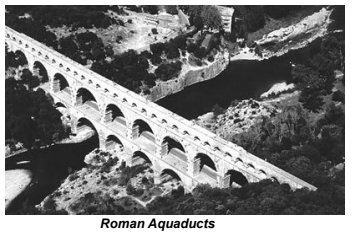
Arches

- *ancient*
- *traditional shape to span long distances*

Rainbow Bridge National Monument



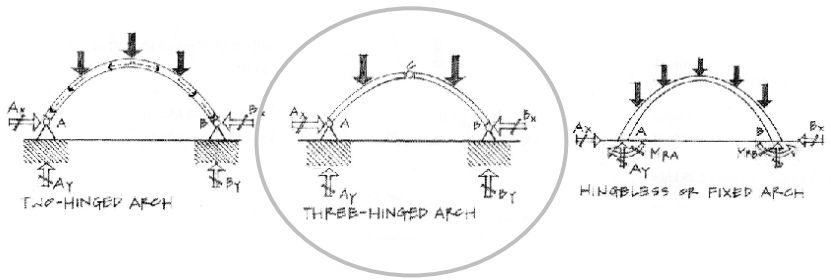
Packhorse Bridge, UK



Roman Aquaducts

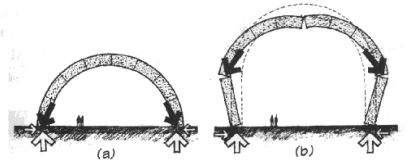
Arches

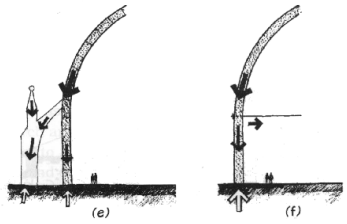
- *primarily sees compression*
- *a brick "likes an arch"*



Arches

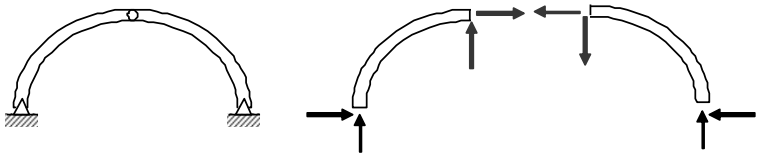
- *behavior*
  - *thrust related to height to width*





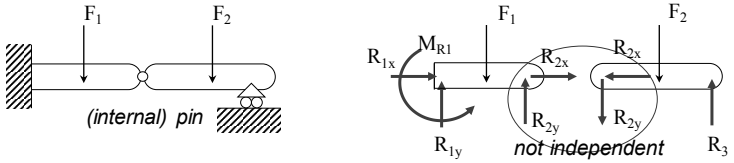
Three-Hinged Arch

- *statically determinant*
  - *2 bodies, 6 equilibrium equations*
  - *4 support, 2 pin reactions (= 6)*



Compound Beams

- *statically determinant when*
  - *3 equilibrium equations per link =>*
  - *total of support & pin reactions (properly constrained)*
- *zero moment at pins*

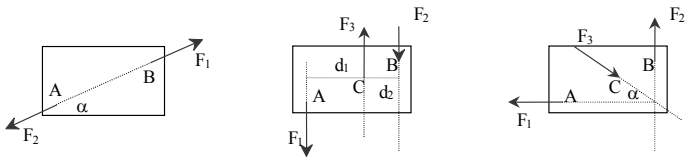


Procedure

- *solve for all support forces you can*
- *draw a FBD of each member*
  - *pins are integral with member*
  - *pins with loads should belong to 3+ force bodies*
  - *pin forces are equal and opposite on connecting bodies*
  - *identify 2 force bodies vs. 3+ force bodies*
  - *use all equilibrium equations*

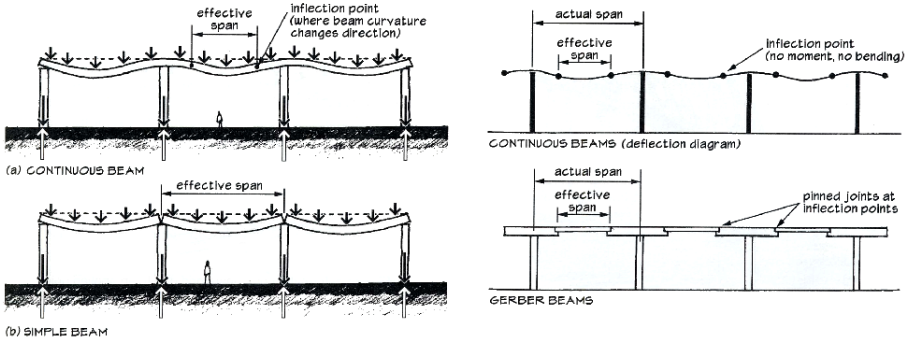
Rigid Body Types

- *two force bodies*
  - *forces in line, equal and opposite*
- *three force bodies*
  - *concurrent or parallel forces*



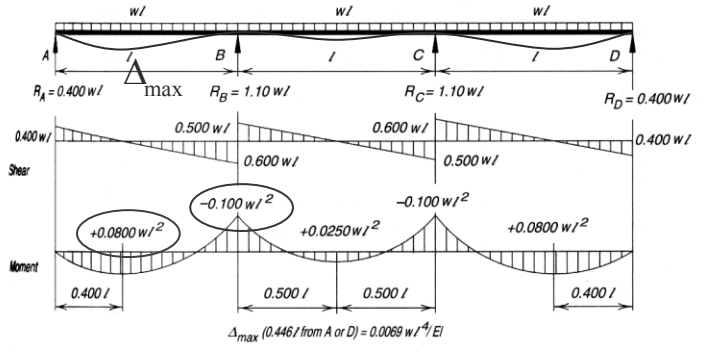
Continuous Beams

- *statically indeterminate*
- *reduced moments than simple beam*



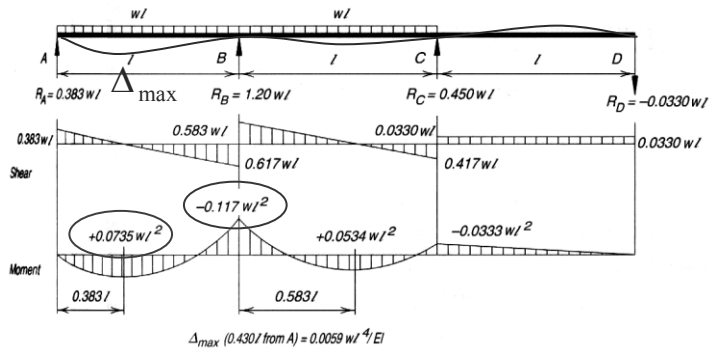
Continuous Beams

- *loading pattern affects*
  - *moments & deflection*



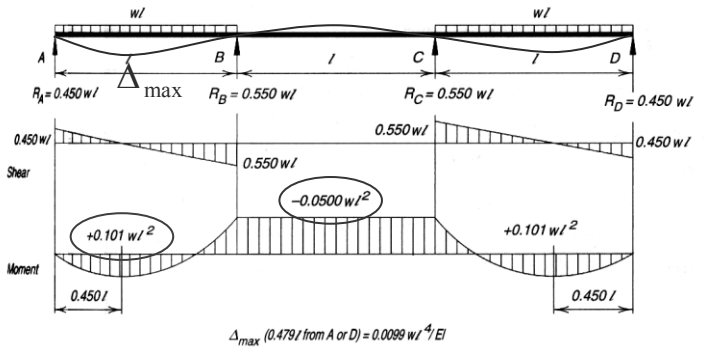
Continuous Beams

- *unload end span*



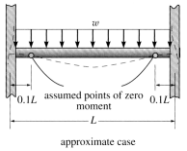
Continuous Beams

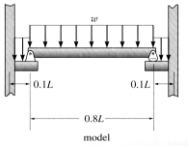
- *unload middle span*



Analysis Methods

- *Approximate Methods*
  - *location of inflection points*
- *Force Method*
  - *forces are unknowns*
- *Displacement Method*
  - *displacements are unknowns*





Two Span Beams & Charts

- *equal spans & symmetrical loading*
- *middle support as flat slope*