Lecture 2: Frames and Design

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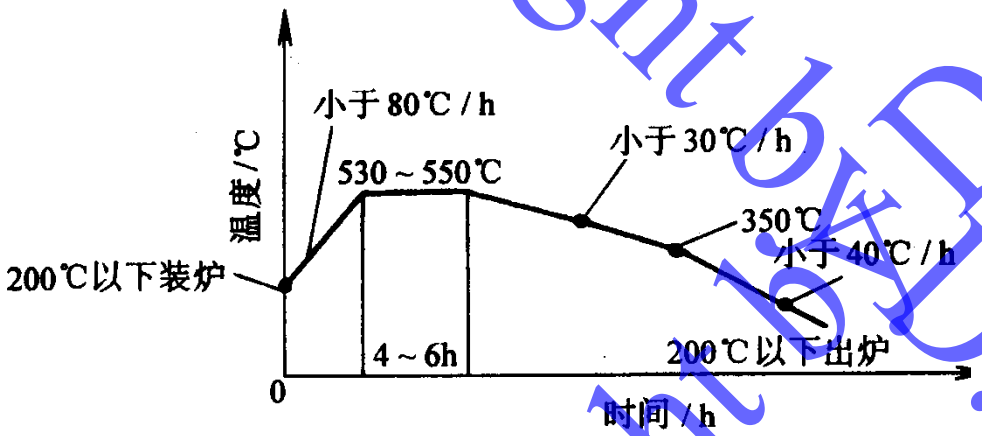
Outline

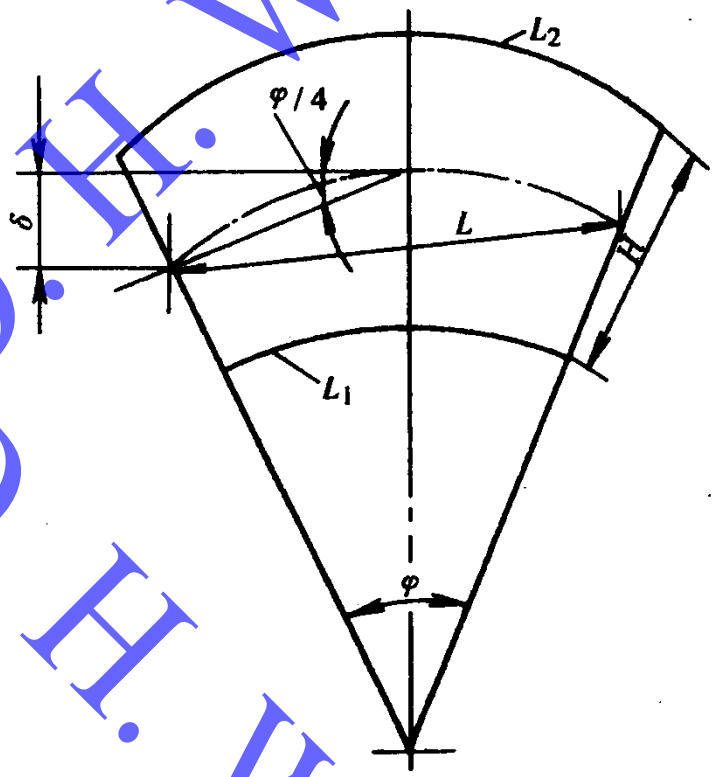
- Functions
- Design Requirements

Design Requirements

- Stiffness requirements
- Damping requirements
- Thermal Expansion
- Stability

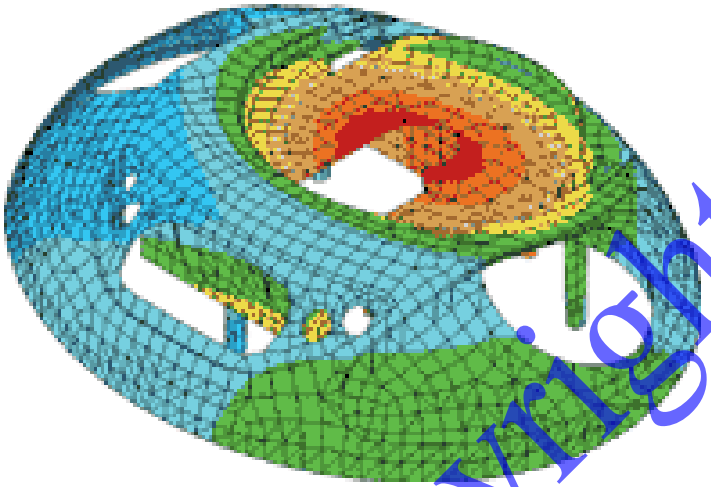
Design for Stability

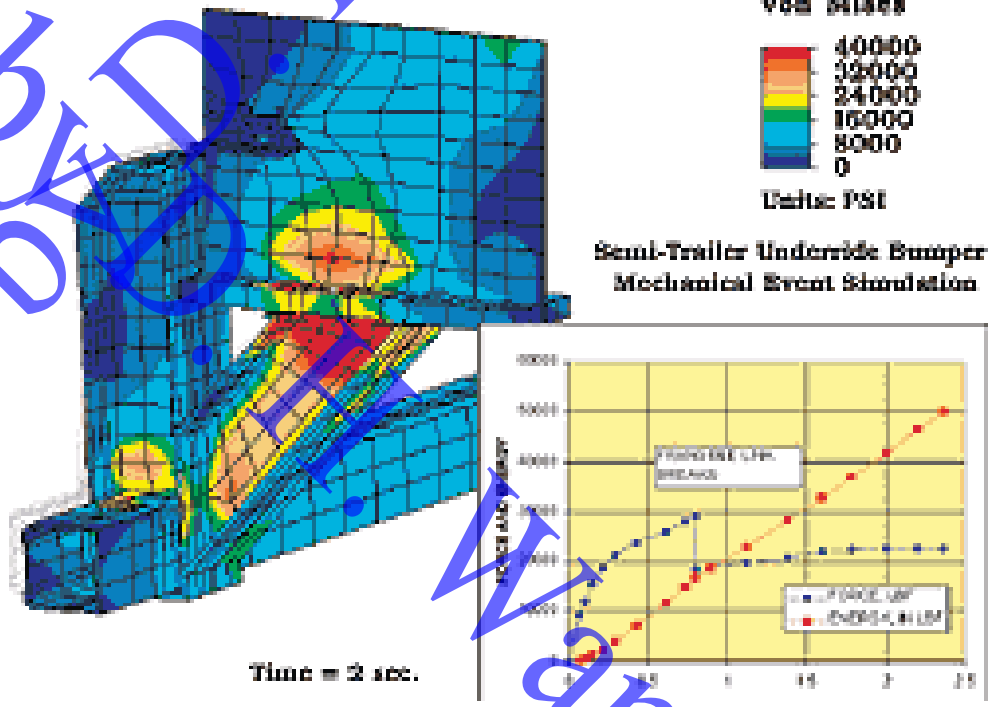




Design for Rigidity

- Methodology
  - FEA: ANSYS, Algor, etc
  - Simulation method



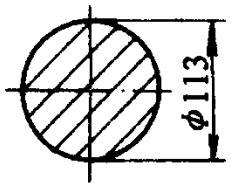
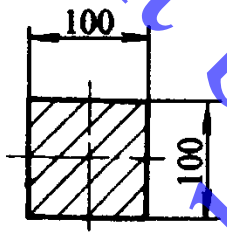
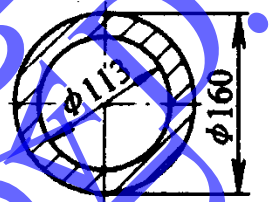
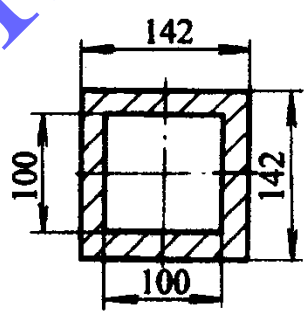
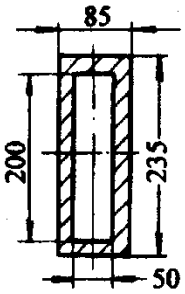


Structural Design

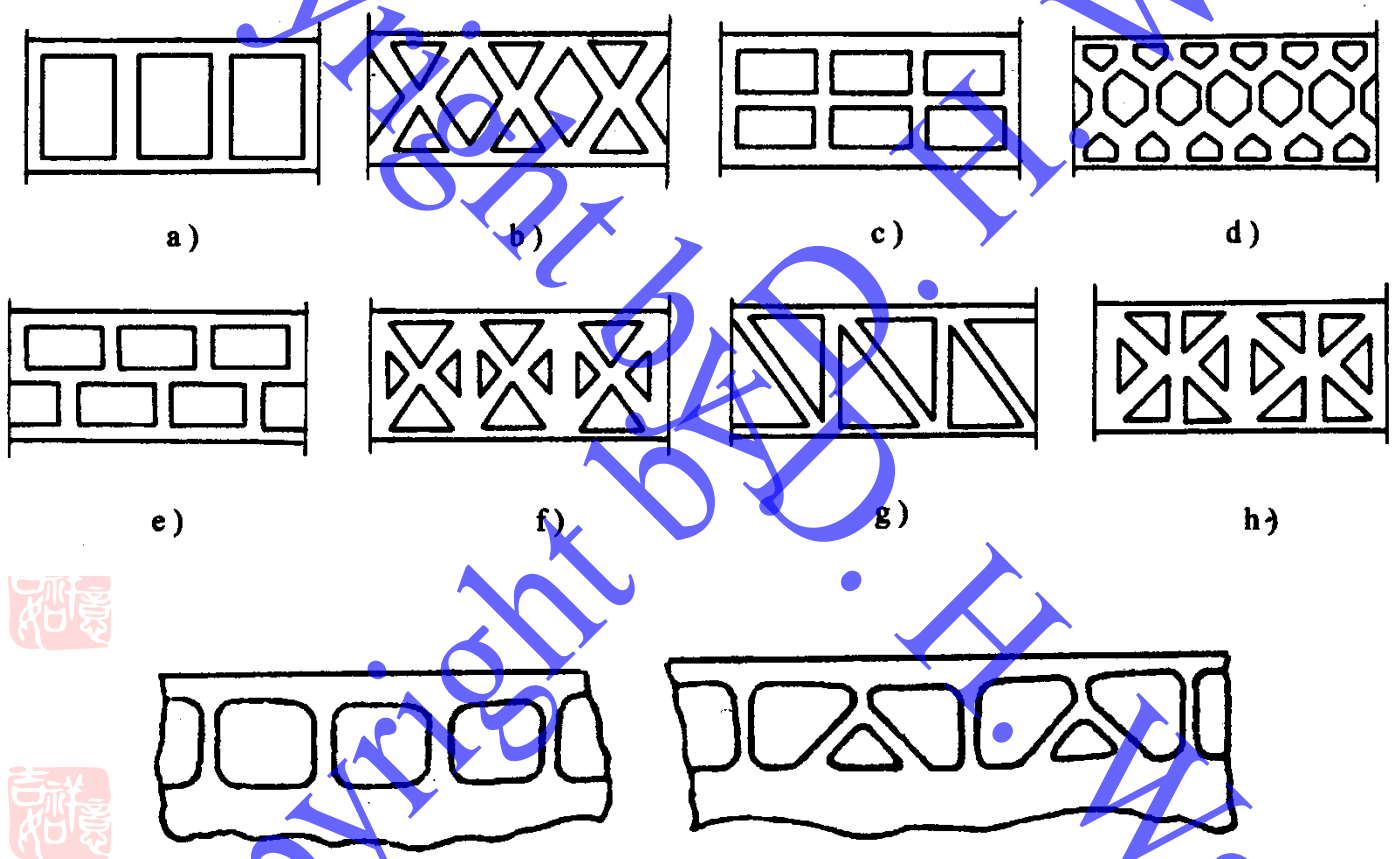
- Cross section and size
- Proper rib size and distribution
- Structural configuration
- Manufacturing considerations
- Materials

Cross Section and Size

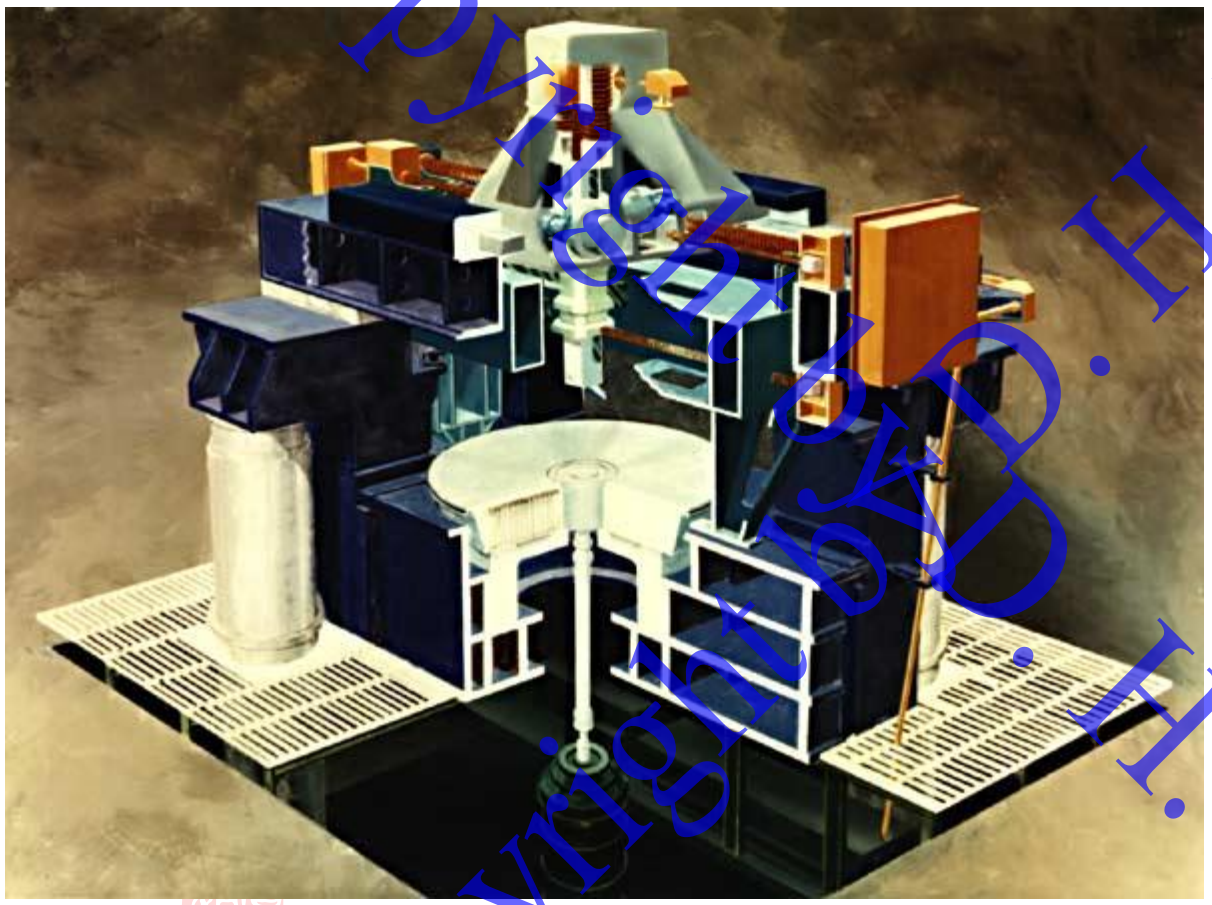
表 4-1　横截面积相同的不同断面形状惯性矩比较

断面形状	实心圆形	实心方形	空心圆形	空心方形	空心矩形
					
抗弯惯性矩（相对值）	1	1.04	5.04	3.21	7.33
抗扭惯性矩（相对值）	1	0.88	5.04	1.27	0.28

Ribs



Rib: Large Optics Diamond Turning Machine (LODTM)



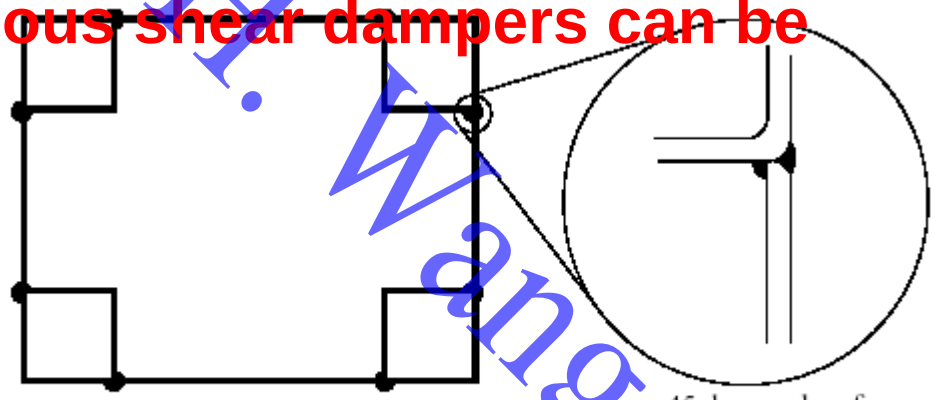
- Precision: Radial 28 nm (280Å); Surface finish 4.3 nm (42Å); Analogy 280Å is ~ 3500 times smaller than diameter of human hair
- Lawrence Livermore National Laboratory

Materials

- Cast iron structures
  - Widely used.
  - Stable with thermal anneal, aging, or vibration stress relieve.
  - Good damping and heat transfer.
  - Modest cost for modest sizes.
  - Integral ways can be cast in place.
  - Design rules are well established (see text).

Materials

- **Welded steel structures**
  - Often used for larger structures or small-lot sizes.
  - Stable with thermal anneal.
  - Low damping, improved with shear dampers.
  - Modest cost.
  - Integral ways can be welded in place.
  - Structures can be made from tubes and plates:
  - Replicated in place viscous shear dampers can be placed in the tubes.



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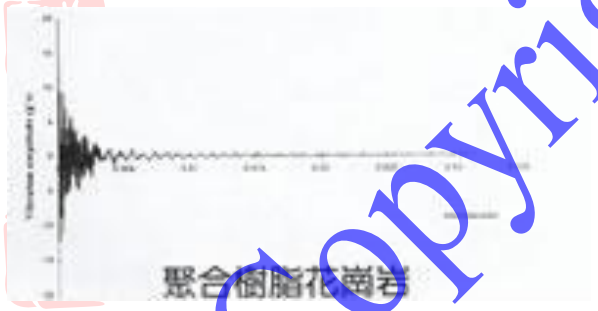
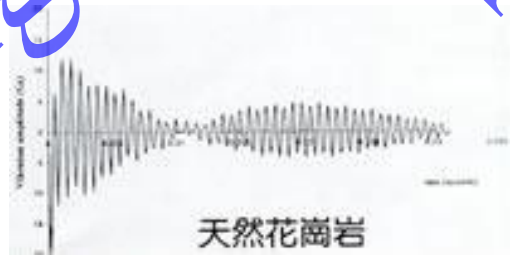
Materials

- **Epoxy granite structures**
  - Can be cast with intricate passages and inserts.
  - Eepoxy granite/Ecast iron = 5/20
  - Exterior surface can be smooth and is ready to paint.
  - Cast iron or steel weldments can be cast in place, but beware of differential thermal expansion effects.
  - Epoxy granite's lower modulus, and use of foam cores means that local plate modes require special care when designing inserts to which other structures are bolted!
  - Sliding contact bearing surfaces can be replicated onto the epoxy granite.

Materials

- Epoxy granite structures
- http://www.pmc.org.tw/english/products/06_epoxy_granite.html





Acknowledgement

Thank you very much for your attention !