Overview of Structural Design Process

Purpose: Assure “structural integrity” while minimizing cost

Structural integrity: “Capability of a structure to carry out the operation for which it was designed”

Aspects to consider:
- Loads
- Deformations
- Corrosion
- Fatigue/Long life

Factors in Determining cost:
- Material
- Waste amount
- Manufacturing
- Weight
- Subassembly/Assembly
- Durability and maintenance
- Useful life
- Repair
STRUCTURAL DESIGN PROCESS

1. Design restrictions/specifications
2. Determine applied loads and operating environment to which structure is subjected
3. Layout structural arrangement, select materials, size components
4. Determine internal stresses and deflections
5. Determine capability of structure to carry loads (of box 2) subject to design restrictions (of box 1)

Manufacturing & Maintenance considered throughout

SOURCES OF APPLIED LOADS (and resulting stresses and strains)

- Normal operative environment
- Environmental effects
- Isolated effects/special conditions

TERMINOLOGY

*Limit* load/stress/condition: maximum load/stress/condition where structure shows no permanent deformation (operationally defined as maximum condition the structure is expected to see under normal operation)

*Ultimate* load/stress/condition: maximum load/stress/condition where structure does not “fail” (operationally defined as limit condition times factor of safety).

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\text{Ultimate Factor of Safety} = \frac{\text{Ultimate Condition}}{\text{Limit Condition}}
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\text{Margin of Safety} = \frac{\text{Tested Value – Design Value}}{\text{Design Value}}
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Definition of “failure” depends on operational requirements.