

# Build a Bridge

Post 630 Starting Point

# Agenda

1. Mass vs Force ?
2. Why do we Structural/Mechanical Engineers
3. Project 1 - Design, Build and Test a model bridge.

# Mass vs. Force

What is mass ?

Mass - a quantity or aggregate of matter

What is force ?

Force - cause of motion

What is weight ?

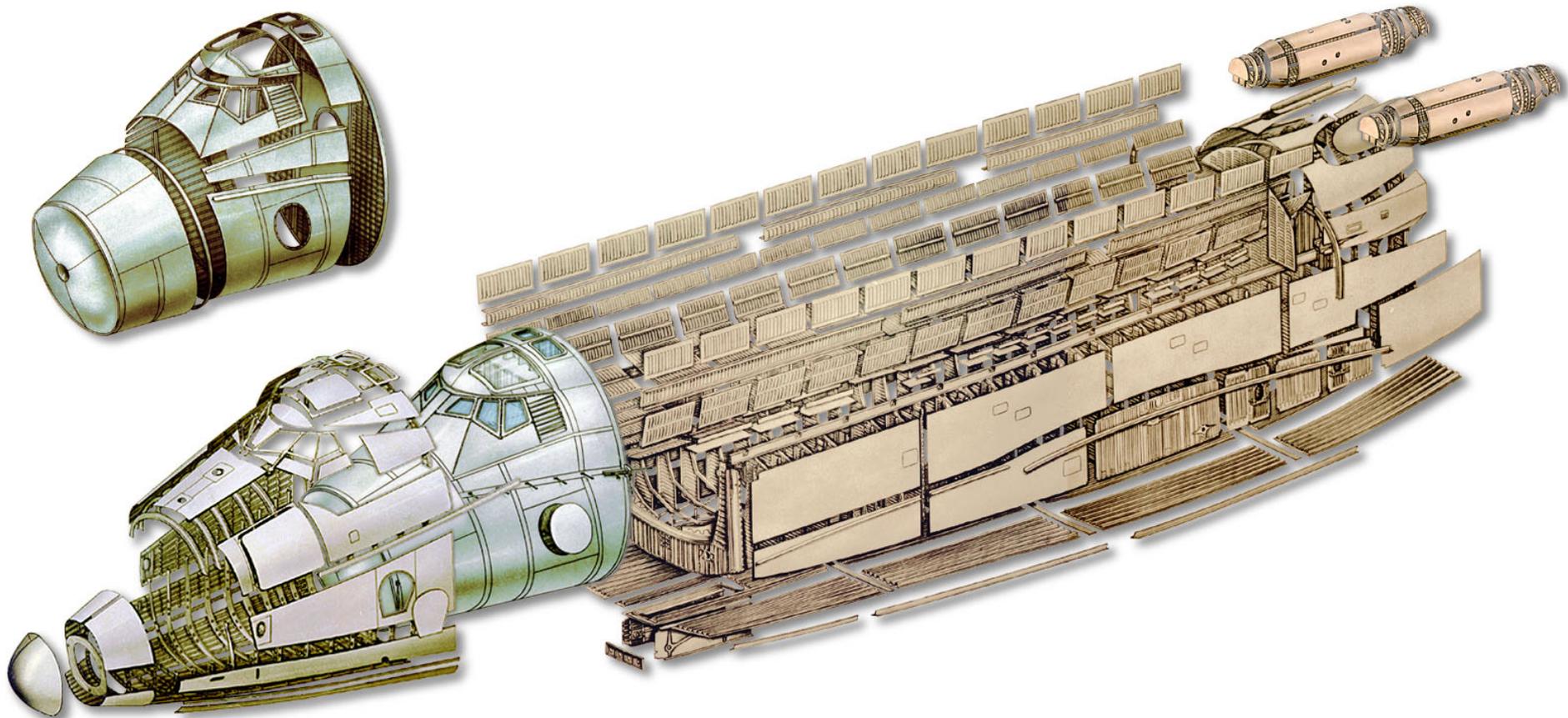
Weight - amount things that weighs

$$\mathbf{w = m \times g}$$

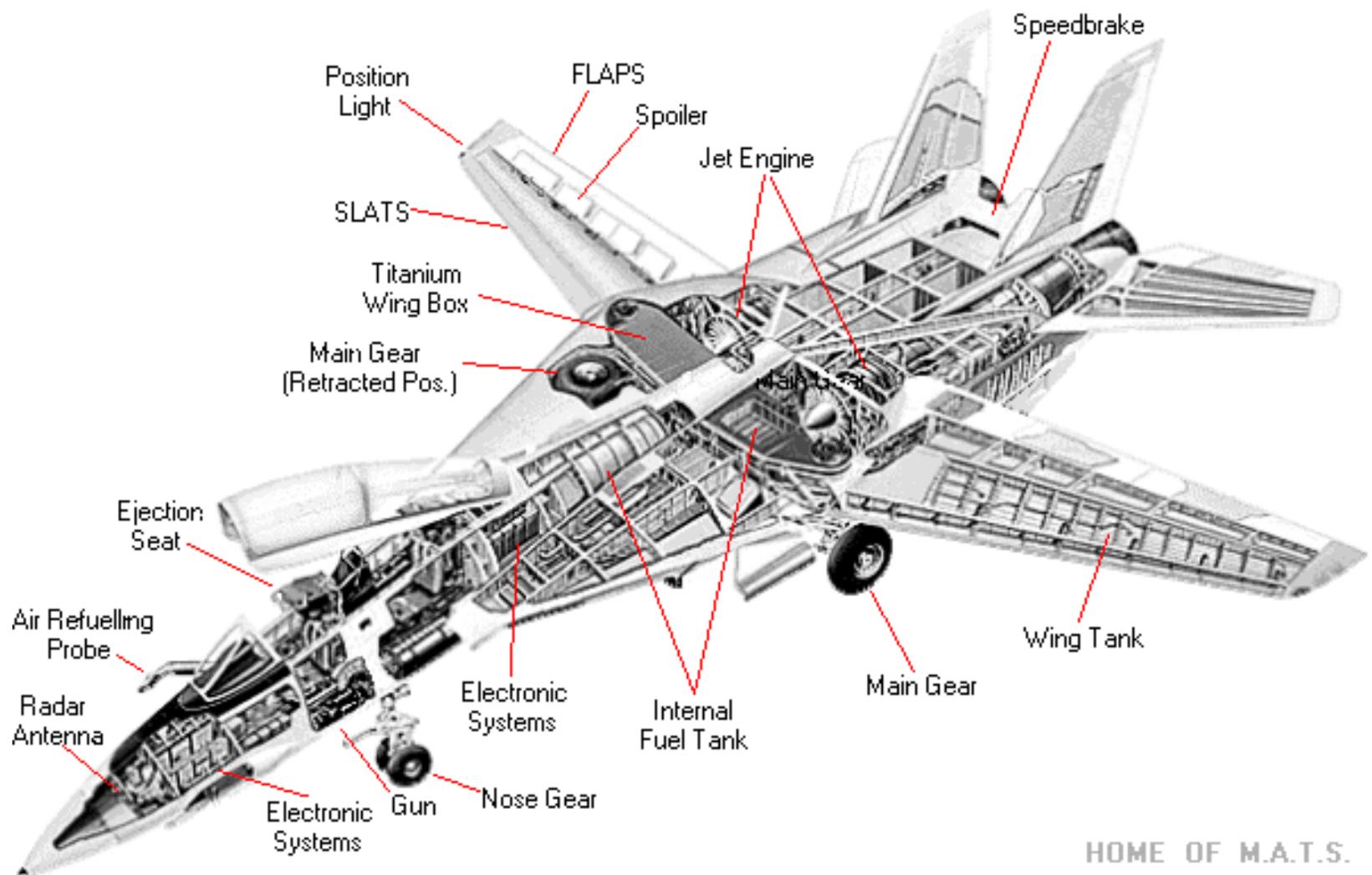
# Classical Truss Bridge



# Buran Structure

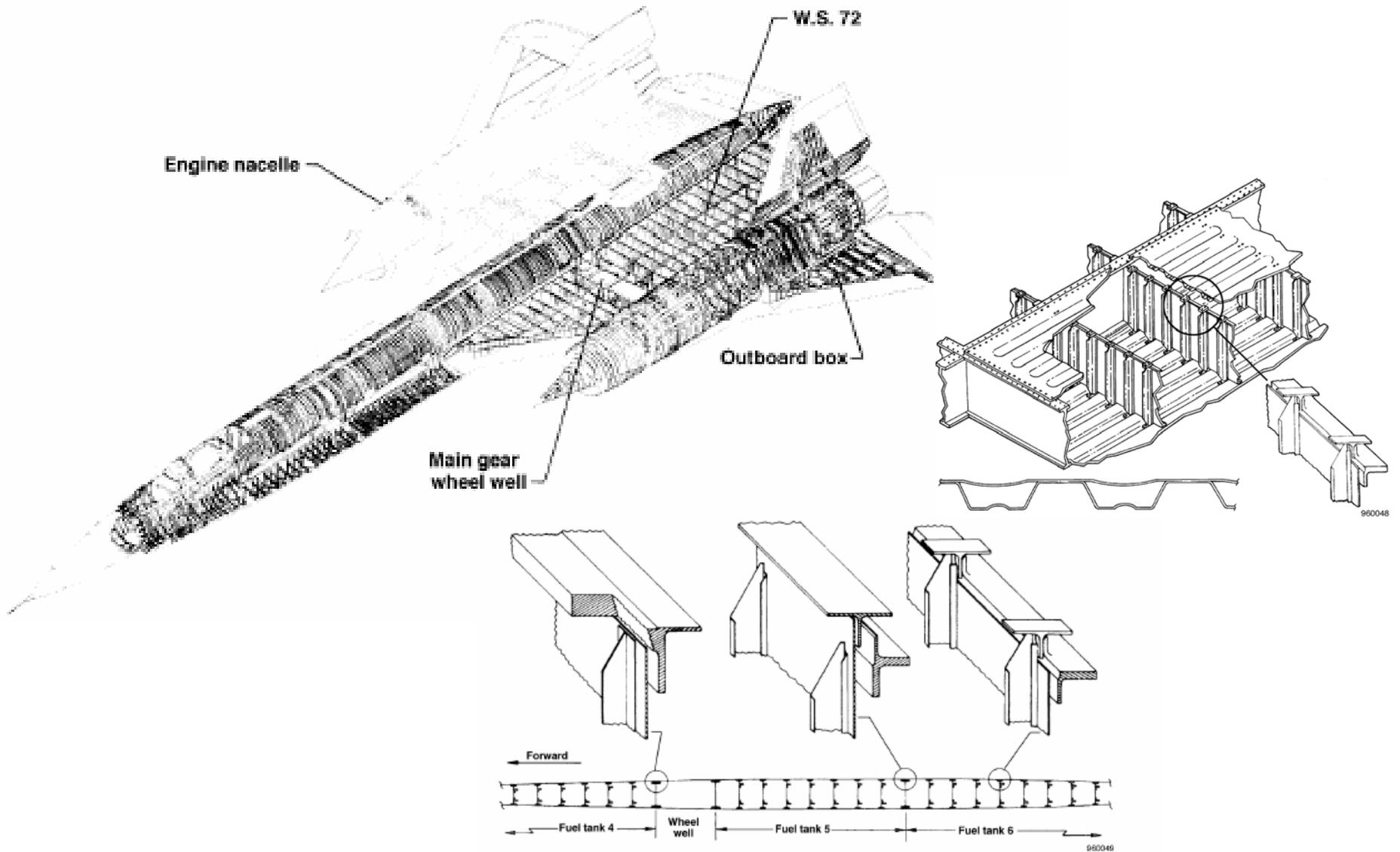


# Wing structure



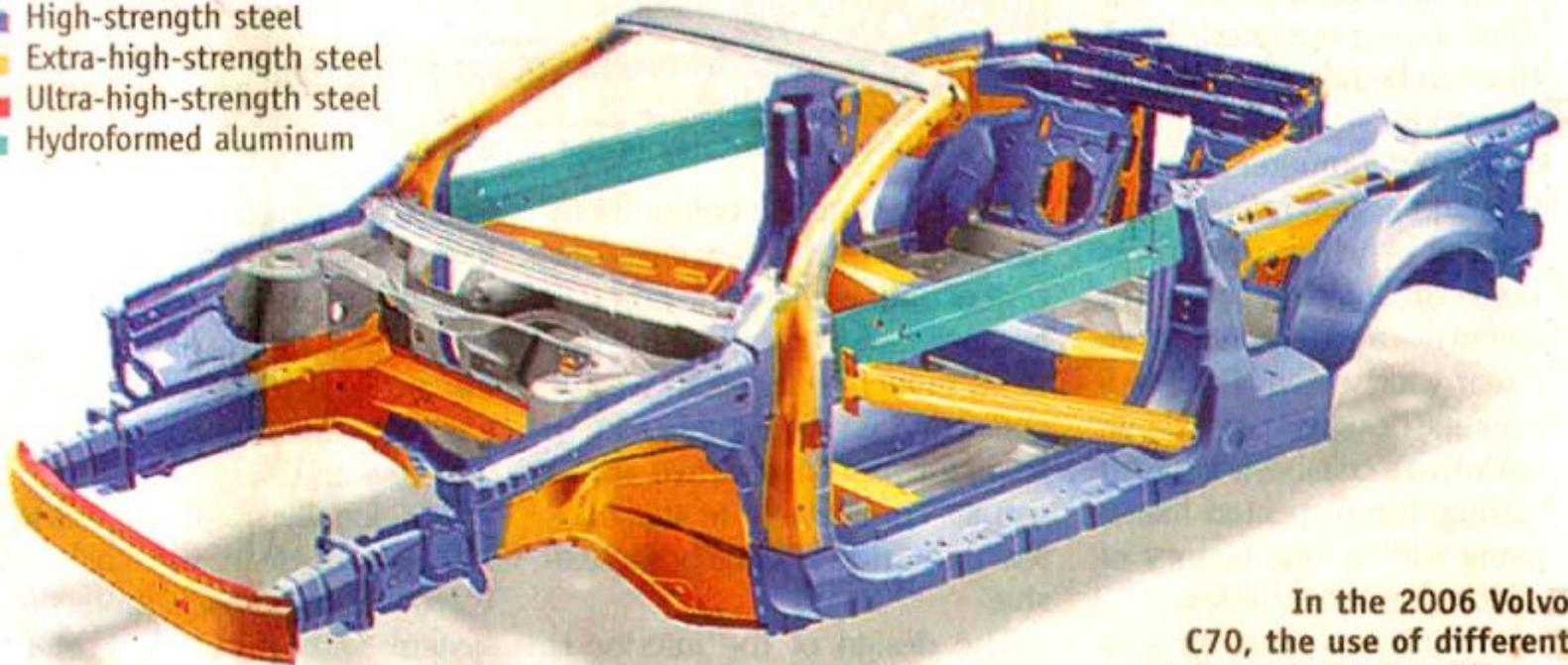
HOME OF M.A.T.S.

# YF-12A



# Volvo Structure

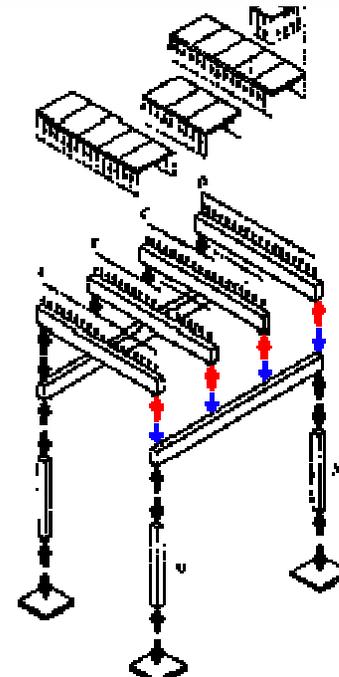
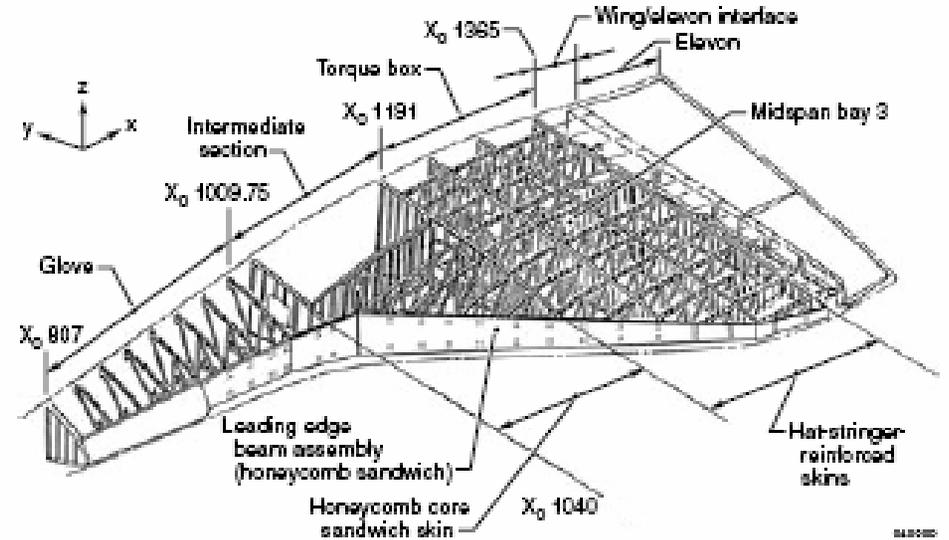
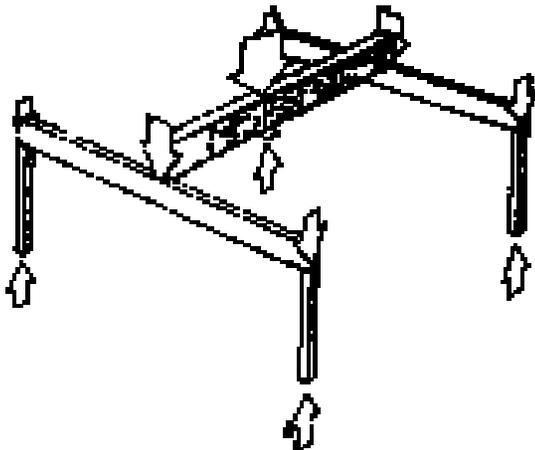
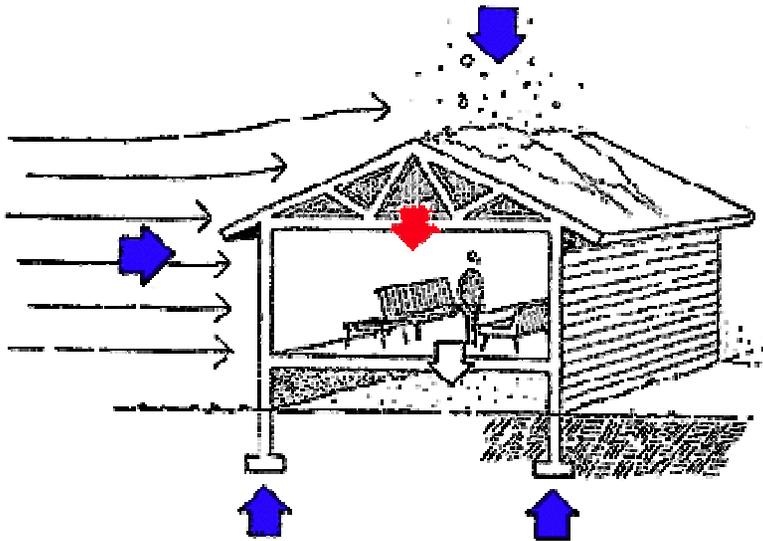
- Mild steel
- High-strength steel
- Extra-high-strength steel
- Ultra-high-strength steel
- Hydroformed aluminum



In the 2006 Volvo C70, the use of different metal strengths for different components protects the passenger compartment in case of collision.

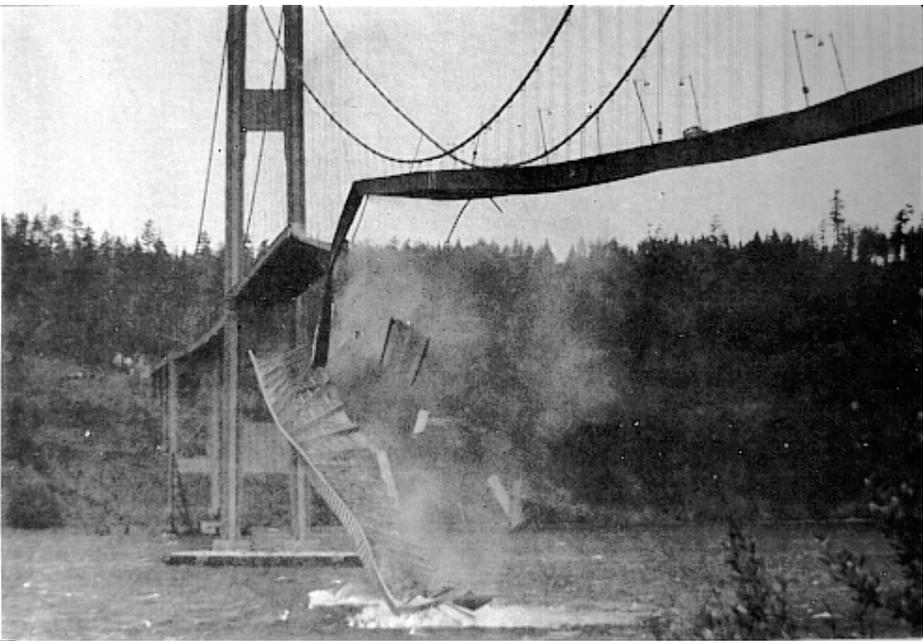
# Structural Models

## ❖ Model vs. Reality



04.0000





# Using your 'noodles' contest:)



# Bridge Build



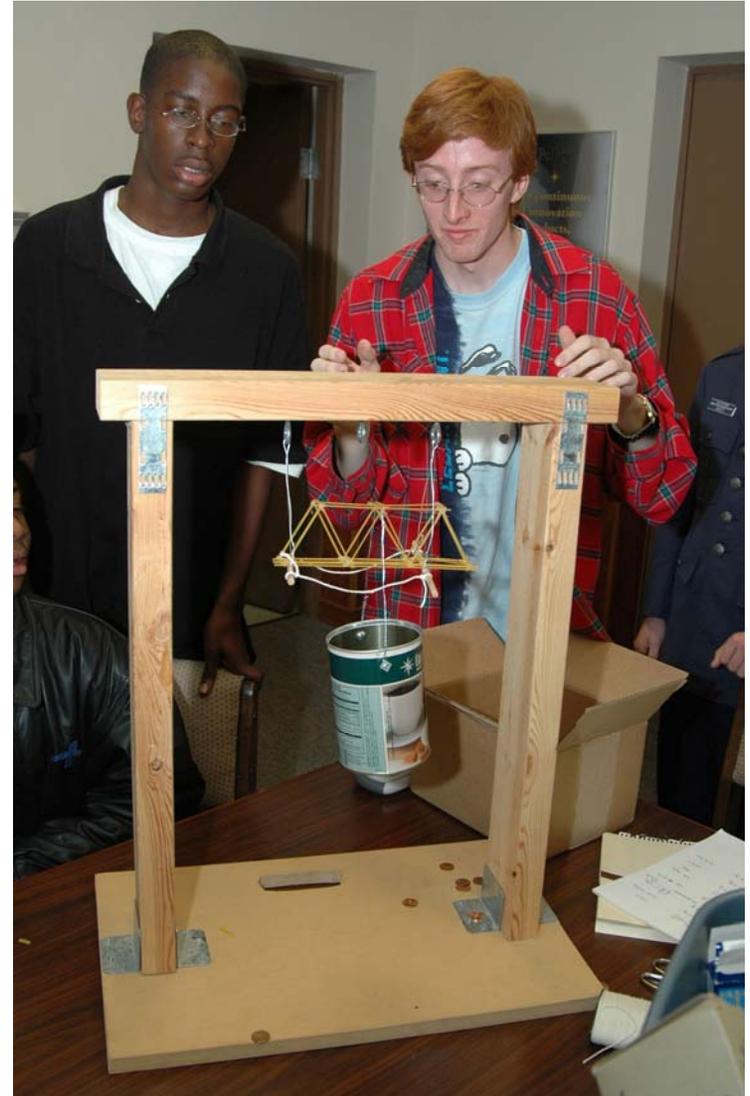
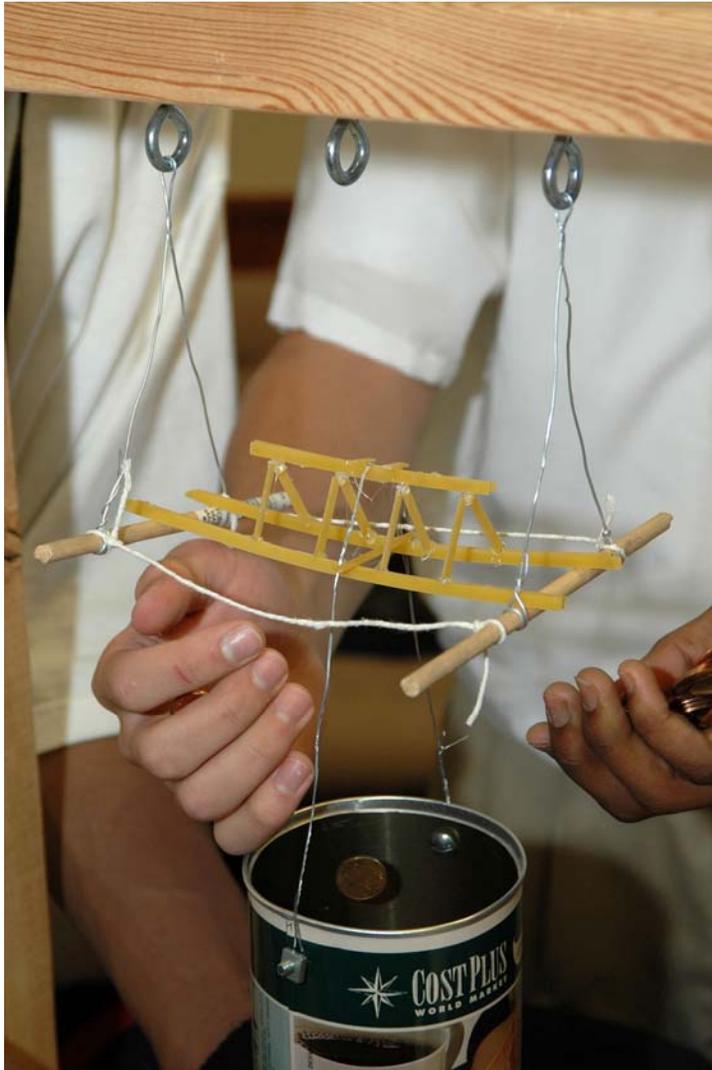
# *Discussion*



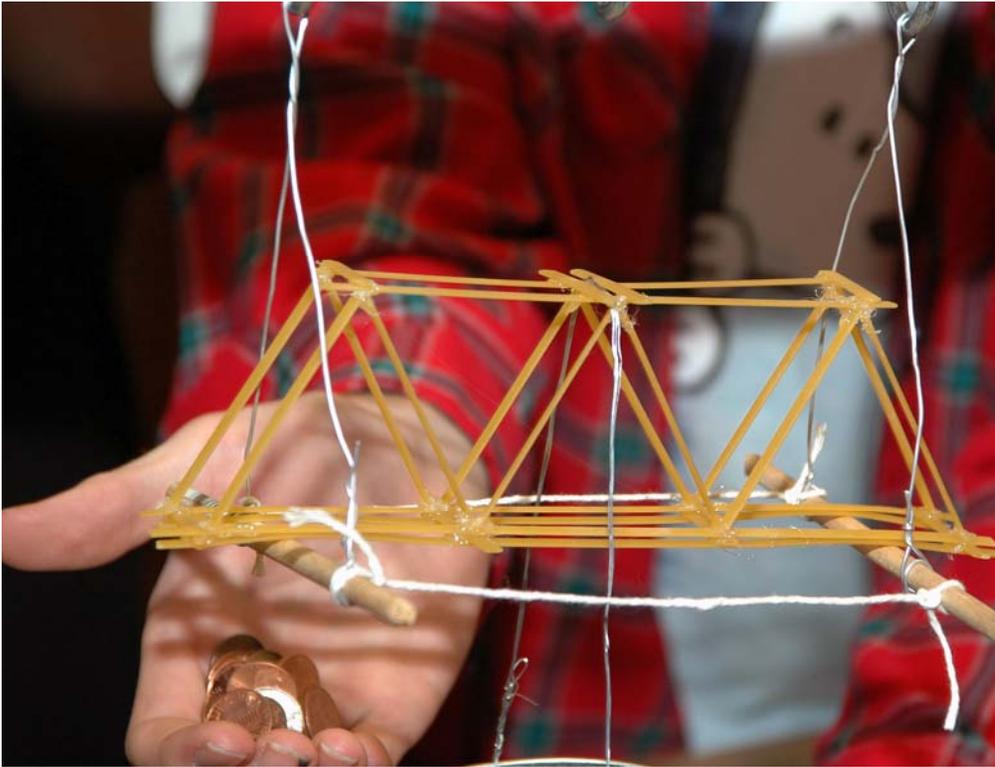
# *Discussion*



# *Discussion*



# *Discussion*



# Design Engineering

## – How it works

**Big Company Announcements: Widget Needed  
hold large (penny) load using “Structural”  
material.**

**Buy 1~2 million at mega\$ profits plus deal.**

**Load off to determine the winner of the contract.**

**Winner: Cheapest, highest load to weight factor.**

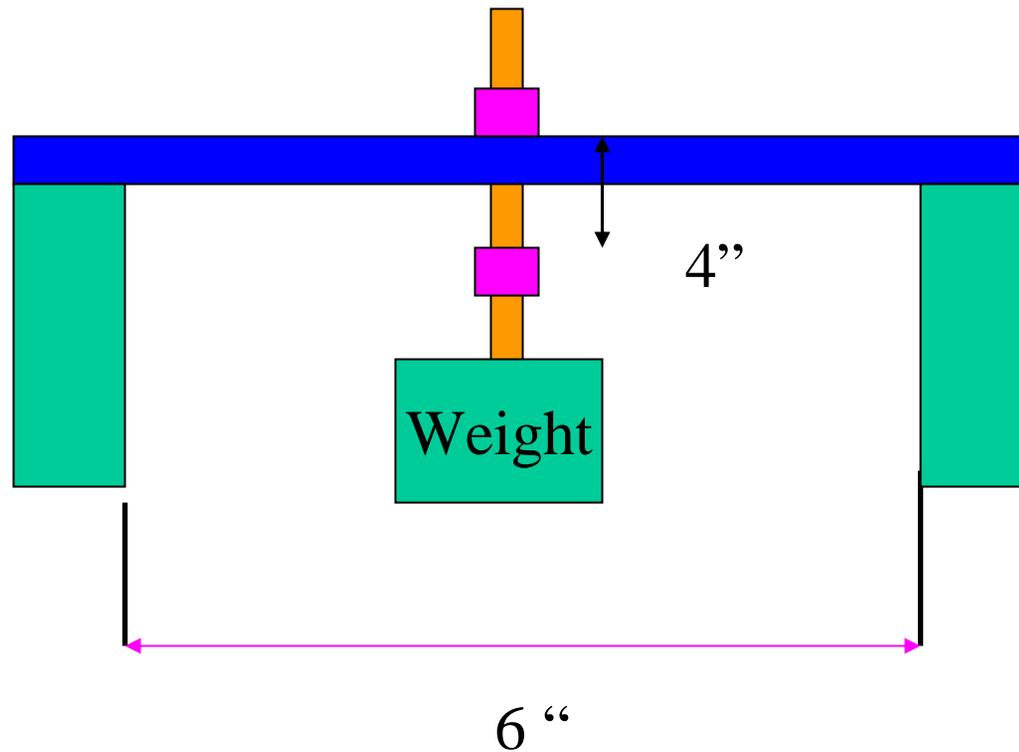
# The Rules

- Must be a Team Effort (but can enter more than one structure per person but less than the number of members in a team)
- Must be constructed of **eatable** material
- One meeting shall be given to discuss a plan with the team.
- One meeting shall be given to build/test
- Longest element(part) must be less than 6" span**
- Must fit into load rig given in the Figures

# Size Requirement (Side View)

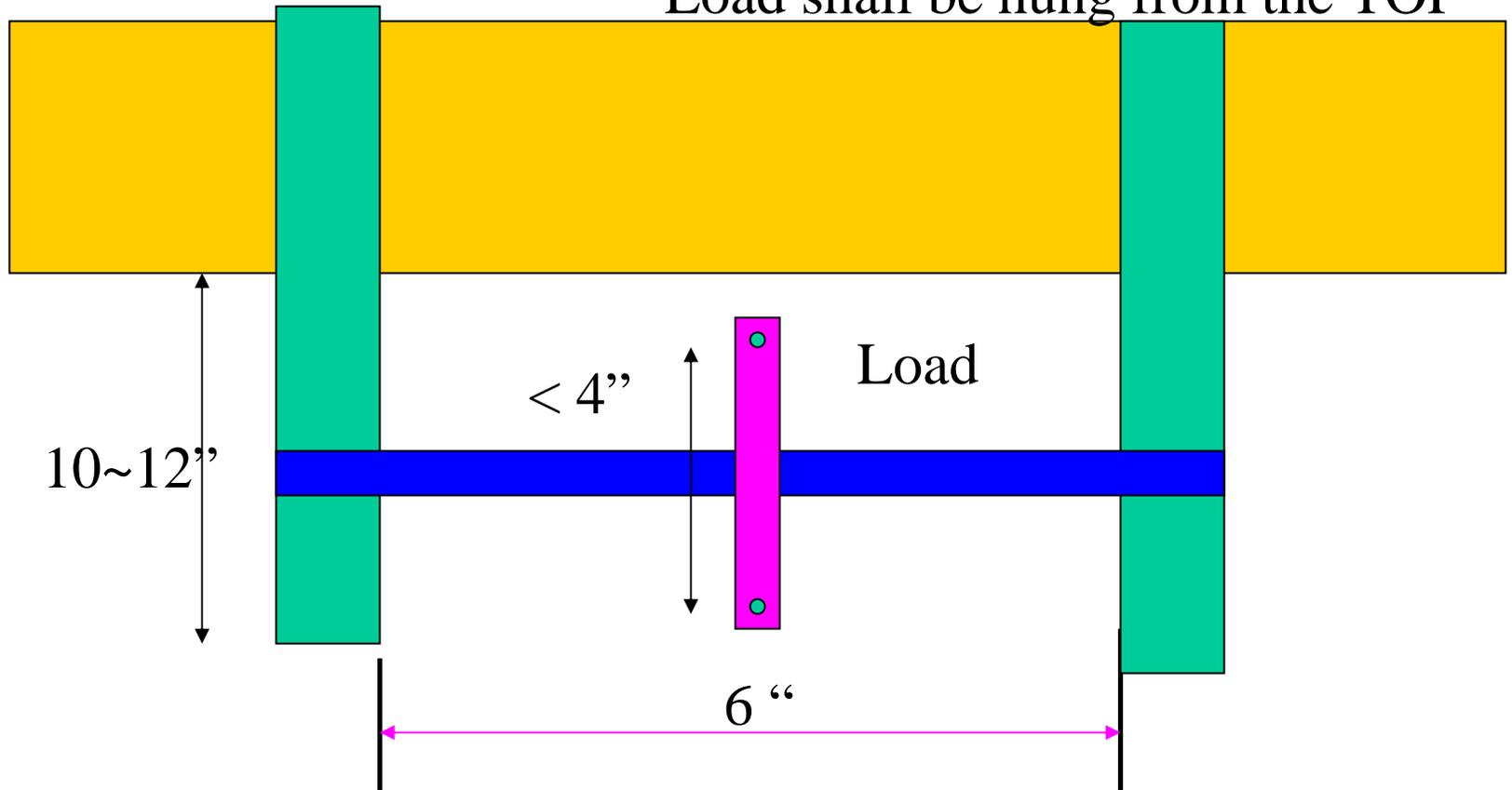
Load shall be hung from the TOP

Load



# Size Requirement (Top View)

Load shall be hung from the TOP



# Rating Sheet Team

Name: \_\_\_\_\_

<b>Weight of Structure</b>	
<b>Total Weight Held</b>	
Innovative (Advisor ?)	1 - 5
<b>Aesthetics (beauty, does it look like a bridge- peer)</b>	1 - 5
	(Total weight held/Weight of Structure/Averaged Value) +
<b>Figure of Merit</b>	<b>Aesthetics/Average Value + Innovation/Average Values</b>

# *Discussion*

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<b>Team</b>	<b>no of material</b>	<b>Weight(g)</b>	<b>Load(lbf)</b>	<b>Note</b>
3	5	11.2	2.375	
4	6	13.4	6	5~7
2	5	10.5	2.81	
1	5	26.9	7.87	
1	5	12.4	0.31	
3	5	12.5	6.18	
4	5	10.8	3.56	
2	9	13.3	5.5	
2	9	25	4.93	4.93~7.56
1	5	12.8	3.69	
2	7	17.1	1.74	

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# *Discussion*

<b>Team</b>	<b>Load/Weight</b>	<b>Figure of Merit* 1000</b>	
3	0.0005	1.17	Only good at point load
<del>4</del>	<del>0.0010</del>	<del>2.96</del>	
2	0.0006	1.47	
1	0.0006	1.61	
1	0.0001	0.14	
3	0.0011	2.72	
4	0.0007	1.81	
<del>2</del>	<del>0.0009</del>	<del>4.09</del>	
2	0.0004	1.95	
1	0.0006	1.59	
2	0.0002	0.78	

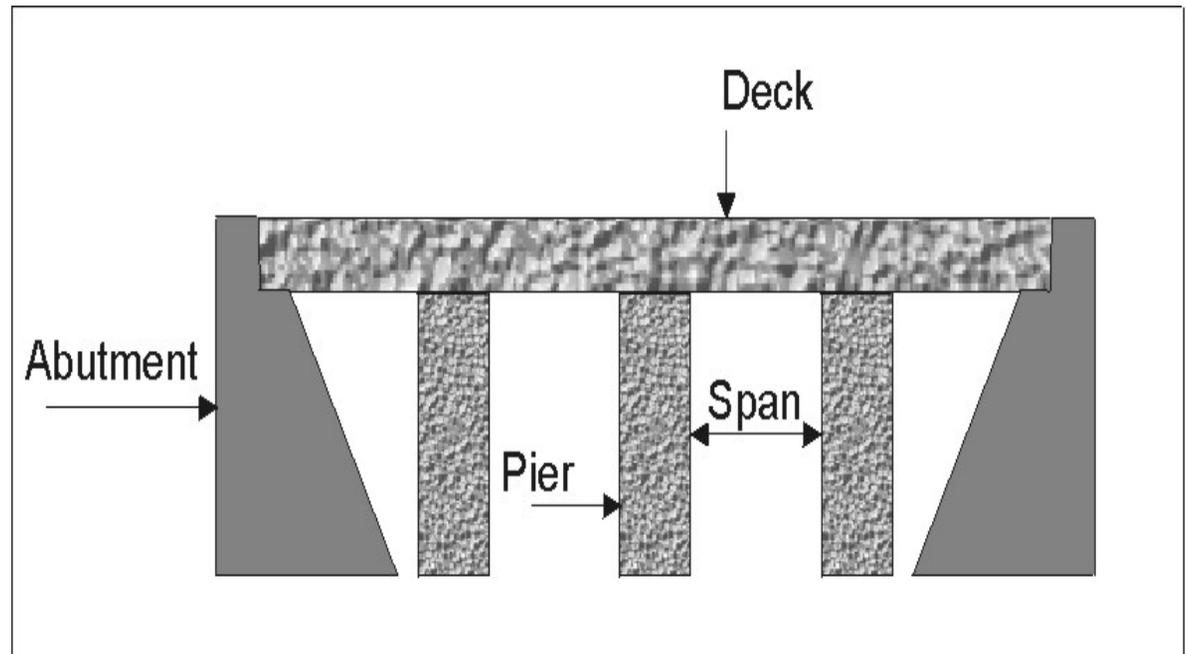
# *Things to Talk about*

- Team Roles?
- What to build?
- How to build?
- Who brings what?
- Develop a team process!
- Remember the time constraints (~2 hours)
- Plan/Discuss a head of time.. Otherwise, you'll building a bridge with what we have in the office

Remember the rule: we may require you to demonstrate that material is eatable!

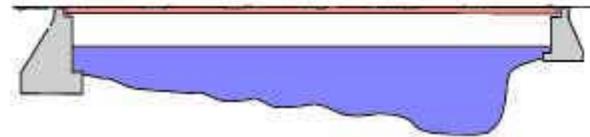
# Bridge Components

- Deck
- Pier
- Span
- Abutment

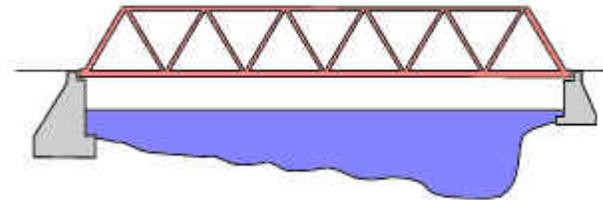


# Bridge types

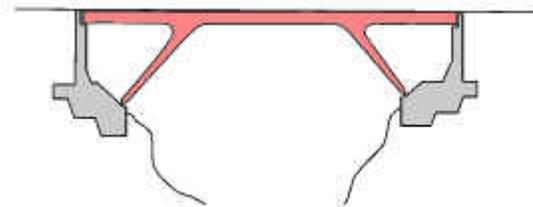
- Girder



- Truss

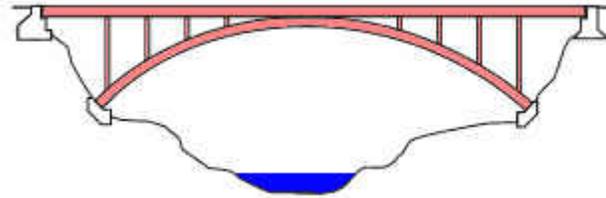


- Rigid Frame

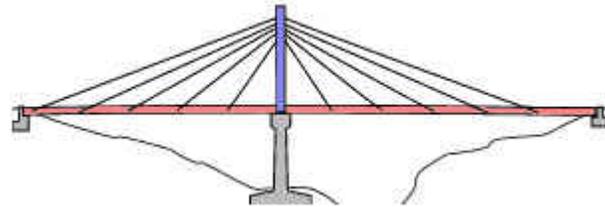


# Bridge types (continued)

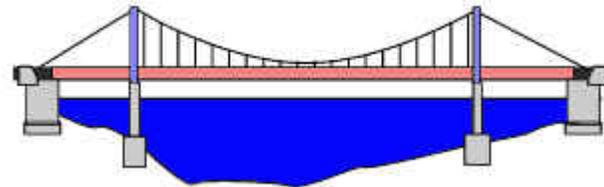
- Arch



- Cable Stayed

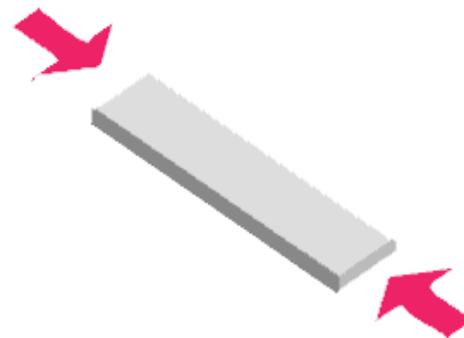
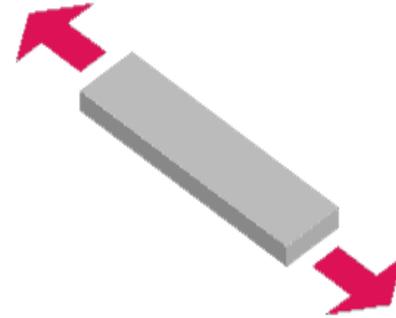


- Suspension



# Forces in a simple Truss

- Tensile forces tend to lengthen a member
- Compressive forces tend to shorten or compress a member



# Common Forms of Failure

- Buckling or crushing for members in compression
- Pulling apart in the middle for members in tension
- Pulling apart at the joints

# Materials Supplied by the Advisors

- Building Mats
- Test Rig
- Advice
- Encouragement