

**STRUCTURAL SHAPES AND FORCES**

By Joseph Sanford

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**Educational Goals**:

* Learn about Structural Terms and their use
* Be introduced to Basic Structural Shapes and learn how they are strong and weak
* Discover what Structural Forces are and how they affect the Structural Shapes
* Review how the Shapes and their Joints can be strengthened to resist Structural Forces
* Learn about Materials used in construction and their strengths and weaknesses
* Review Basic Bridge Types (as examples of how to build bridges) and their good and bad points
* See examples of Structural Shapes in life
* Review examples of Structural Failure brought on by the Structural Forces

Ov**erview**: This module has several sections:

Glossary of Structural Terms (6 pages)

Structural Shapes (1 page)

Structural Forces (1 page)

Structural Joints (17 pages)

Materials (2 pages)

Basic Bridge Types (5 pages)

Structural Shape Examples (12 pages)

Structural Force Failures (8 pages)

**Content:** It is suggested that the Mentor use the Glossary more as a backup to answer questions for those students who have an interest to go deeper than this module intends, which is to give a visual primer to structural concepts related to the house-building and bridge-building modules. It is suggested that the Mentor starts with the Structural Shapes page, and then go through the pages together with the students and describe the forces acting on the Structural Joints (the main point of the module) as shown in the sketches. The focus is to help the student think about which joint could or should be used in a particular place in a bridge or building design to attain maximum resistance to force for that design, and result in a better overall structure. The pictorial pages at the back can be used to reinforce the concepts in real life and show how forces affect structure and were able to still overcome structural elements even though built properly.

**Time**: At the mentor’s discretion, the time can be shortened to about 1.5 hours or can be stretched to 3 hours. It is suggested that more time will cement the concepts into the students’ heads more securely.

**Materials Needed**: None, other than the handouts. However, enterprising Mentors may wish to construct examples of the shapes and their joints ahead of time out of paper or better, balsa, to show what they look like in real life and how the forces act upon them, even to destruction (probably can be glued back together).

**Directions**: The suggestion is to take this module slowly and answer questions as much as necessary as a preparatory step (perhaps mention this to the students up front) to learning how to build the house or bridge modules. Help the student to recognize each of the joints and shapes and how they relate to the forces in either strength or weakness. Help them to study the solutions to each shape, so that when they design their structures, they use this information to design stronger, safer structures.

**Topics to Discuss**:

* What the Structural Shapes and Structural Forces are and how they work
* How Structural Forces affect the Shapes and why
* How Materials act and which ones to use where
* The shapes of Basic Bridges and which ones work best for which situation
* Examples of the Shapes, and where they can be found in everyday life (relate back to students)
* How savage Structural Forces can be and how destructive they are in our lives, and how buildings and structures can be designed to withstand their onslaught
* How the student can observe the shapes, and force-resistant designs in their daily life—to be aware of them and understand them

M**entor Notes**: While this topic seems complex and somewhat technical, if the Mentor spends some time beforehand studying the material, it becomes quite simple and logical. Also, if the Mentor prepares well, then the students are rewarded with a great learning experience. This material can either be dry or quite interesting…it comes down to relating it to the students’ lives and their everyday experience, while expanding their understanding of design and the built environment. That is pretty much up to the Mentor’s attitude towards the material and the subject itself.