



Science, Engineering,
Technology & Math

Yo Structures!
(Understanding Structures)



Class Structure

Week #1:

- Introductions
- What are structures?
- Who makes structures?
- Overview of “Understanding Structures Enrichment Camp” guide
- Do Building Skills #1 through #3

Week #2: Level 1

- Review of first week
- Basic Structures: Post and Lintel, bracing, and struts (X and I)
- Build Projects #1 through #3
- If time, do Challenge #1 (Bridge-building)

Week #3: Level 2

- Review second week

Week 3: Level 2 (continued)

- Bracing, tall structures, and wind/earthquake vibrations
- Build Projects #1 through #3 (#3 takes a LONG time)

Week #4: Level 3

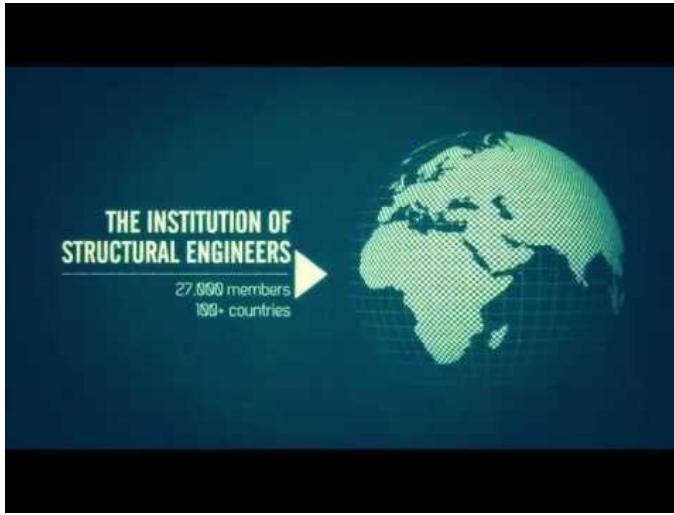
- Review third week
- Dynamic Structures
- Build Project #1 and #2

Week #5: Level 4

- Review entire content
- Design Challenges; build ANY structure that is or is not in the guide

Week #6: Finish-up all projects

Week #1: What are “structures”? Who builds them?



mode of building, construction, or organization; arrangement of parts, elements, or constituents



This will be our guidebook for the session!

We will learn about the following:

- Level 1: Structure Basics
- Level 2: Bracing
- Level 3: Dynamic Structures
- Level 4: Design Challenges

Each level has a few different structures to be built, as well as key concepts of various structures.

Vocabulary

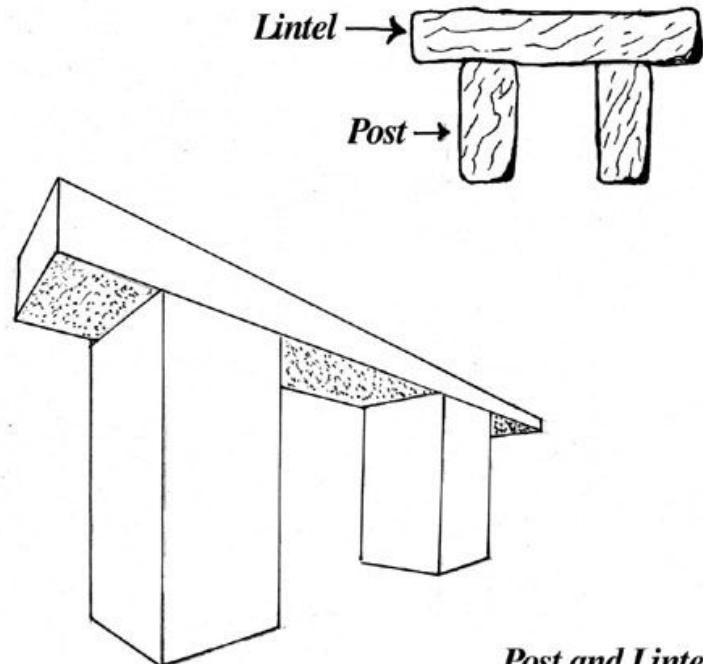
- Deck: a flat surface in a structure, on which items can be stored and activities can occur
- Bracing: members that are added to stabilize the structure
- Member: a distinct piece of material
- Shear: pressure that causes members to break vertically (as opposed to bending)
- Structural failure: when a structure breaks or collapses
- Loading: when a structure experiences forces from outside
- Tension: when a load stretches a member
- Compression: when a load squishes together a member
- Foundation: the bottom-most part of a structure
- Torsion: when a load makes a member or structure want to twist/rotate
- Frequency: number of cycles per second. Low frequency is a lower vibration.
- Bending Moment: amount of rotational load applied toward bending
- Mass: a large amount of material; the quantity of matter that a body contains
- Resistant: the ability to not be affected by something, or at least withstand it
- Fundamental: very important
- Shear: a strain in the structure produced by pressure, when its layers are laterally shifted in relation to each other
- Laterally: side to side



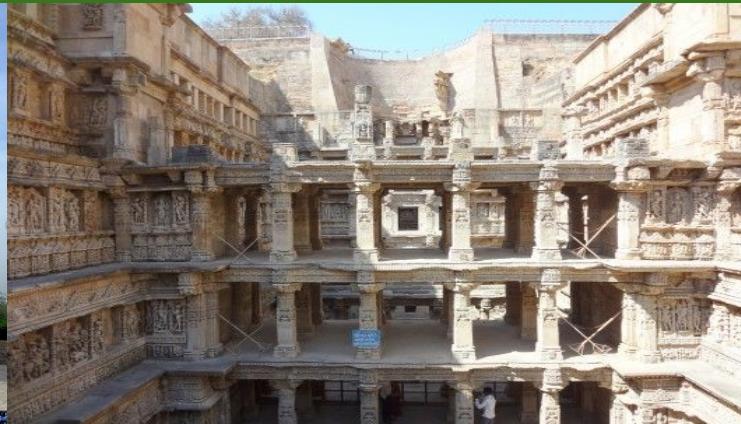
Level 1: Basic Structures

Level 1: Basic Structures

Post and Lintel structure is one of the most fundamental. Post is the column and the lintel is the deck.



Post and Lintel



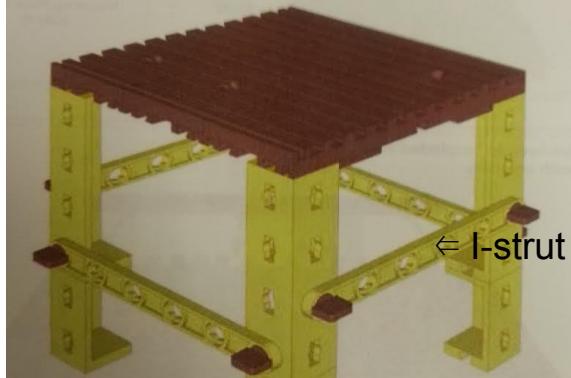
Point out the Posts and Lintels in these pictures!

Level 1: Basic Structures

Struts are long, thin support structures used to allow for a lighter, taller, wider building. Struts create bracing for structures.

There are X-struts and I-struts. X-struts (angled struts) prevent the structure from “moving” around and allows for larger deck.

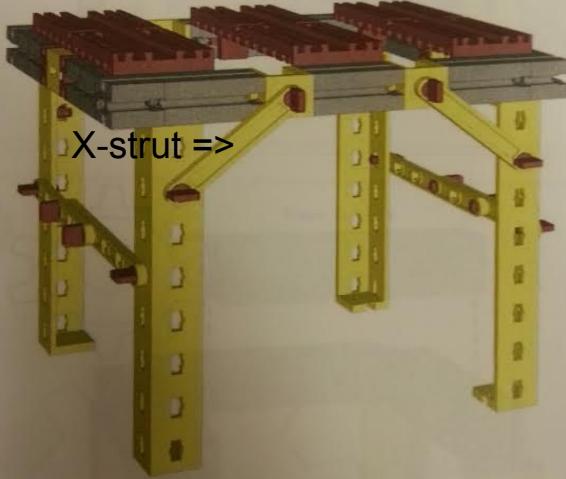
them on the bottom (since loading will come from the top).



INTS

ing (using struts or brace members) can have a big impact on the structure.

deck is not a diaphragm, though it acts as a semi-rigid diaphragm in the walls.



KEY POINTS

X-struts (angled struts) can be used to resist toppling/bending.

Con
align
a wa
vert

I-strut and X-strut example



Level 2: Bracing



Earthquake-resistant structure!



Wind-resistant structure!

Level 2: Bracing

Bracing creates stability for a structure by preventing tipping, rocking, and shearing.

Bracing also helps prevent bending.

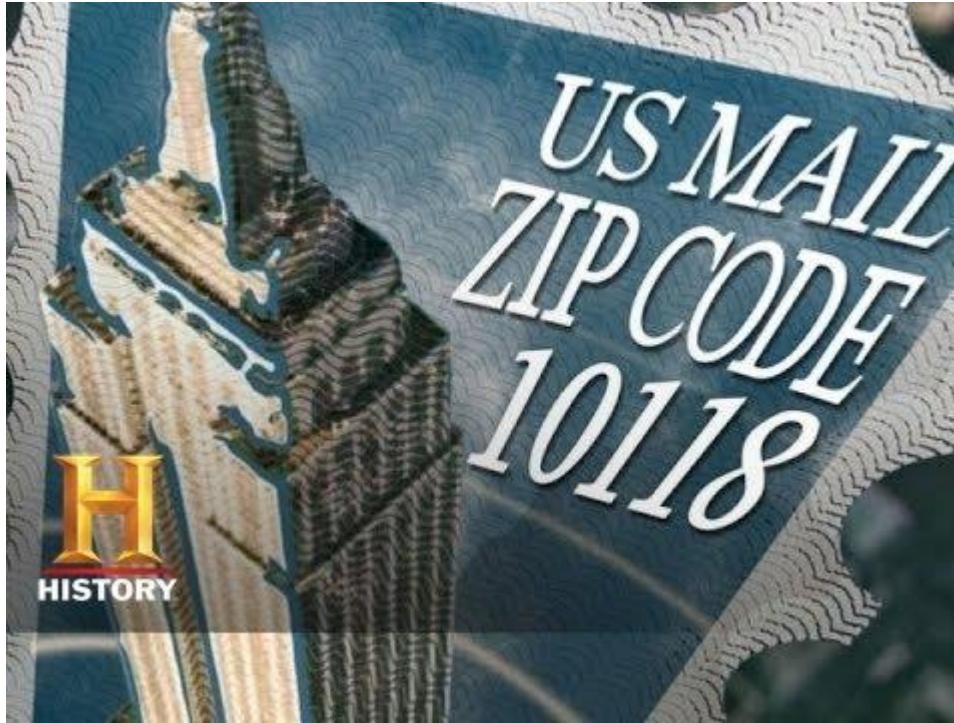
Bending is the most common cause of structural failure.

Struts and brace members are used for bracing a structure.



[Sears Tower](#)

Tallest building in America! Why is bracing important for it?



Empire State Building in a nutshell!



Level 3: Dynamic Structures

Level 3: Dynamic Structures

Dynamic structures are ones that move. Moving systems are added to structures to move people around or perform mechanical tasks (i.e. wind mill).

Static (not moving) structures often contain moving parts.

Elevators and cranes are examples of dynamic structures.



Dynamic Structures!



How an elevator works!



How a crane works!



Level 4: Design Challenges



**Make ANY design! Use concepts from the book to help out in your design!
They have ideas in the guidebook, but do not have step by step
instructions fyi.**



Tools

This is the guide book that all the concepts come from. You will also be using the Fischertech building kits.

Creative Challenge:



Some kids will naturally do well at building these structures and grasping the engineering concepts. So you can choose to all move as one by having everyone do the same structure, but I had my advanced students move on to different structures while the others worked on the ones they were struggling with. I wanted the kids who were struggling to spend more time on their structures, and I wanted the advanced kids to not be bored. It is up to you on how to go about this challenge.

Materials & Supplies

- Understanding Structures Guidebook
- Fishertech building kits
- Access to Youtube/internet
- Zip Lock bags (to put building blocks in for intense structures for the following week)
- Name tags to label the kids' building kits

Pro Tips by C-Bass

- Show video clips at the beginning of each class period.
- Take video and photos of the kids throughout the class and add it to the presentation.
- Some kids will need more hands-on help than others, so I build the models before class to show what they look like. I then let the kids build and I help the ones that have a hard time. Also, if there a lot of kids struggling have the ones who are excelling teach their peers.
- I have the kids partner up for the later concepts because they are more difficult but to have the kids work on collaboration/teamwork as well.
- Reviewing terms every week is important, especially if they are presenting their structures at a science fair or for class. Each chapter builds on the previous concepts and vocabulary.