Chair Design

Of all of the objects out there in the world, the chair is one that is used most consistently. Think about how often you are sitting. You spend many of your waking hours here at school, sitting on chairs. All of the important work you do throughout your high school career is done while sitting on a chair. How often do you really think about the chair you are sitting on? If you're like many people, you only consider the chair when you become uncomfortable. If and when that happens, you may not be able to stop thinking about it. Chairs come in all shapes and sizes, materials and costs. From the late 1800's chairs have been designed with various considerations in mind. They have been redesigned countless times to improve form and function and designers continue to tackle the chair today.

Panton Chair, 1968-1999
Polypropylene (1999 version)
Design: Verner Panton
Production: Vitra, Switzerland

Chair_One, 2003
Die-cast aluminium
Design: Konstantin Grcic
Production: Magis, Italy

MYTO Chair, 2008
BASF Ultradur® High Speed plastic
Design: Konstantin Grcic
Production: PLANK Ora, Italy

http://designmuseum.org/exhibitions/online/a-century-of-chairs/1960s

For this assignment, you will be learning about how designers brainstorm, plan and engineer their designs for chairs and you will be creating your own full scale models using materials from the classroom. Here's the thing...as a society, we have enough chairs. People design chairs every day. Most designers and architects have designed chairs at least once in their career. I'd like to think that your generation is more environmentally conscious and considers sustainability above the ego of having your product be amongst the mountain of others that are like it. With this in mind, we will be focusing on two things: First, the function of a chair and how to create one that holds weight well and doesn't fall over, and second, the redesign and improvement of a chair that already exists. Your project will be broken up into two parts:

1. Draw, Plan, and Build a model chair that holds weight and doesn't fall over
2. Using an existing chair, redesign it to improve the form and function.

Both portions of the project will be done as a group.

Structures

Chairs hold weight. That is their main purpose and goal. If a chair can't hold weight, people fall down and get hurt. We don't want that. In order for a chair to hold weight, a designer must understand how structures work.

Tension and Compression

All structures can only pull or push, therefore they are always in either tension or compression. A structure fails when it is not sufficiently strong in tension or compression.

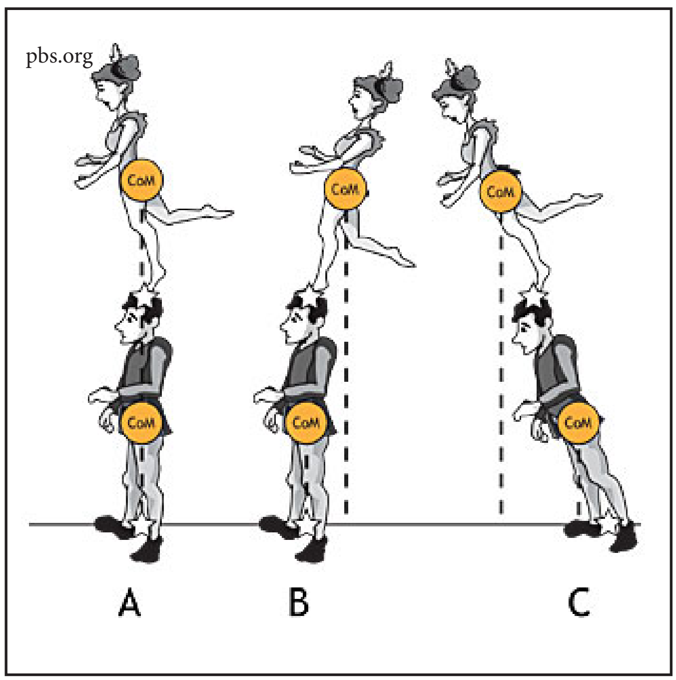
Try this: Take a thin rubber band. Pull on it. You are putting the rubber band in tension and the rubber band becomes longer. When a part of a structure becomes longer it is in tension.

Try this: Take a thick sponge and push on it. When you push down on it, it is in compression and it becomes shorter. When a part of a structure becomes shorter it is in compression.

Center of Gravity

A building of any structure can remain standing if its center of gravity is directly over the perimeter of its base as defined by the most extreme points at which it touches the ground.

Consider the leaning tower of Pisa. Would this building fall down unless it is straightened out?



Also consider the cheerleading team. They do their best to lift their teammates, defying gravity in what is called a stunt. The team-members holding the "flyer" look to the person's center of gravity to determine which way she may fall.

Loads and Joints

To insure a structure can hold heavier than typical loads, designers, engineers and architects often add extra members. They may also make some members stronger than minimally necessary. This is known as increasing the structures "factor of safety."

Static and Dynamic Loads

As long as a person sits still on your chair the load is said to be static (or not moving.) If the user does not sit down gently or moves around while sitting the load is dynamic (or moving.) You have seen this when you discovered it is easier to break something with a quick shot than with a gradual and steady force.
Dynamic loads require greater structure strength or a higher factor of safety

Loads at unexpected locations.

Not everyone will sit on your chair where you planned. For example, they may sit on the front edge rather than towards the back of the seat. This would put a greater load on the front columns, requiring them to carry a load that would have been distributed among several columns or other load bearing members. Therefore it is useful to
plan your structure for the person who may not follow your instructions about where to sit

Making Joints Tight

Keeping in mind that your chair will fail at its weakest link, you should make slots that will not allow any motion or "play" of the members as they sit in the joints. (Joints are where members are joined together.) You should try to cut all slots carefully so they are straight, parallel and the exact width of the material that will fit into them

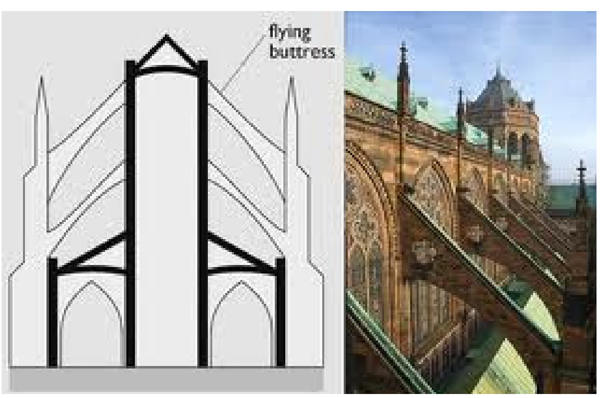
Undesired play can allow a column to shift from being vertical. It can also lead to your chair swaying which in turn can lead to material tearing and breaking. Many chairs fail from unwanted swaying.

Shapes that Make Strucutres Strong
It is necessary to understand the important role of triangles in building strenth in structures.
Rectangles are common in all types of structures, especially buildings. Windows and doorways nearly always take the form of rectangles. However, this shape is generally chosen for aesthetics and reasons of uniformity, not because it is inherently strong. In fact, without support along its vertical sides or the strengthening of its joints -- or both -- a rectangle is highly unstable.

If there is a single most important shape in engineering, it is the triangle. Unlike a rectangle, a triangle cannot be deformed without changing the length of one of its sides or breaking one of its joints. In fact, one of the simplest ways to strengthen a rectangle is to add supports that form triangles at the rectangle's corners or across its diagonal length. A single support between two diagonal corners greatly strengthens a rectangle by turning it into two triangles.

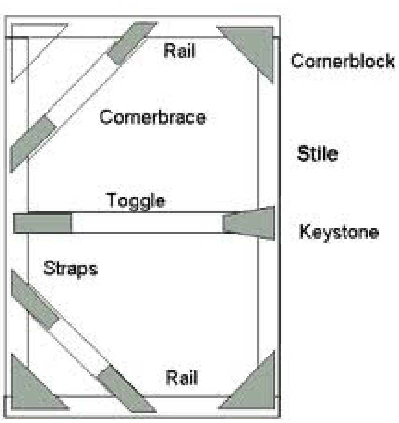
Arches are also very strong shapes. A force applied to the top of an arch, for example, will be carried vertically and horizontally in an arc along the length of the arch's sides all the way to its base. Still, very heavy loads can cause an arch to deform, or bend. To overcome this weakness, engineers sometimes strengthen arches with heavy buttresses or walls along their sides and bases. If an arch is rotated 360 degrees in a circle, it becomes a strong, three-dimensional, symmetrical shape -- a dome.
http://www.teachersdomain.org/resource/phy03.sci.phys.mfe.triarch/

Trusses
A truss is a diagonal structural member. It is generally found inside the structure.
Typically, a truss, when connected at its ends to two sides of a structure or a side and another truss, forms a triangle. Trusses generally work in tension. (They may also be subject to compressive forces.)



architecturaldictionary.org

Butresses
A buttress is attached to the outside of a structure. It forms a triangle when attached to the outside wall.
A buttress is always in compression. It may be formed by a solid piece or consist of a single member. Its purpose is to provide a force against the forces pushing a wall or a member out and away from the structure.



Hidden triangles?
Structural triangles may not always look like triangles. Sometimes this triangulation effect will be achieved by
using solid sections.

Chair Design Project Part 1

Challenge: Design and Build a chair

Specifications:
You must use the cardboard provided by the teacher
No adhesives or non-cardboard connectors of any type may be used to make or assemble your chair
The chair must have a back for the sitter to be able to rest on.
The chair must support a person of at least 150 pounds.

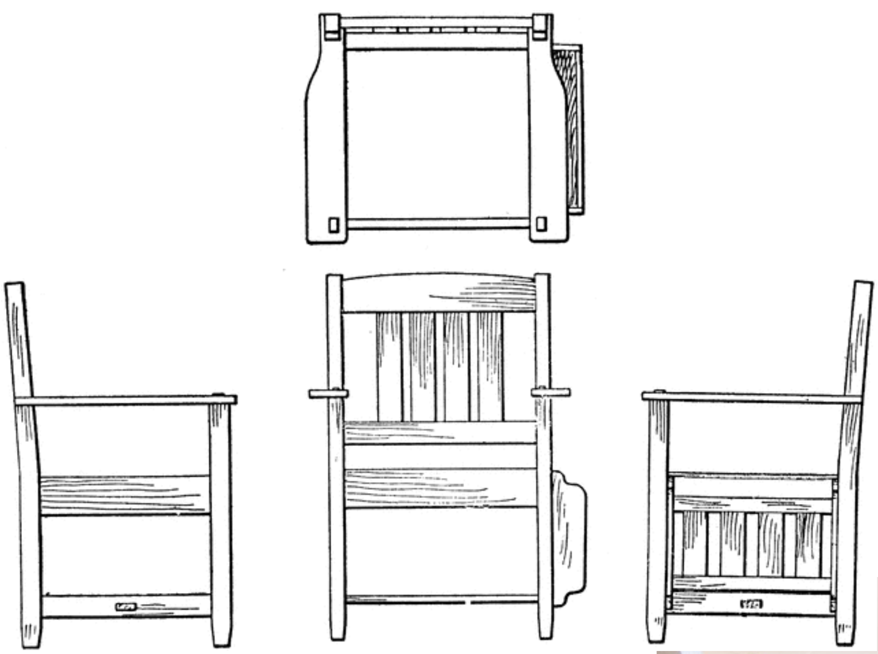
Steps:
1. Use index cards to experiment with creating structures that hold strenth. See how you can fold, cut, and asemble the cards in different ways to create strenth when subject to compression.

2. With your group, sketch your ideas for the design of the chair. How can you use the information gathered so far about strength to design a chair that holds weight and doesn't fall down?

3. Decide on a design that you will build. Draw the chair's front view, top view, and right side view.

4. Create a small model of yoru design using cardstock. Share with the class and analyze

5. Create your full scale model using cardboard.



http://www.instructables.com/id/Zig-Zag-Structure-Cardboard-Chair/

http://etc.usf.edu/clipart/52100/52103/52103_chair_o-p.htm

Front View

Right Side

Top View

Chair Design Project Part 2

Challenge: Redesign a chair that already exists.

Specifications:
You must have access to the chair that you are redesigning.

Steps:
1. Find a chair that already exists and that you have access to. Analyse the design of the chair to determine what improvements can be made.

2. Brainstorm ideas for the redesign of the chair to improve function. How can the chair be improved in terms of how comfortable it is? How can it be improved to increase the user's satisfaction?

3. Brainstorm ideas for the redesign of the chair to improve form. How can the aesthetic improve to change the chair's look? How does changing the look of the chair change the user's experience? Consider redesigning the chair to be more satisfying for a specific age group or gender.

4. Determine if the brainstormed changes can be made to the existing chair or if a completely new chair would have to be built. Create detailed sketches of your new chair from front, side, and top view.

5. Write instructions in step/list form to help someone redesign the current chair. What steps would a person have to take to create the new and improved chair from the original. What materials would be needed? What tools would be needed?

Project 1 Assessment	4 Advanced	3 Proficient	2 Basic	1 Does not meet expectations
Experimenting My index card structures were able to hold weight	Structure is able to hold weight without exceptions	Structure is able to hold weight in most areas.	Structure is able to hold weight in some to little areas.	Structure is unable to support weight.
I tried a variety of different ways to fold, cut and assemble the cards to make different solutions.	5+ structures were created in time period.	3-5 structures were created in time period.	1-3 structures were created in time period.	No successful structures were created in time period.
Brainstorming I was an active and responsible member of my group.	I was a leader in my group and helped others to be successful.	I participated fully and helped the group achieve success.	I did the minumum work and allowed others to carry the group.	I did not participate in group work and distracted others.
My sketches were detailed and thoughtful.	Sketches show evidence of critical thinking, and I paid close attention to detail	Sketches show evidence of critical thinking, and are neat. More detial can be shown	Sketches are basic and fail to show detail and creativity.	Sketches are incomplete.
Planning My drawing clearly shows the front, top and right side views of the chair.	All viewpoints are drawn neatly with detail. Extra attention was paid to sketches.	All viewpoints are drawn neatly with detail.	All viewpoints are drawn.	Sketches are incomplete
My drawing shows evidence of consideration of strength of structure.	A chair built based on the sketch will be able to hold weight.	A chair built based on the sketch might be able to hold weight	A chair built based on the sketch is not likely to be able to hold weight.	Incomplete drawing: I can't determine if the chair will be able to hold weight.
Building My structure is a clear model of my chair drawing	The chair looks like the sketch and improvements have been made.	The chair looks like the sketch.	The chair does not look like the sketch. I took shortcuts when building.	My chair is incomplete.
My chair is able to hold weight	The chair meets and exceeds the weight limit.	The chair meets the weight limit and can hold weight	The chair does not meet the weight limit or only does so in certain spots.	My chair cannot hold weight or does not stand up.
My chair has a place to rest a person's back	The chair has a place to rest a person's back. I thought about form of this aspect.	The chair has a place to rest a person's back.	The chair has a place to rest a person's back but no weight can be placed on it.	The chair does not include a place for a person to rest his/her back.
My chair shows evidence of good craftmanship.	The chair is well built with considerations of form and function. It is professional and neat.	The chair is well built with considerations of form and function.	The chair is put together with careless construction techniques or falls apart.	The chair is incopmlete or does not stay upright,
My chair shows creativity	I exceed expectations of the chairs' form and function.	I met expectations of the chairs' form and function.	The chair is a simple structure with no thought about form or function.	The structure does not work as a chair and does not show creativity.
notes:				

Total:

Project 2 Assessment	4 Advanced	3 Proficient	2 Basic	1 Does not meet expectations
Brainstorming My sketches show evidence of creative and critical thinking.				
Planning My redesign chair drawing is clear, creative and professional and shows evidence of critical thinking.				
Analysis My instructions are clear. Someone attempting to create the chair would be able to follow my instructions for success.				

notes:

Total: