Date: _____ Page _____

DESIGNING STRUCTURES

There are four main parts to the design process:

* FUNCTION * SHAPE * MATERIALS * JOINTS

FUNCTION

Function is what the structure is supposed to do. Most structures do more than one thing. Think of a structure than does the following functions. You may use the same structure twice if it is possible.

	FUNCTION	DEVICE
1)	CONTAINING	_____
2)	TRANSPORTING	_____
3)	SHELTERING	_____
4)	SUPPORTING	_____
5)	LIFTING	_____
6)	FASTENING	_____
7)	SEPARATING	_____
8)	COMMUNICATING	_____
9)	BREAKING	_____
10)	HOLDING	_____

Designers work with a set of CRITERIA or SPECIFICATIONS that give precise, measurable standards that their structure must meet. Designs must also be "aesthetically pleasing", in other words, they must look good. Most designers believe that simplicity is an important part of the design. They follow the K.I.S.S. principle – Keep It Simple, Stupid!

SHAPE

The shape of a structure helps to determine how useful it will be. Square and rectangular frames squish easily when a load presses on them and then they might collapse. Rectangular and square frames are very easy to build, however, and so designers have found ways to overcome their weaknesses.

- Use the information on pages 392 and 393 to fill in the information and do the diagrams required on the worksheet below.

Problem 1: Rectangular frames can be easily pushed or pulled out of shape.

Solution: Use triangles called _____, _____ and _____ to turn rectangular corners into _____ triangles able to resist _____ _____.

Using a ruler and pencil, draw and label figure 13.11 on page 392 in the space below.

Problem 2: Frames made of vertical columns and horizontal beams are weak in the middle. Pressing down in the middle causes the beam to bend and push sideways and the structure will collapse.

Solution 1: Brace the middle of the beam and make the side columns into a triangle.

Using a ruler and pencil, draw and label solution 1 from figure 13.12 page 392.

Solution 2: Support the load by using an _____. The arch carries _____ _____ all the way to the _____. This principle is used when building _____.

Using a ruler and pencil, draw and label solution 2 from figure 13.12 page 392.

Solution 3: Support the load using a special arch called a double _____. It is a very strong design with a strong _____ _____ and _____ that supports beams on either side.

Using a ruler and pencil, draw and label solution 3 from figure 13.12 on page 392.

Problem 3: Solid, four-sided beams use a lot of building materials and are very heavy.

Solution 1: Use cylinder –shaped columns that use less materials.

Solution 2: Make the beam or column thinner in places that carry less load.

Using a ruler and pencil, draw and label figure 13.13 on page 393 in the space below.

Problem 4: Plywood, cardboard and other building materials are in flat, rectangular sheets. When a load presses on the middle of the sheet, the sheet bends out of shape and collapses.

Solution: Make the material of layers called **LAMINATIONS.** Arrange the layers so They strengthen each other. An example is **corrugated cardboard.**

Use a ruler and a pencil to draw figure 13.14 on page 393 in the space below.

MATERIALS

(text pages 395-397)

Choosing the right building materials is another very important design decision. The _____ or _____ or the materials must match the _____ of the structure. Different materials can be _____ or carefully arranged to give the exact _____ you need.

Different types of materials are often combined to make use of the best qualities of more than one material. These types of materials are called **COMPOSITE MATERIALS**. Some examples of composite materials are _____ concrete, waterproof hulls of boats made from _____ and _____ shafts in golf clubs and frames of tennis racquets.

Layers of different materials, pressed and glued together, often produce useful combinations of _____. Three examples of layered materials commonly used are:

1) _____

2) _____

3) _____

Woven and knit materials are two ways commonly used to make flexible materials. Knit materials stretch in _____ _____, so they fit well over _____ shapes, like human bodies. _____ and _____ are made from _____ that have been pressed and matted together. Aluminum _____ and _____ _____ are made by _____ and dissolving a substance and then letting it harden into thin solid sheets. No matter how they are made, materials that can be _____ or _____ are extremely useful for _____ structures that must be easily transported and stored such as _____, _____ and _____.

JOINTS

(text pages 398- 401)

Joints are the places where parts of a structure are joined together. Structures are often weakest where their parts are joined together.

MOBILE JOINTS: are joints that allow movement. Door hinges, _____ and the pins in a _____ _____ are examples of mobile joints. They hold parts of a structure together while still allowing some _____. Their complicated shapes are difficult to make, and they must be coated with some type of _____ so that they move smoothly. Human joints, such as the ball-and-socket joint in the shoulder, are example of _____ joints.

RIGID JOINTS: are joints that fasten parts of a structure firmly together, but they too can also be _____ _____ in a structure.

There are <u>five main types of rigid joints</u>:

1) FASTENERS 2) TIES 3) ADHESIVES 4) MELTED JOINTS 5) INTERLOCKING

1) FASTENERS:	nails, staples, bolts, screw, rivets, and dowels.
2) TIES:	thread, string, rope, shoelaces, drawstrings, seams
3) ADHESIVES:	thermosetting glue, solvent-based glues, epoxy glues
4) MELTED:	welding, brazing, soldering
5) INTERLOCKING:	folded seams, dovetail joint, Lego, paving stones

In the space below, draw and label any three of the joints shown on pages 398-401 of your textbook.