

## ► Key Question: What forms do structures have?

Different structures have different functions. We can group structures based on their functions.

We can also group structures based on their forms. Structures have three basic forms:

- solid
- frame
- shell

Complex structures are often combinations of these forms.

Different structural forms can support different loads.

## SOLID STRUCTURES

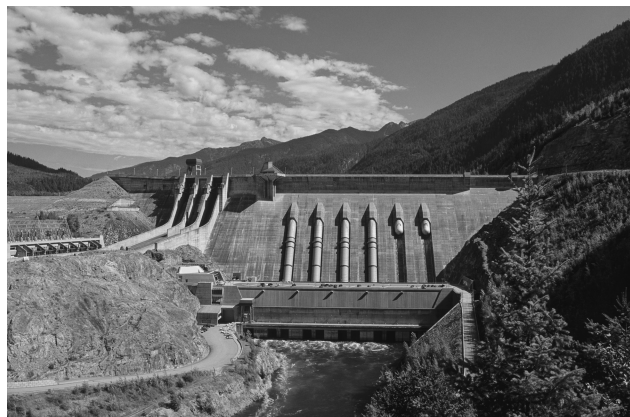
### solid structure

an object that uses solid construction to support loads

A **solid structure** uses solid construction materials to support loads. A solid structure usually has a large mass. A well-made solid structure can last a long time.

A concrete dam, a wooden telephone pole, and a marble statue are examples of solid structures.

Figure 1 shows a concrete dam. The dam has thick concrete at the bottom where the load forces of the water are huge.



**Figure 1** This dam is made of strong, solid concrete.

**frame structure**  
a network of parts  
that supports loads

## FRAME STRUCTURES

A **frame structure** uses a network, or skeleton, of materials that support each other.

Frame structures can be very strong. The parts of a frame work together to resist forces. Frame structures are also lighter than solid structures.

A goalie's net and a spiderweb are examples of frame structures. Many buildings use frame structures (Figure 2).



**Figure 2** You can see the frame structure that supports this building.

A frame structure may have a membrane stretched over it, but the membrane does not help support loads. For example, a tent may be made of a metal frame with fabric stretched over it. The fabric does not help support loads.

**shell structure**  
a hollow structure  
with a curved shape  
providing high  
strength and rigidity

## SHELL STRUCTURES

A **shell structure** has a hollow, curved shape. An egg and a bike helmet are shell structures (Figure 3).



**Figure 3** A helmet is an example of a shell structure.

Shell structures are strong and rigid, but they can also be very light.

# COMBINATION STRUCTURES

Most structures are combination structures. They have solid, shell, and frame parts.

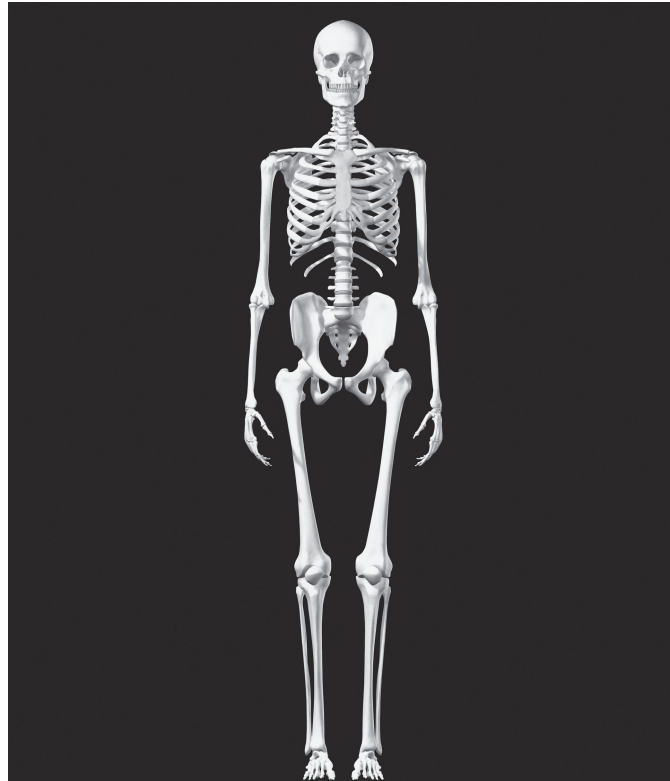
For example, most buildings have a solid foundation. They also have a frame of wood or metal that supports a shell of brick or concrete. Table 1 shows other examples of combination structures.

**Table 1** Examples of Combination Structures

Structure	Forms
car	<ul style="list-style-type: none"><li>• metal frame</li><li>• plastic or metal shell</li></ul>
bridge	<ul style="list-style-type: none"><li>• solid pier</li><li>• steel frame supports</li></ul>
domed stadium	<ul style="list-style-type: none"><li>• solid concrete walls</li><li>• metal frame</li><li>• shell roof</li></ul>

## The Human Skeleton

The human skeleton is a combination structure (Figure 4). Bones can be considered solid structures. The network of bones is a frame structure. The skull is a shell structure.



**Figure 4** The human skeleton includes solid, frame, and shell parts.

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



**CHECK YOUR UNDERSTANDING**

1. What three forms can structures have? Give an example of each.

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2. How does a frame structure support a load?

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3. Which structural forms are found in the human body? Explain.

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4. Think back to the Key Question. Where do you see the three structural forms in your community? Give an example of each.

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