ACTIVITIES

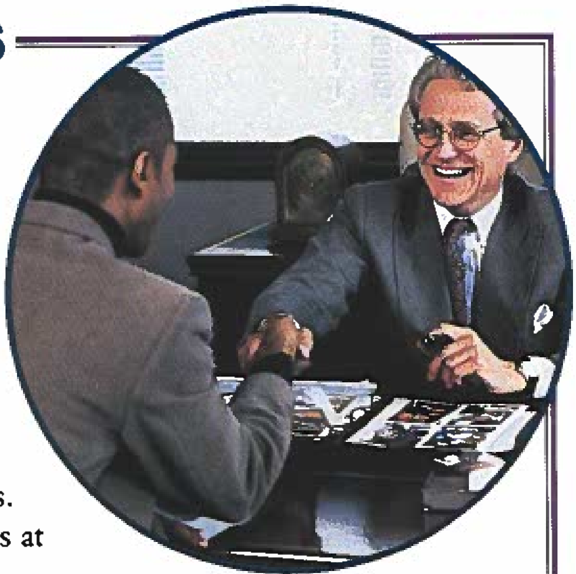
CROSS-CURRICULAR EXTENSIONS

1. **COMMUNICATION** Choose a product that you think is packaged without concern for the environment. Redesign the package. Make a sketch of your design, and send it with a letter to the company that made the product.

2. **MATHEMATICS** Use a spreadsheet to calculate the break-even point for your company. What was the biggest expense in your company?

3. **SCIENCE** Research bio-related technology companies on the Internet and find out what they do. See Chapter 19 for information on bio-related technology.

EXPLORING CAREERS



To be successful in business today, people need to study new approaches, such as electronic commerce. Changes in business will affect the career opportunities found, too. Here are only two of the many careers found in business today.

Product Manager Product managers oversee every step of the process for developing a product. They participate in choosing the original design and in deciding how to sell the product. They make presentations explaining how the product works. Managers must often be able to do a number of things at one time.

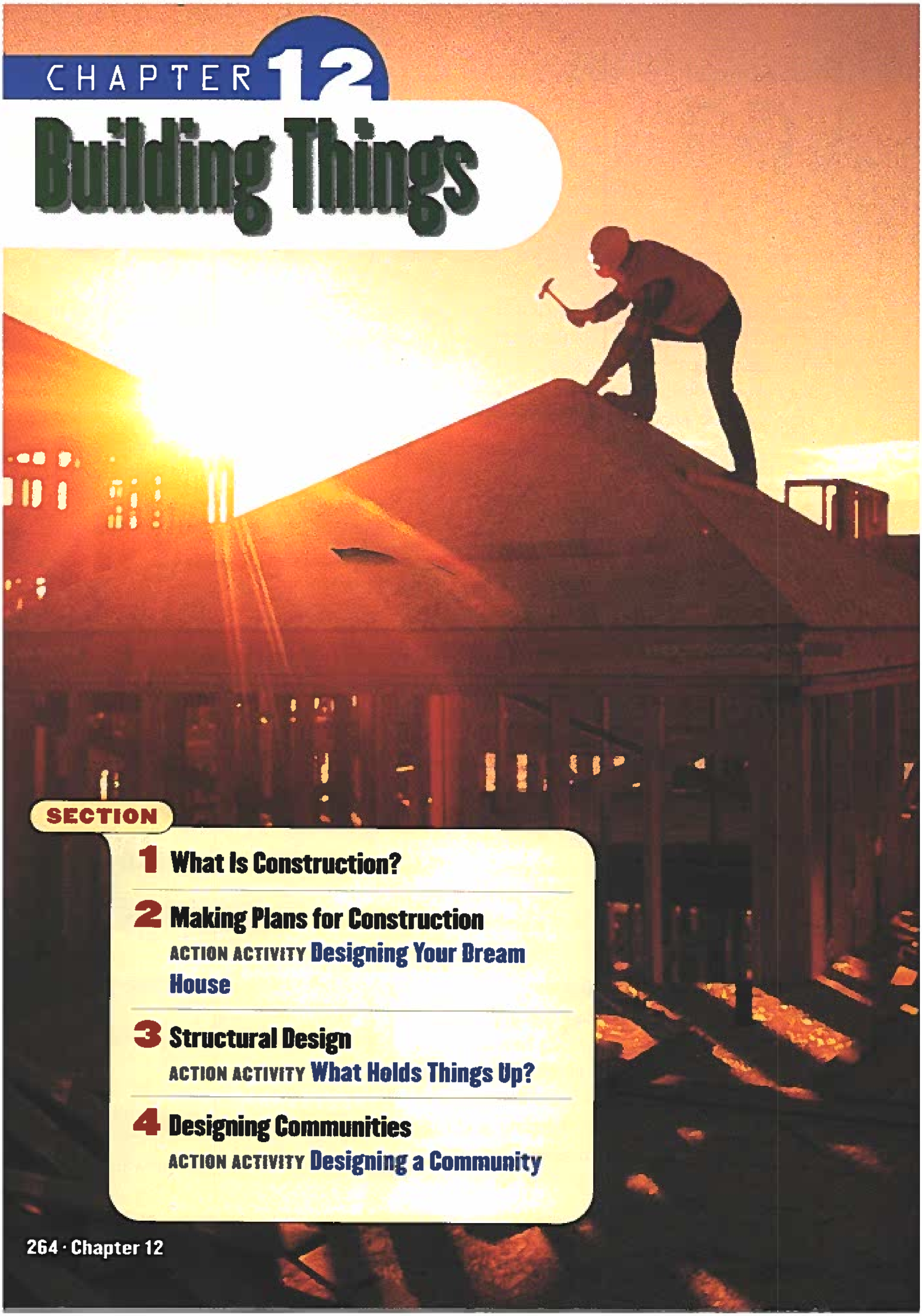
Employment Interviewer
Employment interviewers interview job applicants and refer them for jobs. They work in human resources departments or for employment agencies. Interviewers must be able to communicate well with people and keep up to date on hiring laws. While it helps to be familiar with technology and different high-tech jobs, it is not a must for success in this field.

ACTIVITY

Find out if your school provides *job shadowing*. In job shadowing, you spend time with someone at the workplace. By watching and listening, you learn about the job.

CHAPTER 12

Building Things



SECTION

SECTION 1

What Is Construction?

THINGS TO EXPLORE

- Define construction and give examples of different structures that people build.
- Explain how construction has changed with the development of new materials and different needs.

TechnoTerms
constructed
construction
shelter

You've learned about the production of smaller products from cars to crayons. Now you will learn about the production of larger products, such as houses and bridges. This area of production is called **construction**.

The Construction Industry

The construction industry uses the resources of raw materials, money, land, and technology to produce the structures you're used to seeing. Construction is a large and complex industry that affects you in many ways.

How much do you know about building structures? Look around you at all the houses, office buildings, schools, and factories that people have **constructed** (built). Fig. 12-1. Most people think of construction as buildings. But construction also gives us highways, airports, bridges, dams, and tunnels, to name just a few. Sometimes structures, like the Washington Monument or the Lincoln Memorial, are important for their design or historical meaning. But most of the time, we design our buildings and other structures to meet a special need.

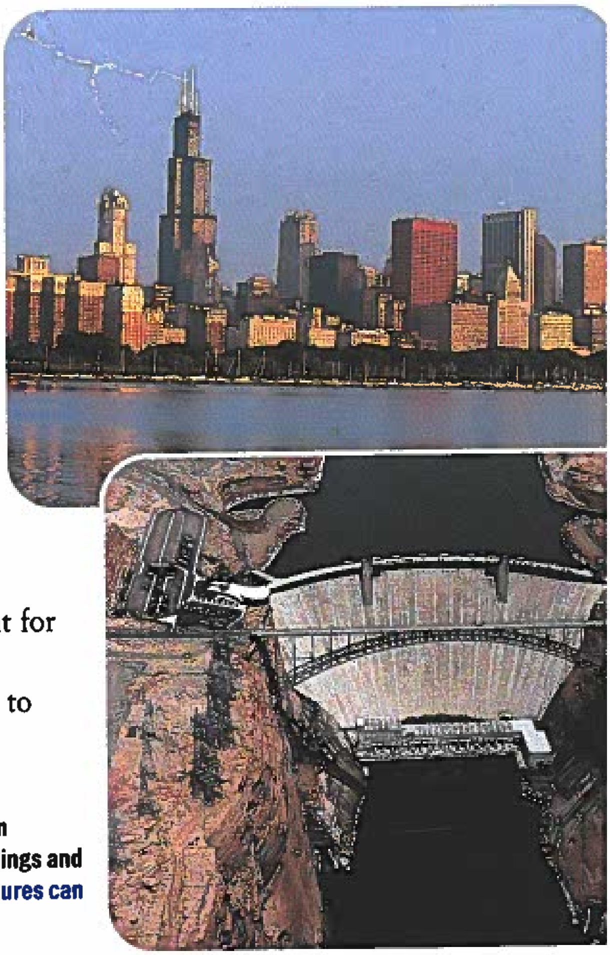


Fig. 12-1. Construction involves more than buildings and dams. What other structures can you name?

OPPOSITE Construction is the building of structures.

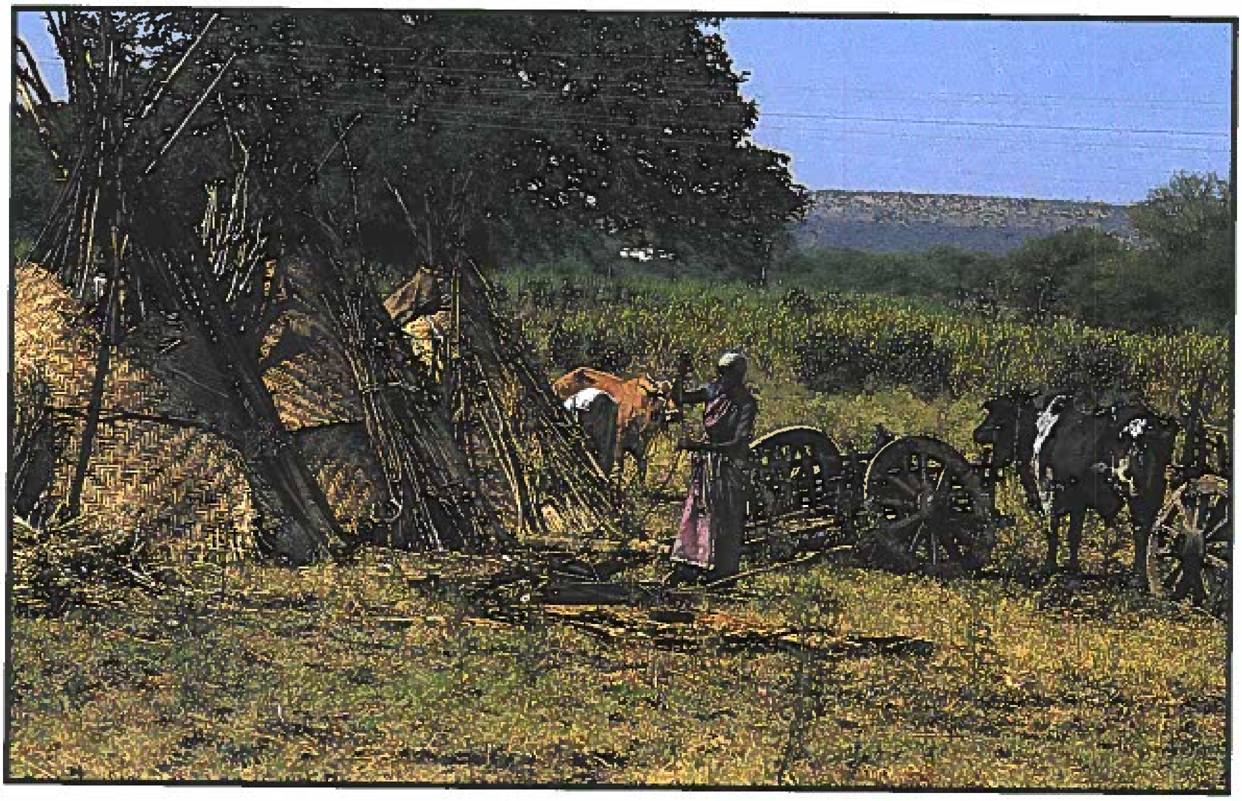
A Brief History of Construction

In the beginning, people needed a **shelter** (place out of the cold and rain). Early shelters were caves or structures made mostly of animal skins, twigs, branches, mud, or other natural materials that they found. Fig. 12-2. As people started to settle in one place, they needed more permanent dwellings. They needed shelters that wouldn't blow over in a strong wind and that could withstand different kinds of weather.

> **TechnoFact**
>
> **A GREAT WALL** The Great Wall of China is the longest structure ever built. It stretches 4,000 miles across China's northern plains. It can be spotted from space!

Though no one knows the name of the world's first structural engineer, early humans learned to build some amazing structures without machinery or iron tools. Have you seen pictures of the pyramids? The Great Pyramid at Gizeh, Egypt, was built about 2600 B.C. from huge limestone blocks cut with copper chisels and saws. The people who built it had no mortar or cement, so the entire pyramid is held together only by the weight of the stones. Later, the Romans built huge arenas, bridges, dams, aqueducts (waterways), and temples to serve their needs. You can still visit many of them today.

Fig. 12-2. Nomadic villagers in India build these teepee-like homes. Look up the word *nomad.* Why do you think nomads would prefer structures like these?



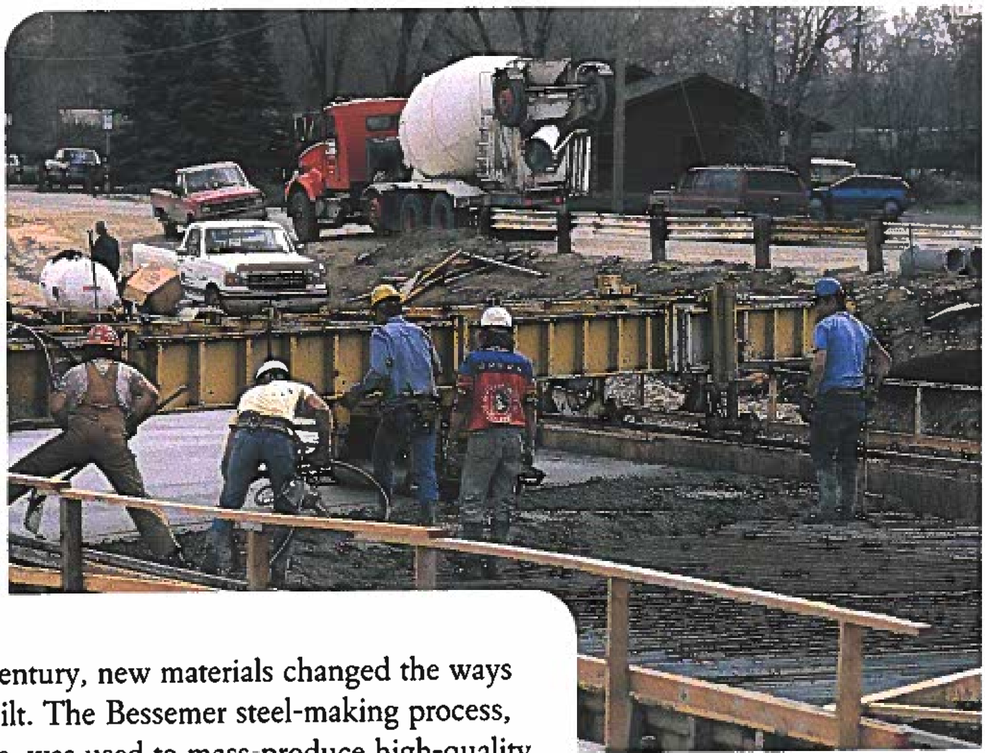


Fig. 12-3. Concrete is used in road construction.

By the nineteenth century, new materials changed the ways structures could be built. The Bessemer steel-making process, developed in the 1850s, was used to mass-produce high-quality steel. This steel made it possible to build structures that were stronger, more reliable, and longer lasting. Then new concretes that could be poured and would set underwater were developed. Concrete combined with steel produced *reinforced concrete* that had the best properties of both materials. Fig. 12-3.

Today, plastics, fiberglass, and improved metals enable architects and structural engineers to build even better and stronger structures. Better sources of power and new technologies also have helped the construction industry move ahead.

SECTION 1 TechCHECK

1. What is construction?
2. List five different examples of construction.
3. What developments have helped architects and structural engineers build better and stronger structures?
4. **Apply Your Knowledge.** Research different construction projects in your area. Find out why they are being built and what materials are being used to build them.

SECTION 2

Making Plans for Construction

TechnoTerms

detail drawing
elevation drawing
floor plan
orthographic projection
section view
site plan

THINGS TO EXPLORE

- List information designers need to know before they can begin designing plans.
- Explain what a floor plan is.
- Identify different kinds of working drawings, such as site plans, floor plans, elevation drawings, and section views.
- Design and draw a floor plan.

TechnoFact

HERE COMES THE SUN In cool northern climates, energy can be saved by facing most of the windows of a structure toward the south for more sun exposure. If the building was located in the Southern Hemisphere, you would want your windows to face north. Also, new technologies have made it possible to build windows that are more energy-efficient. The windows have a transparent film that lets light pass through but reflects heat.

Before any actual building begins, you have to plan your design. If you were an architect or a structural engineer for a project, you would meet with your *client* (the person you are building for) to discuss the client's needs. Some things you as the designer would need to know are

- What the building will be used for
- How much space is needed to build the structure
- How much money the client wants to spend on this project
- Where the *site* (building location) is
- Soil, water, and other conditions at the site
- Any special community building codes that must be followed

The Planning Process

INFOLINK

See Chapter 5 for more information about CAD.

After discussing your client's specific needs, you would start with some *preliminary* (first) sketches. From these you would make more detailed plans until you and your client were both satisfied. Then you would make accurate, detailed, scale drawings called **floor plans**.

You might use either CAD (computer-aided design) software or traditional drafting tools to make your drawings. Often, house plans and plans for other small buildings are drawn to a scale of 1/4 inch. In other words, each foot of the actual building is represented by 1/4 inch on the plans.

Working Drawings

Many kinds of working drawings are needed to build a house. You need a site plan, floor plans, elevation drawings, section views, and maybe other special information. Drawings made using **orthographic projection** show several views of the project in two dimensions. You can be looking down on top of the structure, looking directly at the front, or looking at the back or sides.

- **Site plan.** A site plan is drawn to show the property boundaries and the exact location of the structure. Fig. 12-4. Surveyors are sent to the site to accurately locate boundaries and to stake out the building site.
- **Floor plan.** This is a view looking down on the house without the roof. Fig. 12-5. You can see the location of the walls, all door and window openings, and the size of each one. You would have a separate floor plan for each floor of the building, including a second floor or a basement.

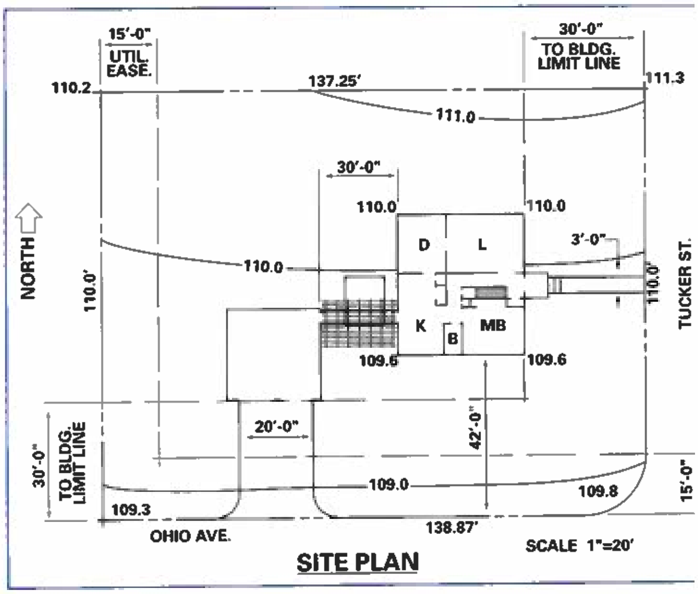


Fig. 12-4. Site plans are drawn using information from surveyor's instruments. Draw an approximate site plan for your school.

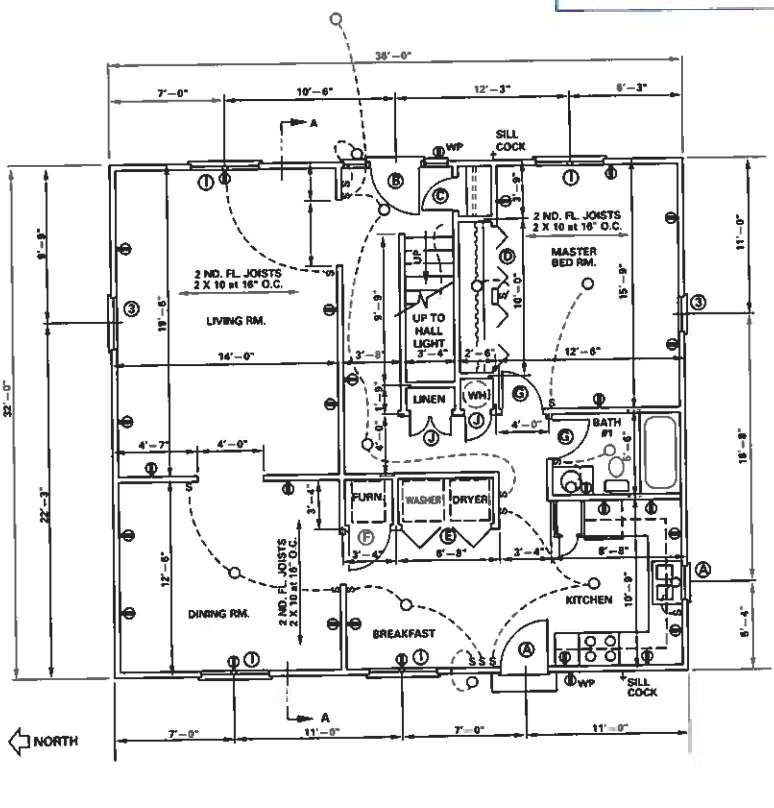


Fig. 12-5. This is a floor plan of a house. Draw a floor plan of your classroom.

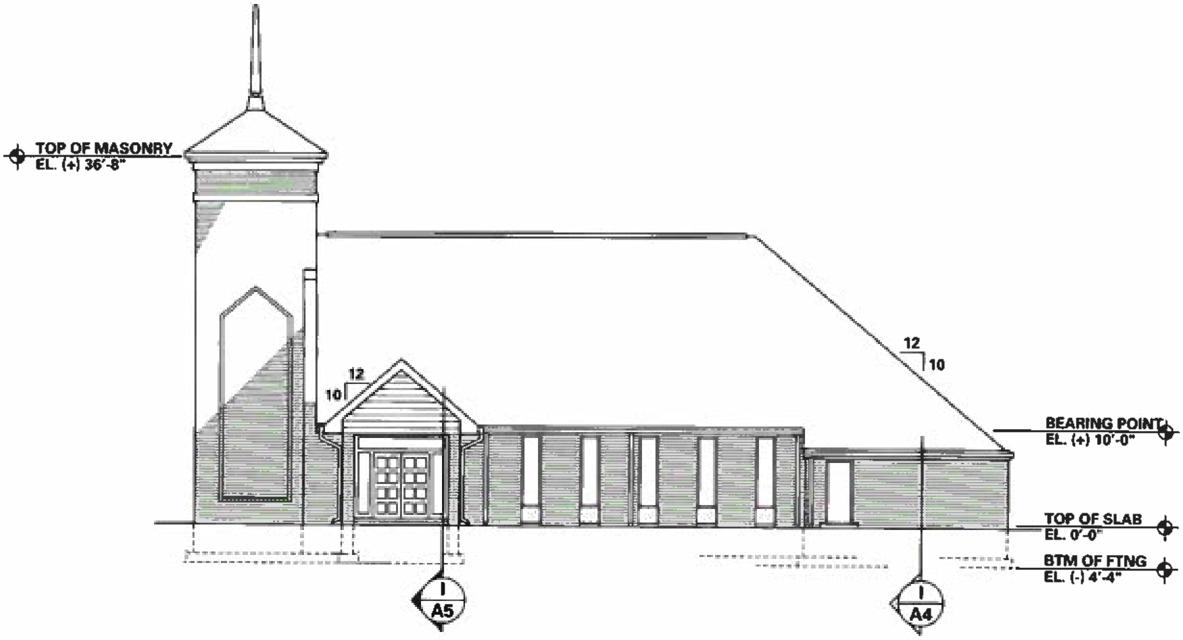
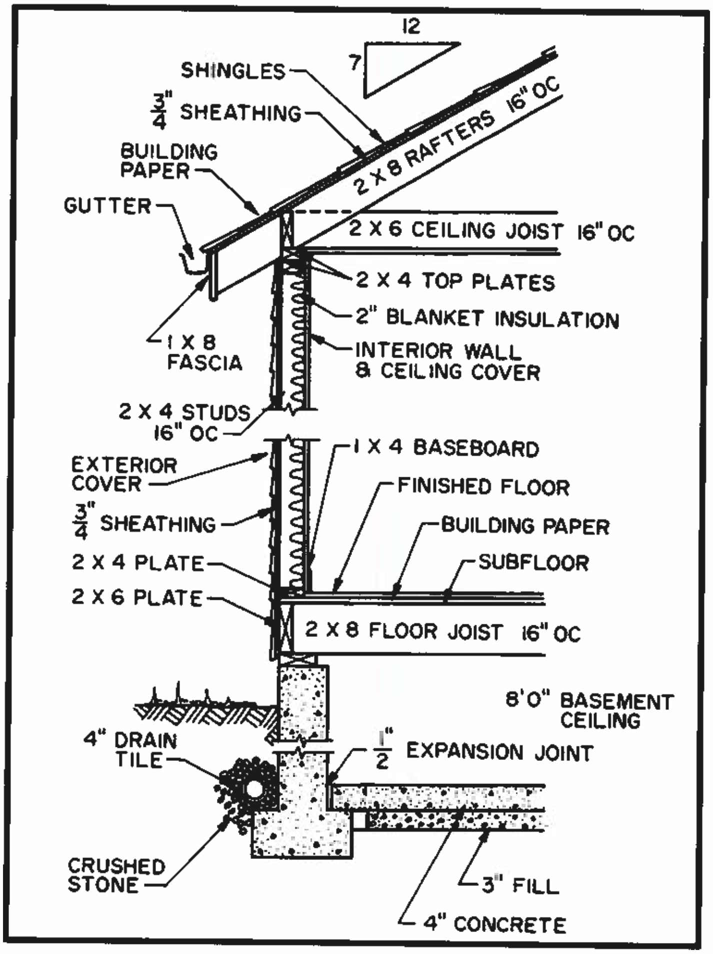


Fig. 12-6. This elevation shows the front of a church. **What is the height of the tower masonry?**

TechnoFact

BUILDING BY THE RULES Designers and builders need to follow certain rules. For example, *zoning laws* regulate the type and size of building that can be constructed in a neighborhood. Almost all communities have *building codes.* These are laws that set the minimum requirements a building must meet. Most local building codes are based on guidelines published by national organizations. For example, the National Electrical Code (NEC) provides guidelines on wiring materials and methods.

Fig. 12-7. This section view shows the roof and outer walls of a house. **Why do you think section views are necessary?**



- **Elevation drawings.** These are views looking at a building from the front, the sides, or the back. Fig. 12-6.
- **Section views.** These are views looking into the building as if a part had been removed. Fig. 12-7.
- **Detail drawings.** These drawings are usually done to a large scale and have more information about a particular part of the project. Fig. 12-8.

A *pictorial drawing* shows a structure in three dimensions. It resembles a picture. Sometimes you might use it to show a client what a structure will look like when finished.

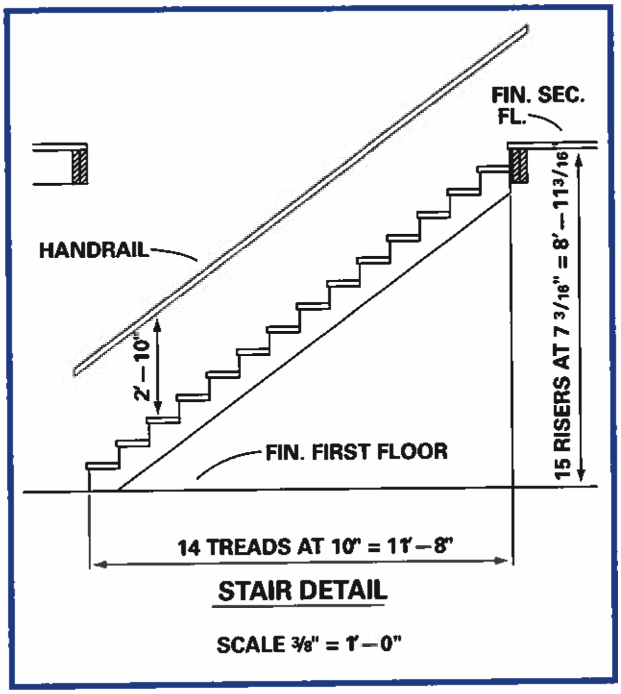


Fig. 12-8. The detail drawing for a stair tells how many steps it must have. **Why must each step be the same size?**

Scale Models

You might decide to build a scale model. Models make it easier to show a client what you have designed. Models also make it easier and less expensive to test for such things as wind resistance and strength before the actual structure is built. Can you imagine building a tall skyscraper only to find out that the wind is so strong at the top that all the windows pop out? That has happened to buildings before!

SECTION 2 TechCHECK

1. What is a floor plan?
2. What are some things an architect needs to know in order to plan a structure for a client?
3. List five different kinds of working drawings you might need to build a house.
4. **Apply Your Knowledge.** Ask an architect to show you the types of working drawings used on a project. See if you can identify them, or bring samples to class.

ACTION ACTIVITY

Designing Your Dream House

Be sure to fill out your TechNotes and place them in your portfolio.

Real World Connection

House designs are often made by the owner of the house. There are many things that must be considered in the design of a house. The cost can be reduced and more livable space built in if you plan carefully. In this activity, you will design a dream house that you might build someday.

Design Brief

Design and draw the floor plan for a house that you would like to build some day. Your design must be practical and efficient. It must include the following:

- three bedrooms
- two bathrooms
- kitchen and dining area
- two-car garage
- utility room and laundry area
- living room or den
- closet space

Materials/Equipment

- graph paper
- drafting tools
- model-making materials (optional)
- CAD system (optional)

SAFETY FIRST

Follow the safety rules listed on pages 42-43 and the specific rules provided by your teacher for tools and machines.

Hints for House Design

- Imagine yourself walking through the house you've designed. Can you get to the rooms easily without bothering people in other rooms? Are the bedrooms located near noisy areas such as the kitchen or living room?
- Remember that safety is an important part of your design. There must be at least two outside doors in case of fire. The windows should be large enough for people to exit through in an emergency.
- Too many hallways are usually a sign of wasted space. The cost of a house is usually calculated by the square foot. You pay as much per square foot per hallway as you do for living space.
- If your design will include a second story or a basement, you will need a floor plan for each level. Be sure the stairs for each level are located carefully.
- Design the stairways so that furniture can be moved up or down easily.

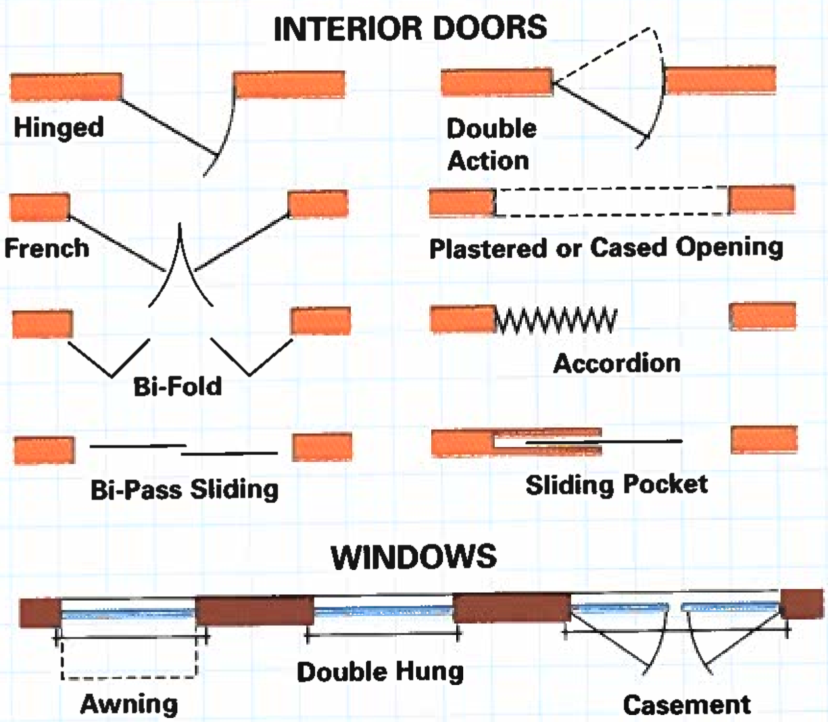
Procedure

1. Make some preliminary sketches on graph paper. It is easiest to use 1/4" graph paper and a scale of 1/4" = 1'. Remember, your first idea may not be the best.
2. Architects and contractors use a set of symbols to draw floor plans. A wall, for example, is not drawn as a thin line. Walls are really 4 1/2" to 12" thick, depending on the construction materials used. The drawing should be made to show the actual thickness of walls. Some of the common symbols you might need to use in your design are shown in Fig. A.
3. Page 272 shows some general hints to help you design a house that will be livable and efficient. They are guidelines, not hard-and-fast rules.
4. When you have refined your preliminary sketch, it is time to make a finished drawing. If you use a computer, changing the plan will be very easy.
5. Complete your floor plan, and present your design to the class.

Evaluation

1. How many square feet (area) are in your design? Include all living spaces and hallways in your calculations.
2. Ask your teacher to find out the average cost per square foot for building a house in your area. Calculate the cost of building your house using this formula:
   cost = cost per square foot x area in square feet
3. How could the building cost of a house be reduced?
4. **Going Beyond.** Design a solar-heated house. Provide for large windows that face south. Make the inside area of the house from a material that can absorb heat during the day and radiate the heat at night.
5. **Going Beyond.** Build a scale model from your floor plan.

Fig. A



SECTION 3

Structural Design

THINGS TO EXPLORE

- Explain what structural drawings are and what information they provide.
- Identify the forces that work on structures and tell how they affect the structure.
- Explain the difference between static and dynamic loads.
- Tell what tension, compression, and shear forces are.
- Design, build, and test a model bridge.

TechnoTerms

compression
dead load
dynamic load
live load
shear
static load
structural drawing
tension

Now that you've made the design plans, you need **structural drawings**. These drawings show structural parts. Kinds and sizes of materials that will be used, where parts go, and how the parts will be fastened should all be included. For example, if you were constructing a large building, you might need different kinds of glass for windows. The structural drawings would show where reflective glass should go or where you are supposed to put some wired glass for security reasons.

Forces Working on Structures

All structures, no matter what their shape or function, are in a game of tug-of-war. Nature's forces act on one side and the strength of the structure's design and materials act on the other.

Structural engineers have to plan structures that have enough strength to stand a sudden gust of wind, an extreme increase in temperature, an earthquake, the pull of gravity, and even the wearing effects of water. The San Francisco earthquake in 1989 caused skyscrapers to move, bridges to buckle, and buildings to collapse. Structural engineers were amazed that most of the area's structures made it through the quake. Fig. 12-9.

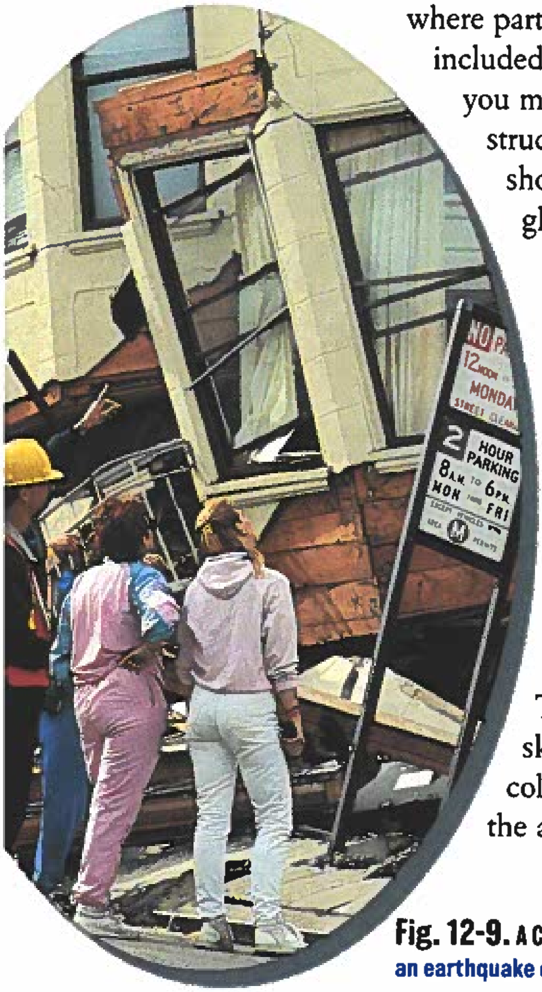


Fig. 12-9. A California earthquake destroyed this building. Research how an earthquake causes damage and share your findings with the class.

Loads Did you know that the forces working on structures are called *loads*? The structural engineer's first job is to figure out which loads will act on a structure and how strong they might be in an unusual situation.

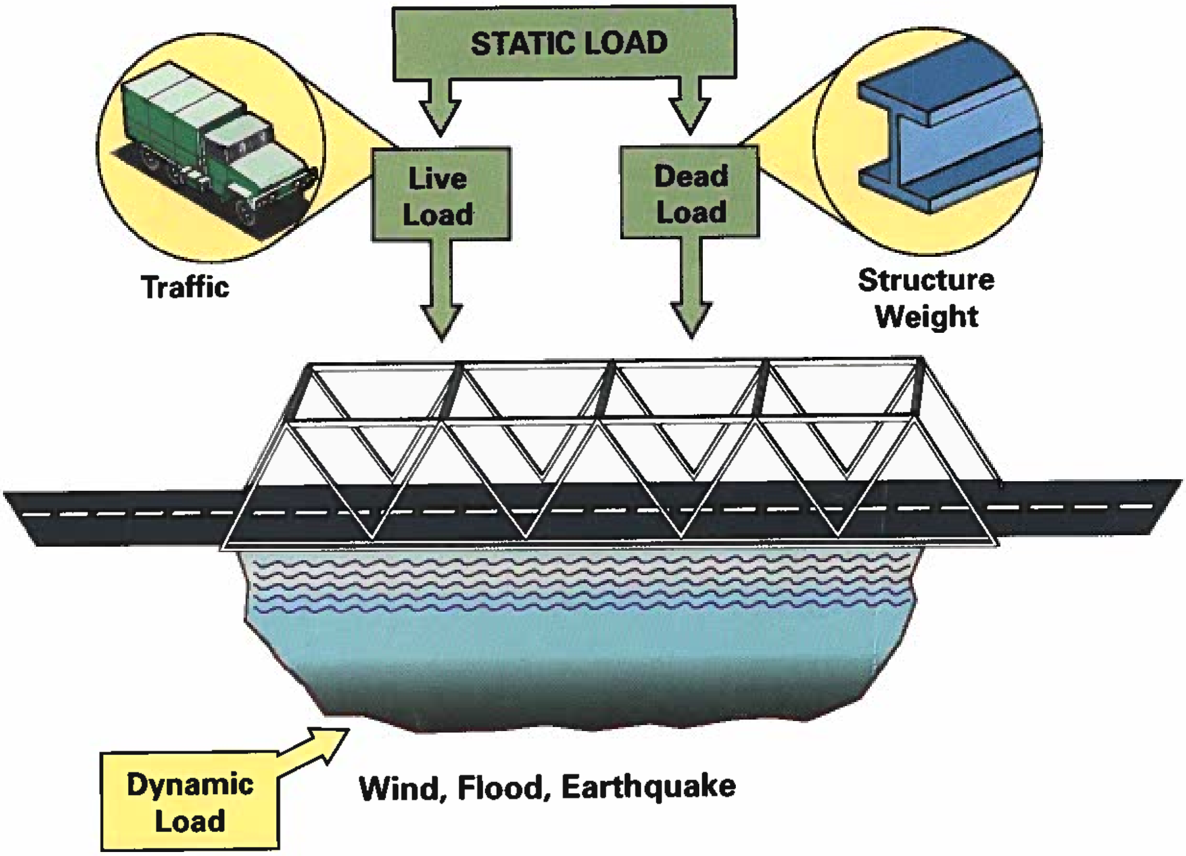
Static loads are loads that are unchanging or slowly changing. Fig. 12-10. Static loads are broken down into two groups, dead loads and live loads. **Dead loads** include the entire weight of the structure itself—the beams, floors, walls, insulation materials, columns, and ceilings of a building, or the deck of a bridge, and so on.

Live loads are forces that a structure supports as it is used under normal weather conditions. Live loads include people, furniture, equipment, or stored materials. Cars and trucks that pass over a bridge or even the weight of snow, rain, or ice on a structure are all live loads.

TechnoFact

THE MIGHTY SPIDER Did you know that the only human-made material that compares in strength to a spider's silk is steel? If you've ever watched a spider spin its web, you've actually watched it build a suspension bridge complete with cables and anchored supports. The silk on the inside of the web is more elastic than the silk on the outside, so it can cope with forces such as strong winds!

Fig. 12-10. Structures must withstand both static and dynamic loads. Which do you think withstands more dynamic loads, a bridge or a dam? Explain your answer.



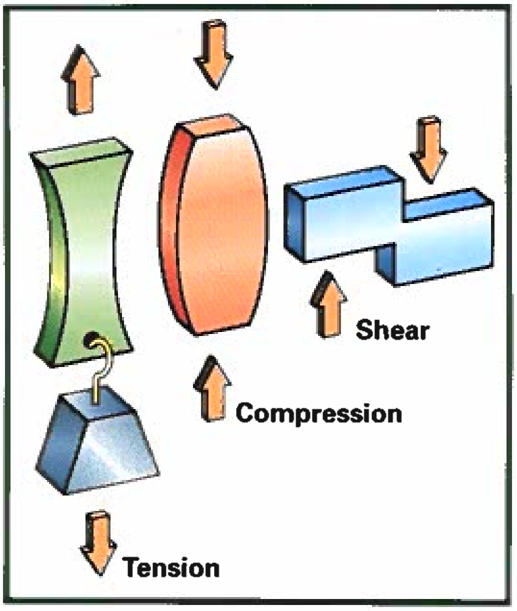


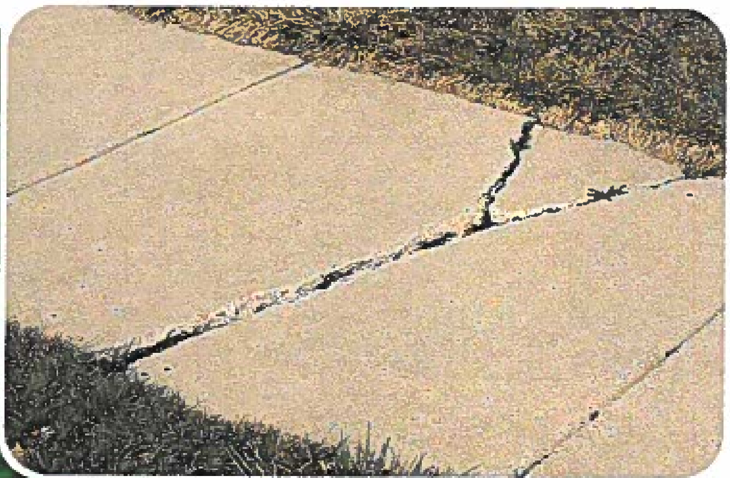
Fig. 12-11. **Concrete is strong under compression but weak under tension. Steel bars are strong under tension but weak under compression.** **Why do you think both are used to make reinforced concrete that is used in roadways?**

Dynamic loads are loads that change rapidly, like sonic booms, vibrations from heavy machinery, vibrations from people walking along a floor, a sudden gust of powerful wind, or an earthquake. Dynamic loads can be very dangerous because they happen so quickly and they produce forces greater than normal. Wind loads are extremely important, especially since we started building tall buildings. That's because the taller the structure, the more it is affected by wind. In very tall buildings, up to 10 percent of the structural weight goes into *wind bracing* (resistance to wind).

Compression, Tension, and Shear Other stresses affect structures too. Under **compression** an object is squeezed. Fig. 12-11. A standing column is always under compression. Concrete is the best material for withstanding compression. That's why it is used so much in construction.

SCIENCE CONNECTION

Thermal Expansion



Have you ever wondered why sidewalks are made in short sections instead of one long piece? The answer may surprise you. It has to do with a scientific principle called *thermal expansion.*

Tension is the opposite of compression. It is a pulling force that stretches materials. Tension is the main force at work in the steel cables of a suspension bridge or the inflated domes of some stadiums.

Shear is when opposing forces act on an object. The blades of scissors cut through paper by forcing it in opposite directions as the blades slide by each other.

When you're building structures, you need to remember how important the loads and other stresses are. It is important to plan for these before you start the actual building process.

SECTION 3 TechCHECK

1. What information should be included in a structural drawing?
2. How are static loads different from dynamic loads?
3. What do compression, tension, and shear forces do?
4. **Apply Your Knowledge.** Take a closer look at a bridge or highway overpass and find examples of tension and compression forces at work.

TechnoFact

THE NEW BUILDERS Robots and computers are changing construction. New architectural software and advanced graphics allow people to "walk through" a structure before construction starts. Construction robots are being used to apply plaster and to spray on fireproofing. Architects and engineers also want robots that can move around a construction site easily or use artificial intelligence to make decisions. They are not far away!

Thermal means "heat," and when something expands it gets bigger. The lines you see in sidewalks are called *expansion joints*. When the sun heats the concrete, it expands. The expansion joints are filled with a material that remains flexible, such as tar. Without expansion joints, the sidewalk would soon crack.

Expansion causes the roadways of bridges to get longer in hot weather and shorter on a cold winter day. The movement is so great that special metal finger joints are used to keep large cracks from forming.

ACTIVITY

Look for other types of expansion joints in the roadways of bridges or in concrete roads. Take pictures of examples you find.

ACTION ACTIVITY

What Holds Things Up?

Be sure to fill out your TechNotes and place them in your portfolio.

Real World Connection

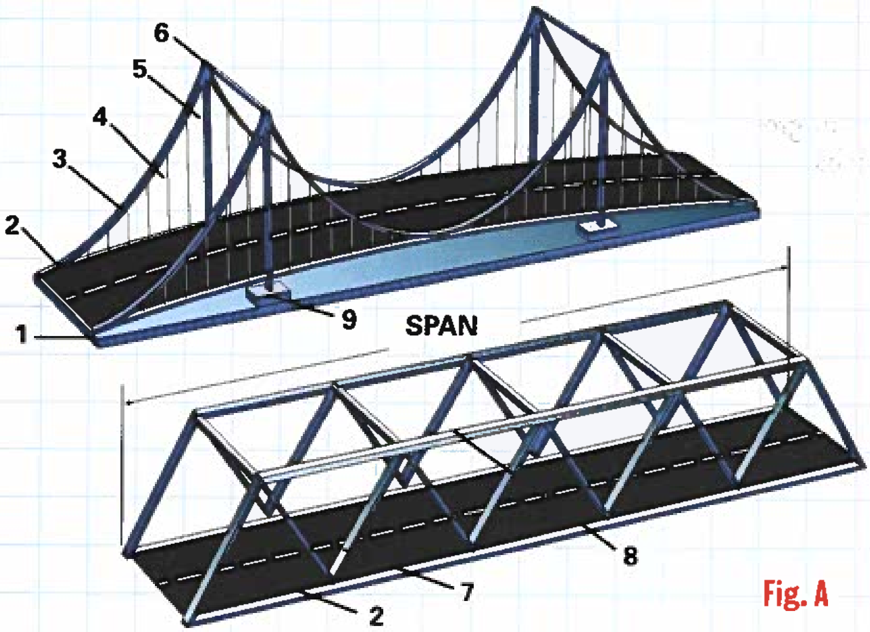
The basic structure of a building is often covered with other building materials so that people can't see it. But it is the most important part of the building. Without it, the building would not stand up. However, the structure of a bridge is usually exposed so you can see exactly how it was built. In this activity, you will build two types of bridges and compare their strength.

Design Brief

Design and build a model of a suspension bridge and one of a truss bridge. Your bridges will be made to span a distance of 4 feet. Similar materials will be used for both.

Materials/Equipment

- plywood
- string
- hardboard
- wood glue
- scroll or band saw
- scissors
- power hand drill
- hot glue gun
- computer with CAD software (optional)



KEY:
1. Base: Plywood 3/4" x 6" x 48"
2. Roadbed: Hardboard 1/8" x 5" x 48"
3. String: 10 strands
4. String: 1 strand
5. Dowel Rod: 5/8" x 14"
6. Dowel Rod: 1/4" x 5 1/2"
7. Welding Rod: 1/16"
8. Wood: 3/8" x 3/8"
9. Wood: 2" x 4" x 6"

Fig. A

Procedure

1. As a class, divide into two groups. One group will design and make a suspension bridge. The other group will design and build a truss bridge. Your designs might look like those in Fig. A. The bridge shown on top is a suspension bridge; on the bottom is a truss bridge.
2. Elect a job contractor from your group. The contractor will be responsible for organizing the building of your bridge. This is a big job. Your group may also elect an assistant contractor to help make the contractor's job easier.
3. Most large construction jobs have a definite date set for their completion. Sometimes, the contract between the builder and the contractor will have a penalty clause. This means that if the project is not finished on time, the contractor must pay a penalty.
4. Design your bridge, and make plans for how it will be built. You might use a computer with CAD software to help. When both groups have completed their design, the class should meet to discuss the completion date for both bridges. Your group should negotiate with your teacher to decide on the due date and a penalty clause.
5. Gather the materials that your group will need. Large construction jobs require a large storage area for construction materials. Your contractor will assign a specific job for everyone in the group to complete.
6. Complete the construction of your bridge. If your due date has passed, you might try to renegotiate the penalty clause so it won't hurt your grade as much.
7. Put the two bridges near each other so that their ends are supported on a block of wood about 3" off the floor. Start testing the bridges by placing weights (books or bricks, for example) in the middle of the roadbed. Be careful not to let the weights fall on you when the bridge fails.

Evaluation

1. How much weight did your bridge support?
2. What are the advantages and disadvantages of suspension bridges?
3. What are the advantages and disadvantages of truss bridges?
4. Where is the longest bridge that is closest to your school? What type of bridge is it?
5. **Going Beyond.** Design and build a drawbridge that will move out of the way of large ships.
6. **Going Beyond.** Use CAD software to design a bridge of the future.

SAFETY FIRST

- **Follow the safety rules listed on pages 42-43 and the specific rules provided by your teacher for tools and machines.**
- **Remember to wear eye protection. Take your time, and work safely with machines and materials. Even though you are trying to work quickly, your first consideration is safety. This is true in this activity and on a real job, too.**

SECTION 4

Designing Communities

THINGS TO EXPLORE

- Explain how communities are affected by new construction.
- Tell why planning is an important part of community development.
- Design and build a model of a community.

TechnoTerms

community

development plan

What effect does modern construction have on you? Do you move around your **community** (area where you live) more easily because of a superhighway near you? How is shopping at the mall different from shopping in town? Fig. 12-12. Your answers to these questions might be different from someone else's answers. Some people might want to move away from an area that is being developed. But you might want to move into an area just because development has made it easy to get around.

Fig. 12-12. This roadway links these homes to a nearby shopping center. Draw a map of roadways linking your home to your school.

Development Requires Planning

Most construction is done to satisfy a need. The need might be for homes, shopping centers, parks, waste management, and roads. Most people care about their community. They want it to continue to meet their needs in the future. To make this happen, the community must have a **development plan** that shows the type of construction and where it will be located. The plan includes laws to control what kinds of construction can take place.

Planning boards, elected officials, and city planners plan for the future and guide community construction projects. They try to make the community a good place to live and work by planning what fits into it. How would you feel about a fast-food restaurant being built next door to your house? Fig. 12-13. Would you like the extra traffic?

Fig. 12-13. **Many people like having restaurants close by. What would be the advantages and disadvantages?**

Community Design Brings Changes

Designing a community is an enormous job. You have to make decisions that might not please all the people. This sometimes happens, for example, when a new highway is built through a city. Sometimes old buildings must be torn down to make room for the road. People must be moved to new neighborhoods away from friends and familiar surroundings. A quiet neighborhood might change to a busy place with new traffic.

Whenever possible, structural engineers and architects should meet with community people and planners to talk over these changes before any construction starts. That way, the people in the community feel they are part of any construction decisions.

Energy Conscious Communities

Several new kinds of communities are being built to save energy. The homes are energy efficient, and these communities have no roads or cars. People walk to the surrounding shops.

Earth-sheltered construction is an example of a design meant to help save energy. Part of the finished building is below ground, where the earth keeps heat from escaping during cold weather.

TechnoFact

SAVING ENERGY

Energy shortages are changing construction techniques. New homes, schools, and other buildings have better insulation, so you don't have to use as much electricity or gas for heating or cooling. Many new homes are also being built with solar panels to collect *solar energy* (energy from the sun). Existing homes are being converted (changed) to solar heat.

SECTION 4 TechCheck

1. Why do we need to plan communities?
2. What are some changes that happen when new construction occurs?
3. What kinds of construction projects might a community need?
4. **Apply Your Knowledge.** Ask your city planner what new changes are coming for your neighborhood or town.

ACTION ACTIVITY

Designing a Community

Be sure to fill out your TechNotes and place them in your portfolio.

Real World Connection

Proper planning and efficient use of land can make our lives in a community safer and more enjoyable. Community planners must consider many factors, such as the need for public buildings. Fig. A. In this activity, you will be a city planner. Your job will be to design an entire community that you would enjoy living in.

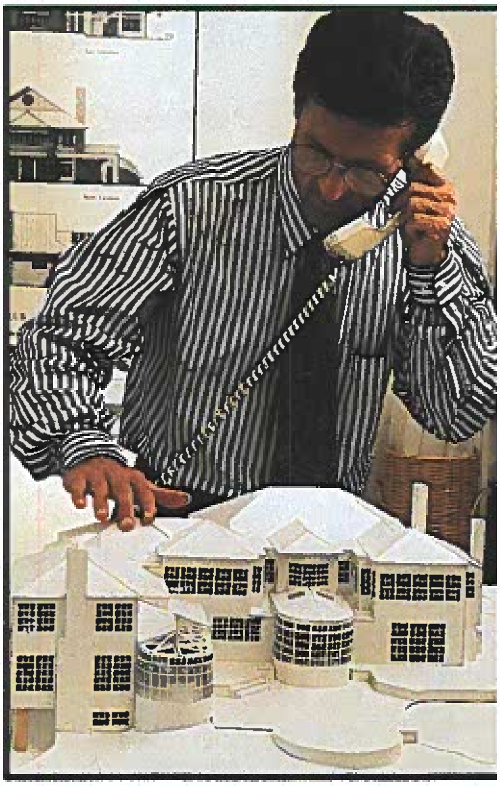
Design Brief

Design and build a model of a community. Your design should consider how people work and play as well as how they shop and move from one place to another. Your community should provide space for at least 20,000 people.

Materials/Equipment

- materials for making models, such as 1/8" x 1/8" balsa wood or Styrofoam plastic foam
- utility knife
- masking tape
- 4' x 4' plywood or particleboard
- 4' roll of butcher's paper
- 4-foot T-square or straightedge and triangles
- wood or hot-melt glue
- hot wire cutter
- hot glue gun
- scroll or band saw
- computer with CAD or city planning software

Fig. A



SAFETY FIRST

Follow the safety rules listed on pages 42-43 and the specific rules provided by your teacher for tools and machines.

Procedure

1. In this activity, you will be part of a planning team to design an entire town or city. Your group will need a leader to coordinate its activities. Be sure to name your city, and decide where it is located in your state or county.

2. Use a 4' x 4' square board as the base for your community. Choose an appropriate scale so the area included in your model will be large enough to represent a town. Consider the size of an average home in your scale. For example, if you chose the scale of 1 foot = 1 mile, a house would measure less than 1/8" x 1/8".

3. Make a rough sketch of how you would like your city to look. Following are some of the things you might want to include in your design:

- *Industrial*—light-industry area (small companies); large-industry area; electric power generation plant
- *Residential*—single-family, low-density housing (individual homes); multiple-family, high-density housing (apartments); public areas
- *Public*—open space, parks, bike and jogging paths; schools, libraries, vocational training centers, colleges or universities; transportation access (major highways, railroad stations, airports, boat docks); waste management.
- *Commercial*—office space, fire departments, police stations; shopping centers, service areas, retail stores

4. Cover a 4' x 4' square plywood or particleboard base with butcher's paper. Lay out the streets and highways. Include bridges or tunnels where they might be needed. Consider the location of industrial areas that need access to highways and residential (home) areas that need quiet. Where should shopping centers be located? How much park space do you think is needed? Where should park space be located? Do you think one or two large parks are better than many smaller parks?

5. With your teacher's help, cut balsa wood or Styrofoam models for the homes, apartment buildings, shopping centers, schools, factories, and so on. Glue the model buildings to the paper layout. Name and label streets and highways. Put any finishing touches on your model.

Evaluation

1. How many people live in the following areas of your city? What is the total population?

- high-density housing
- low-density housing

2. Would you like to live and work in your town? In which areas? Explain.

3. What would happen if a disaster such as a hurricane or a flood required an emergency evacuation of your town?

4. **Going Beyond.** Modify your town to hold two or three times the population for which it was designed. How would schools, police and fire departments, or roads have to change? Would high-rise apartment buildings solve the housing shortage, or would they create other problems? Why do you think there are zoning laws that control how structures can be built?

5. **Going Beyond.** What could be added to your city to make it a place that people would want to visit on a vacation?

CHAPTER 12

REVIEW &

CHAPTER SUMMARY

SECTION 1

- Construction is the part of production that deals with building structures.
- Building structures has changed with the development of stronger, better materials such as steel and concrete.

SECTION 2

- Structures must be thoroughly planned before construction starts.
- Preliminary sketches are refined into floor plans, elevations, structural views, and section views.

SECTION 3

- Static loads either stay the same or change slowly; dynamic loads change quickly.
- Compression forces squeeze objects together and tension pulls objects apart. Shear tends to cut through objects.

SECTION 4

- Designing communities is done by city planners and zoning committees that try to meet the needs of the people.
- Some factors in designing communities include the location of industrial areas, residential areas, and commercial areas.

REVIEW QUESTIONS

1. What resources does the construction industry use to produce buildings and other structures?
2. What are elevation drawings?
3. Name the two types of static loads and give examples of each.
4. Why might someone like living by a freeway?
5. Why is planning a community a difficult job?
6. How could your city or town be changed to make evacuation faster and easier in an emergency?

CRITICAL THINKING

1. Contact the highway department, and ask how bridges are inspected.
2. Research how bridges must be maintained so they will be safe for many years.
3. Research one of these topics and make a model that demonstrates your findings:
    - geodesic dome
    - pneumatic structures
    - earthquake-resistant design
    - undersea structures
    - space stations or moon bases
4. Modify your community model to show what it will look like in the future. How could the city be changed to help prevent air and water pollution?
5. Ask a physician to discuss what tension and compression do to the human body. Share your findings with the class.