

L 2.3 : 2450-17 Construction Trades and Extractive Occupations



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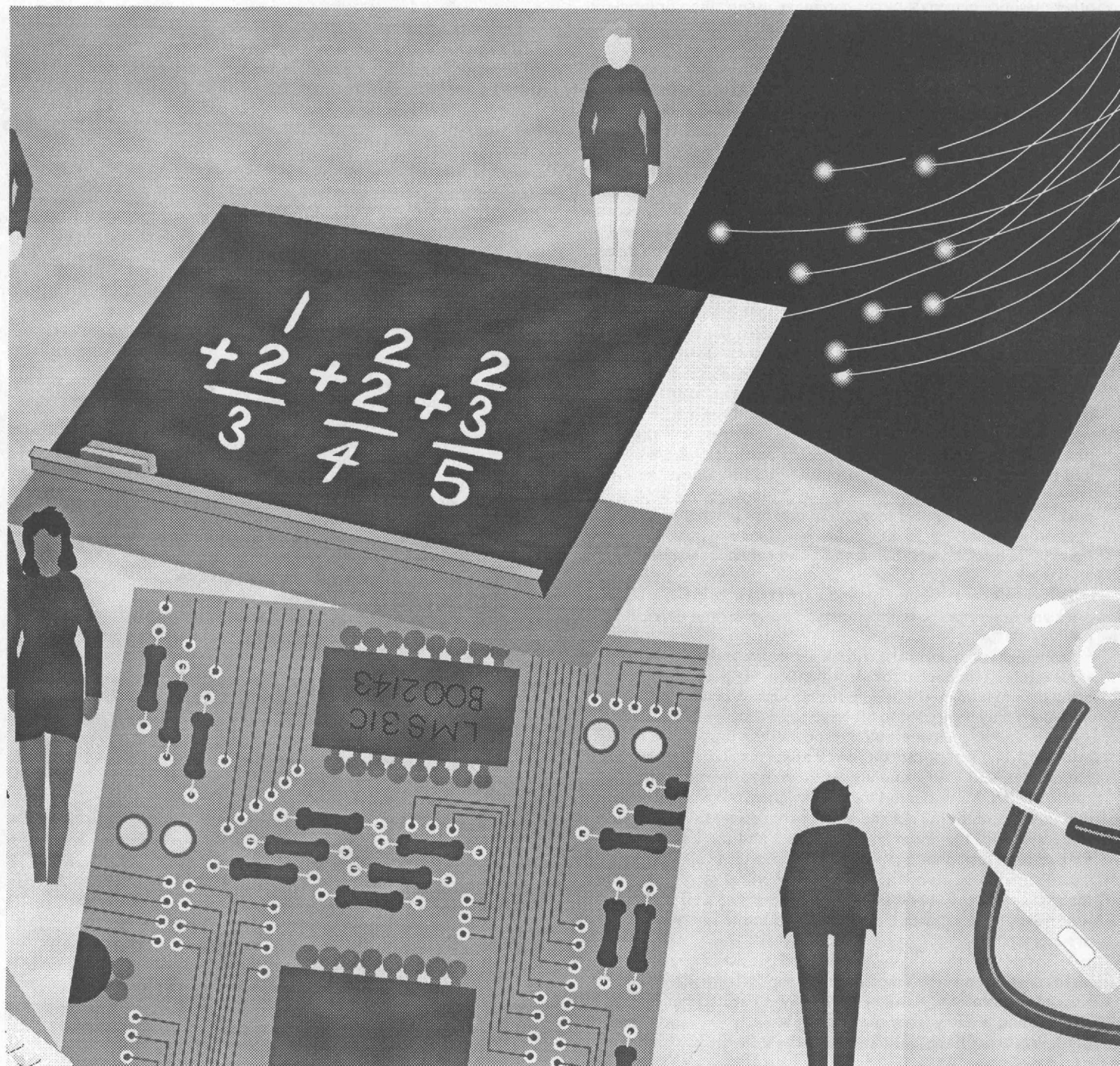
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Bricklayers and Stonemasons

(D.O.T. 779.684-058; 861.361-010 and -014, .381-010 through -042, except -034, .684-010 and -014; and 899.364-010)

Nature of the Work

Bricklayers and stonemasons work in closely related trades that produce attractive, durable surfaces and structures. The work they perform varies in complexity, from laying a simple masonry walkway to installing the ornate exterior of a highrise building. Bricklayers build walls, floors, partitions, fireplaces, chimneys, and other structures with brick, precast masonry panels, concrete block, and other masonry materials. Some specialize in installing firebrick linings in industrial furnaces. Stonemasons build stone walls as well as set stone exteriors and floors. They work with two types of stone—natural cut, such as marble, granite, and limestone and artificial stone made from concrete, marble chips, or other masonry materials. Stonemasons usually work on structures such as houses of worship, hotels, and office buildings.

In putting up a wall, bricklayers traditionally have built the corners of the structure first. Because of the necessary precision, these corner leads are very time consuming to erect and require the skills of the most experienced bricklayers on the job. After the corner leads are complete, less experienced bricklayers fill in the wall between the corners, using a line from corner to corner to guide each course or layer of brick. Because of the expense associated with building corner leads, an increasing number of bricklayers are using corner poles, also called masonry guides, that enable them to build the entire wall at the same time. They fasten the corner posts or poles in a plumb position to define the wall line and stretch a line between them. The line serves as a guide for each course of brick. Bricklayers then spread a bed of mortar (cement, sand, and water mixture) with a trowel (a flat, bladed metal tool with a handle), place the brick on the mortar bed, and then press and tap it into place. As blueprints specify, they either cut brick with a hammer and chisel or saw them to fit around windows, doors, and other openings. Mortar joints are finished with jointing tools for a sealed, neat, and uniform appearance. Although bricklayers generally use steel supports or "lintels" at window and door openings, they sometimes build brick arches that support and enhance the beauty of the brickwork.

Bricklayers are assisted by hod carriers, or helpers, who bring brick and other materials, mix mortar, and set up and move the scaffolding.

Stonemasons often work from a set of drawings in which each stone has been numbered for identification. Helpers may locate and bring the prenumbered stones to the masons. A derrick operator using a hoist may be needed to lift large pieces into place.

When building a stone wall, masons set the first course of stones into a shallow bed of mortar. They align the stones with wedges, plumb lines, and levels, and adjust them into position with a hard rubber mallet. Masons build the wall by alternating layers of mortar and courses of stone. As the work progresses, they remove the wedges and fill the joints between stones and use a pointed metal tool, called a tuck pointer, to smooth the mortar to an attractive finish. To hold large stones in place, stonemasons attach brackets to the stone and weld or bolt them to anchors in the wall. Finally, masons wash the stone with a cleansing solution to remove stains and dry mortar.

When setting stone floors, which often consist of large and heavy pieces of stone, masons first trowel a layer of damp mortar over the surface to be covered. Using crowbars and hard rubber mallets for aligning and leveling, they then set the stone in the mortar bed. To finish, workers fill the joints and wash the stone slabs.

Masons use a special hammer and chisel to cut stone. They cut it along the grain to make various shapes and sizes. Valuable pieces often are cut with a saw that has a diamond blade. Some masons specialize in setting marble which, in many respects, is similar to setting large pieces of stone. Bricklayers and stonemasons also repair imperfections and cracks or replace broken or missing masonry units in walls and floors.

Refractory masons are bricklayers who install firebrick and refractory tile in high-temperature boilers, furnaces, cupolas, ladles, and soaking pits in industrial establishments. Most work in steel mills, where molten materials flow on refractory beds from furnaces to rolling machines.

Many masons are qualified to work with a variety of materials and, in areas that experience lower demand for full-time stone and marble masons, bricklayers also will install these materials.

Working Conditions

Bricklayers and stonemasons usually work outdoors. They stand, kneel, and bend for long periods and may have to lift heavy materials. In addition, they are exposed to injuries from tools and from falls from scaffolds.

Employment

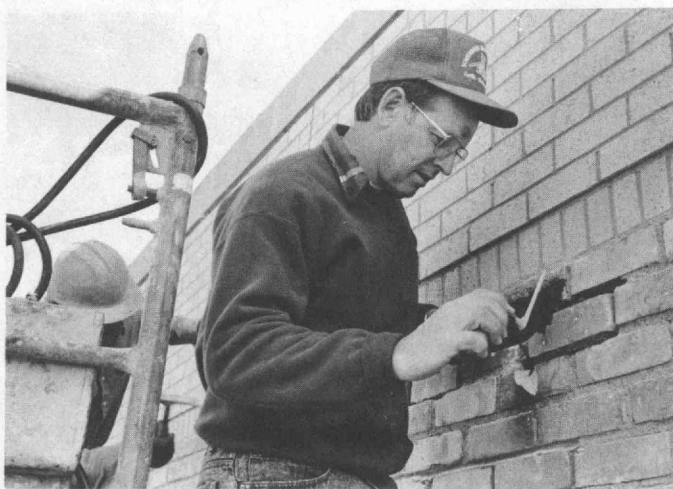
Bricklayers and stonemasons held about 139,000 jobs in 1992. The vast majority were bricklayers. Workers in these crafts are employed primarily by special trade, building, or general contractors. They work throughout the country but, like the general population, are concentrated in metropolitan areas.

Three of every 10 bricklayers and stonemasons are self-employed. Many of the self-employed specialize in contracting on small jobs such as patios, walks, and fireplaces.

Training, Other Qualifications, and Advancement

Most bricklayers and stonemasons pick up their skills informally by observing and learning from experienced workers. Many get training in vocational education schools. The best way to learn these skills, however, is through an apprenticeship program, which generally provides the most thorough training.

Individuals who learn the trade on the job usually start as helpers, laborers, or mason tenders. They carry materials, move scaffolds, and mix mortar. When the opportunity arises, they are taught to spread mortar, lay brick and block, or set stone. As they gain experience, they make the transition to full-fledged craft workers. The learning period generally lasts much longer than an apprenticeship program, however.



Apprenticeship programs provide the most thorough training.

Apprenticeships for bricklayers and stonemasons usually are sponsored by local contractors or by local union-management committees. The apprenticeship program requires 3 years of on-the-job training in addition to a minimum 144 hours of classroom instruction each year in subjects such as blueprint reading, mathematics, layout work, and sketching.

Apprentices often start by working with laborers, carrying materials, mixing mortar, and building scaffolds. This period generally lasts about a month and familiarizes them with job routines and materials. Next, they learn to lay, align, and join brick and block. Apprentices also learn to work with stone and concrete. This enables them to be certified to work with more than one masonry material.

Applicants for apprenticeships must be at least 17 years old and in good physical condition. A high school education is preferable, and courses in mathematics, mechanical drawing, and shop are helpful. The International Masonry Institute operates training centers in several large cities that help jobseekers develop the skills they will need to successfully complete the formal apprenticeship program.

Experienced workers can advance to supervisory positions or become estimators. They also can open contracting businesses of their own.

Job Outlook

Employment of bricklayers and stonemasons is expected to grow about as fast as the average for all occupations through the year 2005. Population and business growth will create a need for new factories, schools, hospitals, offices, and other structures. Also stimulating demand will be the increasing use of brick for decorative work on building fronts and in lobbies and foyers. Brick exteriors continue to be very popular as the trend continues toward more durable exterior materials requiring less maintenance. Employment of bricklayers who specialize in refractory repair will decline, along with employment in other occupations in the primary metal industries.

In addition to jobs created by an increase in demand for these workers, openings will result from the need to replace bricklayers and stonemasons who retire, transfer to other occupations, or leave the trades for other reasons.

Employment of bricklayers and stonemasons, like that of many other construction workers, is sensitive to changes in the economy. When the level of construction activity falls, workers in these trades can experience periods of unemployment.

Earnings

Median weekly earnings for bricklayers and stonemasons were about \$480 in 1992. The middle 50 percent earned between \$335 and \$640 weekly. The highest 10 percent earned more than \$785 weekly; the lowest 10 percent, less than \$260. Earnings for workers in these trades may be reduced on occasion because poor weather and downturns in construction activity limit the time they can work.

In each trade, apprentices or helpers usually start at about 50 percent of the wage rate paid to experienced workers. The rate increases as they gain experience.

Some bricklayers and stonemasons are members of the International Union of Bricklayers and Allied Craftsmen.

Related Occupations

Bricklayers and stonemasons combine a thorough knowledge of brick, concrete block, stone, and marble with manual skill to erect very attractive yet highly durable structures. Workers in other occupations with similar skills include concrete masons, plasterers, terrazzo workers, and tilesetters.

Sources of Additional Information

For details about apprenticeships or other work opportunities in these trades, contact local bricklaying, stonemasonry, or marble setting contractors; a local of the union listed above; a local joint

union-management apprenticeship committee; or the nearest office of the State employment service or State apprenticeship agency.

For general information about the work of either bricklayers or stonemasons, contact:

International Union of Bricklayers and Allied Craftsmen, International Masonry Institute Apprenticeship and Training, 815 15th St. NW., Washington, DC 20005.

Information about the work of bricklayers also may be obtained from:

Associated General Contractors of America, Inc., 1957 E St. NW., Washington, DC 20006.

Brick Institute of America, 11490 Commerce Park Dr., Reston, VA 22091-1525.

National Association of Home Builders, Home Builders Institute, 1090 Vermont Ave. NW., Washington, DC 20005.

National Concrete Masonry Association, 2302 Horse Pen Rd., Herndon, VA 22071.

Carpenters

(D.O.T. 806.281-058; 860.281-010 through .684-014; 863.684-010; 869.361-018, .381-010, -034, .684-018, -034, -042, and -058; and 962.281-010)

Nature of the Work

Carpenters are involved in many different kinds of construction activity. They cut, fit, and assemble wood and other materials in the construction of buildings, highways and bridges, docks, industrial plants, boats, and many other structures. The duties of carpenters vary by type of employer. A carpenter employed by a special trade contractor, for example, may specialize in one or two activities such as setting forms for concrete construction or erecting scaffolding, while a carpenter employed by a general building contractor may perform many tasks, such as framing walls and partitions, putting in doors and windows, hanging kitchen cabinets, and installing paneling and tile ceilings. Although each carpentry task is somewhat different, most tasks involve the following steps.

Working from blueprints or instructions from supervisors, carpenters first do the layout—measuring, marking, and arranging materials. Local building codes often dictate where certain materials can be used, and carpenters have to know these requirements. Carpenters cut and shape wood, plastic, ceiling tile, fiberglass, and drywall, with hand and power tools, such as chisels, planes, saws, drills, and sanders. Carpenters then join the materials with nails, screws, staples, or adhesives. In the final step, they check the accuracy of their work with levels, rules, plumb bobs, and framing squares and make any necessary adjustments. When working with prefabricated components, such as stairs or wall panels, the carpenter's task is somewhat simpler because it does not require as much layout work or the cutting and assembly of as many pieces. These components are designed for easy and fast installation and can generally be installed in a single operation.

Carpenters employed outside the construction industry do a variety of installation and maintenance work. They may replace panes of glass, ceiling tiles, and doors, as well as repair desks, cabinets, and other furniture. Depending on the employer, carpenters may install partitions, doors, and windows; change locks; and repair broken furniture. In manufacturing firms, carpenters may assist in moving or installing machinery. (For more information on workers who install this machinery, see the statements on industrial machinery repairers and millwrights elsewhere in the *Handbook*.)

Working Conditions

As in other building trades, carpentry work is sometimes strenuous. Prolonged standing, climbing, bending, and kneeling often are necessary. Carpenters risk injury from slips or falls, from working with sharp or rough materials, and from the use of sharp tools and power equipment. Many carpenters work outdoors.



Carpenters must be very careful when operating power equipment.

Some carpenters change employers each time they finish a construction job. Others alternate between working for a contractor and working as contractors themselves on small jobs.

Employment

Carpenters—the largest group of building trades workers—held about 990,000 jobs in 1992. Three of every 4 worked for contractors who build, remodel, or repair buildings and other structures. Most of the remainder worked for manufacturing firms, government agencies, wholesale and retail establishments, and schools. About 4 of every 10 were self-employed.

Carpenters are employed throughout the country in almost every community.

Training, Other Qualifications, and Advancement

Carpenters learn their trade through on-the-job training and through formal training programs. Some pick up skills informally by working under the supervision of experienced workers. Many acquire skills through vocational education. Others participate in employer training programs or apprenticeships.

Most employers recommend an apprenticeship as the best way to learn carpentry. Because the number of apprenticeship programs is limited, however, only a small proportion of carpenters learn their trade through these programs. Apprenticeship programs are administered by local chapters of the Associated Builders and Contractors and by local chapters of the Associated General Contractors, Inc., as well as by local joint union-management committees of the United Brotherhood of Carpenters and Joiners of America and the Associated General Contractors, Inc. or the National Association of Home Builders. These programs combine on-the-job training with related classroom instruction. Apprenticeship applicants generally must be at least 17 years old and meet local requirements. For example, some union locals test an applicant's aptitude for carpentry. The length of the program, usually about 3 to 4 years, varies with the apprentice's skill.

On the job, apprentices learn elementary structural design and become familiar with common carpentry jobs such as layout, form building, rough framing, and outside and inside finishing. They also learn to use the tools, machines, equipment, and materials of the trade. Apprentices receive classroom instruction in safety, first aid, blueprint reading and freehand sketching, basic mathematics, and different carpentry techniques. Both in the classroom and on the

job, they learn the relationship between carpentry and the other building trades.

Informal on-the-job training usually is less thorough than an apprenticeship. The degree of training and supervision often depends on the size of the employing firm. A small contractor who specializes in homebuilding may only provide training in rough framing. In contrast, a large general contractor may provide training in several carpentry skills.

A high school education is desirable, including courses in carpentry, shop, mechanical drawing, and general mathematics. Manual dexterity, eye-hand coordination, good physical condition, and a good sense of balance are important. The ability to solve arithmetic problems quickly and accurately also is helpful. Employers and apprenticeship committees generally view favorably training and work experience obtained in the Armed Services.

Carpenters may advance to carpentry supervisors or general construction supervisors. Carpenters usually have greater opportunities than most other construction workers to become general construction supervisors because they are exposed to the entire construction process. Some carpenters become independent contractors.

Job Outlook

Job opportunities for carpenters are expected to be plentiful through the year 2005, due primarily to extensive replacement needs. Well over 100,000 jobs will become available each year as carpenters transfer to other occupations or leave the labor force. The total number of job openings for carpenters each year usually is greater than for other craft occupations because the occupation is large and turnover is high. Since there are no strict training requirements for entry, many people with limited skills take jobs as carpenters but eventually leave the occupation because they find they dislike the work or cannot find steady employment.

Increased demand for carpenters will create additional job openings. Employment is expected to increase about as fast as the average for all occupations through the year 2005. Construction activity should increase in response to demand for new housing and commercial and industrial plants and the need to renovate and modernize existing structures. The demand for carpenters will be offset somewhat by expected productivity gains resulting from the increasing use of prefabricated components that can be installed much more quickly than by traditional construction methods. In addition, light, cordless pneumatic and combustion tools such as nailers and drills as well as sanders with electronic speed controls reduce fatigue and make workers more efficient.

Although employment of carpenters is expected to grow over the long run, people entering the occupation should expect to experience periods of unemployment. This results from the short-term nature of many construction projects and the cyclical nature of the construction industry. Building activity depends on many factors—interest rates, availability of mortgage funds, government spending, and business investment—that vary with the state of the economy. During economic downturns, the number of job openings for carpenters is reduced. The introduction of new and improved tools, equipment, techniques, and materials has vastly increased carpenters' versatility. Therefore, carpenters with all-round skills will have better opportunities than those who can only do relatively simple, routine tasks.

Job opportunities for carpenters also vary by geographic area. Construction activity parallels the movement of people and businesses and reflects differences in local economic conditions. Therefore, the number of job opportunities and apprenticeship opportunities in a given year may vary widely from area to area.

Earnings

Median weekly earnings of carpenters who were not self-employed were \$425 in 1992. The middle 50 percent earned between \$320 and \$585 per week. Weekly earnings for the top 10 percent of all carpenters were more than \$770; the lowest 10 percent earned less than \$255.

Earnings may be reduced on occasion because carpenters lose work time in bad weather and when jobs are unavailable. A large proportion of carpenters are members of the United Brotherhood of Carpenters and Joiners of America.

Related Occupations

Carpenters are skilled construction workers. Workers in other skilled construction occupations include bricklayers, concrete masons, electricians, pipefitters, plasterers, plumbers, stonemasons, and terrazzo workers.

Sources of Additional Information

For information about carpentry apprenticeships or other work opportunities in this trade, contact local carpentry contractors, a local of the union mentioned above, a local joint union-contractor apprenticeship committee, or the nearest office of the State employment service or State apprenticeship agency.

For general information about this trade, contact:

☞ Associated Builders and Contractors, 729 15th St. NW., Washington, DC 20005.

☞ Associated General Contractors of America, Inc., 1957 E St. NW., Washington, DC 20006.

☞ Home Builders Institute, Educational Arm of the National Association of Home Builders, 1090 Vermont Ave. NW., Washington, DC 20005.

☞ United Brotherhood of Carpenters and Joiners of America, 101 Constitution Ave. NW., Washington, DC 20001.

Carpet Installers

(D.O.T. 864.381-010)

Nature of the Work

Many homes, offices, stores, restaurants, and other buildings have carpet that was installed by a carpet installer. Before installing the carpet, these craft workers first inspect the floor to determine its condition and, if necessary, correct any imperfections that could show through the carpet. Then they measure the area to be carpeted and plan the layout of the carpet, keeping in mind expected traffic patterns and placement of seams for best appearance and maximum wear.

For wall-to-wall carpet, installers first lay and tack or tape a cushion or underlay. Next, they roll out, measure, mark, and cut the carpet, allowing for 3 to 4 inches of extra carpet on each side for the final fitting. They then install the carpet by stretching it to fit evenly on the floor and snugly against each wall and door threshold, and trim the excess. Finally, they attach the carpet to a stripping to hold it in place.

Because most carpet comes in 12-foot widths, wall-to-wall installations require installers to tape or sew sections together for large rooms. They join the seams by sewing them with a large, curved needle and special thread or by using heat-taped seams (a special plastic tape made to join seams when activated with heat).

Carpet installers use handtools such as hammers, drills, staple guns, and rubber mallets. They also use carpet-laying tools, such as carpet knives, knee kickers, and power stretchers.

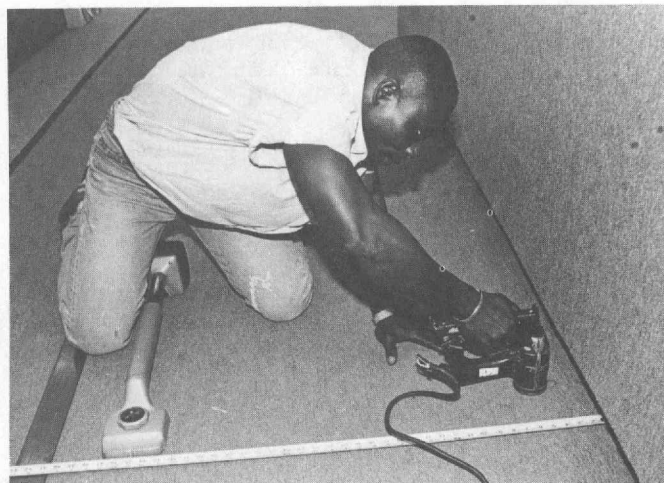
Working Conditions

Installers work under better conditions than most other construction workers. Because carpets are installed in finished or nearly finished structures, work areas usually are clean, well lighted, safe, and comfortable. Installers kneel, reach, bend, stretch, and frequently lift heavy rolls of carpet. Installers generally work regular daytime hours. However, when recarpeting stores or offices, they may work evenings and weekends to avoid disturbing customers or employees.

Employment

Carpet installers held about 62,000 jobs in 1992. Many worked for flooring contractors or floor covering retailers. Two of every 3 carpet installers are self-employed.

Installers are employed throughout the Nation, but are concentrated in urban areas that have high levels of construction activity.



Carpet installers get paid either an hourly wage or by the number of yards installed.

Training, Other Qualifications, and Advancement

The vast majority of carpet installers learn their trade informally on the job as helpers to experienced installers. Others learn through formal apprenticeship programs, which include on-the-job training as well as related classroom instruction.

Informal training is often sponsored by individual contractors and generally lasts about 1 1/2 to 2 years. Helpers begin with simple assignments, such as installing stripping and padding, and helping stretch newly installed carpet. With experience, helpers take on more difficult assignments, such as measuring, cutting, and fitting.

Apprenticeship programs and some contractor-sponsored programs provide comprehensive training in all phases of carpet laying. Most union-sponsored apprenticeship programs consist of weekly classes and on-the-job training that usually last 3 to 4 years.

Helpers and apprentices should be 18 years old and have manual dexterity. Employers also want individuals who are clean, courteous, and tactful. A high school education is preferred, though not necessary. Courses in general mathematics and shop may be helpful. A driver's license and a criminal background check are usually required.

Carpet installers may advance to supervisors or installation managers for large installation firms. Some installers become salespersons or estimators. Many installers also go into business for themselves as independent subcontractors.

Job Outlook

Employment of carpet installers is expected to grow about as fast as the average for all occupations through the year 2005 in response to the continued need to renovate and refurbish existing structures and a growing demand for carpet in new industrial plants, schools, hospitals, and other structures.

The use of carpet as a floor covering continues to be popular. In the many houses built with plywood rather than hardwood floors, wall-to-wall carpet is a necessity. Similarly, offices, hotels, motels, and shopping centers often cover concrete floors with wall-to-wall carpet. Carpet will continue to be used in renovation work. Moreover, new fibers that are more durable, stain, and crush resistant and that come in fashionable colors will contribute to the growing demand for carpet and, consequently, for carpet installers. Despite this growth in demand, however, most openings will arise as experienced installers transfer to other occupations or leave the labor force.

Although this occupation is less sensitive to changes in economic conditions than most other construction crafts, it too is affected by downturns in the economy. When the economy slows down, the demand for new carpet falls, lowering the demand for carpet installers. However, because much of their work involves replacing carpet in existing buildings, employment generally remains relatively stable even when new construction activity declines.

Earnings

Median weekly earnings of all full-time carpet installers were about \$375 in 1992. The middle 50 percent earned between \$275 and \$510 per week. The top 10 percent earned more than \$700 and the lowest 10 percent earned less than \$185.

Carpet installers get paid either on an hourly basis or by the number of yards installed. The rates vary widely depending on the geographic location and whether the installer is affiliated with a union. According to limited information available, union carpet installers earned between \$16 and \$25 an hour in 1992, including fringe benefits. Starting wage rates for apprentices and other trainees usually are about half of the experienced worker's rate. Some installers belong to the United Brotherhood of Carpenters and Joiners of America or the International Brotherhood of Painters and Allied Trades.

Nonunion carpet installers are usually paid by the number of yards installed. In 1992, they received between \$1.50 and \$2.75 a yard.

Related Occupations

Carpet installers measure, cut, and fit carpet materials. Workers in other occupations involving different materials but which require similar skills include carpenters, cement masons, drywall installers, floor layers, lathers, painters and paperhangers, roofers, sheet-metal workers, terrazzo workers, and tilers.

Sources of Additional Information

For details about apprenticeships or work opportunities, contact local flooring contractors or retailers; locals of the unions previously mentioned; or the nearest office of the State apprenticeship agency or the State employment service.

For general information about the work of carpet installers, contact:

☞ Floor Covering Installation Contractors Association, P.O. Box 948, Dalton, GA 30722-0948.

☞ United Brotherhood of Carpenters and Joiners of America, 101 Constitution Ave. NW., Washington, DC 20001.

☞ International Brotherhood of Painters and Allied Trades, 1750 New York Ave. NW., Washington, DC 20006.

For information concerning training contact:

☞ New York City District Council of Carpenters Labor Technical College, 395 Hudson St., New York, NY 10014.

Concrete Masons and Terrazzo Workers

(D.O.T. 844.364-010, -014, .461-010, .684-010; and 861.381-046, and -050)

Nature of the Work

Concrete—a mixture of Portland cement, sand, gravel, and water—is used for many types of construction projects. These range from small jobs such as patios and floors to huge dams or miles of roadway. Concrete masons place and finish the concrete for these projects. They also may color concrete surfaces, expose aggregate (small stones) in walls and sidewalks, or fabricate concrete beams, columns, and panels.

Terrazzo workers create attractive walkways, floors, patios, and panels by exposing marble chips and other fine aggregates on the surface of finished concrete. Much of the preliminary work of terrazzo workers is similar to that of concrete masons.

In preparing a site for placing concrete, masons set the forms for holding the concrete to the desired pitch and depth and properly align them. They then direct the casting of the concrete and supervise laborers who use shovels or special tools to spread the concrete. Masons then guide a straightedge back and forth across the top of the forms to screed (level) the freshly placed concrete.

Immediately after leveling the concrete, masons carefully smooth the concrete surface with a long-handled tool about 8 by 48 inches (called a bull float) to cover coarser materials and bring a rich mixture of fine cement paste to the surface.

After the concrete has been leveled and floated, finishers press an edge between the forms and the concrete and guide it along the edge and the surface. This produces slightly rounded edges and helps prevent chipping or cracking. They use a special tool (called a groover) to make joints or grooves at specific intervals that help control cracking.

Next, finishers trowel the surface with a powered trowel or by hand with a small, smooth, rectangular metal tool. This troweling removes most imperfections and brings the fine cement paste to the surface.

As the final step, masons retrowel the concrete surface back and forth with powered and hand trowels to create a smooth finish. For a coarse, nonskid finish, masons brush the surface with a broom or stiff-bristled brush. For a pebble finish, they embed small gravel chips into the surface. They then wash any excess cement from the exposed chips with a mild acid solution. For color, they use colored premixed concrete.

On concrete surfaces that will remain exposed after forms are stripped, such as columns, ceilings, and wall panels, concrete masons cut away high spots and loose concrete with hammer and chisel, fill any large indentations with a Portland cement paste and smooth the surface with a rubbing carborundum stone. Finally, they coat the exposed area with a rich Portland cement mixture using either a special tool or a coarse cloth to rub the concrete to a uniform finish.

Attractive, marble-chip terrazzo requires three layers of materials. First, concrete masons or terrazzo workers build a solid, level concrete foundation that is 3 to 4 inches deep. After the forms are removed from the foundation, workers place a 1-inch deep mixture of sandy concrete. Before this layer sets, terrazzo workers partially embed metal ferrule strips into the concrete wherever there is to be a joint or change of color in the terrazzo. These strips separate the different designs and colors of the terrazzo panels and help prevent cracks. For the final layer, terrazzo workers blend and place a fine marble chip mixture that may be color-dyed into each of the panels, then hand trowel each panel until it is level with the tops of the ferrule strips. While the mixture is still wet, workers toss additional marble chips of various colors into each panel and roll a lightweight roller over the entire surface.

When the terrazzo is thoroughly dry, helpers grind it with a terrazzo grinder (somewhat like a floor polisher, only much heavier). Slight depressions left by the grinding are filled with a matching grout material and hand troweled for a smooth, uniform surface. Terrazzo workers then clean, polish, and seal the dry surface for a lustrous finish.

Working Conditions

Concrete or terrazzo work is fast paced and strenuous. Since most finishing is done at floor level, workers must bend and kneel a lot. Many jobs are outdoors, but work is generally halted during rain or



Improved materials, equipment, and tools are making concrete masons and terrazzo workers more productive.

freezing weather. To avoid chemical burns from uncured concrete and sore knees from frequent kneeling, many workers wear kneepads. Workers usually wear water-repellent boots while working in wet concrete.

Employment

Concrete masons and terrazzo workers held about 100,000 jobs in 1992; terrazzo workers accounted for a very small proportion of the total. Most concrete masons work for concrete contractors or for general contractors on projects such as highways, bridges, shopping malls, or large buildings such as factories, schools, and hospitals. A small number are employed by firms that manufacture concrete products. Most terrazzo workers work for special trade contractors who install decorative floors and wall panels.

About 1 out of 17 concrete masons and terrazzo workers is self-employed, a smaller proportion than in other building trades. Most self-employed masons specialize in small jobs, such as driveways, sidewalks, and patios.

Training, Other Qualifications, and Advancement

Concrete masons and terrazzo workers learn their trades either through on-the-job training as helpers or through 2- or 3-year apprenticeship programs. Many masons first gain experience as construction laborers.

On-the-job training programs consist of informal instruction from experienced workers in which helpers learn to use the tools, equipment, machines, and materials of the trade. They begin with tasks such as edging and jointing and using a straightedge on freshly placed concrete. As they progress, assignments become more complex, and trainees usually can do finishing work within a short time.

Two- and 3-year apprenticeship programs, usually jointly sponsored by local unions and contractors, provide on-the-job training in addition to a recommended minimum of 144 hours of classroom instruction each year. A written test and a physical exam may be required. In the classroom, apprentices learn applied mathematics, plan reading, and safety. Apprentices generally receive special instruction in layout work and cost estimating.

When hiring helpers and apprentices, employers prefer high school graduates who are at least 18 years old, in good physical condition, and licensed to drive. The ability to get along with others also is important because concrete masons frequently work in teams. High school courses in shop mathematics and blueprint reading or mechanical drawing provide a helpful background.

Experienced concrete masons or terrazzo workers may advance to supervisors or contract estimators. Some open their own concrete contracting businesses.

Job Outlook

Employment of concrete masons and terrazzo workers is expected to grow more slowly than the average for all occupations through the year 2005. In addition to job openings that will stem from the rising demand for the services of these workers, other jobs will become available as experienced workers transfer to other occupations or leave the labor force.

The demand for concrete masons and terrazzo workers will rise as the population and the economy grow. More masons will be needed to build highways, bridges, subways, factories, office buildings, hotels, shopping centers, schools, hospitals, and other structures. In addition, the increasing use of concrete as a building material—particularly in nonresidential construction—will add to the demand. More concrete masons also will be needed to repair and renovate existing highways, bridges, and other structures. Employment of concrete masons and terrazzo workers, however, will not keep pace with the demand for these construction projects because of rising productivity resulting from improved materials, equipment, and tools. Greater use of improved concrete pumping systems, quicker setting cement, troweling machines, prefabricated masonry systems, and other timesaving technologies are enabling concrete masons and terrazzo workers to work more efficiently.

Employment of concrete masons and terrazzo workers, like that of many other workers, is sensitive to ups and downs in the economy. Workers in these trades can experience periods of unemployment when the level of nonresidential construction falls. On the other hand, shortages of these workers may occur in some areas during peak periods of building activity.

Earnings

According to the limited information available, average hourly earnings—including benefits—for concrete masons who belonged to a union and worked full time ranged between \$15 and \$37 in 1992. Concrete masons in Boston, New York, San Francisco, Los Angeles, Philadelphia, and other large cities received the highest wages. Nonunion workers generally have lower wage rates than union workers. Apprentices usually start at 50 to 60 percent of the rate paid to experienced workers.

Concrete masons often work overtime, with premium pay, because once concrete has been placed, the job must be completed.

Annual earnings of concrete masons and terrazzo workers may be lower than the hourly rates suggest because bad weather and downturns in construction activity can limit the time they can work.

Many concrete masons and terrazzo workers belong to the Operative Plasterers' and Cement Masons' International Association of the United States and Canada, or to the International Union of Bricklayers and Allied Craftsmen. Some terrazzo workers belong to the United Brotherhood of Carpenters and Joiners of the United States.

Related Occupations

Concrete masons and terrazzo workers combine skill with knowledge of building materials to construct buildings, highways, and other structures. Other occupations involving similar skills and knowledge include bricklayer, form builder, marble setter, plasterer, stonemason, and tilesetter.

Sources of Additional Information

For information about apprenticeships and work opportunities, contact local concrete or terrazzo contractors; locals of unions previously mentioned; a local joint union-management apprenticeship committee; or the nearest office of the State employment service or apprenticeship agency.

For general information about concrete masons and terrazzo workers, contact:

- ☛ Associated General Contractors of America, Inc., 1957 E St. NW., Washington, DC 20006.
- ☛ International Union of Bricklayers and Allied Craftsmen, 815 15th St. NW., Washington, DC 20005.
- ☛ Operative Plasterers' and Cement Masons' International Association of the United States and Canada, 1125 17th St. NW., Washington, DC 20036.
- ☛ Portland Cement Association, 5420 Old Orchard Rd., Skokie, IL 60077.
- ☛ National Terrazzo and Mosaic Association, 3166 Des Plaines Ave., Suite 132, Des Plaines, IL 60018.

Drywall Workers and Lathers

(D.O.T. 842.361-010, -014, and -030, .664-010, .684-014; and 869.684-050)

Nature of the Work

Drywall consists of a thin layer of gypsum sandwiched between two layers of heavy paper. It is used today for walls and ceilings in most buildings because it is both faster and cheaper to install than plaster.

There are two kinds of drywall workers: installers and finishers. Installers, also called applicators, fasten drywall panels to the inside framework of residential houses and other buildings. Finishers, or tapers, prepare these panels for painting by taping and finishing joints and imperfections.

Because drywall panels are manufactured in standard sizes—usually 4 feet by 8 or 12 feet—installers must measure, cut, and fit some pieces around doors and windows. They also saw or cut holes in panels for electrical outlets, air-conditioning units, and plumbing.

After making these alterations, installers may glue, nail, or screw the wallboard panels to the wood or metal framework. Because drywall is heavy and cumbersome, a helper generally assists the installer in positioning and securing the panel. A lift is often used when placing ceiling panels.

After the drywall is installed, finishers fill joints between panels with a joint compound. Using the wide, flat tip of a special trowel, they spread the joint compound into and along each side of the joint with brushlike strokes. They immediately use the trowel to press a paper tape—used to reinforce the drywall and to hide imperfections—into the wet compound and to smooth away excess material. Nail and screw depressions also are covered with this compound, as are imperfections caused by the installation of air-conditioning vents and other fixtures. On large commercial projects, finishers may use automatic taping tools that apply the joint compound and tape in one step. Finishers apply second and third coats, sanding the treated areas after each coat to make them as smooth as the rest of the wall surface. This results in a very smooth and almost perfect surface. Some finishers apply textured surfaces to walls and ceilings with trowels, brushes, or spray guns.

Lathers apply metal or gypsum lath to walls, ceilings, or ornamental frameworks to form the support base for plaster coatings. Gypsum lath is similar to a drywall panel, but smaller. Metal lath is used where the plaster application will be exposed to weather or water, or for curved or irregular surfaces for which drywall is not a practical material. Lathers usually nail, screw, staple, or wire-tie the lath directly to the structural framework.

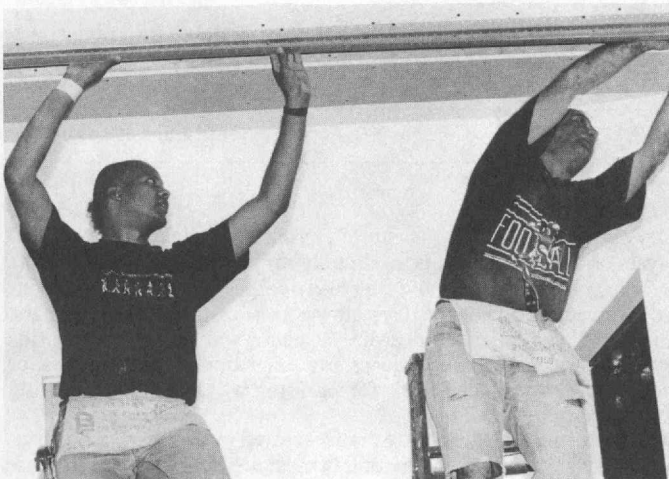
Working Conditions

As in other construction trades, drywall and lathing work sometimes is strenuous. Applicators, tapers, finishers, and lathers spend most of the day on their feet, either standing, bending, or kneeling. Some finishers use stilts to tape and finish ceiling and angle joints. Installers have to lift and maneuver heavy panels. Hazards include falls from ladders and scaffolds, and injuries from power tools. Because sanding joint compound to a smooth finish creates a great deal of dust, some finishers wear masks for protection.

Employment

Drywall workers and lathers held about 121,000 jobs in 1992. Most worked for contractors who specialize in drywall or lathing installation; others worked for contractors who do many kinds of construction.

Most installers, finishers, and lathers are employed in urban areas. In other areas, where there may not be enough work to keep a drywall worker or lather employed full time, the work is usually done by carpenters and painters.



Drywall installation can be very strenuous.

Training, Other Qualifications, and Advancement

Most drywall and lathing workers start as helpers and learn their skills on the job. Installer and lather helpers start by carrying materials, lifting and holding panels, and cleaning up debris. Within a few weeks, they learn to measure, cut, and install materials. Eventually, they become fully experienced workers. Finisher apprentices begin by taping joints and touching up nail holes, scrapes, and other imperfections. They soon learn to install corner guards and to conceal openings around pipes. At the end of their training, they learn to estimate the cost of installing and finishing drywall and gypsum lath.

Some installers and lathers learn their trade in an apprenticeship program. The United Brotherhood of Carpenters and Joiners of America, in cooperation with local contractors, administers an apprenticeship program in carpentry that includes instruction in drywall and lath installation. In addition, local affiliates of the Associated Builders and Contractors and the National Association of Home Builders conduct a similar training program for nonunion workers. The International Brotherhood of Painters and Allied Trades conducts a 2-year apprenticeship program for drywall finishers.

Employers prefer high school graduates who are in good physical condition, but they frequently hire applicants with less education. High school or vocational school courses in carpentry provide a helpful background for drywall work. Regardless of educational background, installers must be good at simple arithmetic.

Drywall workers and lathers with a few years' experience and leadership ability may become supervisors. Some workers start their own contracting businesses.

Job Outlook

Replacement needs will account for almost all job openings for drywall workers and lathers through the year 2005. Tens of thousands of jobs will open up each year because of the need to replace workers who transfer to jobs in other occupations or leave the labor force. Turnover in this occupation is very high, reflecting the lack of formal training requirements and the ups and downs of the business cycle to which the construction industry is very sensitive. Because of their relatively weak attachment to the occupation, many workers with limited skills leave the occupation when they find they dislike the work or because they can't find steady employment.

Additional job openings will be created by the rising demand for drywall work. Employment is expected to grow faster than the average for all occupations as the level of new construction and renovation increases. In addition to traditional interior work, the growing acceptance of insulated exterior wall systems will add to the demand for drywall workers.

Despite the growing use of exterior panels, most drywall installation, finishing, and lathing are usually done indoors. Therefore, these workers lose less work time because of bad weather than some other construction workers. Nevertheless, they may be unemployed between construction projects and during downturns in construction activity.

Earnings

Median weekly earnings for drywall workers and lathers were about \$420 in 1992. The middle 50 percent earned between \$305 and \$645 weekly. The top 10 percent earned over \$870 and the bottom 10 percent earned less than \$235 a week. Trainees start at about half the rate paid to experienced workers and receive wage increases as they become more highly skilled.

Some contractors pay these workers according to the number of panels they install or finish per day; others pay an hourly rate. A 40-hour week is standard, but sometimes the workweek may be longer. Those who are paid hourly rates receive premium pay for overtime.

Related Occupations

Drywall workers and lathers combine strength and dexterity with precision and accuracy to make materials fit according to a plan. Other occupations that require similar abilities include carpenters, floor covering installers, form builders, insulation workers, and plasterers.

Sources of Additional Information

For information about work opportunities in drywall application and finishing, contact local drywall installation contractors; a local of the unions previously mentioned; a local joint union-management apprenticeship committee; a State or local chapter of the Associated Builders and Contractors; or the nearest office of the State employment service or State apprenticeship agency.

For details about job qualifications and training programs in drywall application and finishing, write to:

☞ Associated Builders and Contractors, Inc., 729 15th St. NW., Washington, DC 20005.

☞ International Brotherhood of Painters and Allied Trades, 1750 New York Ave. NW., Washington, DC 20006.

For information on training programs in drywall application and lathing, write to:

☞ United Brotherhood of Carpenters and Joiners of America, 101 Constitution Ave. NW., Washington, DC 20001.

☞ National Association of Home Builders, Home Builders Institute, 1090 Vermont Ave. NW., Washington, DC 20005.

Electricians

(D.O.T. 729.381-018; 806.381-062; 822.361-018, -022; 824.261, -281-010, -018, -381, -681; 825.381-030, -034; 829.261-018; and 952.364 and -381)

Nature of the Work

Electricity is essential for light, power, air-conditioning, and refrigeration. Electricians install and maintain electrical systems for a variety of purposes, including climate control, security, and communications. They also may install and maintain the electronic controls for machines in business and industry. Although most electricians specialize in either construction or maintenance, a growing number do both.

Electricians work with blueprints when they install electrical systems in factories, office buildings, homes, and other structures. Blueprints indicate the location of circuits, outlets, load centers, panel boards, and other equipment. Electricians must follow the National Electric Code and comply with State and local building codes when they install these systems. In factories and offices, they first place conduit (pipe or tubing) inside designated partitions, walls, or other concealed areas. They also fasten to the wall small metal or plastic boxes that will house electrical switches and outlets. They then pull insulated wires or cables through the conduit to complete circuits between these boxes. In lighter construction, such as residential, plastic-covered wire usually is used rather than conduit.

Regardless of the type of wire being used, electricians connect it to circuit breakers, transformers, or other components. Wires are joined by twisting ends together with pliers and covering the ends with special plastic connectors. When stronger connections are required, electricians may use an electric "soldering gun" to melt metal onto the twisted wires, which they then cover with durable electrical tape. When the wiring is finished, they test the circuits for proper connections.

In addition to wiring a building's electrical system, electricians may install coaxial or fiber optic cable for computers and other telecommunications equipment. A growing number of electricians install telephone and computer wiring and equipment. They also may connect motors to electrical power and install electronic controls for industrial equipment.

Maintenance work varies greatly, depending on where the electrician is employed. Electricians who specialize in residential work may rewire a home and replace an old fuse box with a new circuit breaker to accommodate additional appliances. Those who work in large factories may repair motors, transformers, generators, and electronic controllers on machine tools and industrial robots. Those in office buildings and small plants may repair all kinds of electrical equipment. Maintenance electricians spend much of their time in preventive maintenance. They periodically inspect equipment and locate and correct problems before breakdowns occur. When breakdowns occur, they must make the necessary repairs as quickly as

possible in order to minimize inconvenience. Electricians may replace items such as circuit breakers, fuses, switches, electrical and electronic components, or wire. When working with complex electronic devices, they may work with engineers, engineering technicians, or industrial machinery repairers. (For information about each of these occupations, see the statements located elsewhere in the *Handbook*.) Electricians also may advise management whether continued operation of equipment could be hazardous. When needed, they install new electrical equipment.

Electricians use handtools such as screwdrivers, pliers, knives, and hacksaws. They also use power tools and testing equipment such as oscilloscopes, ammeters, and test lamps.

Working Conditions

Electricians' work is sometimes strenuous. They may stand for long periods and frequently work on ladders and scaffolds. They often work in awkward or cramped positions. Electricians risk injury from electrical shock, falls, and cuts; to avoid injuries, they must follow strict safety procedures. Most electricians work a standard 40-hour week, although overtime may be required. Those in maintenance work may have to work nights, on weekends, and be on call.

Employment

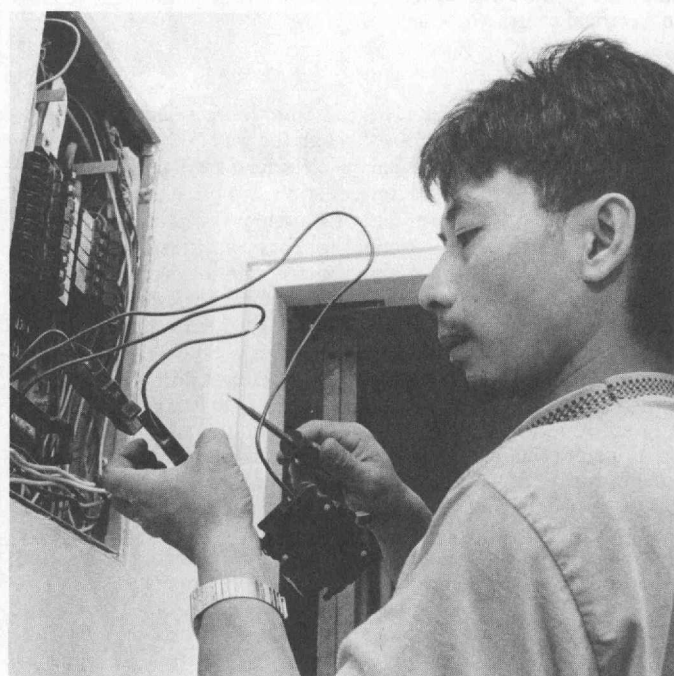
Electricians held about 518,000 jobs in 1992. More than half were employed in the construction industry. Others worked as maintenance electricians and were employed in virtually every industry. In addition, about 1 out of 10 electricians was self-employed.

Because of the widespread need for electrical services, jobs for electricians are found in all parts of the country.

Training, Other Qualifications, and Advancement

The best way to learn the electrical trade is by completing a 4- or 5-year apprenticeship program. Apprenticeship gives trainees a thorough knowledge of all aspects of the trade and generally improves their ability to find a job. Although more electricians are trained through apprenticeship than workers in other construction trades, some still learn their skills informally on the job.

Large apprenticeship programs are usually sponsored by joint training committees made up of local unions of the International Brotherhood of Electrical Workers and local chapters of the National Electrical Contractors Association. Training may also be provided by company management committees of individual electrical



Electricians use handtools such as screwdrivers.

contracting companies and by local chapters of the Associated Builders and Contractors and Independent Electrical Contractors. Because of the comprehensive training received, those who complete apprenticeship programs qualify to do both maintenance and construction work. The typical large program provides at least 144 hours of classroom instruction each year and 8,000 hours of on-the-job training over the course of the apprenticeship. In the classroom, apprentices learn blueprint reading, electrical theory, electronics, mathematics, electrical code requirements, and safety and first aid practices. On the job, under the supervision of experienced electricians, apprentices must demonstrate mastery of the electrician's work. At first, they drill holes, set anchors, and set up conduit. Later, they measure, fabricate, and install conduit, as well as install, connect, and test wiring, outlets, and switches. They also learn to set up and draw diagrams for entire electrical systems.

Those who do not enter a formal apprenticeship program can begin to learn the trade informally by working as helpers for experienced electricians. While learning to install conduit, connect wires, and test circuits, helpers also are taught safety practices. Many helpers supplement this training with trade school or correspondence courses.

Regardless of how one learns the trade, previous training is very helpful. High school courses in mathematics, electricity, electronics, mechanical drawing, science, and shop provide a good background. Special training offered in the Armed Forces and by postsecondary technical schools also is beneficial. All applicants should be in good health and have at least average physical strength. Agility and dexterity also are important. Good color vision is needed because workers frequently must identify electrical wires by color.

Most apprenticeship sponsors require applicants for apprentice positions to be at least 18 years old and have a high school diploma or its equivalent. For those interested in becoming maintenance electricians, a background in electronics is increasingly important because of the growing use of complex electronic controls on manufacturing equipment.

Most localities require electricians to be licensed. Although licensing requirements vary from area to area, electricians generally must pass an examination that tests their knowledge of electrical theory, the National Electrical Code, and local electric and building codes.

Electricians periodically take courses offered by their employer or union to keep abreast of changes in the National Electrical Code, materials, or methods of installation.

Experienced electricians can become supervisors and then superintendents. Those with sufficient capital and management skills may start their own contracting business, although this may require an electrical contractor's license.

Job Outlook

Employment of electricians is expected to increase about as fast as the average for all occupations through the year 2005. As the population and the economy grow, many electricians will be needed to install and maintain electrical devices and wiring in homes, factories, offices, and other structures. New technologies also are expected to continue to stimulate the demand for these workers. Increasingly, buildings will be prewired during construction to accommodate use of computers and telecommunications equipment. More and more factories will be using robots and automated manufacturing systems. Installation of this equipment, which is expected to increase, also should stimulate demand for electricians. Additional jobs will be created by rehabilitation and retrofitting of existing structures.

In addition to jobs created by increased demand for electrical work, many openings will occur each year as electricians transfer to other occupations, retire, or leave the labor force for other reasons. Because of their lengthy training and relatively high earnings, a smaller proportion of electricians than other craft workers leave their occupation each year. The number of retirements is expected to rise, however, as more electricians reach retirement age.

Although the employment outlook for electricians is expected to be very good over the long run, people wishing to become construction electricians should be prepared to experience periods of unemployment. These result from the limited duration of construction projects and the cyclical nature of the construction industry. During

economic downturns, job openings for electricians are reduced as the level of construction declines. Apprenticeship opportunities also are less plentiful during these periods.

Although employment of maintenance electricians is steadier than that of construction electricians, those working in the automotive and other manufacturing industries that are sensitive to cyclical swings in the economy may be laid off during recessions. Also, efforts to reduce operating costs and increase productivity through the increased use of contracting out for electrical services may limit opportunities for maintenance electricians in many industries. However, this should be partially offset by increased demand by electrical contracting firms.

Job opportunities for electricians also vary by geographic area. Employment opportunities follow the movement of people and businesses among States and local areas and reflect differences in local economic conditions. The number of job opportunities in a given year may fluctuate widely from area to area. Some parts of the country may experience an oversupply of electricians, for example, while others may have a shortage.

Earnings

Median weekly earnings for full-time electricians who were not self-employed were \$550 in 1992. The middle 50 percent earned between \$412 and \$717 weekly. The lowest 10 percent earned less than \$321, while the highest 10 percent earned more than \$887.

According to a survey of workplaces in 160 metropolitan areas, maintenance electricians had median hourly earnings of \$16.68 in 1992. The middle half earned between \$13.10 and \$19.65 an hour. Annual earnings of electricians also tend to be higher than those of other building trades workers because electricians are less affected by the seasonal nature of construction.

Depending on experience, apprentices usually start at 30-50 percent of the rate paid to experienced electricians. As they become more skilled, they receive periodic increases throughout the course of the apprenticeship program. Many employers also provide training opportunities for experienced electricians to improve their skills.

Many construction electricians are members of the International Brotherhood of Electrical Workers. Among unions organizing maintenance electricians are the International Brotherhood of Electrical Workers; the International Union of Electronic, Electrical, Salaried, Machine, and Furniture Workers; the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; and the United Steelworkers of America.

Related Occupations

To install and maintain electrical systems, electricians combine manual skill and a knowledge of electrical materials and concepts. Workers in other occupations involving similar skills include air-conditioning mechanics, cable installers and repairers, electronics mechanics, and elevator constructors.

Sources of Additional Information

For details about apprenticeships or other work opportunities in this trade, contact local electrical contractors; local chapters of the Independent Electrical Contractors, Inc., the National Electrical Contractors Association, Home Builders Institute, or the Associated Builders and Contractors; a local union of the International Brotherhood of Electrical Workers; a local union-management electrician apprenticeship committee; local firms that employ maintenance electricians; or the nearest office of the State employment service or State apprenticeship agency.

For general information about the work of electricians, contact:

☞ Independent Electrical Contractors, Inc., P. O. Box 10379, Alexandria, VA 22310.

☞ National Electrical Contractors Association (NECA), 3 Bethesda Metro Center, #1100, Bethesda, MD 20814.

☞ International Brotherhood of Electrical Workers (IBEW), 1125 15th St. NW., Washington, DC 20005.

☞ Associated Builders and Contractors, 1300 North 17th St., Rosslyn, VA 22209.

☞ Homebuilders Institute, 1010 Vermont Ave. NW., Washington, DC 20005.

Elevator Installers and Repairers

(D.O.T. 825.261-014, .281-030, -034, and .361-010)

Nature of the Work

Elevator installers and repairers—also called elevator constructors or mechanics—assemble, install, and replace elevators, escalators, and similar equipment in new and old buildings. Once the equipment is in service, they maintain and repair it. They sometimes modernize older equipment.

In order to install, repair, and maintain modern elevators, which are almost all electronically controlled, elevator constructors must have a thorough knowledge of electronics, electricity, and hydraulics. Many elevators today are installed with microprocessors, which are programmed to constantly analyze traffic conditions to dispatch elevators in the most efficient manner. With these computer controls, it is now possible to get the greatest amount of service with the least number of cars.

Elevator constructors begin by studying blueprints to determine the equipment layout of the framework to install rails, machines, car enclosures, motors, pumps, cylinders, and plunger foundations. Once the layout analysis is completed, mechanics begin equipment installation. Working on scaffolding or platforms, constructors bolt or weld steel rails to the walls of the shaft to guide the elevator up and down.

Elevator mechanics install electrical wires and controls by running tubing called conduit along the shaft's walls from floor to floor. Once the conduit is in place, mechanics pull plastic-covered electrical wires through it. They install electrical components and related devices required at each floor and at the main control panel in the machine room.

Mechanics bolt or weld together the steel frame of the elevator car at the bottom of the shaft, install the car's platform, walls, and doors, and attach guide shoes and rollers which minimize the lateral motion of the car as it travels through the shaft. Mechanics also install the outer doors and door frames at the elevator entrances on each floor.

For cabled elevators, workers install geared or gearless machines with a traction drive sheave which moves heavy steel cables connected to the elevator car and counterweight. The counterweight moves in the opposite direction from the car and aids in its swift and smooth movement.

These workers also install elevators in which a car sits on a hydraulic plunger that is driven by a pump. The cylinder pushes the elevator car from underneath, like a lift in an auto service station.

Elevator constructors also install escalators. They put in place the steel framework, the electrically powered stairs, and the tracks, and install associated motors and electrical wiring.

In addition to elevators and escalators, elevator constructors install devices such as dumbwaiters and material lifts, which are similar to elevators in design, and moving walkways, which more closely resemble escalators.

After installation, adjusters fine-tune the equipment to make sure that the elevator is working according to specifications, such as stopping correctly at each floor or picking up passengers within a specified time period. Once an elevator is operating properly, it must be maintained and serviced regularly to keep it in safe, perfect condition. Maintenance mechanics generally do preventive maintenance—oiling and greasing moving parts, replacing worn parts, testing equipment with meters and gauges, and adjusting equipment for optimal performance. They also troubleshoot and do emergency repairs.

A service crew usually handles major repairs—for example, repairing and setting doors back on their tracks. This may require cutting torches or rigging equipment—tools the maintenance mechanic doesn't normally carry. Service crews also do major modernization and alteration work such as moving and replacing electrical motors, hydraulic pumps, and control panels.

Elevator constructors usually specialize in installation, maintenance, or repair work. Maintenance and repair workers generally need more knowledge of electricity and electronics than installers

because a large part of maintenance and repair work is troubleshooting. Similarly, construction adjusters need a thorough knowledge of electricity, electronics, and computers to ensure that newly installed elevators operate properly.

Working Conditions

Most elevator constructors work a 40-hour week. However, maintenance and service mechanics often work overtime when repairing essential elevator equipment. They are sometimes on 24-hour call. Maintenance mechanics, unlike most elevator constructors, are on their own most of the day and typically service the same elevators periodically. Elevator installers lift and carry heavy equipment and parts and are exposed to falls and electrical shocks. They also may work in cramped spaces or awkward positions. Because most elevator constructors' work is performed indoors in buildings under construction or in existing buildings, they lose less worktime due to inclement weather than other building trades workers.

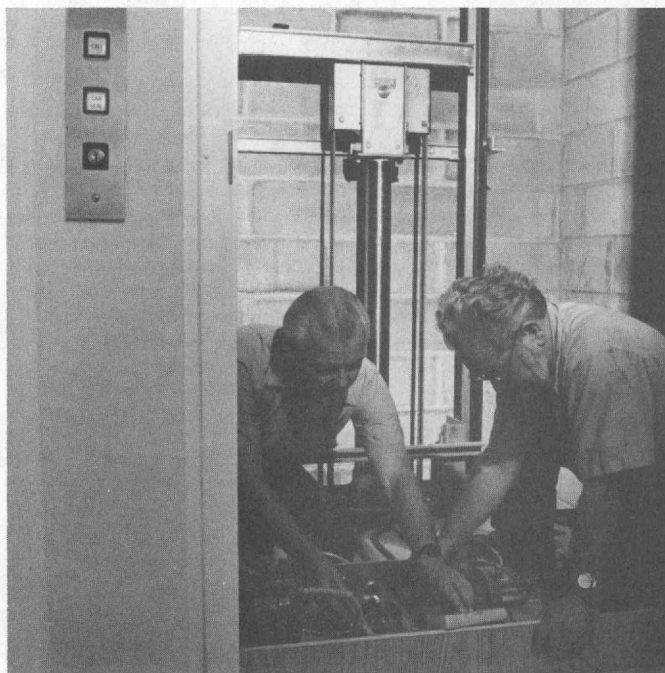
Employment

Elevator installers and repairers held about 22,000 jobs in 1992. Most were employed by special trade contractors. Others were employed by field offices of elevator manufacturers; wholesale distributors; small, local elevator maintenance and repair contractors; or by government agencies or businesses that do their own elevator maintenance and repair.

Training, Other Qualifications, and Advancement

Most elevator constructors apply for their jobs through a local of the International Union of Elevator Constructors, and learn their trade in programs administered by joint committees of employers and the union. These programs, through which the trainee learns everything from installation to repair, combine on-the-job training with classroom instruction in electrical and electronic theory, mathematics, applications of physics, and safety. Elevator installers and repairers in nonunion shops may complete training programs sponsored by independent contractors. Most trainees or helpers assist experienced elevator mechanics. Beginners carry materials and tools, bolt rails to walls, and assemble elevator cars. Eventually, they learn to do more difficult tasks, such as wiring, which requires a knowledge of local and national electrical codes.

Generally, helpers must complete a 6-month probationary period. After successful completion, they work toward becoming fully



Elevator constructors often receive training throughout their careers.

qualified mechanics within 4 to 5 years. Most States and cities require elevator constructors to pass a licensing examination.

Many elevator installers and repairers also receive training from their employers to become familiar with the company's particular equipment. Retraining is very important to keep abreast of technological developments in elevator repair. In fact, elevator constructors typically receive training throughout their careers, either through correspondence courses or seminars. Although voluntary, this training greatly improves one's chances for promotion.

Applicants for trainee positions must be at least 18 years old, have a high school education, and pass an aptitude test; courses in electricity, mathematics, and physics provide a useful background. As elevators become increasingly sophisticated, workers may find it necessary to acquire more advanced formal education—for example, in postsecondary technical school or junior college—with an emphasis on electronics. Workers with more formal education generally advance more quickly than their counterparts. Better educated workers often can forego some of the union training if they successfully complete the examinations required during their training. Good physical condition and mechanical aptitude also are important.

Some installers advance to mechanic-in-charge, adjuster, supervisor, or elevator inspector. Others may move into management, sales, or product design.

Job Outlook

Employment of elevator installers and repairers is expected to increase about as fast as the average for all occupations through the year 2005. The job outlook for these workers is largely dependent on activity in the construction industry. Growth will occur as the construction of buildings with elevators and escalators increases and as the stock of equipment needing maintenance grows. In addition, demand will be spurred by the need to modernize older equipment, which can involve anything from improving appearance to introducing new computer controls. However, most job openings will result from replacement of experienced workers who transfer to other occupations or leave the labor force. Job prospects should be best for those with postsecondary training in electronics.

Opportunities for elevator installers vary from year to year as conditions change in the construction industry. Economic downturns generally have less adverse effects on maintenance and repair mechanics because the equipment must still be kept in operating condition. More maintenance and repair work also will be needed as elevators become increasingly complex. The more intricate the equipment, the more maintenance it requires to keep it running smoothly.

Earnings

Average weekly earnings for elevator installers and repairers were about \$740 in 1992, according to data from the International Union of Elevator Constructors. Probationary helpers started at about 50 percent of the rate for experienced elevator mechanics, or \$370 per week, while non-probationary helpers earned 70 percent of this rate, or \$518 per week. Mechanics-in-charge averaged \$830 a week.

In addition to free continuing education, elevator installers and repairers receive basic benefits enjoyed by most other workers.

A large percentage of elevator constructors are members of the International Union of Elevator Constructors.

Related Occupations

Elevator constructors combine electrical and mechanical skills with construction skills such as welding, rigging, measuring, and blueprint reading. Other occupations that require many of these skills are boilermaker, electrician, industrial machinery repairer, millwright, sheet-metal worker, and structural ironworker.

Sources of Additional Information

For further details about opportunities as an elevator constructor, contact elevator manufacturers, elevator repair and maintenance contractors, a local of the International Union of Elevator Constructors, or the nearest local public employment service office.

Glaziers

(D.O.T. 865.361 and .381)

Nature of the Work

Glass serves many uses in modern buildings. Insulated and specially treated glass keeps in warmed or cooled air and provides good condensation and sound control qualities; tempered and laminated glass makes doors and windows more secure. In large commercial buildings, glass panels give skyscrapers a distinctive look while reducing the need for artificial lighting. The creative use of large windows, glass doors, skylights, and sunspace additions make homes bright, airy, and inviting.

Glaziers select, cut, install, and remove all types of glass as well as plastics and similar materials used as glass substitutes. They also install mirrors, shower doors and bathtub enclosures, and glass for table tops and display cases. They may mount steel and aluminum sashes or frames and attach locks and hinges to glass doors. Sometimes glaziers build the metal framework needed to install glass panels or curtainwalls in large commercial buildings.

For most jobs, the glass is precut and mounted in frames at a factory or a contractor's shop. It arrives at the job site ready for glaziers to position and secure it in place. These workers may use a crane or hoist with suction cups to lift large, heavy pieces of glass. They then gently guide the glass into position by hand.

Once glaziers have the glass in place, they secure it with mastic, putty or other pastelike cement, bolts, rubber gaskets, glazing compound, metal clips, or metal or wood molding. When they use a rubber gasket—a thick, molded rubber half-tube with a split running its length—to secure glass, they first secure the gasket around the perimeter within the opening, then set the glass into the split side of the gasket, causing it to clamp to the edges and hold the glass firmly in place.

When they use metal clips and wood molding, glaziers first secure the molding to the opening, place the glass in the molding, and then force springlike metal clips between the glass and the molding. The clips exert pressure and keep the glass firmly in place.

When a glazing compound is used, glaziers first spread it neatly against and around the edges of the molding on the inside of the opening. Next, they install the glass. Pressing it against the compound on the inside molding, workers screw or nail outside molding that loosely holds the glass in place. To hold it firmly, they pack the space between the molding and the glass with glazing compound and then trim any excess material with a glazing knife.

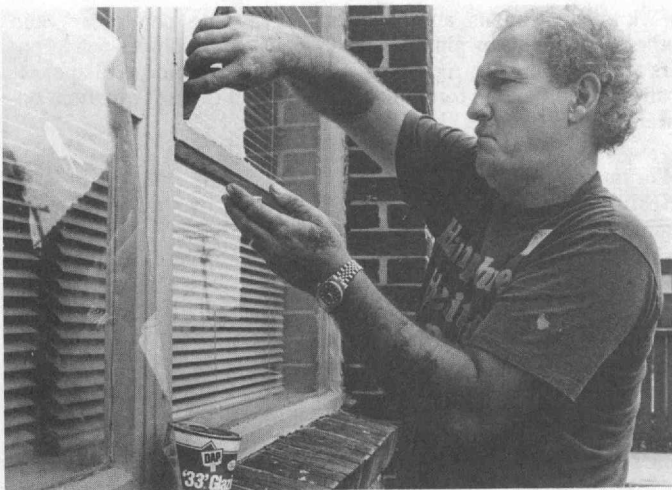
For some jobs, the glazier must cut the glass manually at the job site. To prepare the glass for cutting, glaziers rest it either on edge on a rack or A-frame or flat against a cutting table. They then measure and mark the glass for the cut.

Glaziers cut glass with a special tool that has a very hard metal wheel about 1/6 inch in diameter. Using a straightedge as a guide, the glazier presses the cutter's wheel firmly on the glass, guiding and rolling it carefully to make a score just below the surface. To help the cutting tool move smoothly across the glass, workers brush a thin layer of oil along the line of the intended cut or dip the cutting tool in oil. Immediately after cutting, the glazier presses on the shorter end of the glass to break it cleanly along the cut.

In addition to handtools such as glasscutters, suction cups, and glazing knives, glaziers use power tools such as saws, drills, cutters, and grinders. An increasing number of glaziers use computers in the shop or at the job site to improve their layout work and reduce the amount of glass that is wasted.

Working Conditions

Glaziers often work outdoors—sometimes in inclement weather. At times they work on scaffolds at great heights. The job requires a considerable amount of bending, kneeling, lifting, and standing. Glaziers may be injured by broken glass or cutting tools, falls from scaffolds, or from improperly lifting heavy glass panels.



Glazier secures glass in window frame with glazing compound.

Employment

Glaziers held about 39,000 jobs in 1992. Most worked for glazing contractors engaged in new construction, alteration, and repair. Others worked for retail glass shops that install or replace glass and wholesale distributors of products containing glass. Glaziers work throughout the country, but jobs are concentrated in metropolitan areas.

Training, Other Qualifications, and Advancement

Employers recommend that glaziers learn the trade through an apprenticeship program that lasts 3 to 4 years. Apprenticeship programs, which are administered by the National Glass Association and local union-management committees or local contractors' associations, consist of on-the-job training as well as 144 hours of classroom instruction or home study each year.

On the job, apprentices learn to use the tools and equipment of the trade; handle, measure, cut, and install glass and metal framing; cut and fit moldings; and install and balance glass doors. In the classroom, they are taught basic mathematics, blueprint reading and sketching, general construction techniques, safety practices, and first aid.

Many glaziers learn the trade informally on the job. These workers usually start by carrying glass and cleaning up debris in glass shops. They often practice cutting on discarded glass. After a while they are given an opportunity to cut glass for a job. Eventually, helpers assist experienced workers on a simple installation job. Learning the trade this way may not provide training as complete as an apprenticeship program, however, and may take longer.

Local apprenticeship administrators determine how apprentices are recruited and selected. In general, applicants for apprenticeships and for helper positions must be in good physical condition and at least 17 years old. High school or vocational school graduates are preferred. In some areas, applicants must take mechanical aptitude tests. Courses in general mathematics, blueprint reading or mechanical drawing, general construction, and shop provide a good background.

Standards for acceptance into apprenticeship programs are rising to reflect changing requirements associated with new products and equipment. Glaziers need a basic understanding of electricity and electronics in order to be able to install electrochromatic glass and electronically controlled glass doors. In addition, the growing use of computers in glass layout requires more and more that glaziers be familiar with personal computers.

Advancement consists of increases in pay for most glaziers; some may advance to supervisory jobs or become contractors or estimators.

Job Outlook

Employment of glaziers is expected to increase faster than the average for all occupations through the year 2005. This growth will be in

response to anticipated increases in residential and non-residential construction and a need to modernize and repair existing structures. Glass is expected to remain popular in bathroom and kitchen design, causing demand for glaziers to grow. Improved glass performance in insulation, privacy, safety, condensation control, and noise reduction are also expected to stimulate the demand for glaziers.

Although the employment outlook for glaziers is expected to be good over the long run, people wishing to become construction glaziers should expect to experience periods of unemployment. These result from the limited duration of construction projects and the cyclical nature of the construction industry. During bad economic times, job openings for glaziers are reduced as the level of construction declines. Because construction activity varies from area to area, job openings, as well as apprenticeship opportunities, fluctuate with local economic conditions. Consequently, some parts of the country may experience an oversupply of these workers while others may have a shortage. Employment and apprenticeship opportunities should be greatest in metropolitan areas, where most glazing contractors and glass shops are located.

In addition to jobs created by increased demand for glaziers, openings will occur each year from the need to replace experienced workers who die, retire, or leave the occupation for other jobs.

Earnings

According to the *Engineering News Record*, union glaziers received an average hourly wage of \$24.75 in 1992, including fringe benefits. Wages ranged from a low of \$15.80 in Dallas to a high of \$35.92 in New York City. Glaziers covered by union contracts generally earn more than their non-union counterparts. Apprentice wage rates usually start at 50 to 60 percent of the rate paid to experienced glaziers and increase every 6 months. Because glaziers can lose time due to weather conditions and fluctuations in construction activity, their overall earnings may be lower than their hourly wages suggest.

Many glaziers employed in construction are members of the International Brotherhood of Painters and Allied Trades.

Related Occupations

Glaziers use their knowledge of construction materials and techniques to install glass. Other construction workers whose jobs also involve skilled, custom work are bricklayers, carpenters, floor layers, paperhangers, terrazzo workers, and tilesetters.

Sources of Additional Information

For more information about glazier apprenticeships or work opportunities, contact local glazing or general contractors; a local of the International Brotherhood of Painters and Allied Trades; a local joint union-management apprenticeship agency; or the nearest office of the State employment service or State apprenticeship agency.

For general information about the work of glaziers, contact:
 ☞ International Brotherhood of Painters and Allied Trades, 1750 New York Ave. NW., Washington, DC 20006.

For information concerning training for glaziers contact:
 ☞ Member Services, National Glass Association, 8200 Greensboro Dr., McLean, VA 22102.

☞ Flat Glass Marketing Association, White Lakes Professional Building, 3310 Southwest Harrison St., Topeka, KS 66611-2279.

Heating, Air-Conditioning, and Refrigeration Technicians

(D.O.T. 637.261-014, -026, -030, and -034, and .381; 827.361-014; 862.281-018, .361-010; and 869.281-010)

Nature of the Work

What would those living in Chicago do without heating, those in Miami do without air-conditioning, or blood banks in all parts of the country do without refrigeration? People always have sought ways to make their environment more comfortable. Today, heating and

air-conditioning systems control the temperature, humidity, and the total air quality in residential, commercial, industrial, and other buildings. Refrigeration systems make it possible to store and transport food, medicine, and other perishable items. Heating, air-conditioning, and refrigeration technicians install, maintain, and repair such systems.

Heating, air-conditioning, and refrigeration systems consist of many mechanical, electrical, and electronic components, including motors, compressors, pumps, fans, ducts, pipes, thermostats, and switches. In central heating systems, for example, a furnace heats the air that is then distributed throughout the building via a system of metal or fiberglass ducts. Technicians must be able to maintain, diagnose, and correct problems within the entire system—the ducts as well as the other components. They adjust system controls to recommended settings and test the performance of the entire system using special tools and test equipment.

Technicians may specialize in installation or in maintenance and repair. They may further specialize in one type of equipment, such as oil burners, solar panels, or commercial refrigerators. However, more and more technicians do both installation and servicing, and work with heating, cooling, and refrigeration equipment. The following describes some of the specific jobs in this field.

Furnace installers, also called heating equipment technicians, follow blueprints or other specifications to install oil, gas, electric, solid-fuel, and multifuel heating systems. After putting the equipment in place, they may install fuel and water supply lines, air ducts and vents, pumps, and other components. They may connect electrical wiring and controls and check the unit for proper operation. To ensure the proper functioning of the system, furnace installers often use combustion test equipment such as carbon dioxide and oxygen testers.

After a furnace has been installed, technicians often perform routine maintenance and repair in order to keep the system operating efficiently. During the fall and winter, when the system is needed most, they service and adjust burners and blowers. If the system is not operating properly, they check the thermostat, burner nozzles, controls, and other parts in order to diagnose the problem and then correct it by adjusting or replacing parts. During the summer, technicians do maintenance work, such as replacing filters and vacuum-cleaning vents, ducts, and other parts of the heating system that may accumulate soot, ash, and dust during the operating season.

Air-conditioning and refrigeration technicians install and service central air-conditioning systems and a variety of refrigeration equipment. Technicians follow blueprints, design specifications, and manufacturers' instructions to install motors, compressors, condensing units, evaporators, and other components. They connect this equipment to the duct work, refrigerant lines, and electrical power source. After making the connections, they charge the system with refrigerant and check it for proper operation.

When air-conditioning and refrigeration equipment breaks down, technicians diagnose the problem and make repairs. To find defects, they test parts such as compressors, relays, and thermostats. During the winter, air-conditioning technicians inspect the systems and do required maintenance, such as overhauling compressors. When servicing equipment, heating, air-conditioning, and refrigeration technicians must use care to conserve, recover, and recycle chlorofluorocarbon (CFC) refrigerants used in air-conditioning and refrigeration systems. The release of CFC's contributes to the depletion of the stratospheric ozone layer, which protects plant and animal life from ultraviolet radiation. Technicians conserve the refrigerant by making sure that there are no leaks in the system; they recover it by venting the refrigerant into proper cylinders; and they recycle it for reuse with special filter-dryers.

Heating, air-conditioning, and refrigeration technicians use a variety of tools, including hammers, wrenches, metal snips, electric drills, pipe cutters and benders, and acetylene torches, to work with refrigerant lines and air ducts. They use voltmeters, thermometers, pressure gauges, manometers, and other testing devices to check air flow, refrigerant pressure, electrical circuits, burners, and other components.

Cooling and heating systems sometimes are installed or repaired by other craft workers. For example, on a large air-conditioning installation job, especially where workers are covered by union contracts, duct work might be done by sheet-metal workers; electrical

work by electricians; and installation of piping, condensers, and other components by plumbers and pipefitters. Room air-conditioners and household refrigerators are serviced by home appliance repairers. Additional information about each of these occupations appears elsewhere in the *Handbook*.

Working Conditions

Heating, air-conditioning, and refrigeration technicians work in homes, supermarkets, hospitals, office buildings, factories—anywhere there is climate control equipment. They may be assigned to specific job sites at the beginning of each day, or they may be dispatched to jobs by radio or telephone.

Technicians may work outside in cold or hot weather or in buildings that are uncomfortable because the air-conditioning or heating equipment is broken. In addition, technicians often work in awkward or cramped positions and sometimes are required to work in high places. Hazards include electrical shock, burns, muscle strains, and other injuries from handling heavy equipment.

Technicians usually work a 40-hour week, but during peak seasons they often work overtime or irregular hours. Maintenance workers, including those that provide maintenance services under contract, often work evening or weekend shifts, and are on call. Most employers try to provide a full workweek the year round by doing both installation and maintenance work. Therefore, in most shops that service both heating and air-conditioning equipment, employment is very stable throughout the year.

Employment

Heating, air-conditioning, and refrigeration technicians held about 212,000 jobs in 1992. One of every 2 worked for cooling and heating contractors. The remainder were employed in a wide variety of industries. Some worked for fuel oil dealers, refrigeration and air-conditioning service and repair shops and schools. Others were employed by the Federal Government, hospitals, office buildings, and other organizations that operate large air-conditioning, refrigeration, or heating systems. Approximately 1 of every 8 technicians was self-employed. Jobs are found throughout the country, reflecting the widespread dependence on climate control systems.

Training, Other Qualifications, and Advancement

Because of the increased sophistication of heating, air-conditioning, and refrigeration systems, employers prefer to hire those with technical school or apprenticeship training. A sizable number of these workers, however, still learn the trade informally on the job.

Many secondary and postsecondary technical and trade schools, junior and community colleges, and the Armed Forces offer 1- to 2-year programs in heating, air-conditioning, and refrigeration. Students study theory, design, and equipment construction, as well as electronics. They also learn the basics of installation, maintenance, and repair.



Air-conditioning mechanics diagnose the problem and make repairs.

Apprenticeship programs are frequently run by joint committees representing local chapters of the Air-Conditioning Contractors of America, the Mechanical Contractors Association of America, the National Association of Plumbing, Heating, and Cooling Contractors, and locals of the Sheet Metal Workers' International Association or the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada. Other apprenticeship programs are sponsored by local chapters of the Associated Builders and Contractors and the Home Builders Institute of the National Association of Home Builders. These programs generally last 4 or 5 years and combine on-the-job training with 144 hours of classroom instruction each year in related subjects, such as the use and care of tools, safety practices, blueprint reading, and air-conditioning theory. Applicants for these programs must have a high school diploma or its equivalent.

Those who acquire their skills on the job usually begin by assisting experienced technicians and doing simple jobs. They may carry materials, insulate refrigerant lines, or clean furnaces. In time, they do more difficult jobs, such as cutting and soldering pipes and sheet metal and checking electrical and electronic circuits. In 4 to 5 years, new technicians should be able to do all types of repair and installation.

Courses in shop math, mechanical drawing, applied physics and chemistry, electronics, and blueprint reading provide a good background for those interested in entering this occupation. A basic understanding of microelectronics is becoming more important because of the increasing use of this technology in solid-state equipment controls. Because technicians frequently deal directly with the public, they should be courteous and tactful, especially when dealing with an aggravated customer. They also should be in good physical condition because they sometimes have to lift and move heavy equipment.

Provisions of the Clean Air Act require that all air-conditioning and refrigeration technicians be certified by November 1994 to work on systems involving refrigerant recovery or recycling. Training programs designed to prepare workers for the certification examination, as well as for general skills improvement training, are provided by heating and air-conditioning equipment manufacturers; the Refrigeration Service Engineers Society (RSES); the Air Conditioning Contractors of America (ACCA); the Mechanical Service Contractors of America; local chapters of the National Association of Plumbing, Heating-Cooling Contractors; and the United Association of Plumbers and Pipefitters. RSES also offers a basic self-study course for individuals with limited experience.

Advancement usually takes the form of higher wages. Some technicians advance to positions as supervisors. Those with sufficient money and managerial skill can open their own contracting business.

Job Outlook

Job prospects for air-conditioning, heating, and refrigeration technicians are expected to be very good. In addition to jobs created by economic growth, thousands of openings will result from the need to replace workers who transfer to other occupations or leave the labor force. Although relatively few heating, air-conditioning, and refrigeration technicians transfer to other occupations—reflecting their lengthy investment in training and the relatively high wages and benefits in this trade—the number of retirements is expected to rise as more of these workers reach retirement age.

Employment of heating, air-conditioning, and refrigeration technicians is expected to increase faster than the average for all occupations through the year 2005. As the population and economy grow and new residential, commercial, and industrial structures are built, more technicians will be needed to install and maintain climate control systems. A growing concern about energy management and conservation also should prompt installation of new energy-saving heating and air-conditioning systems in existing homes and buildings. Regulations in the 1990 Clean Air Act prohibiting the intentional discharge of CFC refrigerants and banning CFC production by the year 2000 could result in additional retrofitting and replacement of existing equipment and create more jobs for heating, air-conditioning, and refrigeration technicians.

Those who specialize in the installation of new systems may experience periods of unemployment when the level of construction activity declines. On the other hand, employment of those doing maintenance work is relatively stable—people and businesses depend on their climate control systems regardless of economic conditions.

Earnings

Median weekly earnings of air-conditioning, heating, and refrigeration technicians who worked full time were \$474 in 1992. The middle 50 percent earned between \$356 and \$596. The lowest 10 percent earned less than \$280 a week, and the top 10 percent earned more than \$743 a week.

Apprentices usually begin at about 50 percent of the wage rate paid to experienced workers. As they gain experience and improve their skills, they receive periodic increases until they reach the wage rate of experienced workers.

Heating, air-conditioning, and refrigeration technicians enjoy a variety of employer-sponsored benefits. In addition to some typical benefits like health insurance and pension plans, some employers pay for work-related training and provide uniforms, company vans, and a few tools.

Related Occupations

Heating, air-conditioning, and refrigeration technicians work with sheet metal and piping, and repair machinery, such as electrical motors, compressors, and burners. Other workers who have similar skills are boilermakers, electrical appliance servicers, electricians, plumbers and pipefitters, and sheetmetal workers.

Sources of Additional Information

For more information about employment and training opportunities in this trade, contact local vocational and technical schools; local heating, air-conditioning, and refrigeration contractors; a local of the unions previously mentioned; a local joint union-management apprenticeship committee; a local chapter of the Associated Builders and Contractors; or the nearest office of the State employment service or State apprenticeship agency.

For information on career opportunities and training, write to:

- ✉ Associated Builders and Contractors, 1300 North 17th St. NW., Rosslyn, VA 22209.
- ✉ Refrigeration Service Engineers Society, 1666 Rand Rd., Des Plaines, IL 60016-3552.
- ✉ National Association of Home Builders, Home Builders Institute, 1010 Vermont Ave. NW., Washington, DC 20005.
- ✉ National Association of Plumbing, Heating, and Cooling Contractors, P.O. Box 6808, Falls Church, VA 22046.
- ✉ New England Fuel Institute, P.O. Box 888, Watertown, MA 02172.
- ✉ Mechanical Contractors Association of America, 1385 Piccard Dr., Rockville, MD 20850-4329.
- ✉ Air Conditioning and Refrigeration Institute, 1501 Wilson Blvd., Arlington, VA 22209.

Insulation Workers

(D.O.T. 863.364-010 and -014, .381-010 and -014, .664-010, .685-010; and 869.684-082)

Nature of the Work

Properly insulated buildings reduce energy consumption by keeping heat in during the winter and out in the summer. Refrigerated storage rooms, vats, tanks, vessels, boilers, and steam and hot water pipes also are insulated to prevent the wasteful transfer of heat. Insulation workers install this insulating material.

Insulation workers cement, staple, wire, tape, or spray insulation. When covering a steam pipe, for example, insulation workers measure and cut sections of insulation to the proper length, stretch it open along a cut that runs the length of the material, and slip it over the pipe. They fasten the insulation with adhesive, staples, tape, or wire bands. Sometimes they wrap a cover of aluminum, plastic, or

canvas over it and cement or band the cover in place. Sometimes insulation workers screw on sheet metal around insulated pipes to protect the insulation from weather conditions or physical abuse.

When covering a wall or other flat surface, workers may use a hose to spray foam insulation onto a wire mesh. The wire mesh provides a rough surface to which the foam can cling and adds strength to the finished surface. Workers may then install drywall or apply a final coat of plaster for a finished appearance.

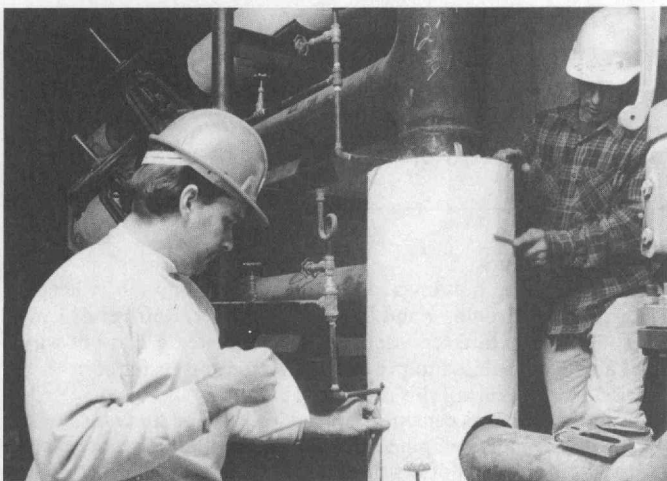
In attics or exterior walls of uninsulated buildings, workers blow in loose-fill insulation. A helper feeds a machine with shredded fiberglass, cellulose, or rock wool insulation while another worker blows the insulation from the compressor hose into the space being filled.

In new construction or major renovations, insulation workers staple fiberglass or rockwool batts to exterior walls and ceilings before drywall, paneling, or plaster walls are put in place. In major renovations of old buildings or when putting new insulation around pipes and industrial machinery, insulation workers often must first remove the old insulation. In the past, asbestos—now known to cause cancer in humans—was used extensively in walls and ceilings and for covering pipes, boilers, and various industrial equipment. Because of this danger, U.S. Environmental Protection Agency regulations require that asbestos be removed before a building undergoes major renovations or is demolished. When removing asbestos, insulation workers must follow carefully prescribed asbestos removal techniques and work practices. First they seal and depressurize the area that contains the asbestos, then they remove it using hand tools and special filtered vacuum cleaners and air-filtration devices.

Insulation workers use common handtools—trowels, brushes, knives, scissors, saws, pliers, and stapling guns. They use power saws to cut insulating materials, welding machines to join sheet metal or secure clamps, and compressors for blowing or spraying insulation.

Working Conditions

Insulation workers generally work indoors. They spend most of the workday on their feet, either standing, bending, or kneeling. Sometimes they work from ladders or in tight spaces. However, the work is not strenuous; it requires more coordination than strength. Insulation work is often dusty and dirty. The minute particles from insulation materials, especially when blown, can irritate the eyes, skin, and respiratory system. Removing cancer-causing asbestos insulation is a hazardous task and is done by specially trained workers. To protect themselves from the dangers of asbestos and irritants, workers follow strict safety guidelines, wear protective suits, masks, and respirators, take decontamination showers, and keep work areas well ventilated.



Insulation workers use handtools such as knives, trowels, and stapling guns.

Employment

Insulation workers held about 57,000 jobs in 1992; most worked for insulation or other construction contractors. Others worked for the Federal Government, in wholesale and retail trade, in shipbuilding, and in other manufacturing industries that have extensive installations for power, heating, and cooling. Most worked in urban areas. In less populated areas, insulation work may be done by carpenters, heating and air-conditioning installers, or drywall installers.

Training, Other Qualifications, and Advancement

Most insulation workers learn their trade informally on the job. Trainees are assigned to experienced insulation workers for instruction and supervision. They begin with simple tasks, such as carrying insulation or holding material while it is fastened in place. On-the-job training can take up to 2 years, depending on the work. Learning to install insulation in homes generally requires less training than insulation application in commercial and industrial settings. As they gain experience, trainees receive less supervision, more responsibility, and higher pay.

In contrast, trainees in formal apprenticeship programs receive in-depth instruction in all phases of insulation. Apprenticeship programs may be provided by a joint committee of local insulation contractors and the local union of the International Association of Heat and Frost Insulators and Asbestos Workers, to which many insulation workers belong. Programs normally consist of 4 years of on-the-job training coupled with classroom instruction, and trainees must pass practical and written tests to demonstrate a knowledge of the trade.

Insulation workers who work with asbestos usually have to be licensed. Although licensure requirements vary from area to area, most States require asbestos removal workers to complete a 3-day training program in compliance with the 1986 Asbestos Hazard Emergency Act (AHERA). The National Asbestos Council (NAC) provides this training in over 100 locations. This program emphasizes "hands-on" training. Typically, students build a decontamination unit, handle a respirator and filtered vacuum cleaners, and perform simulated asbestos removal. In addition, they receive classroom instruction on a wide variety of topics, such as government regulations, health effects and worker protection, sampling for asbestos, and work practices. NAC also offers a 2-day course on compliance with Occupational Safety and Health Administration (OSHA) regulations governing industrial asbestos removal in plants and factories, and an annual AHERA recertification program.

For entry jobs, insulation contractors prefer high school graduates who are in good physical condition and are licensed to drive. High school courses in blueprint reading, shop math, sheet-metal layout, and general construction provide a helpful background. Applicants seeking apprenticeship positions must have a high school diploma or its equivalent, and be at least 18 years old.

Skilled insulation workers may advance to supervisor, shop superintendent, insulation contract estimator, or set up their own insulation or asbestos abatement business.

Job Outlook

Employment of insulation workers is expected to grow much faster than the average for all occupations through the year 2005, reflecting the demand for insulation associated with new construction and renovation as well as the demand for asbestos removal in existing structures. Construction of new residential, industrial, and commercial buildings will drive employment demand for insulation workers. In addition, renovation and retrofitting work in existing structures will increase demand.

Asbestos removal also will provide many jobs for insulation workers, not only because insulation workers often remove asbestos, but because they replace it with another insulating material. The 1986 Asbestos Hazard Emergency Act requires that all public and private schools have an asbestos management plan. Federal regulations also require that asbestos be removed from buildings that are to be demolished or will undergo major renovations. In addition, many banks require that buildings be free of asbestos before a real estate loan will be granted. All these regulatory requirements are expected to stimulate asbestos removal and employment growth. The

need to maintain, remove, and replace asbestos insulation on old pipes, boilers, and a variety of equipment in chemical and refrigeration plants and petroleum refineries will also add to employment requirements.

Despite this growth in demand, replacement needs will account for most job openings. This occupation has the highest turnover of all the construction trades. Each year thousands of jobs will become available as insulation workers transfer to other occupations or leave the labor force. Since there are no strict training requirements for entry, many people with limited skills work as insulation workers for a short time and then move on to other types of work, creating many job openings.

Insulation workers in the construction industry may experience periods of unemployment because of the short duration of many construction projects and the cyclical nature of construction activity. Workers employed in industrial plants generally have more stable employment because maintenance and repair must be done on a continuing basis.

Unlike other construction occupations, insulation workers usually do not lose work time when weather conditions are poor. Most insulation is applied after buildings are enclosed.

Earnings

Median weekly earnings for insulation workers who worked full time were \$446 in 1992. The middle 50 percent earned between \$334 and \$608. The lowest 10 percent earned less than \$279, and the top 10 percent earned more than \$796.

According to the *Engineering News Record*, union insulation workers received an average hourly wage of \$28.65 in 1992, including benefits. Wages ranged from a low of \$19.73 an hour in New Orleans to a high of \$42.47 in New York City. Insulation workers doing commercial and industrial work earn substantially more than those working in residential construction, which does not require as much skill.

Related Occupations

Insulation workers combine a knowledge of insulation materials with the skills of cutting, fitting, and installing materials. Workers in occupations involving similar skills include carpenters, carpet installers, drywall applicators, floor layers, roofers, and sheet-metal workers.

Sources of Additional Information

For information about training programs or other work opportunities in this trade, contact a local insulation contractor; a local of the International Association of Heat and Frost Insulators and Asbestos Workers; the nearest office of the State employment service or State apprenticeship agency, or:

☞ National Insulation and Abatement Contractors Association, 99 Canal Center Plaza, Suite 222, Alexandria, VA 22314.

☞ Insulation Contractors Association of America, 1321 Duke St., Suite 303, Alexandria, VA 22314.

Painters and Paperhangers

(D.O.T. 840.381, .681, and .684; 841.381; and 845.681)

Nature of the Work

Paint and wall coverings make surfaces clean, attractive and bright. In addition, paints and other sealers protect outside walls from wear caused by exposure to the weather. Although some people do both painting and paperhanging, each requires different skills.

Painters apply paint, stain, varnish, and other finishes to buildings and other structures. They choose the right paint or finish for the surface to be covered, taking into account customers' wishes, durability, ease of handling, and method of application. They first prepare the surfaces to be covered so the paint will adhere properly. This may require removing the old coat by stripping, sanding, wire

brushing, burning, or water and abrasive blasting. Painters also may wash walls and trim to remove dirt and grease, fill nail holes and cracks, sandpaper rough spots, and brush off dust. On new surfaces, they apply a primer or sealer to prepare them for the finish coat. Painters also mix paints and match colors, relying on knowledge of paint composition and color harmony.

There are several ways to apply paint and similar coverings. Painters must be able to choose the right paint applicator for each job, depending on the surface to be covered, the characteristics of the finish, and other factors. Some jobs may only need a good bristle brush with a soft, tapered edge; others may require a dip or fountain pressure roller; still others can best be done using a paint sprayer. Many jobs need several types of applicators. The right tools for each job not only expedite the painter's work but also produce the most attractive surface.

When working on tall buildings, painters erect scaffolding, including "swing stages" (scaffolds suspended by ropes or cables attached to roof hooks). When painting steeples and other conical structures, they use a "bosun chair" (a swinglike device).

Paperhangers cover walls and ceilings with decorative wall coverings made of paper, vinyl, or fabric. They first prepare the surface to be covered by applying "sizing," which seals the surface and makes the covering stick better. When redecorating, they may first remove the old covering by soaking, steaming, or applying solvents. When necessary, they patch holes and take care of other imperfections before hanging the new wall covering.

After the surface has been prepared, paperhangers must prepare the paste or other adhesive. Then they measure the area to be covered, check the covering for flaws, cut the covering into strips of the proper size, and closely examine the pattern to match it when the strips are hung.

The next step is to brush or roll the adhesive onto the back of the covering, then to place the strips on the wall or ceiling, making sure the pattern is matched, the strips are hung straight, and the edges butted together to make tight, closed seams. Finally, paperhangers smooth the strips to remove bubbles and wrinkles, trim the top and bottom with a razor knife, and wipe off any excess adhesive.

Working Conditions

Painters and paperhangers must stand for long periods. Their jobs also require a considerable amount of climbing and bending. These workers must have stamina because much of the work is done with their arms raised overhead. Painters and paperhangers risk injury from slips or falls off ladders and scaffolds. They may sometimes work with hazardous materials. Painters often work outdoors, but seldom in wet, cold, or inclement weather.

Some painting jobs can leave a worker covered with paint; some can be hazardous if masks are not worn or if ventilation is poor.



Painters need to develop a knowledge of paint composition and color harmony.

Employment

Painters and paperhangers held about 440,000 jobs in 1992; most were held by painters. The majority of painters and paperhangers work for contractors engaged in new construction, repair, restoration, or remodeling work. In addition, organizations that own or manage large buildings, such as apartment complexes, employ maintenance painters, as do some schools, hospitals, and factories.

One of every 2 painters and paperhangers is self-employed, compared to 1 out of 4 other building trades workers. Many painters work part time.

Training, Other Qualifications, and Advancement

Painting and paperhanging are learned through apprenticeship or informal, on-the-job instruction. Although training authorities recommend completion of an apprenticeship as the best way to become a painter or paperhanger, most painters learn the trade informally on the job. Few opportunities for informal training exist for paperhangers because few paperhangers have a need for helpers.

The apprenticeship for painters and paperhangers consists of 3 to 4 years of on-the-job training, in addition to 144 hours of related classroom instruction each year. Apprentices receive instruction in color harmony, use and care of tools and equipment, surface preparation, application techniques, paint mixing and matching, characteristics of different finishes, blueprint reading, wood finishing, and safety.

On-the-job instruction covers similar skill areas for both apprentices and helpers. Under the direction of experienced workers, trainees carry supplies, erect scaffolds, and do simple tasks while they learn about paint and painting equipment. Within 2 or 3 years, trainees learn to prepare surfaces for painting and paperhanging, to mix paints, and to apply paint and wall coverings efficiently. Near the end of their training, they may learn decorating concepts, color coordination, and cost-estimating techniques.

Apprentices or helpers generally must be at least 16 years old and in good physical condition. A high school education or its equivalent that includes courses in mathematics is generally required to enter an apprenticeship program. Applicants should have manual dexterity and a good color sense.

Painters and paperhangers may advance to supervisory or estimating jobs with painting and decorating contractors. Many establish their own painting and decorating businesses.

Job Outlook

Employment of painters and paperhangers is expected to grow faster than the average for all occupations through the year 2005 as the level of new construction increases and the stock of buildings and other structures that require maintenance and renovation grows. In addition to job openings created by rising demand for the services of these workers, many tens of thousands of jobs will become available each year as painters and paperhangers transfer to other occupations or leave the labor force. Because there are no strict training requirements for entry, many people with limited skills work as painters or paperhangers for a short time and then move on to other types of work, creating many job openings. Because the number of paperhangers is comparatively small, many fewer openings will exist in this occupation.

Prospects for persons seeking jobs as painters or paperhangers should be quite favorable, due to the high turnover and minimal training requirements. Despite the favorable overall conditions, job-seekers considering these occupations should expect some periods of unemployment because of the short duration of many construction projects and the cyclical and seasonal nature of construction activity. Remodeling, restoration, and maintenance projects, however, often provide many jobs for painters and paperhangers even when new construction activity declines. The most versatile painters and paperhangers are most apt to be kept on the payroll during downturns in the economy.

Earnings

Median weekly earnings for painters who were not self-employed were about \$376 in 1992. Most earned between \$283 and \$534

weekly. The top 10 percent earned over \$703 and the bottom 10 percent earned less than \$202 a week. In general, paperhangers earn more than painters.

Hourly wage rates for apprentices usually start at 40 to 50 percent of the rate for experienced workers and increase periodically.

Many painters and paperhangers are members of the International Brotherhood of Painters and Allied Trades. Some maintenance painters are members of other unions.

Related Occupations

Painters and paperhangers apply various coverings to decorate and protect wood, drywall, metal, and other surfaces. Other occupations in which workers apply paints and similar finishes include billboard posterers, metal sprayers, undercoaters, and transportation equipment painters.

Sources of Additional Information

For details about painting and paperhanging apprenticeships or work opportunities, contact local painting and decorating contractors; a local of the International Brotherhood of Painters and Allied Trades; a local joint union-management apprenticeship committee; or an office of the State apprenticeship agency or State employment service.

For general information about the work of painters and paperhangers, contact:

☞ Associated Builders and Contractors, 729 15th St. NW., Washington, DC 20005.

☞ International Brotherhood of Painters and Allied Trades, 1750 New York Ave. NW., Washington, DC 20006.

☞ National Association of Home Builders, Home Builders Institute, 1090 Vermont Ave. NW., Washington, DC 20005.

Plasterers

(D.O.T. 842.361-018, -022, and -026, and .381-014)

Nature of the Work

Plastering—one of the oldest crafts in the building trades—is enjoying a resurgence in popularity because of the introduction of newer, less costly materials and techniques. Plasterers apply plaster to interior walls and ceilings to form fire-resistant and relatively soundproof surfaces. They also apply plaster veneer over drywall to create smooth or textured abrasion-resistant finishes. They apply durable plasters such as polymer-based acrylic finishes and stucco to exterior surfaces, and may install prefabricated exterior insulation systems over existing walls for good insulation and interesting architectural effects. In addition, they may cast ornamental designs in plaster. Drywall workers and lathers—a related occupation—use drywall instead of plaster when erecting interior walls and ceilings. (See the statement on drywall workers and lathers elsewhere in the *Handbook*.)

When plasterers work with interior surfaces such as cinder block and concrete, they first apply a brown coat of gypsum plaster that provides a base, followed by a second or finish coat (also called white coat), which is a lime-based plaster. When plastering metal lath (supportive wire mesh) foundations, they apply a preparatory or scratch coat with a trowel. They spread this rich plaster mixture into and over the metal lath. Before the plaster sets, they scratch its surface with a rake-like tool to produce ridges so the subsequent brown coat will bond to it tightly.

Laborers prepare a thick, smooth plaster for the brown coat. Plasterers spray or trowel this mixture onto the surface, then finish by smoothing it to an even, level surface.

For the finish coat, plasterers prepare a mixture of lime, plaster of Paris, and water. They quickly apply this onto the brown coat using a hawk (a light, metal plate with a handle), trowel, brush, and water. This mixture, which sets very quickly, produces a very smooth, durable finish.

Plasterers also work with a plaster material that can be finished in a single coat. This thin-coat or gypsum veneer plaster is made of lime and plaster of Paris and is mixed with water on the job site. It provides a smooth, durable, abrasion resistant finish on interior masonry surfaces, special gypsum base board, or drywall prepared with a bonding agent.

Plasterers may create decorative interior surfaces as well. They do this by pressing a brush or trowel firmly against the wet plaster surface and using a circular hand motion to create decorative swirls.

For exterior work, plasterers usually apply a mixture of portland cement, lime, and sand (stucco) over cement, concrete, masonry, and lath. Stucco is also applied directly to a wire lath with a scratch coat followed by a brown coat and then a finish coat. Plasterers may also embed marble or gravel chips into the finish coat to achieve a pebblelike, decorative finish.

Increasingly today, plasterers apply insulation to the exteriors of new and old buildings. They cover the outer wall with rigid foam insulation board and reinforcing mesh and then trowel on a polymer-based or polymer-modified base coat. They apply an additional coat of this material with a decorative finish.

Plasterers sometimes do complex decorative and ornamental work that requires special skill and creativity. For example, they may mold intricate wall and ceiling designs. Following an architect's blueprint, they may pour or spray a special plaster into a mold and allow it to set. Workers then remove the molded plaster and put it in place according to the plan.

Working Conditions

Most plastering jobs are indoors; however, plasterers work outside when applying stucco or exterior wall insulation and decorative finish systems. Because plaster can freeze, heat is usually necessary to complete plastering jobs in cold weather. Sometimes plasterers work on scaffolds high above the ground.

Plastering is physically demanding—requiring considerable standing, bending, lifting, and reaching overhead. The work can be dusty and dirty; plaster materials also soil shoes and clothing and can irritate skin and eyes.

Employment

Plasterers held about 32,000 jobs in 1992. Most plasterers work on new construction, particularly where special architectural and lighting effects are part of the work. Some repair and renovate older buildings. Many plasterers are employed in Florida, California, and the Southwest, where exterior plasters with decorative finishes are very popular.

Most plasterers work for independent contractors. About 3 out of every 10 plasterers are self-employed.



Plasterers create decorative interior surfaces.

Training, Other Qualifications, and Advancement

Although most employers recommend apprenticeship as the best way to learn plastering, many people learn the trade by working as helpers to experienced plasterers.

Apprenticeship programs, sponsored by local joint committees of contractors and unions, generally consist of 2 or 3 years of on-the-job training, in addition to at least 144 hours annually of classroom instruction in drafting, blueprint reading, and mathematics for layout work.

In the classroom, apprentices start with a history of the trade and the industry. They also learn about the uses of plaster, estimating materials and costs, and casting ornamental plaster designs. On the job, they learn about lath bases, plaster mixes, methods of plastering, blueprint reading, and safety. They also learn how to use various tools, such as hand and powered trowels, floats, brushes, straightedges, power tools, plaster-mixing machines, and piston-type pumps. Some apprenticeship programs also allow individuals to obtain training in related occupations such as cement masonry and bricklaying.

Those who learn the trade informally as helpers usually start by carrying materials, setting up scaffolds, and mixing plaster. Later they learn to apply the scratch, brown, and finish coats.

Applicants for apprentice or helper jobs generally must be at least 17 years old, be in good physical condition, and have manual dexterity. Applicants who have a high school education are preferred. Courses in general mathematics, mechanical drawing, and shop provide a useful background.

Plasterers may advance to supervisors, superintendents, or estimators for plastering contractors, or may become self-employed contractors.

Job Outlook

Employment of plasterers is expected to increase about as fast as the average for all occupations through the year 2005. In addition to job openings due to rising demand for plastering work, additional jobs will open up as plasterers transfer to other occupations or leave the labor force.

In past years, employment of plasterers declined as more builders switched to drywall construction. This decline has halted, however, and employment of plasterers is expected to continue growing as a result of greater appreciation for the durability and attractiveness that troweled finishes provide. Thin-coat plastering or veneering, in particular, is gaining greater acceptance as more builders recognize its ease of application, durability, quality of finish, and fire-retardant qualities. New polymer-based or polymer-modified acrylic exterior insulating finishes are also gaining popularity, not only because of their durability, attractiveness, and insulating properties but also because of their lower cost. In addition, plasterers will be needed to renovate plaster work in older structures and create special architectural effects such as curved surfaces, which are not practical with drywall materials.

Most plasterers work in construction, where prospects fluctuate from year to year due to changing economic conditions. Bad weather affects plastering less than other construction trades because most work is indoors. On exterior surfacing jobs, however, plasterers may lose time because materials cannot be applied under wet or freezing conditions. Best employment opportunities should continue to be in Florida, California, and the Southwest, where exterior plaster and decorative finishes are expected to remain popular.

Earnings

According to the limited information available, average hourly earnings—including benefits—for plasterers who belonged to a union and worked full time ranged between \$15 and \$33 in 1992. Plasterers in Boston, New York, Chicago, San Francisco, Los Angeles, and other large cities received the higher hourly earnings. Apprentice wage rates start at about half the rate paid to experienced plasterers. Annual earnings for plasterers and apprentices may be less than the hourly rate would indicate because poor weather and periodic declines in construction activity may limit their work time.

Many plasterers are members of unions. They are represented by the Operative Plasterers' and Cement Masons' International Association of the United States and Canada, or the International Union of Bricklayers and Allied Craftsmen.

Related Occupations

Other construction workers who use a trowel as their primary tool include drywall finishers, bricklayers, concrete masons, marble setters, stonemasons, terrazzo workers, and tilesetters.

Sources of Additional Information

For information about apprenticeships or other work opportunities, contact local plastering contractors; locals of the unions previously mentioned; a local joint union-management apprenticeship committee; or the nearest office of the State apprenticeship agency or the State employment service.

For general information about the work of plasterers, contact:
International Union of Bricklayers and Allied Craftsmen, 815 15th St. NW., Washington, DC 20005.
Operative Plasterers' and Cement Masons' International Association of the United States and Canada, 1125 17th St. NW., Washington, DC 20036.

Plumbers and Pipefitters

(D.O.T. 806.381-062, 862.261, .281-010, -014, and -022, .361-014, -018, and -022, and .381 except -010 and -038, .681, .682-010, and .684-034)

Nature of the Work

Most people are familiar with the plumber who comes to their home to unclog a drain or install an appliance. In addition to this, however, plumbers and pipefitters install, maintain, and repair many different types of pipe systems. For example, some systems move water to a municipal water treatment plant, and then to residential, commercial, and public buildings. Others dispose of waste. Some bring in gas for stoves and furnaces. Others supply air-conditioning. Pipe systems in powerplants carry the steam that powers huge turbines. Pipes also are used in manufacturing plants to move material through the production process.

Although plumbing and pipefitting sometimes are considered a single trade, workers generally specialize in one or the other. Plumbers install and repair the water, waste disposal, drainage, and gas systems in homes and commercial and industrial buildings. They also install plumbing fixtures—bathtubs, showers, sinks, and toilets—and appliances such as dishwashers and water heaters. Pipefitters install and repair both high- and low-pressure pipe systems that are used in manufacturing, in the generation of electricity, and in heating and cooling buildings. Some pipefitters specialize in only one type of system. *Steamfitters*, for example, install pipe systems that move liquids or gases under high pressure. *Sprinklerfitters* install automatic fire sprinkler systems in buildings.

Plumbers and pipefitters use many different materials and construction techniques, depending on the type of project. Residential water systems, for example, use copper, steel, and increasingly plastic pipe that can be handled and installed by one or two workers. Municipal sewerage systems, on the other hand, are made of large cast iron pipes; installation normally requires crews of pipefitters. Despite these differences, all plumbers and pipefitters must be able to follow building plans or blueprints and instructions from supervisors, lay out the job, and work efficiently with the materials and tools of the trade. The following example illustrates how plumbers install piping in a house.

Construction plumbers work from blueprints or drawings that show the planned location of pipes, plumbing fixtures, and appliances. They lay out the job to fit the piping into the structure of the house with the least waste of material and within the confines of the structure. They measure and mark areas where pipes will be installed and connected. They check for obstructions, such as electrical wiring, and, if necessary, plan the pipe installation around the problem.

Sometimes they have to cut holes in walls, ceilings, and floors. For some systems, they may have to hang steel supports from ceiling joists to hold the pipe in place. To assemble the system, plumbers cut and bend lengths of pipe using saws, pipe cutters, and pipe-bending machines. They connect lengths of pipe with fittings; the method depends on the type of pipe used. For plastic pipe, plumbers connect the sections and fittings with adhesives. For copper pipe, they slide fittings over the end of the pipe and solder the fitting in place with a torch.

After the piping is in place, plumbers install the fixtures and appliances and connect the system to the outside water or sewer lines. Using pressure gauges, they check the system to insure that the plumbing works properly.

Working Conditions

Because plumbers and pipefitters frequently must lift heavy pipes, stand for long periods, and sometimes work in uncomfortable or cramped positions, they need physical strength as well as stamina. They may have to work outdoors in inclement weather. They also are subject to falls from ladders, cuts from sharp tools, and burns from hot pipes or from soldering equipment.

Plumbers and pipefitters engaged in construction generally work a standard 40-hour week; those involved in maintaining pipe systems, including those who provide maintenance services under contract, may have to work evening or weekend shifts, as well as be on call. These maintenance workers may spend quite a bit of time traveling to and from work sites.

Employment

Plumbers and pipefitters held about 351,000 jobs in 1992. About two-thirds worked for mechanical and plumbing contractors engaged in new construction, repair, modernization, or maintenance work. Others did maintenance work for a variety of industrial, commercial, and government employers. For example, pipefitters were employed as maintenance personnel in the petroleum and chemical industries, where manufacturing operations require the moving of liquids and gases through pipes. One of every 6 plumbers and pipefitters is self-employed.

Jobs for plumbers and pipefitters are distributed across the country in about the same proportion as the general population.



Most plumbers work for plumbing contractors.

Training, Other Qualifications, and Advancement

Virtually all plumbers undergo some type of apprenticeship training. Many programs are administered by local union-management committees comprising members of the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada, the Mechanical Contractors Association of America, Inc., the National Association of Plumbing-Heating-Cooling Contractors, or the National Fire Sprinkler Association, Inc.

Nonunion training and apprenticeship programs are administered by local chapters of the Associated Builders and Contractors, the National Association of Plumbing-Heating-Cooling Contractors, the American Fire Sprinkler Association, and the National Association of Home Builders, Home Builders Institute.

Apprenticeships—both union and nonunion—consist of 4 to 5 years on-the-job training, in addition to at least 144 hours annually of related classroom instruction. Classroom subjects include drafting and blueprint reading, mathematics, applied physics and chemistry, safety, and local plumbing codes and regulations. On the job, apprentices first learn basic skills such as identifying grades and types of pipe, the use of the tools of the trade, and the safe unloading of materials. As apprentices gain experience, they learn how to work with various types of pipe and to install different piping systems and plumbing fixtures. Apprenticeship gives trainees a thorough knowledge of all aspects of the trade. Although most plumbers are trained through apprenticeship, some still learn their skills informally on the job.

Applicants for union or nonunion apprentice jobs must be 18 years old and in good physical condition. Apprenticeship committees may require applicants to have a high school diploma or its equivalent. Armed Forces training in plumbing and pipefitting is considered very good preparation. In fact, persons with this background may be given credit for previous experience when entering a civilian apprenticeship program. Secondary or postsecondary courses in shop, plumbing, general mathematics, drafting, blueprint reading, and physics also are good preparation.

Although there are no uniform national licensing requirements, most communities require plumbers to be licensed. Licensing requirements vary from area to area, but most localities require workers to pass an examination that tests their knowledge of the trade and of local plumbing codes.

Some plumbers and pipefitters may become supervisors for mechanical and plumbing contractors. Others go into business for themselves.

Job Outlook

Employment of plumbers and pipefitters is expected to grow more slowly than the average for all occupations through the year 2005. Construction activity—residential, industrial, and commercial—is expected to grow significantly over the next decade. Building renovation, including the increasing installation of sprinkler systems; maintenance of powerplants, water and wastewater treatment plants, pipelines, office buildings, factories, and other projects that have large pipe systems; and maintenance of existing residential systems are expected to spur the demand for these workers. However, the growing use of plastic pipe and fittings, which are much easier to use; more efficient sprinkler systems; and other technologies will mean that employment will not grow as fast as it has in past years. In addition, several thousand positions will become available each year from the need to replace experienced workers who leave the occupation.

Traditionally, many organizations with pipe systems have employed their own plumbers and pipefitters to maintain their equipment and keep everything running smoothly. In order to reduce their labor costs, many of these firms are relying on workers provided, under service contracts, by plumbing and pipefitting contractors.

Because of the temporary nature of construction projects, plumbers and pipefitters may experience short bouts of unemployment when the project on which they are working ends. Because construction activity varies from area to area, job openings, as well as

apprenticeship opportunities, fluctuate with local economic conditions.

Employment of these workers generally is less sensitive to changes in economic conditions than in some of the other construction trades. Maintenance, rehabilitation, and replacement of existing piping systems as well as the growing installation of fire sprinkler systems provide jobs for many plumbers, pipefitters, and sprinklerfitters, even when construction activity declines.

Earnings

According to a survey of workplaces in 160 metropolitan areas, maintenance pipefitters had median earnings of \$18.05 an hour in 1992, with the middle half earning between \$16.15 and \$19.66. In comparison, the average wage for all nonsupervisory and production workers in private industry, except farming, was \$10.59.

Apprentices usually begin at about 50 percent of the wage rate paid to experienced plumbers or pipefitters. This increases periodically as they improve their skills. After an initial waiting period, apprentices receive the same benefits as experienced plumbers and pipefitters.

Many plumbers and pipefitters are members of the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada.

Related Occupations

Other occupations in which workers install and repair mechanical systems in buildings are boilermakers, stationary engineers, electricians, elevator installers, heating, air-conditioning, and refrigeration mechanics, industrial machinery repairers, millwrights, and sheet-metal workers.

Sources of Additional Information

For information about apprenticeships or work opportunities in plumbing and pipefitting, contact local plumbing, heating, and air-conditioning contractors; a local or State chapter of the National Association of Plumbing, Heating, and Cooling Contractors; a local chapter of the Mechanical Contractors Association; a local of the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada; the nearest office of the State employment service or State apprenticeship agency; or the National Association of Home Builders, Home Builders Institute, 1090 Vermont Ave. NW., Washington, DC 20005.

For general information about the work of plumbers, pipefitters, and sprinklerfitters, contact:

☞ National Association of Plumbing-Heating-Cooling Contractors, P.O. Box 6808, Falls Church, VA 22046.

☞ Associated Builders and Contractors, 729 15th St. NW., Washington, DC 20005.

☞ National Fire Sprinkler Association, P.O. Box 1000, Patterson, NY 12563.

☞ American Fire Sprinkler Association, Inc., 12959 Jupiter Rd., Suite 142, Dallas, TX 75238-3200.

☞ Mechanical Contractors Association of America, 1385 Piccard Dr., Rockville, MD 20850.

☞ Home Builders Institute, 1090 Vermont Ave. NW., Washington, DC 20005.

Roofers

(D.O.T. 866.381-010, -014, and .684-010)

Nature of the Work

A leaky roof can damage ceilings, walls, and furnishings. To protect buildings and their contents from water damage, roofers repair and install roofs of tar or asphalt and gravel, rubber, thermoplastic, and metal; and shingles made of asphalt, slate, fiberglass, wood, tile, or other material. Repair and reroofing—replacing old roofs on existing buildings—provide many work opportunities for these workers. Roofers also may waterproof foundation walls and floors.

There are two types of roofs, flat and pitched (sloped). Most commercial, industrial, and apartment buildings have flat or slightly sloping roofs. Most houses have pitched roofs. Some roofers work on both types; others specialize.

Most flat roofs are covered with several layers of materials. Roofers first put a layer of insulation on the roof deck. They then spread a coat of molten bitumen (a tar-like substance) over the insulation. Next, they install partially overlapping layers of roofing felt (fabric saturated in bitumen) over the insulation surface and use a mop to spread hot bitumen over it and under the next layer. This seals the seams and makes the surface watertight. Roofers repeat these steps to build up the desired number of layers (called plies). The top layer is either glazed to make a smooth finish, or has gravel embedded in the hot bitumen for a rough surface.

An increasing number of flat roofs are covered with a single-ply membrane of waterproof rubber or thermoplastic compounds. Roofers roll these sheets over the roof's insulation and seal the seams. Adhesive, mechanical fasteners, or stone ballasts hold the sheets in place. The building must be of sufficient strength to hold the ballast.

Most residential roofs are covered with shingles. To apply shingles, roofers first lay, cut, and tack 3-foot strips of roofing felt lengthwise over the entire roof. Then, starting from the bottom edge, they nail overlapping rows of shingles to the roof. Workers measure and cut the felt and shingles to fit intersecting roofs, and to fit around vent pipes and chimneys. Wherever two roof surfaces intersect or shingles reach a vent pipe or chimney, roofers cement or nail flashing (strips of metal or shingle) over the joints to make them watertight. Finally, roofers cover exposed nailheads with roofing cement or caulking to prevent water leakage.

Some roofers also waterproof and dampproof masonry and concrete walls and floors. To prepare surfaces for waterproofing, they hammer and chisel away rough spots or remove them with a rubbing brick before applying a coat of liquid waterproofing compound. They also may paint or spray surfaces with a waterproofing material or attach waterproofing membrane to surfaces. When dampproofing, they usually spray a bitumen-based coating on interior or exterior surfaces.

Working Conditions

Roofers' work is strenuous. It involves heavy lifting, as well as climbing, bending, and kneeling. Roofers risk injuries from slips or falls from scaffolds, ladders, or roofs, and burns from hot bitumen. In fact, of all construction industries, the roofing industry has the highest accident rate. Roofers work outdoors in all types of weather, particularly when making repairs. Roofs are extremely hot during the summer.



Roofers work outdoors in all types of weather.

Employment

Roofers held about 127,000 jobs in 1992. Almost all wage and salary roofers work for roofing contractors. Two of every 5 roofers are self-employed. Many self-employed roofers specialize in residential work.

Training, Other Qualifications, and Advancement

Most roofers acquire their skills informally by working as helpers for experienced roofers. They start by carrying equipment and material and erecting scaffolds and hoists. Within 2 or 3 months, they are taught to measure, cut, and fit roofing materials and then to lay asphalt or fiberglass shingles. Because some roofing materials are used infrequently, it can take several years to get experience working on all the various types of roofing applications.

Some roofers train through 3-year apprenticeship programs administered by local union-management committees representing roofing contractors and locals of the United Union of Roofers, Waterproofers, and Allied Workers. The apprenticeship program generally consists of a minimum of 1,400 hours of on-the-job training annually, plus 144 hours of classroom instruction a year in subjects such as tools and their use, arithmetic, and safety. On-the-job training for apprentices is similar to that for helpers, except that the apprenticeship program is more structured. Apprentices also learn to dampproof and waterproof walls.

Good physical condition and good balance are essential. A high school education or its equivalent is helpful, as are courses in mechanical drawing and basic mathematics. Most apprentices are at least 18 years old.

Roofers may advance to supervisor or estimator for a roofing contractor or become contractors themselves.

Job Outlook

Jobs for roofers should be plentiful through the year 2005, primarily because of the need to replace workers who transfer to other occupations or who leave the labor force. Turnover is high; roofing work is hot, strenuous, and dirty, and a significant number of workers treat roofing as a temporary job until something better comes along. Some roofers leave the occupation to go into other construction trades.

Employment of roofers is expected to increase about as fast as the average for all occupations through the year 2005. Roofs deteriorate faster than most other parts of buildings and periodically need to be repaired or replaced. About 75 percent of roofing work is repair and reroofing, a higher proportion than in most other construction work. As a result, demand for roofers is less susceptible to downturns in the economy than some of the other construction trades. In addition to repair and reroofing work on the growing stock of buildings, new construction of industrial, commercial, and residential buildings will add to the demand for roofers. However, many innovations and advances in materials, techniques, and tools have made roofers more productive and will restrict the growth of employment at least to some extent. Jobs should be easiest to find during spring and summer, when most roofing is done.

Earnings

Median weekly earnings for roofers working full time were about \$315 a week in 1992. The middle 50 percent earned between \$295 and \$595 a week. The top 10 percent earned more than \$830 weekly and the lowest 10 percent, less than \$230.

According to the *Engineering News Record*, average hourly earnings—including benefits—for union roofers were \$23.63 in 1992. Wages ranged from a low of \$14.85 in Atlanta to a high of \$35.13 in New York City. Apprentices generally start at about 40 percent of the rate paid to experienced roofers and receive periodic raises as they acquire the skills of the trade. Earnings for roofers are reduced on occasion because poor weather often limits the time they can work.

Some roofers are members of the United Union of Roofers, Waterproofers & Allied Workers.

Related Occupations

Roofers use shingles, bitumen and gravel, single-ply plastic or rubber sheets, or other materials to waterproof building surfaces. Workers in other occupations who cover surfaces with special materials for protection and decoration include carpenters, concrete masons, drywall applicators, floor covering installers, plasterers, terrazzo workers, and tilesetters.

Sources of Additional Information

For information about roofing apprenticeships or work opportunities in this trade, contact local roofing contractors; a local of the Roofers union; a local joint union-management apprenticeship committee; or the nearest office of the State employment service or State apprenticeship agency.

For information about the work of roofers, contact:

✉ National Roofing Contractors Association, 10255 W. Higgins Rd., Rosemont, IL 60018.

✉ United Union of Roofers, Waterproofers and Allied Workers, 1125 17th St. NW., Washington, DC 20036.



Roustabouts' work is fairly strenuous and requires frequent bending, stooping, climbing, and heavy lifting.

Roustabouts

(D.O.T. 869.684-046 and 939.687-018)

Nature of the Work

Much of the routine physical labor and maintenance in and around oil fields, gas facilities and pipelines is performed by roustabouts. They dig ditches or trenches for foundations or for drainage, load and unload trucks and boats, mix concrete, paint equipment, cut down trees and brush, and connect pipes and hydraulic hoses. They also may assemble and perform minor repairs on oil field machinery and equipment—such as pumps, boilers, valves, and steam engines. Much of their work is done using handtools, such as hammers, wrenches, and shovels. With increasing mechanization in the oil industry, however, roustabouts also operate equipment such as motorized lifts, power tools, electronic testers, and hand-held computers for reading tanks. With such laborsaving equipment, roustabouts are able to assume more maintenance responsibilities.

Most roustabouts work with crews around existing oil wells. Others work for companies engaged in drilling wells, almost all of which is done by specialized companies known as drilling contractors.

Roustabouts frequently assist skilled workers such as welders, electricians, and mechanics. They generally work under the supervision of a maintenance superintendent.

Working Conditions

Roustabouts' work is fairly strenuous and requires frequent bending, stooping, climbing, and heavy lifting. Hazards include falls from rigs or derricks and other platforms, injuries from falling objects, cuts and abrasions from various tools and equipment, and sore or strained muscles from heavy lifting. Roustabouts work outdoors in all kinds of weather. Those working on offshore rigs and platforms can experience strong ocean currents, tides, and storms.

Roustabouts who work on offshore drilling rigs generally work 7 days a week, 12 hours a day, and then have 7 days off. They live on the drilling platform for a week at a time and return to shore by helicopter or crewboat. In contrast, those who work onshore in oil production operations generally work regular 5-day, 40-hour weeks. Many drilling operations continue 24 hours a day until oil is discovered or the location is abandoned as a dry hole. This requires three 8-hour shifts or "tours," 7 days a week.

Roustabouts working with drilling crews move from place to place since their work in a particular field may be completed in a few weeks or months. Those who work on production wells usually remain in the same location for long periods.

Employment

Roustabouts held about 33,000 jobs in 1992. Seven of every 10 jobs were in the oil and gas field services industry. The remaining jobs were in the crude petroleum and natural gas industry. Although drilling for oil and gas is done in a large number of States, about 85 percent of all workers are employed in eight States. Texas leads in the number of oil field jobs, followed by Louisiana, Oklahoma, California, Colorado, Wyoming, Alaska, and New Mexico.

Most jobs are full-time, permanent positions. However, some roustabouts are temporary workers, such as students during the summer.

Training, Other Qualifications, and Advancement

People with little or no formal training or work experience can get jobs as roustabouts. However, with extremely keen competition for jobs in recent years, an increasing proportion of entrants to this occupation have previous work experience as a roustabout or a 2-year degree in petroleum technology—providing knowledge of oil field operations and familiarity with computers and other automated equipment.

Applicants must be physically fit and able to pass a physical examination. Employers seek candidates who have mechanical ability, agility, coordination, and good eyesight. Companies may administer aptitude tests to prospective employees or screen them for drug abuse.

Roustabouts usually are hired in the field by the maintenance superintendent or by a local company representative. Companies generally hire workers who live near the work site.

Employers are often reluctant to invest in training because of the relatively high turnover rate among roustabouts. However, some employees are given an opportunity to take courses offered by various junior colleges. In some companies, roustabouts participate in educational assistance programs that pay for job-related courses taken on the employee's own time.

New hires without postsecondary training or previous work experience learn through on-the-job training under the supervision of a more skilled worker. Roustabouts start by performing basic laborer tasks such as unloading trucks and digging trenches. As they gain experience, they progress to more complex tasks such as fixing motors or repairing pumps. During their training, they learn about safety, maintenance of equipment and machinery, and general oil field operations.

Roustabouts on maintenance and operation crews can advance to jobs as switcher, gauger, pumper, lease operator, or, for those who demonstrate leadership qualities, to chief operator or maintenance superintendent. Those on drilling crews may advance to roughneck, floor hand, or rotary helper in 3 to 6 months. (Roughnecks guide pipe sections to and from oil well openings and help operate drilling machinery.) Roughnecks and other crew members may advance to

derrick operator and, after several years, to driller. A driller with significant experience and supervisory skills can advance to tool pusher in charge of one or more drilling rigs.

Roustabouts who are graduates of petroleum technology programs—generally 2 years long—can advance to engineering technician or related jobs. Some attend company schools where they receive specialized training in electricity, welding, or other subjects, and later advance to various craft jobs—electrician, welder, or pipefitter, for example.

During periods of rapid growth in the oil industry, advancement opportunities are plentiful for capable workers. Because new jobs have been scarce in recent years, however, advancement opportunities have been limited.

Job Outlook

Job opportunities for roustabouts are expected to be limited. Employment of roustabouts is expected to decline through the year 2005 as a result of reduced exploration and falling production in the domestic oil industry, as well as increasing automation of oil field operations.

Replacement needs will account for virtually all job openings in this occupation, but as employment of roustabouts declines, many of those who leave these jobs will not be replaced. Like many entry level occupations, turnover among roustabouts is relatively high, particularly for those workers involved in offshore drilling. Some roustabouts find the work too strenuous or dirty and leave the occupation. Many people take roustabout jobs to earn money for a specific purpose—for example, a college education—and quit after a short time. Still others stay only long enough to acquire the minimum skills to advance into more highly skilled jobs.

In recent years, there has been a worldwide surplus of oil. Major oil finds around the world and increased production by key foreign oil producers, such as the Middle Eastern and North Sea nations, have increased the supply of oil. At the same time, domestic conservation of oil by industry and the public has reduced the demand for oil. This surplus has resulted in lower oil prices and a reduced incentive for exploration and drilling. Many “stripper” oil wells—labor-intensive operations that employ many roustabouts—have been forced to close down, resulting in layoffs of some roustabouts. In an effort to cut costs, oil companies have streamlined operations and maintained their production levels with fewer workers.

The number of job openings for roustabouts should continue to be limited, so employers should continue to be selective in hiring. Job opportunities will be best for persons with previous experience as a roustabout or formal training in petroleum technology. Job opportunities are expected to be better on offshore rigs than in onshore activities.

Employment of roustabouts is sensitive to cyclical swings in the economy, particularly to the level of activity in the oil industry. During a slowdown in activity, roustabouts are subject to layoffs.

Earnings

In 1992, estimated earnings for roustabouts averaged \$11.90 an hour. Roustabouts in the oil and gas field industry earned an estimated average of \$13.30 an hour. Those working offshore had an estimated hourly rate of \$14.40, while onshore workers earned an estimated \$12.50 an hour. Roustabouts working in the contract drilling industry averaged an estimated \$9.90 an hour; those working onshore earned an estimated \$9.70, and offshore workers earned an estimated \$10.60. Average earnings for roustabouts varied by area—ranging from an estimated \$10.20 in the Middle Atlantic States to an estimated \$12.70 in the Western Mountain States.

Only about one-fourth of all firms employing oil field operation workers and less than 5 percent of firms employing contract drilling workers were covered by union contracts. Workers in establishments with collective bargaining agreements are represented by the Associated Petroleum Employees Union or by the Oil, Chemical and Atomic Workers International Union.

Related Occupations

Roustabouts assist skilled oil field workers. Other laborers who assist skilled workers include construction laborers, dockhands, and material handlers.

Sources of Additional Information

Information on job opportunities for roustabouts may be available from local offices of the State employment service or oil companies and drilling contractors. The names and addresses of oil companies are listed in either the *U.S.A. Oil Industry Directory* or the *Time Oil and Gas Directory*.

Sheetmetal Workers

(D.O.T. 804.281-010 and -014)

Nature of the Work

Sheetmetal workers make, install, and maintain air-conditioning, heating, ventilation, and pollution control duct systems; roofs; siding; rain gutters and downspouts; skylights; restaurant equipment; outdoor signs; and many other building parts and products made from metal sheets. They may also work with fiberglass and plastic materials. Although some workers specialize in fabrication, installation, or maintenance, most do all three jobs. (This statement does not include workers employed in the mass production of sheetmetal products.)

Sheetmetal workers usually fabricate their products at a shop away from the construction site. They first study plans and specifications to determine the kind and quantity of materials they will need. They then measure, cut, bend, shape, and fasten pieces of sheet metal to make duct work, counter tops, and other custom products. In an increasing number of shops, sheetmetal workers use computerized metalworking equipment. This enables them to experiment with different layouts and to select the one that results in the least waste of material. They cut or form the parts with computer-controlled saws, lasers, shears, and presses.

In shops without computerized equipment and for products that cannot be made on such equipment, sheetmetal workers use hand calculators to make the required calculations and use tapes, rulers, and other measuring devices for layout work. They then cut or stamp the parts on machine tools.

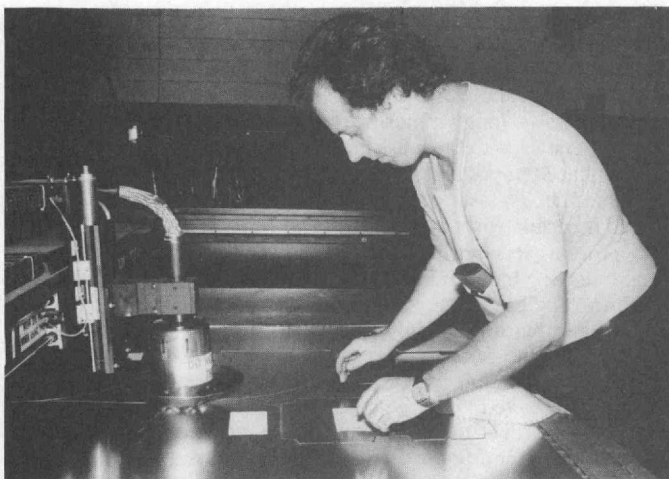
Before assembling the pieces, sheetmetal workers check each part for accuracy and, if necessary, finish it by using hand, rotary, or squaring shears and hacksaws. After the parts have been inspected, workers fasten the seams and joints together with welds, bolts, cement, rivets, solder, specially formed sheetmetal drive clips, or other connecting devices. They then take the parts to the construction site where they further assemble the pieces as they install them. These workers install ducts, pipes, and tubes by joining them end to end and hanging them with metal hangers secured to a ceiling or a wall. They also use shears, hammers, punches, and drills to make parts at the worksite or to alter parts made in the shop.

Some jobs are done completely at the job site. When installing a metal roof, for example, sheetmetal workers measure and cut the roofing panels that are needed to complete the job. They secure the first panel in place and interlock and fasten the grooved edge of the next panel into the grooved edge of the first. Then they nail or weld the free edge of the panel to the structure. This two-step process is repeated for each additional panel. Finally, they fasten machine-made molding at joints, along corners, and around windows and doors for a neat, finished effect.

In addition to installation, some sheetmetal workers specialize in testing, balancing, adjusting, and servicing existing air-conditioning and ventilation systems to make sure they are functioning properly and to improve their energy efficiency. Sheetmetal workers may also perform safe removal of asbestos and toxic materials.

Working Conditions

Sheetmetal workers usually work a 40-hour week. Those who fabricate sheetmetal products work in shops that are well lighted and well ventilated. They stand for long periods and may have to lift heavy materials and finished pieces. Sheetmetal workers must follow safety practices because working around high-speed machines can be dangerous. They may be subject to cuts from sharp metal,



In many shops, sheet-metal workers use computerized equipment to cut parts.

burns from soldering and welding, and falls from ladders and scaffolds. They generally wear safety glasses and must not wear jewelry or loose-fitting clothing that could easily get caught in a machine.

Those doing installation work do considerable bending, lifting, standing, climbing, and squatting, sometimes in close quarters or in awkward positions. Although installing duct systems and kitchen equipment is done indoors, the installation of siding, roofs, and gutters involves much outdoor work, requiring sheetmetal workers to work in all kinds of weather.

Employment

Sheetmetal workers held about 91,000 wage and salary jobs in the construction industry in 1992. Seven of every 10 worked for plumbing, heating, and air-conditioning contractors; 1 of every 5 worked for roofing and sheetmetal contractors; and the rest worked for other special trade contractors and for general contractors engaged in residential and commercial building. Unlike many other construction trades, very few sheetmetal workers are self-employed.

Jobs for sheetmetal workers are distributed throughout the country in about the same proportion as the total population.

Training, Other Qualifications, and Advancement

Sheetmetal contractors consider apprenticeship the best way to learn this trade. The apprenticeship program consists of 4 or 5 years of on-the-job training and a minimum of 144 hours per year of classroom instruction. Apprenticeship programs provide comprehensive instruction in both sheetmetal fabrication and installation. They are administered by local joint committees composed of the Sheet Metal Workers' International Association and local chapters of the Sheet Metal and Air-Conditioning Contractors National Association, or by local chapters of the Associated Builders and Contractors.

On the job, apprentices learn the basics of pattern layout and how to cut, bend, fabricate, and install sheet metal. They begin with basic ductwork and gradually advance to more difficult jobs, such as making more complex ducts, fittings, and decorative pieces. They also use materials such as fiberglass, plastics, and other non-metallic materials.

In the classroom, apprentices learn drafting, plan and specification reading, trigonometry and geometry applicable to layout work, the use of computerized equipment, welding, and the principles of heating, air-conditioning, and ventilating systems. Safety is stressed throughout the program. In addition, apprentices learn the relationship between sheetmetal work and other construction work.

A relatively small number of persons pick up the trade informally, usually by working as helpers to experienced sheetmetal workers. Most begin by carrying metal and cleaning up debris in a metal shop while they learn about materials and tools and their uses. Later, they learn to operate machines that bend or cut metal. In time, helpers go out on the job site to learn installation. Those who

acquire their skills this way often take vocational school courses in mathematics or sheetmetal fabrication to supplement their work experience. Helpers usually must pass an exam to be promoted to the journey level.

Applicants for jobs as apprentices or helpers should be in good physical condition and have mechanical and mathematical aptitude. Good eye-hand coordination, spatial and form perception, and manual dexterity are also important. Local apprenticeship committees require a high school education or its equivalent. Courses in Algebra, trigonometry, geometry, mechanical drawing, and shop provide a helpful background for learning the trade, as does work experience obtained in the Armed Services.

It is important that experienced sheetmetal workers keep abreast of new technological developments such as the growing use of computerized layout and laser cutting machines. Workers often take additional training provided by the union or by their employer in order to improve existing skills or to acquire new ones.

Sheetmetal workers may advance to supervisory jobs. Some take additional training in welding and do more specialized work. Others go into the contracting business for themselves. Because a sheetmetal contractor must have a shop with equipment to fabricate products, this type of contracting business is more expensive to start than other types of construction contracting.

Job Outlook

Employment of sheetmetal workers in construction is expected to increase faster than the average for all occupations through the year 2005. Demand for sheetmetal installation should increase as more industrial, commercial, and residential structures are built. Growing demand for more energy-efficient air-conditioning, heating, and ventilation systems in the growing stock of older buildings, as well as other types of renovation and maintenance work, also should boost employment. In addition, the greater use of decorative sheetmetal products and increased architectural restoration are expected to add to the demand for sheetmetal workers. Despite this growth in demand, most job openings will arise as experienced workers retire or leave the occupation for other reasons.

Job prospects are expected to be excellent for skilled sheetmetal workers over the long run, although workers may experience periods of unemployment when construction projects end and when economic conditions reduce the amount of construction activity. Because local economic conditions can vary so widely, there can be shortages of experienced workers in some areas and an oversupply in other parts of the country. Nevertheless, employment of sheetmetal workers is less sensitive to declines in new construction than employment of some other construction workers, such as carpenters. Maintenance of existing equipment—which is less affected by economic fluctuations than new construction—makes up a large part of the work done by sheetmetal workers. Installation of new air-conditioning and heating systems in existing buildings also continues during construction slumps as individuals and businesses seek more energy-efficient equipment to cut utility bills. Because a large proportion of sheetmetal installation and maintenance is done indoors, these workers usually lose less work time due to bad weather than other construction workers.

Apprenticeship opportunities also should be plentiful as unions and employers strive to meet the rising demand for skilled workers. However, the availability of training slots fluctuates with economic conditions, so the number of openings may vary from year to year and by geographic area.

Earnings

According to the Engineering News Record, average hourly earnings—including benefits—for union sheetmetal workers were \$27.62 in 1992. Wages ranged from a low of \$18.06 in Birmingham, Alabama, to a high of \$42.47 in New York City. Apprentices generally start at about 40 percent of the rate paid to experienced workers. Throughout the course of the apprenticeship program, they receive periodic increases as they acquire the skills of the trade.

In addition, union workers in some areas receive supplemental wages from the union when they are on layoff or shortened workweeks. A large proportion of sheetmetal workers are members of the Sheet Metal Workers' International Association.

Related Occupations

To fabricate and install sheetmetal products, sheetmetal workers combine metalworking skills and knowledge of construction materials and techniques. Other occupations in which workers lay out and fabricate metal products include layout workers, machinists, metal fabricators, metal patternmakers, shipfitters, and tool and die makers. Construction occupations requiring similar skills and knowledge include heating, air-conditioning, and refrigeration technicians and glaziers.

Sources of Additional Information

For more information about apprenticeships or other work opportunities, contact local sheetmetal contractors or heating, refrigeration, and air-conditioning contractors; a local of the Sheet Metal Workers Union; a local of the Sheetmetal and Air Conditioning Contractors Association; a local joint union-management apprenticeship committee; or the nearest office of the State employment service or apprenticeship agency.

For general information about sheetmetal workers, contact:

☞ The Sheet Metal National Training Fund, 601 N. Fairfax St., Suite 240, Alexandria, VA 22314.

☞ Associated Builders and Contractors, 1300 N. 17th St. NW., Rosslyn, VA 22209.

☞ The Sheetmetal and Air Conditioning Contractors Association, 4201 Lafayette Center Dr., Chantilly, VA 22021.

☞ The Sheet Metal Workers International Association, 1750 New York Ave. NW., Washington, DC 20006.

Structural and Reinforcing Ironworkers

(D.O.T. 801.361-014, -018, -022, .381-010, .684-026; and 809.381-022, and -026)

Nature of the Work

Materials made from iron, steel, aluminum, and bronze are used extensively in the construction of highways, bridges, office buildings, power transmission towers, and other large buildings. These structures have frames made of steel columns, beams, and girders. In addition, reinforced concrete—concrete containing steel bars or wire fabric—is an important material in buildings, bridges, and other structures. The steel gives the concrete additional strength. Metal stairways, catwalks, floor gratings, ladders, and window frames, as well as lampposts, railings, fences, and decorative ironwork are used to make these structures more functional and attractive. Structural and reinforcing ironworkers fabricate, assemble, and install these products. These workers also repair, renovate, and maintain older buildings and structures such as steel mills, utility plants, automobile factories, highways, and bridges.

Before construction can begin, ironworkers must erect the steel frames and assemble the cranes and derricks that move structural steel, reinforcing bars, buckets of concrete, lumber, and other materials and equipment around the construction site. This equipment arrives at the construction site in sections. There it is lifted into position by a mobile crane. Ironworkers then connect the sections and set up the cables that do the hoisting.

Once this job has been completed, ironworkers begin to connect steel columns, beams, and girders according to blueprints and instructions from supervisors and superintendents. Structural steel, reinforcing rods, and ornamental iron generally are delivered to the construction site ready for erection—cut to the proper size with holes drilled for bolts and numbered for assembly. This work is done by ironworkers in fabricating shops located away from the construction site. There they lay out the raw steel received from a steel mill and cut, bend, drill, bolt, and weld each piece according to the specifications for that particular job. Ironworkers at the construction site unload and stack the fabricated steel so it can be hoisted easily when needed.

To hoist the steel, ironworkers attach cables from the crane or derrick. One worker directs the hoist operator with hand signals.

Another worker holds a rope (tag line) attached to the steel to prevent it from swinging. The steel is hoisted into place in the framework, where several workers using spud wrenches position it with connecting bars and jacks. Workers use driftpins or the handle of a spud wrench—a long wrench with a pointed handle—to align the holes in the steel with the holes in the framework. Then they bolt the piece in place temporarily, check vertical and horizontal alignment with plumb bobs, laser equipment, transits, or levels and then bolt or weld it permanently in place.

Reinforcing ironworkers set the bars in the forms that hold concrete, following blueprints that show the location, size, and number of reinforcing bars. They fasten the bars together by tying wire around them with pliers. When reinforcing floors, workers place blocks under the reinforcing bars to hold them off the deck. Although these materials usually arrive ready to use, ironworkers may occasionally have to cut the bars with metal shears or acetylene torches, bend them by hand or machine, or weld them with arc-welding equipment. Some concrete is reinforced with welded wire fabric. Workers cut and fit the fabric and, while a concrete crew places the concrete, ironworkers use hooked rods to position it properly in the concrete.

Ornamental ironwork and related pieces are installed after the exterior of the building has been completed. As the pieces are hoisted into position, ironworkers bring them into position, make sure they fit correctly, and bolt, braze, or weld them for a secure fit. They also erect metal tanks used to store petroleum, water, or other fluids and assemble prefabricated metal buildings according to plans or specifications.

Working Conditions

Structural and reinforcing ironworkers usually work outside in all kinds of weather. However, those who work at great heights do not work when it is wet, icy, or extremely windy. Because the danger of injuries due to falls is so great, ironworkers use safety devices such as safety belts, scaffolding, and nets to reduce the risk.

Employment

Structural and reinforcing ironworkers held about 66,000 jobs in 1992. Almost all of these workers were employed in the construction industry. Nearly 6 of every 10 worked for structural steel erection contractors; most of the remainder worked for a variety of contractors specializing in the construction of homes, factories, commercial buildings, churches, schools, bridges and tunnels, and water, sewer, communications, and power lines. Very few are self-employed.

Ironworkers are employed in all parts of the country, but most work in metropolitan areas, where most commercial and industrial construction takes place.



Reinforcing workers work together to tie-wire reinforcing bars.

Training, Other Qualifications, and Advancement

Most employers recommend apprenticeship as the best way to learn this trade. Apprenticeship programs are usually administered by joint union-management committees made up of representatives of local unions of the International Association of Bridge, Structural and Ornamental Ironworkers and local chapters of contractors' associations. The apprenticeship consists of 3 years of on-the-job training and a minimum of 144 hours a year of classroom instruction.

In the classroom, apprentices study blueprint reading, mathematics for layout work, the basics of structural erecting, rigging, reinforcing, welding and burning, ornamental erection and assembling, and the care and safe use of tools and materials. On the job, apprentices work in all aspects of the trade, such as unloading and storing materials at the job site, rigging materials for movement by crane or derrick, connecting structural steel, and welding.

Some ironworkers learn informally on the job. These workers generally do not receive classroom training, although some large contractors have extensive training programs. On-the-job trainees usually begin by assisting experienced ironworkers by doing simple jobs like carrying various materials. With experience, they perform more difficult tasks like cutting and fitting different parts. Learning through work experience alone may not provide training as complete as an apprenticeship program, however, and usually takes longer.

Ironworkers generally must be at least 18 years old. A high school diploma may be preferred by employers and may be required by some local apprenticeship committees. Courses in general mathematics, mechanical drawing, and shop are helpful.

Because materials used in ironworking are heavy and bulky, ironworkers must be in good physical condition. They also need good agility, balance, eyesight, and spatial perception in order to work at great heights on narrow beams and girders. Ironworkers should not be afraid of heights or suffer from dizziness.

Some experienced workers become supervisors. Others may go into the contracting business for themselves.

Job Outlook

Employment of structural and reinforcing ironworkers is expected to increase about as fast as the average for all occupations through the year 2005. Growth in industrial and commercial construction as well as the rehabilitation and maintenance of an increasing number of older buildings, factories, power plants, and highways and bridges is expected to increase employment demand. In addition, more ironworkers will be needed to build incinerators and other structures to contain hazardous materials as part of ongoing toxic waste cleanup. Despite this rising demand for structural and reinforcing ironworkers, most openings will result from the need to replace experienced ironworkers who transfer to other occupations or leave the labor force.

The number of job openings fluctuates from year to year as economic conditions and the level of construction activity change. During economic downturns, ironworkers can experience high rates of unemployment. Similarly, job opportunities for ironworkers may vary widely by geographic area.

Job openings for ironworkers usually are more abundant during the spring and summer months, when the level of construction activity increases.

Earnings

According to the *Engineering News Record*, prevailing union wage rates—including benefits—for ironworkers averaged about \$27 an hour in 1992. Their wages ranged from a low of about \$18 in New Orleans, to a high of between \$38-49 in New York City.

Apprentices generally start at about 40 percent of the rate paid to experienced workers. Throughout the course of the apprenticeship program, they receive periodic increases as they acquire the skills of the trade.

Earnings for ironworkers may be reduced on occasion because work can be limited by bad weather and the short-term nature of construction jobs.

Many workers in this trade are members of the International Association of Bridge, Structural and Ornamental Ironworkers.

Related Occupations

Structural and reinforcing ironworkers play an essential role in erecting buildings, bridges, highways, powerlines, and other structures. Others who also work on these construction jobs are operating engineers, concrete masons, and welders.

Sources of Additional Information

For more information on apprenticeships or other work opportunities, contact local general contractors; a local of the Ironworkers union; a local joint ironworkers' union-management apprenticeship committee; a local or State chapter of the Associated Builders and Contractors, or the nearest office of the State employment service or apprenticeship agency.

For general information about ironworkers, contact:

☞ Associated General Contractors of America, Inc., 1300 North 17th St., Rosslyn, VA 22209-3883

☞ International Association of Bridge, Structural and Ornamental Iron Workers, 1750 New York Ave. NW., Washington, DC 20006.

☞ National Erectors Association, 1501 Lee Hwy., Suite 202, Arlington, VA 22209.

☞ National Association of Reinforcing Steel Contractors, P.O. Box 280, Fairfax, VA 22030.

Tilesetters

(D.O.T. 861.381-054, -058, and .684-018)

Nature of the Work

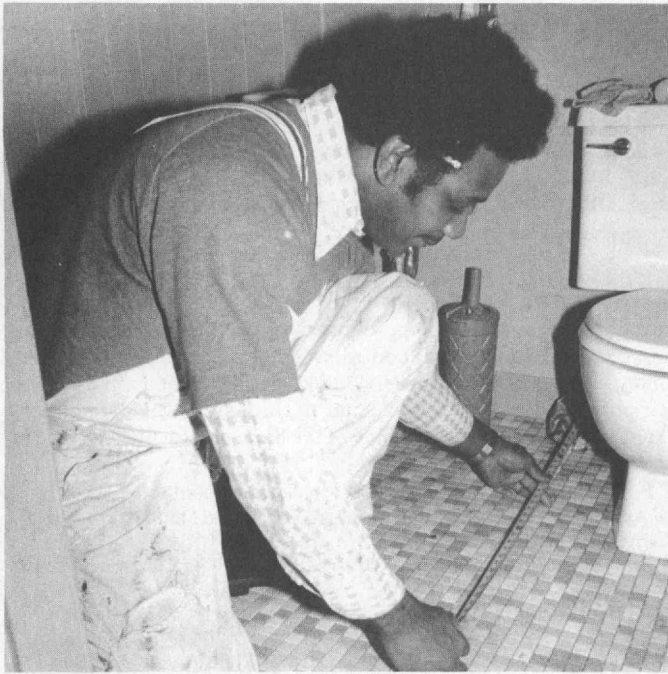
In ancient Egypt and Rome, tile was used for mosaics—an art form using small, decorative ceramic squares. Over the years, tile has been a popular building material because it is durable, impervious to water, and easy to clean. It is used today, for instance, in shopping centers, tunnels, lobbies of buildings, bathrooms, food preparation areas, and hospitals.

Tilesetters, like the ancient artists, apply tile to floors, walls, and ceilings. To set tile, which generally ranges in size from 1 inch to 12 inches square, they use cement or mastic (a very sticky paste). When using cement, tilesetters nail a support of metal mesh to the wall or ceiling to be tiled. They use a trowel to apply a cement mortar, called a scratch coat, onto the metal screen and a small tool, similar to a rake, to scratch the surface of the soft mortar. After the scratch coat has dried, tilesetters apply another coat of mortar to level the surface and then apply mortar to the back of the tile and place it onto the surface.

To set tile in mastic or a cement adhesive (called thin set), tilesetters need a flat, solid surface such as drywall, concrete, plaster, or wood. They use a tooth-edged trowel to spread mastic on the surface or apply cement adhesive to the back of the tile and then properly position it.

Because tile varies in color, shape, and size, workers sometimes prearrange tiles on a dry floor according to a specified design. This allows workers to examine the pattern and make changes. In order to cover all exposed areas, including corners and around pipes, tubs, and wash basins, tilesetters cut tiles to fit with a machine saw or a special cutting tool. Once the tile is placed, they gently tap the surface with their trowel handle or a small block of wood to seat the tiles evenly.

When the cement or mastic has set, tilesetters fill the joints with grout—a very fine cement. They then scrape the surface with a rubber-edged device called a squeegee to dress the joints and remove excess grout. Before the grout sets, they finish the joints with a damp sponge for a uniform appearance.



Tilesetters generally work indoors.

Working Conditions

Tilesetters generally work indoors. Because most of the structure has been completed, the work area is relatively clean and uncluttered. Much of the workday is spent bending, kneeling, and reaching, activities that require endurance but not exceptional strength. To protect their knees, most workers wear kneepads.

Although workers are subject to cuts from tools or materials, falls from ladders, and strained muscles, the occupation is not as hazardous as some other construction occupations.

Employment

Tilesetters held about 30,000 jobs in 1992. Most wage and salary tilesetters were employed by tilesetting contractors who work mainly on nonresidential construction projects, such as schools, hospitals, and office buildings. One of every 2 tilesetters is self-employed, compared to 1 of every 4 construction workers. Most self-employed tilesetters work on residential projects.

Tilesetters are employed throughout the country but are found largely in urban areas.

Training, Other Qualifications, and Advancement

Employers recommend completion of a 3-year apprenticeship program, which consists of on-the-job training and related classroom instruction in subjects such as blueprint reading, layout, and basic mathematics.

In practice, however, most tilesetters acquire their skills informally by working as helpers to experienced workers. They begin by

familiarizing themselves with the tools of the trade, and then they learn to mix and apply cement and to apply mastic. As they progress, they learn to cut and install tile, apply grout, and do finishing work.

When hiring apprentices or helpers, employers usually prefer high school graduates who have had courses in general mathematics, mechanical drawing, and shop. Good physical condition, manual dexterity, and a good sense of color harmony also are important assets.

Skilled tilesetters may start their own contracting businesses or may become supervisors or estimators for other contractors.

Job Outlook

Employment of tilesetters is expected to increase about as fast as the average for all occupations through the year 2005. Population and business growth, which should result in more construction of shopping malls, hospitals, schools, restaurants, and other structures where tile is used extensively, will stimulate demand for tilesetters. Tile is also being used more extensively in more expensive homes, and construction of these homes is expected to increase. Increasing popularity of tile as a building material is also expected to increase the demand for tilesetters.

Despite the increased demand for tilesetting, most job openings will result from the need to replace tilesetters who retire or leave the occupation for other reasons. Job opportunities will not be as plentiful as in other construction occupations because the occupation is small and turnover is relatively low.

Earnings

According to the limited information available, hourly rates for experienced tilesetters ranged from \$10 to \$28 in 1992. Apprentices usually start earning 50 percent of journey workers' wages.

The principal union organizing workers in this trade is the International Union of Bricklayers and Allied Craftsmen. Some tilesetters also belong to the United Brotherhood of Carpenters and Joiners of America.

Related Occupations

Tilesetters use their knowledge of tools and masonry materials along with skill and dexterity to produce attractive, durable surfaces. Other workers with similar abilities include bricklayers, concrete masons, marblers, plasterers, stonemasons, and terrazzo workers.

Sources of Additional Information

For details about apprenticeship or other work opportunities in this trade, contact local tilesetting contractors; locals of the unions previously mentioned; or the nearest office of the State employment service or State apprenticeship agency.

For general information about the work of tilesetters, contact:

☞ International Union of Bricklayers and Allied Craftsmen, International Masonry Institute Apprenticeship and Training, 815 15th St. NW., Washington, DC 20005.

☞ United Brotherhood of Carpenters and Joiners of America, Tile, Marble, Terrazzo Finishers Division, 101 Constitution Ave. NW., Washington, DC 20001.