Chapter 1: What Is Important in the Japanese Construction Site

1.1 Teamwork

In construction work, there are many processes before completion. Specialty contractors in various job categories take on work from the general contractor and proceed with their part of the construction, then passing the baton to the next process. Teamwork among specialty contractors is important to ensure a good flow throughout the construction work. During construction, the foreman consults with the site supervisor and gives instructions to the technicians. At construction sites, senior technicians work side by side with less experienced junior technicians to offer them advice.

1.2 Japan's Construction Work Assignments

There are various patterns of work assignments for construction projects in Japan, depending on the scale of the project. For example, a typical large-scale construction project is carried out by a plan similar to that in Figure 1-1, from the ordering of the work to its execution. In small-scale construction projects such as general housing, the client (the person ordering the building to be build) places the order with a construction company, which acts as the prime contractor and proceeds with the housing construction project while managing the specialty contractors.

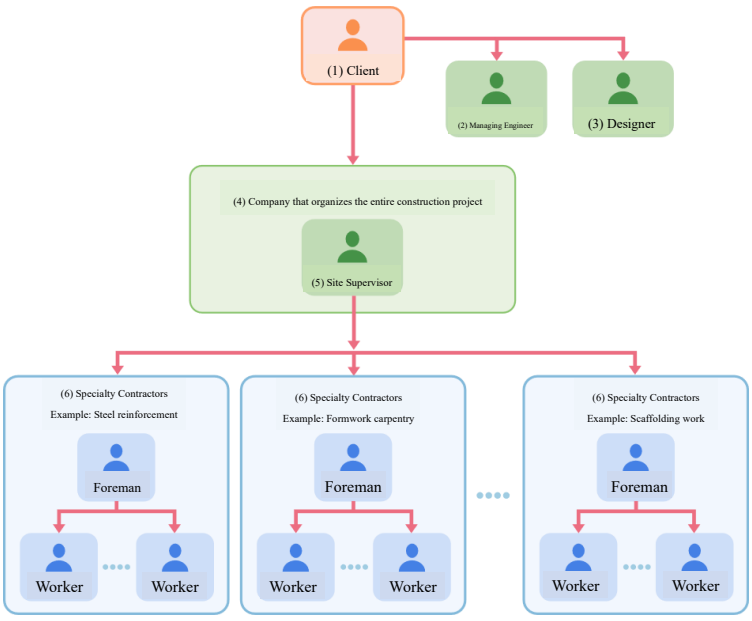


Fig. 1-1 Example of a work assignment

[(1) Hacchusha] (Client)

Asking a contractor to take on a construction project is called *hacchu* (order placement). The organization or company that places that order is *hacchusha* (the client). Examples of clients include the Ministry of Land, Infrastructure, Transport and Tourism, local governments, private companies, and individuals.

[(2) Kanrisha] (Managing Engineer) The engineer in a position to confirm that the construction is being carried out in accordance with the drawings.

[(3) Sekkeisha] (Designer) The engineer who prepares the design documents to realize the requirements of the client.

[(4) Koji zentai wo matomeru kaisha] (The company overseeing the entire project) Commonly referred to as the *zenekon* (general contractor).

[(5) Genba kantoku] (Site supervisor)The engineer who supervises and directs the construction site.

[(6) Senmon koji gyosha] (Specialty contractors) Specialists for each construction process. Several workers will perform the work under the direction of the foreman.

1.3 Construction Career Up System

In Japan, the Construction Career Up System is in place. It is being promoted as a system that registers the work performance and qualifications of each technician so as to realize fair evaluation of skills, improvement of construction quality, and streamlining of on-site work. There are four technician levels, and once registered in the system, each technician is issued a card representing their level.

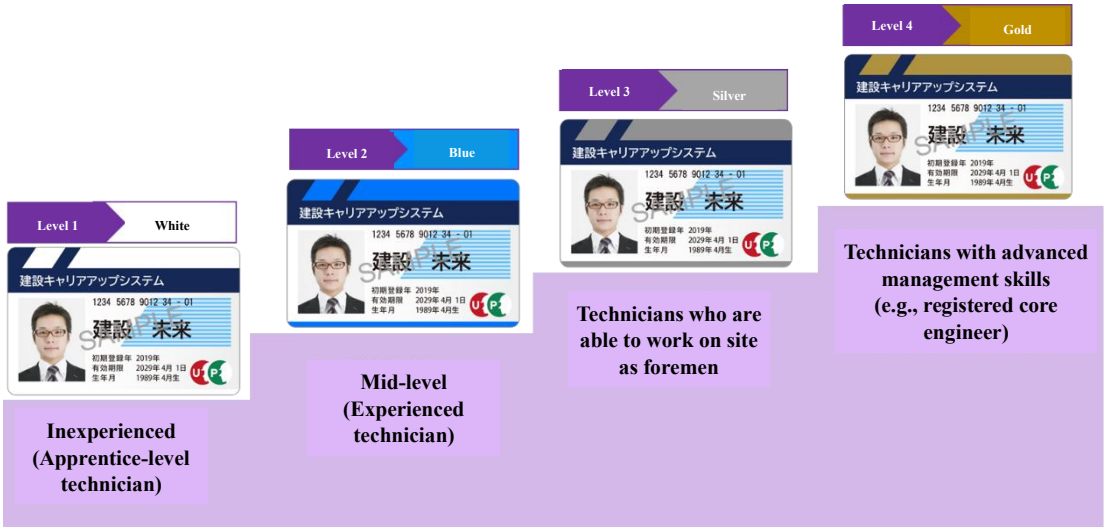


Figure 1 -3 Career Up System levels and colors of cards

The following three categories are subject to technician evaluation.

- Experience (number of working days)

- Knowledge and skills (qualifications held)

- Management skills (training for registered core engineer/experience as a foreman)

Level 2 requires a minimum of 645 working days (3 years) after system registration, so everyone starts at Level 1.

1.4 Greetings

What is deemed important at construction sites in Japan is to prevent onsite accidents. To this end, a variety of initiatives are undertaken every day. The most basic and important aspect of this effort is greetings. When passing workers in the corridor, it is customary to greet each other by saying “ohayogozaimasu (good morning)” or “otsukaresamadesu (thank you for your hard work)” in the morning. Workers from different job categories greeting each other creates a sense of unity, and this creates a pleasant environment in which to work together. Commonly used greetings include “otsukaresamadesu” and “Goanzenni (Be safe today),” which are explained in detail in Chapter 4.

1.5 Morning Meeting

At Japanese construction sites, a meeting of all workers is held daily before work begins. This is called *chorei* (morning meeting). There are two types of morning meetings: general morning meetings and morning meetings by job category. The primary purpose of both morning meetings, also referred to as *anzen chorei* (safety morning meetings), is to prevent accidents on construction sites.

1.5.1 General Morning Meeting

The general morning meeting mainly consists of the following.


During a morning meeting

(1) Greetings from the site supervisor

The greeting of the site supervisor is intended to promote a sense of unity among the workers and to ensure that the day's work proceeds safely and pleasantly.

(2) Radio calisthenics

Warm up exercises before work awaken the body and mind, thus preventing injury. Radio *taiso* (radio calisthenics) is a series of exercises set to music that is well known in Japan, and are performed at morning meetings. Sometimes it is conducted without music, and in such a case, workers move their bodies while counting “1, 2, 3, 4” loudly.

(3) Confirmation of work content

Each foreman who will be working that day informs everyone of the day's work and personnel placement. Workers of different job categories are working together at the site. It is important for workers in other job categories to know the overview of the day’s work in order to prevent hazards. It also helps to know how it will affect your own work. Also at this time, introductions of new workers (called newcomers) on their first day may be made. If you are being introduced as a newcomer, speak

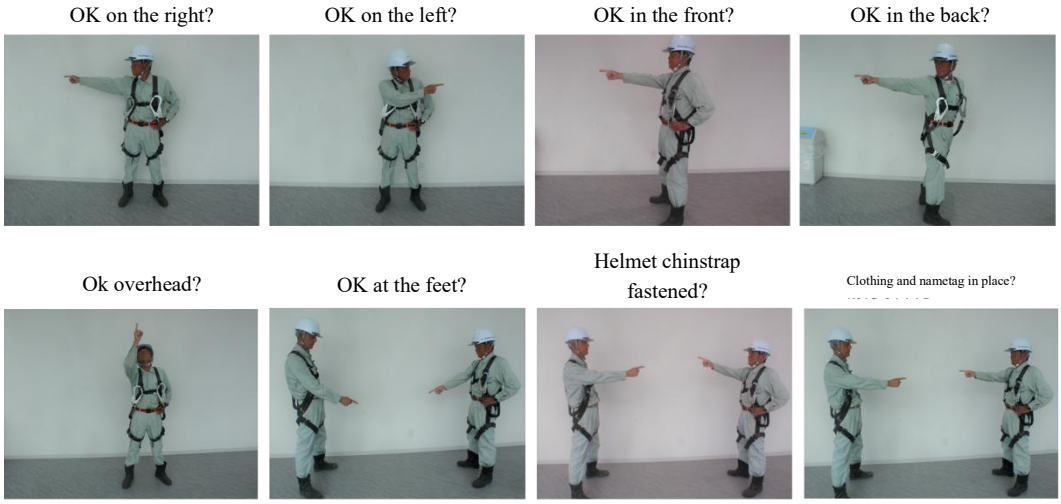
loudly and clearly to state your name, the company to which you belong, etc.

(4) Hazard prediction activities (KY activities)

Hazard prediction activities, also known as KY (Kiken Yochi) activities, are conducted by imagining situations where accidents might occur during the day's work, detecting hazards, and preventing accidents before they occur. In particular, when work is to be performed differently than before, such as when construction materials are to be transported, large construction equipment is to be moved, or new job categories are to be added, take the utmost care in predicting hazards and sharing them with all members of the team.

(5) Checking for safety

Generally, at the end of the morning meeting, the following safety checks are performed out loud in pairs.



Safety check

(6) Greetings and start work

After safety has been checked, everyone says, “kyo mo goanzen ni!” (have a safe day!). The general morning meeting is concluded and the work begins. After this, morning meetings by job categories are held.

1.5.2 Morning Meeting by Job Category

After the general morning meeting, morning meetings by job categories are held.

(1) Safety chant (touch and call)


Touch and call

Everyone says out loud the safety slogan aloud, with fingers pointing. In addition to confirming safety, this helps promote a sense of unity in teamwork. The following is an example of a chant.

"Zero saigai de iko, yoshi!" (Let's achieve zero disasters, good!)

(2) Hazard prediction activities (KY activities)

KY activities

KY activities related to the entire work site are conducted during the general morning meeting, and similarly, KY activities are conducted before starting work at each job category. KY activities generally follow these steps.

[Danger detection]

Extract *kiken no point* (potential dangers). Have workers speak freely on each task about possible hazardous conditions and actions for today's work content. Sometimes workers are nominated to make a presentation in order to share their dangerous experiences and to increase each person's sensitivity to danger as his or her own, thereby preventing accidents.

[Consideration of countermeasures]

Discuss and formulate countermeasures for each potential danger. Once the countermeasures are determined, write them in the Hazard Prediction Activity Chart.

Hazard Prediction Activity Chart

Group work content	
Potential dangers	**Here's what we do.**
Today's safety goals	
Company name	Leader name / Worker people

[Determination of Action Goals]

Decide on the items of particular importance and set them as today's goals.

[Shout out]

All members conduct *shisa kosho* (point and call) at the KY board on which the decided action goals are written, and recite the following.

“XXX, yoshi!” (XXX, good!) “Kyo mo ichinichi anzensagyo de ganbaro! Oh!” (Let's have another day of safe work! Yes!)

Chapter 2: Laws and Regulations that Must Be Observed When Working Onsite in Japan

2.1 Labor Laws

Labor law is the name by which laws on labor issues are collectively referred to.

2.1.1 Labor Standards Act

(1) Overview

Minimum working conditions are set forth in the Labor Standards Act, and any part of the condition that does not meet the standards is subject to the provisions of the Labor Standards Act. Working conditions refer to all treatment in the workplace, including not only wages and working hours but also conditions related to dismissal, accident compensation, health and safety, communal housing, etc.

(2) Key Points

- Deciding Working Conditions

workers and employers are required to keep their promises.

- Equal Treatment

discriminating in wages, working hours, or other working conditions on the basis of a worker's nationality, creed, or social status is prohibited.

- Prohibition of Forced Labor

forcing workers to work against their will by the use of physical violence, intimidation, confinement, or any other means that unjustly restricts that worker's mental or physical freedom is prohibited.

- Prevention of Power Harassment

Power harassment is defined as an act of taking advantage of one's superiority in the workplace to cause mental or physical pain or damage the work environment beyond the scope necessary for the job.

- Making the Working Conditions Explicit

Employers are required to clearly indicate the following six items.

(1) Period of labor contracts (2) Criteria for renewal of fixed-term labor contract (3) Place of employment and nature of work to be performed (4) Matters related to end times, overtime, breaks, holidays, and vacations (5) Matters related to wage determination, payment methods, closing dates, payment dates, and salary increases (6) Matters related to retirement and termination of employment

- Prohibition on Establishing the Compensation for Loss or Damage in Advance

It is prohibited to make a contract that stipulates a monetary penalty or establishes the amount of compensation for breaching the labor contract in advance.

- Restrictions on the Dismissal of Workers

A worker may not be dismissed for a period during which he/she is off work for medical treatment for an injury or illness sustained on the job, nor for 30 days thereafter.

- Advance Notice of Dismissal

If a worker is to be dismissed, 30 days' notice must be given.

- Wages

It is required to pay (1) in currency, (2) directly to the worker, (3) in full, (4) at least once a month, and (5) on a fixed date. (Five Principles of Wage Payment)

- Statutory Working Hours

In principle, employees are not allowed to have workers work more than 40 hours per week and 8 hours per day.

- Breaks

If the working hours exceed 6 hours, a 45-minute break must be provided, and if the working hours exceed 8 hours, a 1-hour break must be provided at the same time during the working hours.

- Statutory Days Off

An employer must provide a worker with at least one day off per week.

- Off-Hours Work and Work on Days Off

Off-hours work (overtime) is allowed in cases of temporary need and when a 36 (*saburoku*) agreement (labor-management agreement based on Article 36 of the Labor Standards Act) is concluded and submitted, and the stipulated premium wages must be paid. Temporary needs refer to disaster restoration work. Surcharge rates are 25% or more for regular overtime, 35% or more for work on days off, and 25% or more for late-night overtime.

The maximum overtime hours are 45 hours per month and 360 hours per year. This upper limit takes effect in April 2024 for the construction industry, but it is recommended to adhere to it before 2024 in order to prevent health problems caused by long working hours.

- Annual Paid Leave

Workers who have worked continuously for six months from the date of hiring and have worked at least 80% of the total working days are entitled to 10 working days of annual paid leave, with one working day added for each additional year of continuous service, and after two years and six months, two working days are added for each additional year of continuous service, up to 20 working days.

2.1.2 Industrial Safety and Health Act

(1) Overview

Life, body, and health are of utmost importance to workers, and the purpose of the Industrial Safety and Health Act is to ensure workers' safety and health in the workplace and to facilitate the creation of comfortable work environments so that they will not be harmed by work.

(2) Key Points

- Safety Flags, Etc.

Safety First signs, the Safety Flag, and Safety and Health Flag are displayed at construction sites to remind workers of the importance of zero accidents and zero injuries and to raise awareness regarding safety and hygiene management.

Examples of the Safety and Health Flag

- Responsibilities of the Worker

In order to prevent industrial injuries, workers are required to observe the necessary particulars and cooperate with measures to prevent industrial injuries taken by employers and other related parties.

- Safety and Health Education

Safety and health education is required when new workers are hired or when the nature of the work is changed. In addition, special training, such as the skill training course, is required for crane operation.

- Causes of Work-Related Accidents

Looking at the number of fatalities in work-related accidents in the construction industry in FY2021 by cause, the overwhelming majority were due to Crashes and Falls (110 out of 288), followed by Collapsing/Crumbling (31), Caught-In/Between/Entanglement (27), Traffic Accident (Roads) (25), and Struck-By (19). Prevention of Crashes and Falls is important particularly in high-place work, and in principle, the full-harness fall protection gear should be used.

- Prevention of Heat Stroke

In summer, it is necessary to provide shade, water, and salt lozenges to prevent heat strokes, and to be prepared to respond to emergency situations.

- Risk Assessment and KY Activities

Risk assessment is a method for identifying and eliminating potential dangers in the workplace. Hazards are always present at construction sites, and hazard prediction activities (also known as KY activities) are widely practiced to prevent accidents b identifying potential risks that may occur at the site.

- Medical Checkup

Companies are required to conduct medical checkups for their employees. There are *teiki kenko shindan* (regular medical checkups) that must be conducted within a year from the previous checkup, and medical checkups conducted at the time of hiring.

- Stress Check

Workplaces with 50 or more employees are required to conduct stress checks once a year by a physician, public health nurse, or other health professional to ascertain the extent of psychological strain on a regular basis.

2.1.3 Minimum Wage Act

(1) Overview

Minimum wages are established to improve working conditions, stabilize workers' lives, improve the quality of the labor force, and ensure fair competition in business.

(2) Key Points

- Regional Minimum Wages

Since prices and workers' wage levels vary by region, regional minimum wages are determined by prefecture. Minimum wages are publicly announced in the official gazette and notified in various ways

such as on the website of each prefectural labor bureau.

2.1.4 Industrial Accident Compensation Insurance (Workers' Compensation Insurance) Act

(1) Overview

When a worker is injured, becomes ill, is left with a disability, or dies as a result of a work-related or commuting accident, workers' compensation insurance provides insurance benefits to the victim or his/her surviving family. All hospital treatment costs are paid by workers' compensation insurance, and the employer is responsible for all insurance premiums.

In the unlikely event of an accident, priority will be given to rescuing victims after confirming safety. In addition, the Labour Standard Inspection Offices will conduct an accident investigation to determine whether an accident is work-related or not.

(2) Key Points

- Occupational Accidents

Occupational accidents are those in which are caused by the affected worker's conduct as part of his/her work or by the management conditions of the facilities and equipment at the workplace.

- Commuting Accidents

Commuting accidents are those that occur between the residence and the place of employment, or while traveling from one place of employment to another. The requirement is for accidents to occur on reasonable routes and methods. For example, if you are registered to use a bus but are involved in an accident while riding a bicycle, you are not eligible.

2.1.5 Employment Insurance Act

(1) Overview

Employers who employ people are required to have employment insurance. When a person enrolls

in the employment insurance, a *koyo hoken hihokenshasho* (employment insurance card) is issued to the person. Employment insurance consists of *shitsugyoto kyufu* (benefits for unemployment) and *koyo hoken nijigyo* (employment insurance services).

Benefits for Unemployment are benefits (payments) provided to those who have lost their jobs or are undergoing educational training. Premiums are paid by the worker himself/herself and the employer, **(2) Key Points**

- Requirements for Employment Insurance Benefits

(1) An insured person (the person with the insurance) of employment insurance has separated from service (left the job) and is in the state of *shitsugyo* (unemployed), meaning that he/she is unable to find a job in spite of his/her willingness and ability to work.

(2) The insured must have been insured for a total of at least 12 months in the two years prior to the date of separation.

2.1.6 Act on the Improvement of Employment of Construction Workers

(1) Overview

The *kensetsu koyo kaizen keikaku* (construction employment improvement plan) was formulated to improve the employment environment in the construction industry, and it defines basic points for measures to improve employment, develop and improve abilities, and promote the welfare of those working in the construction industry.

(2) Construction Employment Improvement Plan

* The content of the dai 10ji kensetsu koyo kaizen keikaku (Tenth Construction Employment Improvement Plan) for the period from FY2021 to FY2025 (March 2021) is as follows.

- Recruitment and training of young people
- Preparation of a foundation for creating an attractive working environment
- Promotion of vocational skills development and skill transfer

- Establishment of a system to promote employment improvement

- Addressing foreign workers

2.1.7 Vocational Abilities Development Promotion Act

(1) Overview

The Vocational Abilities Development Promotion Act aims to enhance the vocational abilities of workers by, for example, improving the content of vocational training and skill tests.

(2) Key Points

- Vocational Training

Vocational training is training to develop and improve the abilities of workers by providing them with the skills and knowledge necessary for their jobs.

- Trade Skills Tests

The Trade Skills Test is a national system that tests the level of skills possessed by workers and certifies these skills by the government.

2.2 Construction Business Act

The Construction Business Act was established to contribute to the promotion of public welfare by achieving five objectives.

Five Objectives

1. Improvement of qualifications of persons engaged in construction business (Construction Business License)

2. Proper contracting for construction work (estimates and contracts)

3. Ensuring proper construction (Chief Engineer and Managing Engineer)

4. Protection of the client (On-Site Agents, Work Ledger, Work Plan)

5. Promotion of sound development of the construction industry

2.3 Building Standards Act

The law establishes minimum rules that must be followed when constructing or using a building. This law was enacted to ensure that rules regarding the construction and use of buildings are observed so that people can live safely and securely. The Building Standards Act consists of two parts: *tantai kitei* (individual provisions) and *shudan kitei* (collective provisions).

[Tantai kitei] (Individual Provisions) Standards are established for the safety and durability of the building itself, earthquake resistance, fire prevention and seismic standards, roofs, exterior walls, lighting and ventilation in living rooms, toilets, performance of electrical equipment, etc.

[Shudan kitei] (Collective Provisions)These provisions are designed to ensure a good urban environment created when buildings are built together in an area. For example, there are standards for sites and roads, building coverage ratio, floor area ratio, height restrictions, various slant plane restrictions, fire prevention districts, and other regulations. In principle, this applies within City Planning Areas and Quasi-city Planning Areas.

2.4 Waste Management Act

The law was created to protect people's living environment by controlling waste generation and properly disposing of generated waste through recycling and other means.

Construction sites are busy with many contractors coming and going, each generating waste through their construction process that must be disposed of.

The prime contractor is required to prepare a manifest (construction waste control slip) regarding the disposal of industrial waste to confirm the series of processes until the proper final disposal of the waste. Final disposal includes recycling. Workers on site must handle waste according to this manifest.

2.5 Construction Material Recycling Act

The Construction Material Recycling Act is a law that encourages the proper disposal and recycling of waste materials. The Construction Material Recycling Act requires that construction waste be separated by material type to promote recycling and reuse. Waste generated at construction sites must be stored in a designated area according to the classification method determined at the site.

2.6 Air Pollution Control Act

The Air Pollution Control Act specifies emission standards, etc., for air pollutants emitted or dispersed from factories and workplaces by type of substance and by type and size of the facility.

2.7 Noise Regulation Act and Vibration Regulation Act

The purpose of this law is to protect the living environment and to help protect the health of the public by regulating the noise and vibration generated by factories and construction work, and by establishing permissible limits for automobile noise. In designing construction work, items must be considered in order to investigate the location conditions around the construction site and to reduce noise and vibration overall.

2.8 Water Pollution Prevention Act

This law was enacted to prevent water pollution of public waters and groundwater. When discharging sewage generated from construction sites into sewers or rivers, the standards set by each prefecture must be followed.

2.9 Fire Service Act

The Fire Service Act is intended to

1. prevent, warn against, and suppress fires, and to protect the lives, bodies, and property of the people from fire,
2. mitigate damage caused by fires or earthquakes and other disasters, and
3. maintain order and contribute to the promotion of public welfare by properly transporting people who have become injured or fallen ill due to disasters, etc.

In buildings, regulations are set for fire extinguishing equipment such as fire extinguishers, indoor fire hydrants and sprinklers; evacuation equipment such as evacuation ladders; and alarm systems in order to prevent fires, warn of and extinguish fires, and rescue people from fires.

2.10 Water Supply Act

The Water Supply Act is the law governing waterworks. The law was established to improve public health and living conditions by ensuring a clean, abundant, and affordable water supply. For this purpose, engineers and technicians as stipulated by the Water Supply Act must be assigned and work must be performed under their direction.

2.11 Sewerage Act

The Sewerage Act is intended to promote the sound development of cities, improve public health, and preserve the quality of public waters through the development of sewerage systems. Some types of wastewater, such as wastewater that contains concentrations of hydrogen ions, suspended solids, cadmium, lead, total chromium, copper, and zinc above the standard values, should not be discharged into the public sewer system.

2.12 Gas Business Act

The Gas Business Act regulates the city gas business, which supplies gas through pipelines, in order to ensure safety and protect gas users. Because gas leaks and improper ventilation can lead to fatal accidents, detailed regulations have been established regarding machines, appliances, and exhaust ventilation used when gas is consumed.

2.13 Electricity Business Act

Electricity can cause fires, equipment accidents, and personal injury if handled improperly. For example, electrical leakage can lead to serious disasters such as fire or electric shocks. The purpose of the Electricity Business Act is to ensure public safety and protect the environment by establishing standards for the proper and reasonable operation of the electricity business, protecting the interests of electricity users and regulating the construction, maintenance, and operation of electric facilities. In addition to the Electricity Business Act, laws and regulations concerning the safety of electrical facilities include the Ministerial Order to Provide Technical Standards for Electrical Equipment (Technical Standards for Electrical Equipment), the Electrical Appliances and Materials Safety Act, the Electricians Act, and the Act on Ensuring Fair Electric Business Practices (Electric Business Act).

2.14 Telecommunications Business Act

The Telecommunications Business Act regulates telecommunications businesses that provide telecommunications services to subscribers by installing lines and other facilities. The Telecommunications Business Act applies not only to wired communications that pass signals over metal wires, but also to wireless communications and communications via optical fiber. Improper construction when connecting telephones, computers, and other terminals to the telecommunication lines of telecommunication carriers can cause communication line failures. Therefore, it is mandatory that construction work be performed and supervised by *koji tanninsha shikaku* (licensed installation

technician).

2.15 Radio Act

The Radio Act is intended to promote public welfare by ensuring the fair and efficient use of radio waves. A license is required for the use of transmitting equipment, depending on the output of the radio waves and the frequencies it uses. It is illegal to use a transceiver that requires a license without a license. The use of transceivers made overseas is also illegal unless they are approved in Japan. It is necessary to observe laws and regulations regarding radio waves at public construction sites and large construction sites where transmitting equipment is used.

2.16 Civil Aeronautics Act

The Civil Aeronautics Act establishes methods to ensure the safety of aircraft navigation and the prevention of obstructions caused by aircraft navigation. Depending on the height of buildings and construction equipment such as cranes, they may interfere with the safe navigation of aircraft. Obstacle lights must be installed on properties that are 60 meters or higher from the ground or water surface.

Recently, unmanned aerial vehicles (drones) have been used for surveying in construction projects. Drones weighing 100 g or more are required to be registered as unmanned aircrafts.

2.17 Parking Lot Act

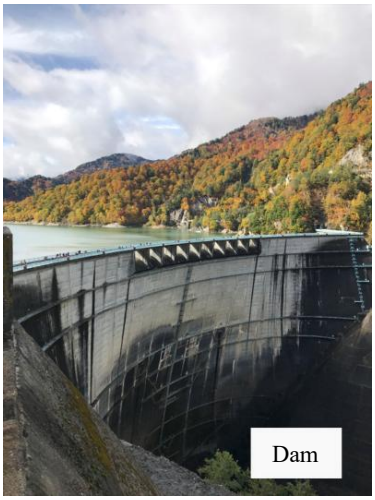
The Parking Lot Act is the law regarding the development of facilities for automobile parking in cities. Its purpose is to facilitate road traffic, thereby contributing to public convenience and maintaining and promoting the functions of the city by stipulating matters necessary for parking facility and equipment. When undertaking parking lot construction, the local government must be notified prior to the start of construction.

Chapter 3: Construction Work Types and Operations

3.1 Construction Work Types

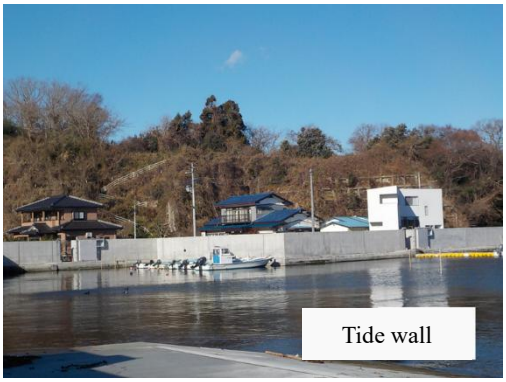
3.1.1 Civil Engineering Work

[Dam koji] (dam construction) Dams are built to regulate the amount of water flowing into rivers. The two purposes of dams are *chisui* (flood control) and *risui* (water utilization). In flood control, water is stored during heavy rains to adjust the amount of water flowing into the river so that the river does not overflow and cause flood damage. In terms of water utilization, it plays a role in regulating the amount of water available so as to ensure stable water supply in agriculture and industry.


Dam

[Kasen/kaigan koji] (river and coastal construction) Various types of construction work for rivers and the sea. This includes construction of breakwaters, tide walls, river revetments, levees, and waterways. The work also includes preservation and creation of river environments that consider local flora and fauna, in order to preserve the natural environment.


Breakwater


Tide wall

[Doro koji] (road construction) This is the construction of roads for people and vehicles to pass through. Roads include highways, national roads, prefectural roads, and municipal roads. In addition to paving the surface with asphalt or cement, a variety of specialized work is performed. Examples include installation of signs and markings, installation of traffic signals and streetlights and the necessary electrical work, landscaping to improve the scenery, brick and block work, construction of sidewalks, and drawing white lines on road surfaces.

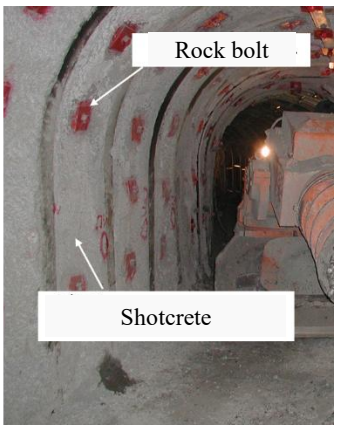

Road construction

[Tunnel koji] (tunnel boring) Tunnels are used in the construction of railroads, roads, waterways, and other infrastructure facilities. There are four types of tunneling methods: the mountain tunneling method, open-cut method, the shield method, and the pipe-jacking method.


Tunnel construction

[Sangaku tunnel] (mountain tunneling method) Tunnels dug by excavating hard rock mainly in mountainous areas. The tunnel is excavated by blasting or tunnel boring machines, and a method called NATM is used to support the tunnel by installing shotcrete, steel shoring, and rock bolts on the excavated surface.


Steel shoring


Rock bolt

Shotcrete

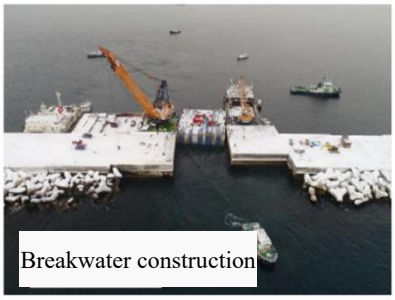
[Kaisaku tunnel] (the open-cut method) Method of excavating from the ground surface using earth-retaining shoring to prevent the ground from collapsing. This is called *kaisaku koho* (the open-cut method). The tunnel is constructed in the excavated space. In this method, the area outside the tunnel is filled back again after tunnel construction.

[Shield tunnel] (the shield method) The shield method uses a tunneling machine, called a shield machine, which is specially designed for tunnel excavation. It can be used when digging soft ground, even if there is an existing structure directly above it.

[Suishin tunnel] (the pipe-jacking method) Tunnels that are constructed by attaching a tunneling machine, a lead shield, or a cutting wheel to the end of a factory-manufactured jacking pipe between the launching and receiving shafts, and then thrusting the jacking pipe into the ground from the launching shaft using the thrusting force from the jack. The jacking pipes are mainly used for social infrastructure (sewage, water, electricity, communication, gas, etc.) in urban areas.


Bridgework

[Kyoryo koji] (bridgework) What provides passage across oceans and rivers are called *kyoryo* (bridges). Construction is carried out in two major processes: *kabuko* (the substructure construction) and *jobuko* (the superstructure construction). In the substructure construction, foundations are laid to support the bridge. In the superstructure construction, the main body of the bridge is constructed for vehicles and people to cross.


Breakwater construction

[Kaiyo doboku koji] (marine civil engineering work) Construction of facilities such as ports and airports on oceans and rivers. This includes building port facilities such as quays where ships can dock, breakwaters to prevent waves, safe passage for ships, reclaimed land where factories and other facilities, as well


Diver

as undersea tunnels, offshore bridges, and other structures such as offshore wind power generation towers.

Construction is done with a large machine called *sagyosen* (work vessels) that can dig the seafloor and lift heavy objects. Another feature of marine civil engineering work is the use of surveying equipment to measure the shape of the seafloor and the use of *sensuishi* (divers), or people who can work underwater in the sea.

[Tetsudo koji] (railroad construction] Construction work completed through the involvement of almost all specialized work related to construction, including not only civil engineering work but also electrical work and building work.

[Josuido koji] (water and sewage works) These can be civil engineering works, water facility works, or sewer pipe works. Civil engineering works here include site development work for water treatment facilities and sewage treatment plants.


Sewage works

[Saigai fukkyu koji] (disaster restoration work) Every year in Japan, roads, rivers, and other civil engineering facilities are damaged by typhoons, torrential rains, earthquakes, and other natural disasters. This construction work is to quickly restore damaged facilities. Various public civil engineering facilities such as rivers, coasts, erosion control facilities, roads, ports, water and sewage systems, etc. are included.


Disaster restoration work

[Sonota no doboku koji] (other civil engineering works) Other works include airport construction, land readjustment, agricultural civil engineering work, erosion control, and forestry civil engineering work.

Airport construction

3.1.2 Building Work

Kenchiku koji (Construction work) is the process of creating buildings

Buildings can be classified by structure as *tekkin* concrete *zo* (reinforced concrete), tekkotsu zo (steel-frame), tekkotsu tekkin concrete zo (reinforced steel frame concrete construction), moku zo (wooden-frame), concrete block-zo (concrete block), etc.

Reinforced concrete buildings are constructed by pouring concrete into a reinforcing steel formwork. A steel-frame building is of a structure that uses steel sections as columns and beams. The difference between the two is that one uses rebars while the other uses steel sections, and the structure that uses both is a called a reinforced steel frame concrete construction. Reinforcing bars are assembled around the steel sections, and concrete is poured to create the building. Wooden-frame structure is a structure often used in general housing, and refers to building structures that use wood for columns and beams. In a concrete block structure, concrete blocks are piled up while reinforcing steel bars are passed through the cavities in the blocks and reinforced with mortar and other materials.

Relatively large scale construction projects such as buildings, condominiums, etc. are carried out in the following sequence.

[Junbi koji] (preparation work) Enclosure is erected around the site where the building is to be constructed, and temporary construction offices and rest areas for construction workers are built. In addition, electrical and plumbing work for the construction will be conducted.

The site where the building is to be constructed is subjected to a ground survey (boring survey) to

investigate the layer that will support the piles (bearing layer).

[Yamadome koji] (soil retaining structure work) The process of preventing soil walls from collapsing as a result of excavation work is called *yamadome*. A temporary wall is built underground to shore the wall so that it will not collapse (called *shihoko* (shoring)).


Soil retaining structure work

[Kui koji] (piling work) Piles are embedded in the ground to support the building. The tip of the pile should reach the bearing layer in the ground. There are two types of piling methods: *bashouchi concrete kui* (cast-in-situ concrete piles) are made on site, and *kisei kui* (precast piles) are factory-made and delivered to the site.

[Do koji] (earthwork) Excavation of the ground to build structures below ground level. It will also be necessary to pump out the water that comes out during the excavation.


Loading earth and sand using a backhoe

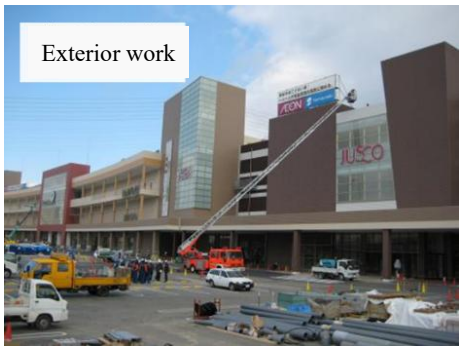
[Chika kutai koji] (underground frame construction] The structural part of a building consisting of foundation, columns, beams, walls, floors, etc. is called *kutai (*the frame). After completion of the earthwork, the underground frame will be constructed. From here on, various specialty contractors come and go. For example, there is rebar work to support the frame, rebar splicing work such as pressure welding to connect the rebars, building formwork into which concrete is poured, concrete pumping work to pour concrete into the formwork, and various types of equipment installation work.


Underground frame construction

[Chijo kutai koji] (above-ground frame construction] The construction of a large building involves the use of heavy-gauge steel sections. This construction is called *tekkotsu koji* (steel framing work). A mobile crane is used to lift the steel section, position it, and bolt it in place.


Above-ground structural

[Nai/gaiso shiage koji] (interior and exterior finishing work] When the frame construction is finished, the building's exterior work begins. Interior and exterior work involves many specialty projects, including waterproofing, sheet metal, roofing, tiles, curtain walling, plastering, painting, and fixtures. masonry work is also done using marble, granite, and other stone materials.


Exterior work


Interior work

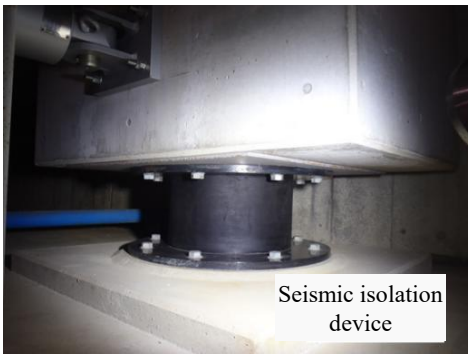
[Taishin koji] (seismic work) Seismic work makes buildings more resistant to earthquake shaking, thereby preventing them from collapsing. Seismic work includes improving seismic resistance, vibration control, and seismic isolation.

- Seismic resistance work: pillars and beams are solidly built to withstand large earthquakes.

- Vibration-control work: energy-absorbing mechanisms such as dampers are installed in buildings to control the vibration.

- Seismic isolation work: seismic isolation devices such as isolators and dampers are installed in the foundation to reduce the transmission of earthquake energy to the building.

Building after vibration control construction



Seismic isolation device

[Iji/hozen/kaishu koji] (maintenance/preservation/renovation work) To keep completed buildings in good condition for a long time, it is important to create a maintenance and preservation plan and conduct renovation work accordingly. For example, the following renovation work will be performed.

- Exterior: cleaning of exterior walls, resealing, exterior design changes, waterproofing retrofitting, etc.

- Interior: barrier-free, layout changes, etc.

- Facilities: replacement of lighting fixtures (LED, etc.), renewal of air conditioning equipment, renewal of water supply and drainage equipment, renewal of sanitation equipment, etc.

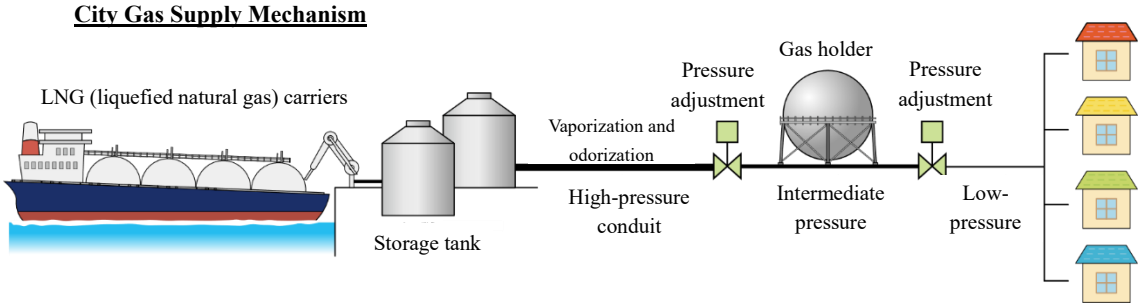
3.1.3 Lifeline Infrastructure/Equipment Installation

(1) Lifeline infrastructure work

[Denki koji] (electrical work) Electricity produced at power plants is sent into buildings via transmission lines from transformer facilities at substations through poles or underground. Electricity sent into the building goes through the distribution board and is supplied to various locations in the building. This is achieved through electrical work. An accident unique to electrical work is *kanden jiko* (electric shock accidents). To prevent electric shock accidents, it is necessary to communicate the

on and off status of power before work is performed, and that safety checks, such as voltage checks of the charging section, are performed before commencing work.

[Toshi gas koji] (city gas work) Liquid natural gas transported by large tankers is placed in storage tanks. Gas in storage tanks passes through gas pipes buried underground, vaporized and odorized along the way, before being stored in spherical tanks called gas holders. Gas stored in gas holders is delivered, with adjusted pressure, to factories, various facilities, and homes through pipes. City gas work mainly involves the construction of pipelines through which gas passes and the installation of equipment for gas use.



[Josuido koji] (waterworks/sewage work)

In waterworks, water taken from rivers and other sources is turned into clean water at water treatment plants and stored in clean water reservoirs and distribution reservoirs. Water from the distribution reservoir is delivered to all parts of the water supply area via water mains buried underground. Holes are born into the water mains, from which the water service lines are branched and connected to the home or building interior. Waterworks involve pulling service lines into the building. In sewage work, sewage used in buildings is collected in sewer mains, turned into clean water at sewage treatment plants, and discharged into rivers or seas.

[Denki tsushin koji] (telecommunications work) This work involves the construction of networks for conveying and using information, primarily telephone construction and the Internet. Cables for telecommunication facilities include metal and fiber-optic cables. Recently, fiber-optic cables are more widely used.

(2) Equipment Installation

Equipment installation includes electric equipment that supplies power to lighting, electrical appliances, IT equipment, and electric motors; disaster prevention facilities; electric facilities that supply power; air conditioning that makes rooms comfortable; and water supply, drainage, and sanitaton facilities.

[Reito kucho setsubi koji] (refrigeration and air conditioning installation) Installation of equipment that adjusts temperature and humidity and cleans the air for comfort.

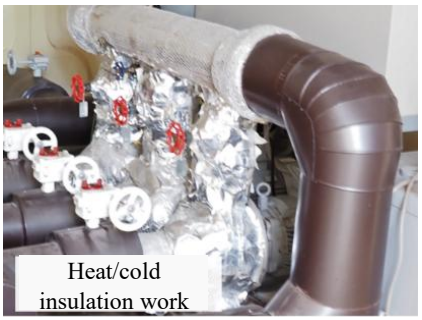

Cooling water circulator

[Kyuhaisui eisei setsubi koji] (water supply, drainage, and sanitation facilities installation) Installation of facilities necessary to maintain a hygienic and clean living environment using water and hot water.


Water feeding pump

[Ho'on/horei koji] (heat/cold insulation work) Work related to piping and equipment that requires heat insulation, thermal insulation, cold insulation, and dew-proofing.

Heat/cold insulation work

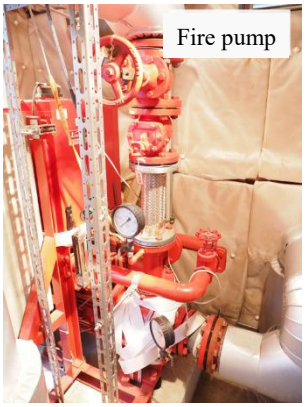


Heat/cold insulation work

【Shobo setsubi koji】(fire fighting equipment installation) Installation of equipment to protect people and buildings from fire. For example, installation of *kasai jushinki* (fire alarm receivers) that receive signals from detectors and transmitters installed in the building and notify the building itself and the fire department of the occurrence of fire, installation of sprinklers that automatically spray water when sensing heat from a fire, and installation of shoka pump (fire pumps) to supply water during fire fighting activities.

Sprinkler

Fire alarm receiver



Fire pump

3.2 Major Specialized Works

3.2.1 Earthwork


Hydraulic excavator

Doing work such as the excavation of land, the loading, hauling and filling of earth and sand, backfilling, compaction, and pushing and grading by hand is called doko (earthwork).

[Kussaku sagyo] (excavation work) The process of digging out and removing earth, sand, and rocks is called *kussaku sagyo*. Explosives are sometimes used to destroy rocks and other materials, and this is called *happa* (blasting). The foundation of the building is buried under the ground. Digging the ground for this purpose is called *negiri*.

[Dosha no tsumikomi/unpan sagyo] (loading and hauling earth and sand) When excavators and dump trucks cannot be used to load and haul earth and sand, the work is done by hand.

[Morido/kirido sagyo] (embankment and cutting soil) *Morido* (filling) is the process of leveling slopes and uneven land by heaping up soil. Cutting and leveling the ground is called *kirido* (cutting soil).

[Umemodoshi sagyo] (backfilling) The process of filling in the structure and the extra space created around it with soil after excavation of the ground and construction of the basement or foundation is completed.


Compaction by hand guided rollers

[Shimekatame sagyo] (compaction work) The process of reducing the amount of space between earth and sand by tamping or vibrating the ground to prevent it from settling.

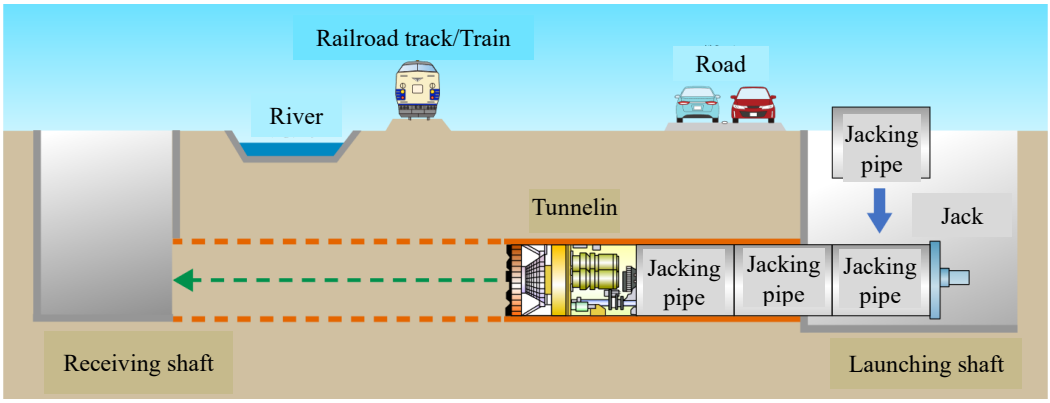
[Suichu pump no secchi to haisui] (installation and drainage of submersible pumps) On sites where a lot of water comes out, submersible pumps or similar devices are installed to pump out the water.

[Norimen no tofu/uetsuke sagyo] (slope surface application and planting work)

Mortar is sprayed and applied to the slope to prevent the slope from collapsing. There is also a method of planting the entire slope surface with mats embedded with seeds, fertilizers, and bed material for plants.

3.2.2 The Pipe-Jacking Tunneling Method

The pipe-jacking tunneling is the same type of construction method as the shield method in that it uses tunneling machines to excavate tunnels. When the tunneling machine is ready, it is launched from the pre-built launching shaft to start excavating the tunnel. In the pipe-jacking method, factory-made pipes are connected to the tunneling machine and pushed into the ground by jacks installed in the launching shaft. This process is repeated to build the tunnel.



3.2.3 Marine Civil Engineering Work

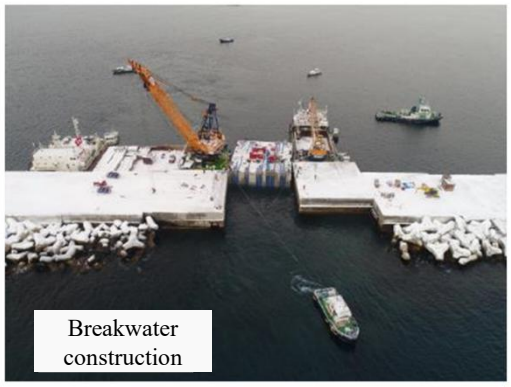
The following are typical examples of marine civil engineering projects that involve the construction of port facilities and offshore structures.

[Shunsetsu koji] (dredging work) The process of removing sediment from the bottom of an ocean or river.

[Umetate koji] (reclamation work) The process of collecting earth and sand to create new land. During construction, sediment removed by dredging is transported by boat or machine to the reclamation site and placed in the sea to construct the site.

[Ganpeki koji] (quay construction) The construction of a facility in a port where ships stop to load and unload cargo.

[Bohatei koji] (breakwater construction)The construction of a facility that prevents waves from entering a harbor so that ships can safely stop, load, and unload their cargo.



3.2.4 Well Drilling Work

The process of digging the ground to create a well is called *sakui koji* (well drilling). There are several types of well construction work.

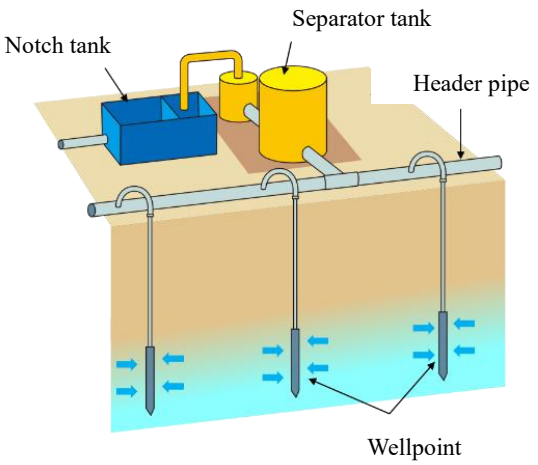
[Suigensei koji] (water source well work) Work to access and pump up groundwater.

[Kansokusei koji] (observation well work)Work to create *Kansokui* (observation wells) used to determine the state of geological formations.

[Onsensei koji] (hot spring well work) Work to access and pump up hot spring water.

[Chinetsusei koji] (geothermal well work) Work to drill wells for geothermal power generation. This requires a higher level of technology than other well drilling projects

3.2.5 Wellpointing



When excavating below the water table for construction of building foundations, underground pipes, or burying septic tanks, it is necessary to pump up and drain groundwater. Wellpointing is one of the methods used for dewatering. A series of wellpoints, or collection pipes connected to the header pipe, are driven into the ground to pump up groundwater using vacuum pumps. The pumped up groundwater up is drained through discharge pipes.

3.2.6 Paving Work

Hoso koji (paving) is the process of laying asphalt or concrete on a road. After surveying the site, the following work is performed.

[Rosho koji] (subgrade layer work) *Rosho* (subgrade layer) is the lowest layer that receives all the weight. After digging down to about 1 meter using heavy machinery, sand is spread evenly at the bottom.

[Roban koji] (aggregate base layer work) The layer above the subgrade layer is called *roban* (aggregate base layer)t. Crushed stone or other material is placed on top of the subgrade layer to create two layers. A heavy machinery called a roller is used to compact the material.

[Kiso koji] (foundation layer work) The asphalt is laid and evened out over the aggregate base layer using a machine called an asphalt finisher.


Asphalt finisher

[Hyoso koji] (surface layer work) Finally, durable, water-resistant and non-slip asphalt is laid and compacted.

3.2.7 Mechanical Earthwork

The earthwork described in 3.2.1 conducted by machinery is called *kikai doko* (mechanical earthwork). To drive and operate the machine, the operator must complete the prescribed skill training courses and safety training.

[Kussaku sagyo] (excavation work) Excavation using hydraulic excavators. If there are large rocks or boulders, rock drills are used.

[Oshido/tsumikomi/unpan sagyo] (dozing/loading/transporting work) *Oshido* (dozing) means to push earth and sand using bulldozers and other machinery for transport. Wheel loaders and hydraulic excavators are used to load dump trucks.

[Morido/shimekatame] (embankment/compaction) Plains are raised by piling soil and compacting it using bulldozers. Slope surfaces are shaped by attaching a slope bucket to a hydraulic excavator. Rollers dedicated to compaction and other machines are also used.

3.2.8 Piling Work

Piling work is the use of concrete or steel pipe piles to build a foundation that supports a building or structure. Foundation piling work is performed for high-rise buildings and large structures such as bridges.


Piling work

[Kisei kui koho] (precast piling method) The piles are fabricated in a factory, transported to the construction site, and driven into the ground.

[Bashouchi kui koho] (cast-in-situ concrete piling method) This method makes piles at the construction site. A hole is dug for the pile, a cylindrical cage made of reinforced steel is placed in the hole, and fresh concrete is added to create the pile.

3.2.9 Scaffolding Work

Construction cannot proceed without scaffolding for the work. The *tobi* that builds this scaffold is called *ashiba-tobi*. In addition to this, there are the following types of *tobi* jobs


Tekkotsu-tobi

[Tekkotsu-tobi] (steel frame steeplejack) Uses steel sections to assemble the framework of high-rise buildings and condominiums.

[Kyoryo-tobi] (bridge frame steeplejack) Assembles steel sections for bridges, dams, steel towers, and highways.

[Juryo-tobi] (heavy-duty steeplejack) Carries and installs machinery and equipment weighing several hundred tons.

[Soden-tobi] (power line steeplejack] Engages in electrical work at heights, such as pulling power

lines from steel towers, and inspecting and maintaining power lines.

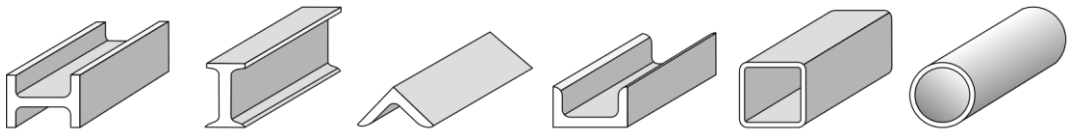
[Machiba-tobi] (local building steeplejack) *Machiba-tobi* builds scaffolding for local buildings, especially houses and condominiums.

3.2.10 Steel Framing Work

Steel framing work is the process of assembling the framework of a building, such as columns and beams, using steel sections. Steel sections are broadly classified into the following categories based on the shape of their cross-sections.

Steel Framing Work

Types of steel sections



H-beam I-beam Angle Channel Square bar Round bar

There are two types of steel framing methods: *tatenige hoshiki (*build-away method) and *suihei tsumiage hoshiki* (horizontal stacking method). *Tatenige hoshiki* uses a mobile crane to assemble the building from the back of the lot toward the front. *Suihei tsumiage hoshiki* uses a tower crane to assemble one floor at a time. This method is used for building skyscrapers.

Safety gear for steel framing work

3.2.11 Steel Reinforcement Work (Rebar Work)


Rebar work

Concrete-covered structures, such as buildings and bridges, use steel bars as a framework, This process is called *tekkin seko* (rebar installation). Rebar is cut and bent at the processing plant and transported to the construction site for assembly.

3.2.12 Rebar Splicing Work

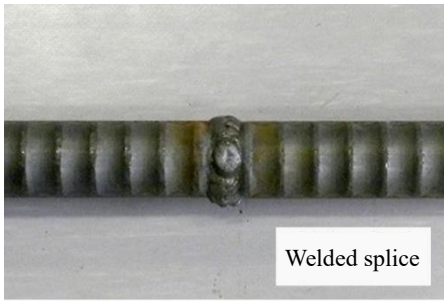

Rebar bending

If a rebar is not long enough, two rebars are joined together to make one long rebar. This construction is called *tekkin tsugite koji* (rebar splicing work). There are several types of splicing methods, as follows.

[Gas assetsu tsugite] (gas pressure welded splice) A method of splicing rebars by heating the joint between the two rebars and applying pressure in the axial direction.


Gas pressure welded splice

[Yosetsu tsugite] (welded splice) A method using arc welding to join the welding faces of rebars. This method is used for rebars with large diameters, precast concrete columns, beam main bars, and *sakigumi tekkin* (preassembled rebars) that cannot be pressure welded.


Welded splice

[Kikai-shiki tsugite] (mechanical splice) A method of joining threaded steel bars using a part called a coupler.

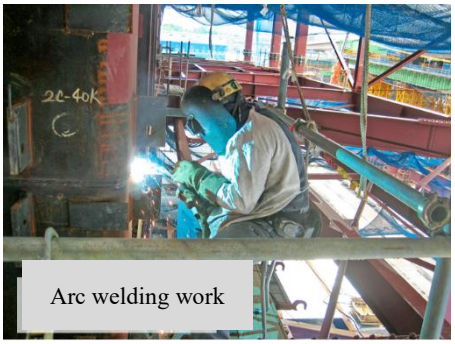
[Kasane tsugite] (rebar lapping) A method used with thin rebars. The portion where the rebars overlap each other (the joint portion) is joined as one by some method, such as arc welding. Where the reinforcing bars intersect in slabs, the rebar lapping method is used, after which they are joined

together by concrete.


Mechanical splice


Rebar lapping

3.2.13 Welding Work


Arc welding work

Welding is the joining of two or more members by applying heat and/or pressure.

It is more airtight and lighter than joining with screws or bolts. Three main types are fusion welding, pressure welding, and soldering.

[Yusetsu] (fusion welding) The most common welding method. There are two methods of welding: one is to melt the base metal (the material to be welded) and the other is to melt the welding rod and the base metal.

[Assetsu] (pressure welding) A welding method in which heat and pressure are applied to the surfaces of the base metals to be joined.

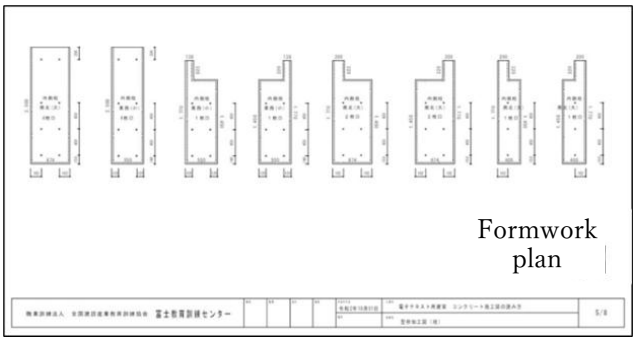
[Rosetsu] (soldering) A welding method in which a filler that has a lower melting temperature than the base metal is melted to act as an adhesive to join the materials.

3.2.14 Formwork Carpentry

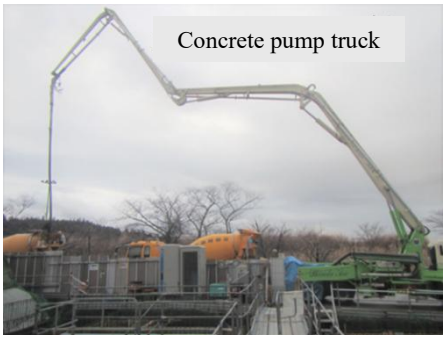
Katawaku koji (formwork carpentry) is the process of building the formwork that cover the reinforcing steel bars installed by rebar work.


Formwork carpentry

Since concrete is poured into the formwork, the formwork is subjected to great pressure from the inside. If the formwork cannot withstand this pressure, it will break and the concrete will leak out. To prevent this, the formwork must be adequately supported and reinforced from the outside. For reinforcement, steel tubes are used. Reinforcing the formwork with steel tubes is called *shihoko* (shoring). High processing skill is required to accurately create formwork that matches the complex shapes of buildings. In addition, the ability to read drawings called *kakozu* (formwork plans) is required to build the formwork.


Formwork plan

3.2.15 Concrete Pumping Work


Concrete pump truck

Once the formwork is completed, concrete is poured (called *dasetsu* (placed)) into it. Quality-controlled concrete (called ready-mixed concrete or *nama-con*) is delivered to the construction site by a concrete agitator truck (*nama-con* truck) and transferred to pump trucks. Fresh concrete is pumped into the formwork using hydraulic or mechanical pressure by means of concrete pumps. This is called concrete *asso* (concrete pumping).

During the placement process, air bubbles end up in the concrete. Vibrators are used to vibrate the all the concrete in the formwork from corner to corner in order to remove unwanted air in order to prevent deterioration of concrete strength. This process is called *shimekatame* (compaction). Fresh concrete hardens over time, so it must be worked efficiently.


Concrete Placement Work

3.2.16 Painting Work

Painting work is a process used to protect and improve the durability and aesthetics of a building's roof and walls. A high level of knowledge about paints is necessary in order to properly choose different paints depending on the surface material to be painted.

[Hake nuri] (brush painting) A painting method that uses *hake* (brush) to apply the paint. Different types of brushes are used depending on the area to be painted.


Exterior painting with a roller

[Roller nuri] (roller painting) A painting method that uses a roller brush. It is suitable for painting large surfaces, such as exterior walls, because it can paint large surfaces efficiently.

[Air spray toso] (air spray painting) A method in which paint is sprayed onto the surface in the form of a mist. Air compressed by an air compressor is mixed with liquid and sprayed using an air spray gun.


Air spray painting

3.2.17 Landscaping Work

Zoen is the process of creating landscape using various types of trees, plants, and stones. It requires an aesthetic sense for balanced placement of trees and stones.

[Shokusai koji] (planting work) Planting trees and plants on the grounds around the building (called *gaiko*).

[Okujo ryokka koji] (rooftop greening work) The greening of building rooftops and walls.

[Hiroba koji] (park work) The construction project to create parks with lawns or athletic fields.

[Koen setsubi koji] (park facility installation) Building flower beds, rest areas, fountains, and walking paths in the park.

[Ryokuchi ikusei koji] (green space cultivation work) Work to improve soil, installing supports for trees, etc. in order to cultivate trees, lawns and floriculture.

Pruning of black pine

Lawn maintenance

3.2.18 Plastering Work

Sakan koji (plastering work) is the process of applying various types of finishing materials using a tool called *kote* (trowel) after the building is completed. It is similar to painting work, but the tools used are different.

Trowels dedicated for inside and outside corners

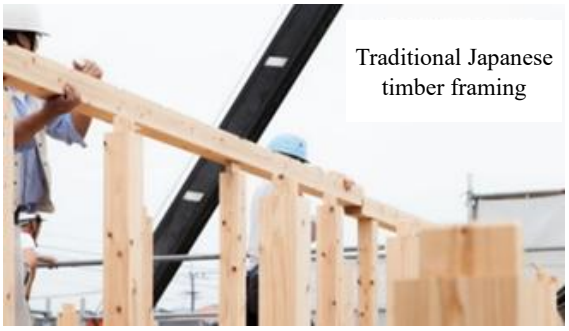
Materials used include wall clay, mortar, Japanese plaster, normal plaster, and fibers. In particular, wall clay and Japanese plaster are materials that have been used in Japan since the old times. Because plastering is often done on the exterior walls and interiors of buildings, workmanship is especially important, and therefore requires a high level of skill for a beautiful finish.


Example of a Japanese plaster wall

3.2.19 Carpentry Work

The job of *kenchiku daiku* (carpenter) is to build these wooden buildings. There are many jobs where the word *daiku* (carpenter) is used, such as those listed below.

[Machi daiku] (town carpenter) A carpenter who works on wooden houses. When uttering the word *daiku-san*, most Japanese people think of *machi daiku*.


Traditional Japanese timber framing

[Zosaku daiku] (joinery carpenter) After the building structure is complete, this carpenter decorates the interior with doors, shoji screens, *fusuma* (sliding doors), and other interior decorations.

[Miya daiku] (shrine and temple carpenter) A carpenter who builds or repairs temples, shrines, and other structures. To make a building that can withstand wind and rain for hundreds of years, knowledge of wood and advanced techniques for connecting wood to wood are required.

[Katawaku daiku] (formwork carpentry)→ See 3.2.14.

3.2.20 Roofing Work

Many Japanese houses use a roofing material called *kawara*. *Kawara* are tiles made of clay, shaped and fired in a kiln. Roofing materials can also be metal shingles and of other materials. Regardless of which material is used, knowledge and techniques on work to prevent rainwater from entering the building (called *amajimai*) are required. Roofing work is not only roofing, but also includes the following work.

[Yane fukikae koji] (re-roofing work) Work to remove existing roofing materials and tarps, and replace them with new roofing materials.

[Yane kasanebuki koji] (roof overlaying work) New roofing materials are applied on top of the existing roof.


Japanese plaster repair work

[Shikkui hoshu koji] (Japanese plaster repair work) Material called *shikkui* (Japanese plaster) is used to protect exposed areas of soil used to tile the roof. Japanese plaster repair work must be periodically conducted.

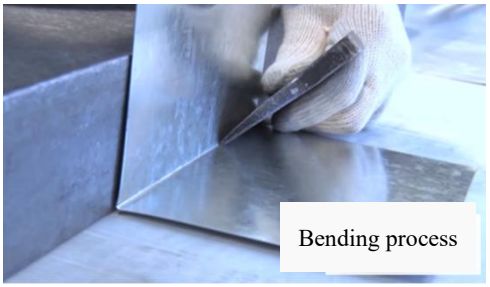

Gutters in need of repair

[Amadoi kokan koji] (gutter replacement work) Replacement of broken gutters.

[Yane toso koji] (roof painting work) Painting on the roof. This is done when the existing roofing material has lost its waterproofing function.

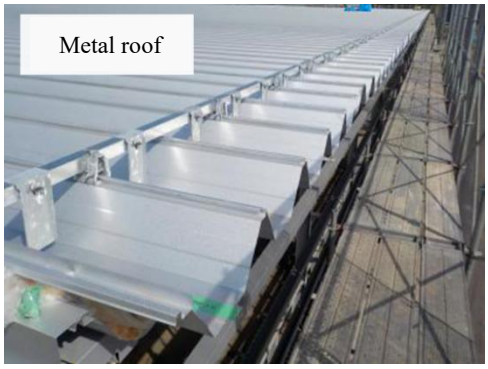
3.2.21 Architectural Sheet Metal Work

Kenchiku bankin koji (architectural sheet metal work) refers to the processing of metal sheets to make metal products needed for buildings and installing them in buildings. Metal sheets are usually thin. They are


Bending process

processed by cutting, bending, forming, and joining. The following work is performed in architectural sheet metal work.

[Yane koji] (roofing work) The process of attaching a roof to a building is called *yane wo fuku*. There are various types of roofing materials including *kawara*, but roofing work using sheet metal in particular is done by architectural sheet metal workers. In addition, rainwater must be drained systematically to protect the building from rainwater that falls from the roof. This is called *amajimai* (rain-proofing). The fabrication and installation of the hardware necessary for rain-proofing is also a part of architectural sheet metal work.


Metal roof

[Duct koji] (duct work) Pipes that carry air are called ducts. Ducts, also called airways, include smoke exhaust ducts that carry smoke outside in the event of a fire, air conditioning ducts that carry cold, warm, and fresh outside air to the inside, and exhaust ducts that exhaust heat and odors generated in machinery rooms, electrical rooms, and lavatories to the outside.


Exhaust ducts for private power generation equipment

[Gaiheki koji] (exterior wall work) Wall materials such as siding and corrugated sheets are used to construct the exterior walls of buildings.

[Kanban/kanamono] (signboards/hardware) Architectural sheet metal work also includes the processing and installation of signboards as well as hardware used in various locations. Hardware used in visible locations must be not only precise but also beautiful.

3.2.22 Tiling Work


Tiling work

Tile *bari koji* (tiling work) is the process of installing tiles on walls and floors.

3.2.23 Interior Finish Work

The interior work of a building is called *naiso shiage koji* (interior finish work).


Steel stud framing work

[Kosei shitaji koji] (steel stud framing work) Construction of the framework for walls and ceilings using materials calledLGS (Light Gauge Steel or Light Gauge Stud). The construction of this framework is also called keiten koji. LGS is sometimes referred to as studs.


Boarding

[Board hari] (boarding) Plasterboard is applied over the steel stud frame. To make the grooves between the plasterboards less noticeable when wallpaper is hung over the plasterboards, the grooves are smoothed out with putty.

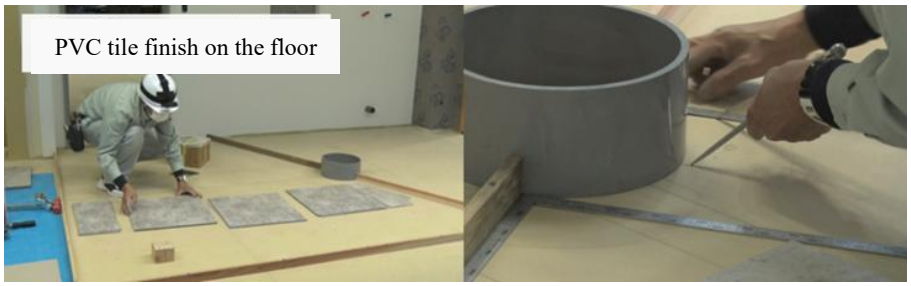
[Cloth bari] (wallpapering) Hanging wallpaper, the wall finishing material, over the plasterboard base.

[Toso shiage] (paint finish) Instead of wallpaper, paint is used to finish the work.

[Yuka shiage] (floor finishing) Work to lay tiles, carpets, tatami mats, etc. on the floor.

[Curtain koji] (curtain work) Work to cut and sew the fabric to make curtains and hang them. This also includes work on curtains (large curtains) used on stages and other venues.

[Yuka shiage (enka vinyl tile)] (floor finishing (vinyl chloride tile)) Processing materials to match the shape of the floor.



3.2.24. Interior Finishing Work

The interior finishing work on buildings described in 3.2.23, excluding steel stud framing and boarding, is called *hyoso koji* (surface work). It mainly refers to finishing walls, ceilings, and floors. Depending on the materials used, there are a variety of finishing methods.

[Kabe shiage (wallpaper)] (wall finish (wallpaper)) Hanging wallpaper over plasterboards. The grooves between the plasterboards are filled in with putty and smoothed out so that the wallpaper will not appear uneven.

[Tenjo shiage (wallpaper)] (ceiling finishing (wallpaper) Work must be done always facing up, and the skill to spread and hang the wallpaper straight without bending is necessary.

Ceiling wallpaper finish

3.2.25 Fittings Work

Buildings have many openings. *Tategu* (fittings) are doors, windows, *fusuma* (sliding doors), *shoji* (paper sliding doors), etc. that fit the openings in the buildings, and the frames used to attach them. Fittings include wood, sash and other aluminum, plastic, steel, and stainless steel fittings. *Tategu koji* (fittings work) is the installation of factory-made fittings on site. Fittings work includes shutter installation and automatic door installation.

Fittings work

3.2.26 Sash Setting Work

Of the fittings work, the installation of metal fittings is called sash *koji* (sash setting work). This includes not only aluminum sashes for windows, but also installation of metal fixtures such as bathroom doors, screens, curtain walls, etc.

3.2.27 Polyurethane Spray Foam Insulation Work

Rigid polyurethane foam is used as a building insulator because of its thermal insulation properties.

Fukitsuke urethane dannetsu koji (polyurethane spray foam insulation work) is work in which rigid polyurethane foam liquid is directly sprayed onto a frame, etc. using a dedicated spraying machine in order to form the rigid polyurethane foam on site. This method of construction allows for a gapless insulation layer.

Polyurethane spray foam insulation work

Before starting, the foam is sprayed onto a square board of about 450 mm per side to check the foam density. During construction, thickness is checked at 4~5 m intervals using a polyurethane foam thickness gauge.

Sprayed surface after the work

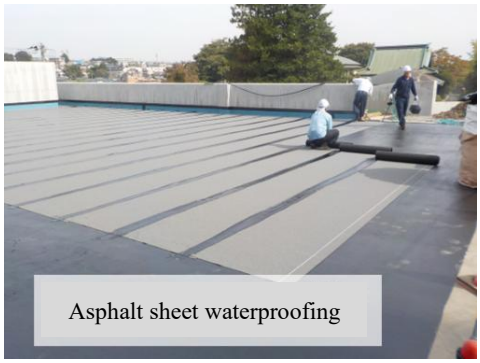
3.2.28 Waterproofing Work

The work done to prevent rainwater and snow from entering the interior of a building is called *bosui koji* (waterproofing). Waterproofing work can be divided into five main types, depending on the materials used.

[Urethane bosui koji] (polyurethane waterproofing work) A method of waterproofing by applying liquid waterproofing material to the surface. This method can waterproof places with complex shapes. It is suitable for waterproofing terraces, balconies, and rooftops, as well as for repairing leaking areas.

[FRP bosui koji] (FRP waterproofing work) A method in which fiberglass mats are laid down, and polyester resin is applied on top of the mats. This method is durable and dries quickly.

[Sheet bosui koji] (sheet waterproofing work) A method in which synthetic rubber or synthetic resin sheets are attached with adhesive. This method can cover large surfaces at once.


Asphalt sheet waterproofing

[Asphalt bosui koji] (asphalt waterproofing work) A method in which synthetic fiber cloth sheet soaked with asphalt is attached to the base surface. To improve adhesion between the base surface and the sheet, asphalt primer is applied to the base surface before the sheet is applied.

[Sealing bosui koji] (sealing waterproofing work) A method used to waterproof the grooves between members. Primer is applied to the grooves before filling with sealant.


Sealing waterproofing work

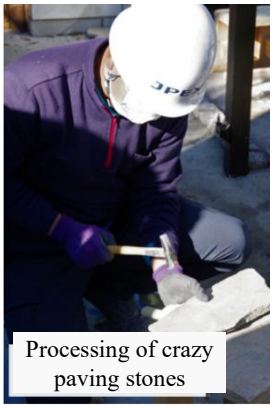
3.2.29 Masonry Work

Ishi koji (masonry work) is the work of processing stones from various parts of the world and installing them where needed.

Stones used include not only natural stone such as *dairiseki* (marble) and *mikageishi* (granite), but also *giseki* (imitation stones) that resemble stones and concrete blocks.


Work to pile up blocks


Bathtub construction for spa facilities


Processing of crazy paving stones

3.2.30 Electrical Work

Therefore, there are many tasks that can only be performed by a qualified *denki kojishi* (electrician). There are two types of electrician certifications: Class I and Class II. Class I certification is required to perform sufficient electrical work in large buildings and factories. Electrical work can be divided into two main categories, generally referred to as *gaisen koji* (outside line work) and *naisen koji* (inside line work).

[Gaisen koji] (outside line work) Work to connect electric wires at utility poles and underground to supply electricity to the building.

Overhead wiring work

[Naisen koji] (inside line work) Work to enable use of electricity in the building. Typical construction projects include the following.

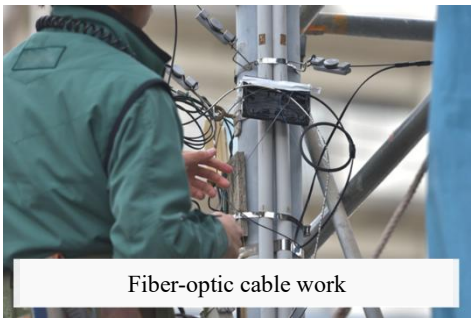
- Grounding work to prevent electric shock and electrical leakage
- Installation of substations
- Installation of power equipment
- Installation of power storage facilities
- Installation of power generation equipment
- Installation of distribution boards
- Supplying power to heating and cooling equipment
- Installation of electric lighting equipment
- Wiring and installation of switches, outlets, etc.

Installation of an outlet box

3.2.31 Telecommunications Work

Work related to telecommunications equipment such as telephones, television, and the Internet is called *denki tsushin koji* (telecommunications work). There are two methods for transmitting information: wired methods using cables and wireless methods using radio waves. Cables are divided into metal cables using copper wires and optical cables using optical fiber.

Therefore, there are some construction projects that can only be performed by qualified *koji tanninsha* (installation technician) or *denki tsushin shunin gijutsusha* (chief telecommunications engineer).



Fiber-optic cable work

3.2.32 Pipe Work

This work enables delivery of water, oil, gas, steam, etc. to where it is needed through metal pipes, etc. This includes plumbing for water supply, drainage, fire suppression systems, room coolers and air conditioners.

Pipe work

Basic skills include the ability to cut pipe material (cutting), connect pipes (joining), and assemble pipes, all with accuracy.

3.2.33 Freezing and Air Conditioning Apparatus Work

Freezing and air conditioning apparatus refers to equipment that uses refrigerants, such as air conditioners and freezers. The freezing and air conditioning apparatus work includes disassembly, assembly, installation, and adjustment work, as well as piping work, for freezing and air conditioning equipment such as freezing apparatus, refrigerating apparatus, freezers, packaged and separate-type air conditioners, home air conditioners, commercial refrigerators and freezers, freezer/refrigerated showcases, transportation refrigeration units, etc.

3.2.34 Water Supply, Drainage, and Sanitation Facilities Installation

Hot water tank

Facilities that use cold and hot water to keep buildings hygienic and clean in order to maintain a safe and comfortable lifestyle for citizens are called *kyuhaisui eisei setsubi* (water supply, drainage, and sanitation facilities).

[Kyusui setsubi koji] (water supply facility installation) Installation of pumps, water receiving tanks, and pipes to supply water from the water main through distribution pipes to toilets, kitchens, etc.


Toilet

[Haisui/tsuki setsubi] (drainage/ventilation system installation) Work to discharge dirty water from toilets and kitchens to the main sewer line.

[Kyuto setsubi] (water heater) Work to enable heating and supplying of hot water.

[Eisei kigu setsubi koji] (sanitation equipment work) Installation of toilet bowls, wash basins, etc.

3.2.35 Heat/Cold Insulation Work

This work aims to keep hot things from getting cold and cold things from getting warm. Installing heat- and cold-insulating materials (materials that do not transfer heat easily) on ducts and pipes reduces heat loss and fuel consumption. Also, attaching a heat insulator to the surface of a hot object is a safety measure that prevents burns.

Heat/cold insulation for pipes

3.2.36 Furnace Installation

Installation for the construction and maintenance of equipment that applies heat to materials to burn or melt them.

[Shokyakuro] (incinerator) Used to burn household and industrial waste.

[Cupola] A furnace for melting iron. Iron is melted by the heat from burning coke. Melted iron is used for casting.

[Shodonro] (annealing furnace) A furnace used to make the properties of metal materials uniform.

[Dasshuro] (deodorizing furnace) A furnace used to eliminate the odor of bad-smelling exhaust gas.

[Alumi yokairo] (aluminum melting furnace) A furnace used to melt aluminum scraps and ingots to make products. Melted aluminum is called molten aluminum.

3.2.37 Fire Fighting Equipment Installation

This equipment work is necessary to minimize damage to buildings, people, and property in the event of a fire or other disasters

Fire fighting equipment installation

[Shoka setsubi] (fire extinguishing equipment) Equipment that allows building occupants to extinguish fires (e.g., installed in hallways), sprinklers, etc.

[Keiho setsubi] (alarm equipment) Alarm equipment that automatically detects smoke and heat, emergency bells, and emergency broadcasts.

Emergency broadcasting equipment and surveillance camera equipment

[Hinan setsubi] (evacuation equipment) Equipment for evacuation in the event of a fire. Evacuation slides and ladders are installed.

3.2.38 Demolition Work

Buildings and structures eventually require rebuilding or removal due to aging or other reasons.

Kaitai koji (demolition work) is the process of breaking down a building or structure. Demolition work in densely populated or busy areas requires careful attention to vibration, noise, and falling demolition materials. The dismantled waste material is called *kaitai gara* (demolition debris). Demolition debris is sorted into concrete, steel, etc., and disposed of.


Demolition work


Demolition debris

3.3 Qualifications Required for Construction Work

In construction work, some tasks require a license, and some tasks may not be conducted without undergoing skill training courses or special education.

3.3.1 Types of Qualifications Under the Industrial Safety and Health Act

There are three types of qualifications under the Industrial Safety and Health Act: *kokka menkyo ga hakko sareru kokka shikaku* (national qualification for which a national license is issued), *gino koshu* (skill training course), and *tokubetsu kyoiku* (special education). For the work specified in the Industrial Safety and Health Act, *sagyo shuninsha* (operations supervisor) must be assigned at the work site to direct the workers who perform such work.

Chapter 4: Greetings, Terminologies, and Tips on Community Living at Construction Sites

Construction sites use special words and terms that are not often used in everyday life. Understanding these important not only for smoother communication, but also to ensure that the work proceeds safely and

4.1 Greetings, Emergency Warnings, Etc.

A person is more likely to have a good impression of those who greet him or her. Also, the choice of phrases can brighten someone's day. Greet everyone cheerfully, even if you don't know them.

4.1.1 "Ohayogozaimasu."

Ohayogozaimasu" is good morning, and is the basic morning greeting. Say "Ohayogozaimasu!" in the morning to everyone when it is the first time seeing them that day.

4.1.2 "Goanzenni."

There are many hazards on construction sites. In addition to considering your own safety, use "Goanzenni" to express your hope that your colleagues will also be safe, and that they may conclude the day's work without any accidents or injuries. Since the phrase shows consideration for the other person, those who hear it will feel encouraged in doing their work.

For example, at the end of the morning meeting, everyone says "Kyo mo ichinichi goanzenni" before starting work, expressing the wish for everyone to have a safe day. Also say, "Goanzenni!" when you pass by someone who is engaged in dangerous work. The person to whom it is said can go to the work site with a positive feeling and a desire to be careful.

4.1.3 “Otsukaresamadesu.”

“Otsukaresamadesu” is a phrase that expresses gratitude and appreciation for the other person's work and hardship. Unlike “Goanzenni” (“stay safe”), “Otsukaresamadesu” can be used not only at construction sites, but anywhere there are workers. It can be used when passing each other in an office, break area, hallway, etc. If you see someone leaving after work, cheerfully say, “Otsukaresamadeshita!” to thank them and send them off.

4.1.4 “Gokurosama.”

“Gokurosama” is a phrase used to _ and show appreciation for what the other person has done for you Although this term can be used for people who are superior to you, such as site supervisors, foremen, and seniors, most Japanese people consider it impolite to use it when speaking to superiors. It is probably best not to use “Gokurosama” with your superiors.

On the other hand, if a superior says to you, “Gokurosama!” it means that they are grateful to you. Reply with an energetic “Arigatogozaimasu!”

4.1.5 “Shitsureishimasu.”

“Shitsureishimasu” (excuse me) is a common phrase used by everyone, not just in the construction industry. *Rei* refers to courtesy (manners), and *shitsu* means to lose. The original meaning of the word is “lacking in manners,” but this phrase is not offensive.

For example, when entering a room, you might say, “Shitsureishimasu (for interrupting your conversation),” indicating that you are aware that you might be interrupting someone who is working in the room.

When the person you need to urgently speak to is in conversation with someone else, you say, “Shitsureishimasu.”

When you are leaving while someone else is still working, you can use the phrase “Osakini

shitsureishimasu" (I will take my leave)." To that, say, "Otsukaresamadeshita."

4.1.6 "Abunai"

When you are concentrating on your work, you may not realize the danger that is approaching you. When people sense that a person is in danger, the first thing they say is "Abunai!" If the danger comes from an object falling down from above or from the side, they will say, "Abunai! Yokero!" ("Look out! Dodge!") If you hear a voice yelling, "Abunai!", react immediately.

4.2 Terms Used on Construction Sites

4.2 explains the terms you need to know when working under the direction of a foreman or senior staff member.

4.2.1 Terms Related to Layout Marking

[Sumidashi] (layout marking) Drawing various reference lines on the ground, etc. that are necessary for construction. Traditional line markers and laser markers are used.

[Kijunzumi] (reference marking) The horizontal and vertical lines that are used as a reference when building. From the reference marking lines, the axis lines of the columns and walls are drawn.

[Torishin] (axis line) The line that passes through the center. Sometimes it is used to refer to *kabeshin* and *hashirashin*.

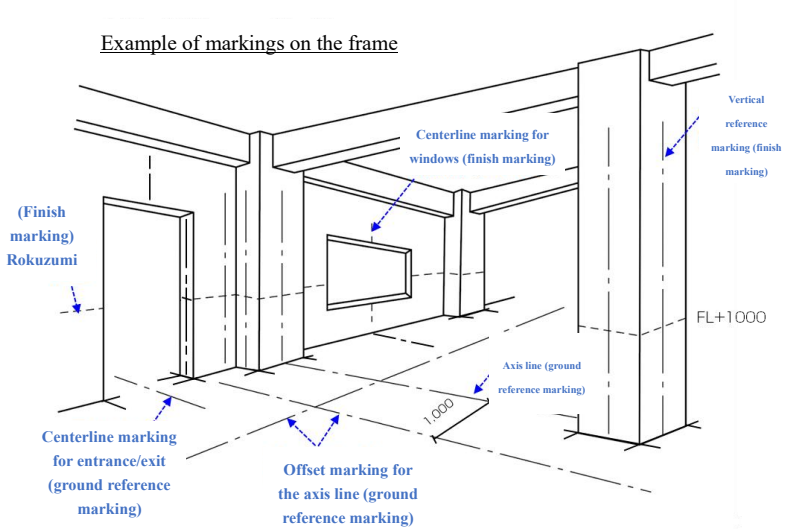
[Nigezumi] (offset marking) A line drawn when a reference marking cannot be drawn due to obstructions. It is also called *kaerisumi*. The line is drawn parallel to or as an extension of the reference marking. The distance from the reference marking is written down for future information.

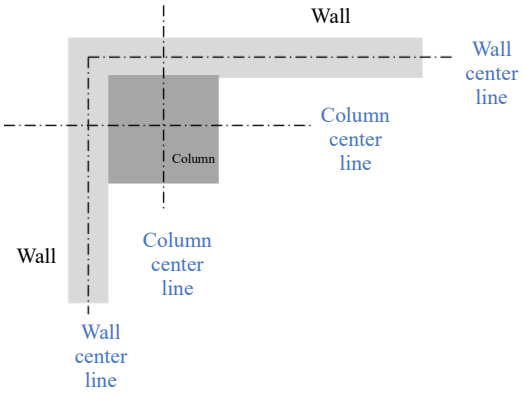
[Rokuzumi] (level marking) Horizontal lines to indicate the standard height, also called *rikuzumi*. Also called *koshizumi*, *mizuzumi*, and *suiheizumi*.

[Tatezumi] (vertical reference marking) Vertical lines indicated on the surfaces of walls, columns, and other surfaces.

[Jizumi] (floor reference line) Reference lines drawn directly onto horizontal surfaces such as floors.

[Shiagezumi] (finish marking) Lines that indicate the finished dimensions based on the axis lines and the building frame surfaces.





[Kabeshin] (wall center line) A line through the center of the wall.

[Hashirashin] (column center line) A line through the center of the column.

[Oyazumi] (parent marking) A line used as a reference for the next process of layout marking work, such as drawing the axis line and the level marking.

[Sumitsuke] (marking out) Marking wooden members for fabrication.

4.2.2 Terms Related to Temporary Enclosures

[Yarikata] (temporary enclosure) A temporary enclosure made so that the reference lines (centerlines

of columns and walls, horizontal line, etc.), position of the building, right angle, and leveling (height reference) can be found. It is made with wooden stakes and boards called *mizunuki*. In civil engineering, the term *chobari* is used.

[Mizunuki] (board) Boards hammered horizontally onto the wooden stakes to make a temporary enclosure.

[Mizumori] (leveling) It is to establish the leveling as the standard for the height of a building. It is called *mizumori* because it uses a tool called *mizumori-kan*.

[Mizuito] (level line) A string indicating the level, stretched between the boards in a temporary enclosure. This is the reference for the axis line.

4.2.3 Terms Related to Earthwork

[Dokoji] (earthwork) Construction work to create the ground base, foundations, and underground structures for buildings.

[Morido] (embankment) The process of creating a flat surface by heaping up soil on slopes, uneven land, and land with low elevation.

[Dankiri] (terracing) When embanking a steep slope, stair-like shapes are cut to prevent the soil from sliding down.

[Shimekatame] (compaction) The process of applying pressure to soil, sand, or asphalt to reduce the gaps between particles and increase their density (called *mitsujitsu*). For example, compaction is used to create a firm aggregate base layer during pavement construction.

[Ten'atsu] (machine compaction) Compaction of soil using tire rollers, etc. Compaction of broken stones and gravel by small machines such as rammers is also called *ten'atsu*.

[Umemodoshi] (backfilling) The process of filling in soil up to the *doma* level (ground under the house) inside and outside of a building after the completion of underground work such as underground beams.

[Tsukikatame] (compaction by tamping) The process of increasing the density of the backfilled soil using rammers, plates, or other means.

[Nekiri] (foundation excavation) This is the process of digging (called *kussaku*) a hole to the bottom of the foundation using heavy machinery or other equipment.

[Dodome] (earth retaining) Taking measures to hold back slopes, fill, excavated trenches, etc. to prevent them from collapsing.

[Yoheki] (retaining wall) A wall-like structure of for *dodome* (earth retaining) is called *yoheki*.

[Utsu] (placing/casting) *Utsu* means to beat, but in construction terminology, pouring concrete is called *utsu* or *dasetsu suru* (casting/placing).

[Dan bane] (step excavation) In order to remove the excavated soil (called *haido*) when the foundation excavation is deep, the ground is left stair-stepped and the excavated soil is successively flung up to the upper level.

[Norimen] (slope) A sloped surface, also called *nori*. On a construction site, it refers to a sloped excavation surface.

[Yamadome] (soil retaining) The use of sheet piles and other means to hold back the soil to prevent the ground from collapsing. If there is room on the site, the open-cut *koho* (open-cut method) is used to cut the ground at an angle. If there is not enough room on the site, the *yamadome kabe* open-cut *koho* (soil-retaining wall open-cut method) is used to provide walls and shoring.

[Yaita] (sheet piles) Boards used to stop earh/soil.

[Koyaita] (steel sheet piles) Steel sheet piles with grooved ends so that they can be joined to each other.

[Mizukae] (water drainage) To drain the water that accumulates at the excavation floor by making a water pit, using a pump. etc.

[Kamaba] (water pit) A pit where a water pump is installed for water drainage.

4.2.4 Terms Related to Subgrade and Foundation Work

[Jigyo] (subgrade] The area under the foundation slab or work related to it. Sand, gravel, broken stones, nonstructural concrete, and piles are used to support the foundation slab. There are a variety of subgrade work depending on the type of material.

[Kiso] (foundation) The portion that transfers the weight of the structure (called *kenzobutsu kaju* (building load)) directly to the ground. Types include shallow foundation and pile foundation.

[Chokusetsu kiso] (shallow foundation) A foundation that transfers the building load directly to the ground. A foundation that covers the entire bottom of the building is called *beta kiso* (mat foundation). In addition, a foundation shaped like an inverted letter "T" that is constructed only where a particular load is applied is called a footing. Both are used in locations where the ground is solid and firm.

[Kui kiso] (pile foundation) A foundation built in areas where the ground is weak. Cylindrical columns called *kui* (piles) are driven in to reach solid ground to support the building load.

[Kui jigyo] (pile foundation work) Work for pile foundation. There are precast concrete pile foundation work, steel pile foundation work, and cast-in-situ concrete pile foundation work.

4.2.5 Terms Related to Scaffolding and Temporary Construction

[Scaffolding] There are various types of scaffolding depending on use and structure. On a construction site, it refers to a temporary floor or walkway assembled with circular hollow section or special materials. Framed scaffolding, tube scaffolding, and ringlock scaffolding are often used.

[Sagyo yuka] (working platform) A scaffold floor is made of scaffold boards (called *nunoita* (scaffold plank with hooks)) and other materials stretched over the floor so that people can work on top of it.

[Karigakoi] (temporary enclosure) Temporary enclosures that separate the construction site from the adjacent land or road in order to restrict access to the site by persons not involved in the construction to prevent danger and theft.

4.2.6 Terms Related to Rebar, Formwork, and Concrete Placement Work

[Haikin] (rebar placement) Placement and assembly of reinforcing bars. Rebar placement methods include double reinforcement, single reinforcement, and staggered reinforcement.

[Hiroidashi] (calculation) To calculate the materials required, their quantities, and labor (how many people it will take) from the drawings and specifications.

[Asobi] (play) Margin and play.

[Aki] (space) The distance between the rebars.

[Kankaku] (spacing) Distance between centers of rebars.

[Sute concrete] (nonstructural concrete) Concrete that is placed flat with a thickness of 5 cm to 10 cm, mainly for layout marking and erecting formwork. It is abbreviated as *sutecon*. In addition to establishing a reference for the marked height, nonstructural concrete is used as a base for accurate placement of formwork and rebars.

[Kessoku] (tie) To tie something up. In rebar work, special binding wire is tied at the intersection of the reinforcing bars using a tool called a hacker. There are two types of knots called *tasukigake* (cross tie) and *kata dasuki* (simple tie)

[Kaburi atsusa] (concrete cover thickness) The distance between the rebars and the surface of the concrete covering them.

[Tatekomi] (formwork erecting) The process of erecting the formwork in accordance with the layout marking lines.

[Noro] (cement slurry) Cement dissolved in water is called *noro*. In formwork carpentry, concrete can leak from gaps between the joints of the formwork, and this is also called *noro*.

[Ten'yo] (reuse) The use of the same formwork material at a different site. When the structure of each floor is the same in a construction project such as a building, the formwork used is moved up to the floor above and used again.

[Panku] (blow-out) When the formwork breaks during placing or hardening (setting) of concrete and

the concrete flows out. Blow-outs occur when the shoring is not sufficient.

[Kugi jimai] (nail removal) Removal of nails from the formwork in order to reuse the formwork material. This is why the term is used to refer to putting away the formwork.

[Uchikomi] (second pouring) Pouring concrete into the formwork and packing without gaps.

[Uchitsugi] (staging) Pouring concrete on top of concrete that has already hardened. Staging is performed at locations determined to have no structural or waterproofing problems.

[Shimekatame] (compaction) A term that also appears in earthwork, but in concrete placement, poured concrete is vibrated with a vibrator or the formwork is tapped with a rubber hammer to eliminate gaps in the concrete and make it dense.

[Tamping] The process of tamping the surface of the slab formwork so that the concrete placed in the slab becomes dense.

[Nerimaze] (mixing) Mixing cement and aggregate uniformly.

[Haigo] (blend) The ratio of each material used to make concrete.

4.2.7 Terms Describing Fit and Condition

[Osamari] (fit) A word used to describe the balance of the arrangement of things. It is used to mean *osamari ga ii* (well-fitted) or *osamari ga warui* (poorly fitted).

[Toriai] (interface) The part where two or more different members meet, or the treatment of that part. When two parts collide with each other at a point where they should not collide, it is called *toriai ga warui* (poor interfacing). The phrase “poorly fitted” is also used in the same sense. The phrase *tenjo to kabe no toriai* (the ceiling-wall interface), refers to the joint between the ceiling and the wall.

[Tori] (straightness) The state of being in a straight line. If something is bent or distorted, it is called *tori ga warui* (not straight). The process of checking to see if something is straight is called *tori wo miru*.

[Tsura] (surface) The surface. It is also called *men*.

[Tsuraichi] (flush) The state in which the surfaces of two members are flat and aligned. It is used as *tsuraichi ni suru* (make flush).

[Sori] (concave) A line or curved surface that is in a concave state.

[Mukuri] (convex) A line or curved surface that is in a convex state.

[Nige] (tolerance) The allowable variation in terms of dimensions or installation that is set in advance. Nige (tolerance) is set in order to absorb material processing errors and on-site installation errors.

[Beta] (fully spread) The term to describe something being spread over the entire surface without **gaps**. *Beta kiso* (mat foundation) is a type of foundation in which concrete is poured to cover the entire bottom of the building. *Beta nuri* is a coating applied to the entire surface.

[Fukashi] (over-dimensioned) Refers to the portion of the finished project that is larger than indicated in the design. It is also used to indicate when the finished surface is made visible from the front. *Fukasu* means to make *fukashi*.

[Temodori] (rework) To redo a process that has already been completed, used as in *temodori ga okoru* (rework occurs).

[Dandori] (preparation) To consider the method of construction and plan the procedure in advance to avoid rework.

[Tenaoshi] (retouch) To correct a part of the work that has already been done. Retouching is conducted when there are any portions that differ from the blueprints or have defective workmanship.

[Dame] (deficiency) A term used to indicate that there are oversights or unfinished portions of a building project that is almost complete. Finishing that part is called *dame naoshi* (deficiency correction)".

4.2.8 Terms Related to Length, Breadth, and Width

[Pitch] Spacing between allocations.

[Ou] (laying out) To take the dimensions from the reference position.

[Sunpo] (length) Length.

[Ikken] (1 ken)A unit of length used in Japan since ancient times. Approx. 1.8 m. 1818 mm to be exact.

[Hitotsubo] (1 tsubo) A unit of area used in Japan since ancient times. 1 tsubo = 1 ken x 1 ken.

4.2.9 Terms Describing Building Structure

[RC structure] RC is abbreviation for Reinforced Concrete. A building structure in which concrete is poured into formwork with reinforcing steel bars and hardened. Also called *tekkin* concrete *zo*.

[S structure] S is abbreviation for Steel. A building structure that uses steel sections for columns and beams. Also called tekkotsu zo.

[SRCstructure] A building structure combining S and RC structures. Reinforcing bars are assembled around the steel section, and then concrete is poured. Also called tekkotsu tekkin concrete zo.

[Moku zo] (wooden-frame structure) A building structure that uses wood for posts and beams.

4.2.10 Terms Related to Electrical and Telecommunications Work

[Setsuzoku] (connection) In general, the term *setsuzoku* (connection) refers to connecting two or more things. When communication lines are connected to each other, it is also called *kessen* (wiring).

[Haisen] (wiring) Running metal cables, fiber-optic cables, etc.

[Rikaku] (clearance) Separation of wiring and piping from each other. The distance is called the *rikaku kyori* (clearance distance).

[Zetsuen] (insulation) To prevent electric current from flowing from one part to another.

[Kantsu] (penetration) To drill a hole in a wall, floor, ceiling, etc. all the way through to the opposite side.

[Kanro] (conduit) A pipe through which electric wires pass. The method of burying wires

underground using pipes is called *kanroshiki* (conduit method).

[Maisetsu] (underground installation) Burying electric cables, etc. underground.

[Kaku haisen] (overhead wiring) This method uses utility poles to route cables into the building.

[Haikan suru] (piping) To install a pipe to pass a cable through.

[Tsusen] (wire pulling) Running cables through piping.

[Slab haikan] (slab piping) Piping that is buried in the floor or ceiling of a building.

[MDF] Abbreviation for Main Distribution Frame, which is a wiring panel used to manage and connect communication lines from inside to outside of a building.

[Kanden] (electric shock) Electric current flowing through the human body.

[Roden] (electric leakage) Electricity flowing to parts where it should not.

[Secchi/earth] (grounding/earth) An electrical connection between electrical equipment or circuits and the earth. This is done to prevent electric shock in the event of a leakage and to protect communication equipment from damages.

[Hiraishin] (lightning rod) Equipment to protect buildings and people from lightning.

[Hiraiki] (surge protector) A device that protects communications equipment, terminal equipment, etc. from lightning strikes.

[Tanraku] (short circuit) A connection between two points in an electric circuit with a low-resistance conductor. Also called short.

[Acchaku] (crimp) Joining by applying pressure. In electrical work, there are special tools (such as crimpers) for crimping core wires and crimp terminals.

[Hifuku] (coating) The vinyl or insulating portion covering the core wire.

[Tsuden] (energized) Electricity is live.

[Ataru] (examine) To examine something. In electrical work, the word is used to check the energized state using a voltage tester or to check the voltage and current using a measuring instrument.

[Kashimeru] (crimping) To tightly fasten a wire joint by using crimpers to crush a crimp terminal

such as a ring sleeve.

[Furu] (reroute) To change the piping or wiring route to avoid obstructions.

[Tobu/ochiru] (trip) When the breaker is tripped and the circuit is opened.

4.2.11 Terms Used in Lifeline Infrastructure/Equipment Installation

[Kucho] (air conditioning) Adjusting the temperature, humidity, etc. in a room. It is short for *kuki chowa setsubi*.

[Ondo] (temperature) The degree of hot and cold. In Japan, the unit used is ℃ (Celsius).

[Shitsudo] (humidity) The percentage of moisture in the air. Humidity is described by saying that it is “damp and humid” when there is a lot of moisture and “fresh and low humidity” when there is little moisture. The unit used is %.

[Kanki] (ventilation) Replacing dirty air in a room with fresh air.

[Haien] (smoke ventilation) To discharge smoke and other substances generated in the event of a fire from the inside of a room to the outside.

[Eisei] (hygiene) Refers to protecting people's health and maintaining cleanliness. The term *eisei setsubi* (sanitary facilities) refers to facilities related to water (e.g., toilets, bathrooms, etc.), excluding the kitchen.

[Bari] (burr) An excess portion of metal or plastic that protrudes from the edge of a product during the processing process. *Bari tori* (deburring) is the process of removing burrs for a smooth finish.

[Lining] Coating the surface of pipes and ducts with a thin film, also called coating. Depending on the thickness of the coating, a thicker coating is called a lining and a thinner coating is called a coating, but they are often used interchangeably.

[Roei shiken] (leakage test) A test to check for water leakage (called leakage) after the piping is finished. There are also water pressure test, full-load test, etc.

[Suiatsu shiken] (water pressure test) A test to confirm that there is no leakage by putting water in pipes such as water supply pipes and hot water pipes to apply pressure.

[Mansui shiken] (full-load test) A test in which drainpipes are filled with water to confirm that there are no leaks.

[Kobai] (gradient) A gentle slope to allow water to flow.

4.3 Precautions for Communal Living

4.3.1 5S Activities

In order to create a safe, pleasant and comfortable working environment, an activity called 5S has been implemented in Japan. 5S stands for five words starting with S: Seiri (sort), Seiton (set in order), Seisou (shine), Seiketsu (standardize), and Shituke (sustain).

(1) Sort

Sort refers to the process of separating the necessary from the unnecessary, discarding what is unnecessary and putting away what will be used later.

(2) Set in order

Set in order refers to putting necessary items in their designated places. Keep materials and other items brought to the site parallel and perpendicular to each other, and maintain tidiness for easy access. In particular, tools and other items that have been used should be returned to their designated places so that they can be easily found by the next user.

(3) Shine

Clean up after the work is completed so that the next workday can begin pleasantly.

(4) Standardize

Standardize means organizing, tidying and cleaning to maintain a clean standard.

(5) Sustain

Sustain means to teach the rules and give instructions to ensure that sort, set in order, shine and standardize are being adhered to. It is important that everyone follows the rules that have been

established.

4.3.2 Workers' Break Facility

On the construction site, temporary buildings are erected to use as the field office and the workers' break facility. The field office is a place for administrative work, meetings, etc. The workers' break facility is a place for workers to change clothes, eat, and take a break. Make sure to follow the established rules in the workers' break facility to ensure that all workers feel comfortable.

(1) Smoke only in the designated areas

Smoking is not permitted on the construction site and in the break facility. Smoke only in the provided smoking area. Hiding to smoke in non-designated spaces is also not allowed.

(2) Littering is prohibited

Throwing garbage away outside of designated places is called *poi sute* (littering) in Japan. Littering is prohibited. Take recycling into consideration, and properly separate and dispose of garbage in designated areas. If you find trash on the ground, actively pick it up and dispose of it in the designated area.

(3) Place helmets and safety belts in designated areas

Helmets and safety belts should not be left scattered after use. Make sure to put them away in designated places before taking a break.

(4) Put personal belongings in lockers

Loss of personal belongings can be the source of trouble. Keep your personal belongings in a locker.

(5) Hand washing, disinfection, and gargling

When entering and exiting the break facility, take care of hygiene by washing hands, disinfecting, gargling, etc.

(6) Check the bulletin board

The bulletin board may contain not only information for everyone, but also information that is useful

to individuals, such as insurance information. Make a habit of checking the bulletin board.

4.3.3 Clothing Precautions

In Japan, there is a saying, “A disorderly attire represents a disorderly mind.” It means, “A person who dresses sloppily does not posses inner beauty,” but on the construction site, it has the added element of safety. The following attire is not permitted.

(1) Entering the worksite wearing short sleeves and shorts

There are many hazards on construction sites. Only the hands and face should be exposed during work. Wear work clothes appropriate for the work at that site. Do not enter the worksite in short sleeves or shorts. Also, wash your work clothes to maintain cleanliness.

(2) Jackets with the front left open

Do not leave your jacket unbuttoned and open in the front. There are many protrusions at the worksite, and getting caught on them can lead to injury or accident.

(3) Rolled-up sleeves

To prevent injury, sleeves should be rolled down to the wrists.

(4) Walking with hands in pockets

Do not walk with your hands in your pockets. This posture hinders response in case of sudden falls, which can lead to injury or accident.

4.3.4 Language

Communication is important for smooth operations at construction sites, and there is a term *horenso* that describes the key to communication. It is a word play using the vegetable called *horenso* (spinach). *Horenso* is a combination of the words *hokoku* (report), *ren*raku (contact), and *so*dan (consult). Be mindful to use a cheerful tone, focus on the points you want to discuss, be clear, and state your

conclusions first.

Report: to inform seniors and the foreman of the progress and results of work.

Contact: to communicate job-related information, your schedule, etc. to your seniors and the foreman.

Consult: to tell a senior staff member and the foreman if a problem arises or if you have any questions.

4.3.5 Cleanup

Always clean up after work completion. Clean up afterwards with the intention of setting up and preparing for the next day's work. If you used fire, make sure it is extinguished.

Chapter 5: Knowledge of Tools, Machines, Materials, and Measuring Instruments Used on Construction Sites

5.1 Tools, machines, materials, and measuring instruments specific to job categories

5.1.1 Construction Machines

[Yuatsu shovel] (hydraulic excavator (backhoe)) A machine that performs digging and loading work using the boom, arm, and bucket, which are operated by hydraulic cylinders, and by rotating the upper unit. By changing attachments, it can be used in various ways as a breaker, a ripper, a crusher, etc.

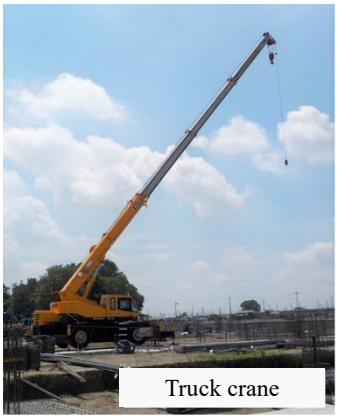

Hydraulic excavator

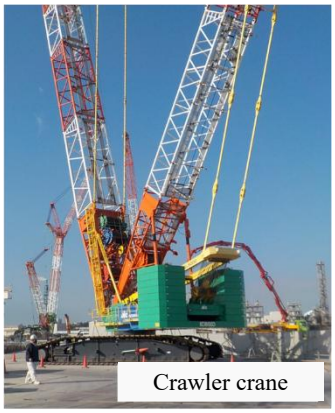
[Crane] A machine that uses power to lift and transport a load horizontally. There are several types of cranes, including tower cranes, truck cranes, and crawler cranes.

[Tower crane] A crane used in the construction of high-rise buildings. The crane section is mounted on a supporting tower called a mast. There are two types: mast climbing, where the crane section climbs up a jointed mast, and floor climbing, where the entire pedestal climbs up the building.

[Truck crane] A construction equipment with a crane mounted on a truck.

[Crawler crane] A crawler-type crane. It can work in a variety of locations, including on snow and unpaved ground.


Truck crane


Crawler crane


Tower crane

5.1.2 Electrical Work


Voltage tester

[Kendenki] (voltage tester) A device that checks whether or not an electric charge is present. There are low voltage testers and high voltage testers.

[Kensoki] (phase tester) A device to check the direction of rotation (phase order) in the 3-phase, 2-wire power supply wiring.

[Tester/multimeter] A device to check the condition of electric circuits, voltages, etc.

[Contester] (outlet tester) A measuring instrument to check the positive/negative and grounding of electrical outlets.

[Clamp meter] A measuring instrument that can measure electric current by simply inserting an electric wire between the clamps of the sensor section.

[Densenkan] (conduit) A metal or synthetic resin tube that can hold electric wires inside.

[Kato densenkan] (flexible conduit) A conduit that can be bent freely.

[Kinzokusei kato densenkan] (metal flexible conduit) A metal conduit that can be easily bent.


Metal conduit


Synthetic resin flexible conduit (PF conduit)

[PF kan] (PF conduit) PF is abbreviation for Plastic Flexible. Synthetic resin flexible conduit without flame resistance.

[CD kan] (CD conduit) CD is abbreviation for Combined Duct. Synthetic resin flexible conduit without flame resistance. It is often used for underground installation in concrete.

[Asshuku tanshi] (compression terminal) A terminal for connecting a wire to a device to another wire. Pressure is applied to the connection to crush the terminal and secure the wire. Various shapes

and sizes are available for different applications.

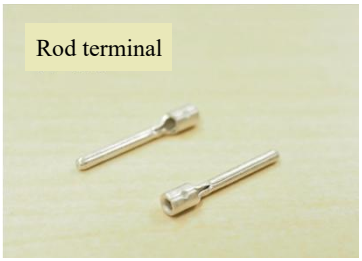
[Asshukuki] (compression tool) A tool used to join compression terminals and wires by applying pressure to the joint.

[Acchaku penchi] (crimpers) A tool used to join crimp terminals and wires by applying pressure to the joints of the crimp terminals. Two types are available: one for terminals (with red handles) and one for ring sleeves (with yellow handles).

[Acchaku tanshi] (crimping terminal) A terminal attached to the end of an electric wire for connection. The cable is secured by placing it in the hole of the crimp terminal and crushing the entire crimp terminal to secure the cable. Use the appropriate tool for the crimp terminal.

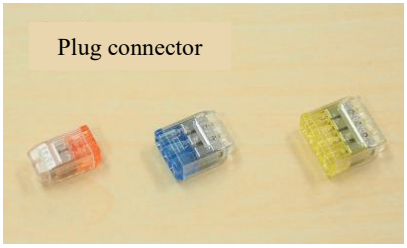
[Ring sleeve] A member used to connect multiple wires. The core wires are inserted into the ring-shaped hole and crimped using a crimping tool for ring sleeves.

[Botanshi] (rod terminal) A crimp terminal with a rod-shaped terminal end.



[T-gata connector] (T-connector) A connector used to crimp the bus bar and branch line when branching a wire from the middle of the bus bar.

[Sashikomi connector] (plug connector) A member used when connecting wires. Connection can be made simply by inserting the core wire.



[COS] Abbreviation for Change Over Switch. A changeover switch.

[Jiko yuchaku tape] (self-amalgamating tape) A tape that when wrapped around a pipe or other object while being stretched 2 to 3 times, the back and front sides of the tape adhere to each other. It is used for water pipes and water leakage prevention.

[Secchibo] (grounding rod) A rod driven into the ground for grounding. It is commonly made of steel with copper plating. Also called earth rod.


Grounding rod

[Handhole] A block manholes used for electrical and telecommunications wiring.

[Yobisen] (fish tape) A wire that is passed through a pipe in advance to make it easier to pass the main line, when pulling an electric wire or cable through the pipe. The main line is connected to the fish tape and pulled through the conduit using the fish tape.

[Cable rack] A ladder-shaped rack used to organize many power lines and other cables together. When the number of cables is small, cable hooks are used.

[Ban] (electric control panel) A device for supplying electricity to each device by branching the power supply. Inside are breakers and other components. There are *jiritsuban* (freestanding panels) that are placed on the floor and *kabekakeban* (wall-mounted panels) that are mounted on the wall.

[Wire stripper] A tool used to strip coated wires of their sheaths.


Wire stripper

[Strip gauge] A gauge used to measure the length when stripping the sheath of an electric wire. It is used by attaching it to a wire stripper.

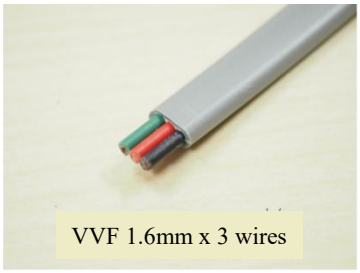
[Denko knife] (electrician's knife) A knife used to peel the sheath of cables during electrical work.


Electrician's knife

[IV] Abbreviation for Indoor PVC. Vinyl-insulated wires for indoor wiring.

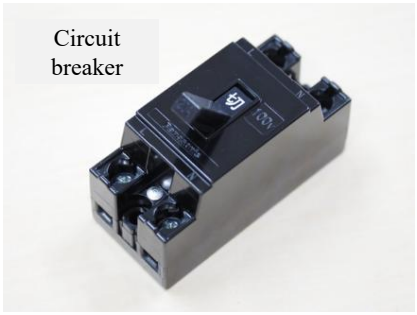
[VVF] Abbreviation for Vinyl insulated Vinyl sheathed Flat-type cable. An electrical wire insulated with flat-shaped vinyl.

[VVR] Abbreviation for Vinyl insulated Vinyl sheathed Round-type cable. An electrical wire insulated with round-shaped vinyl.

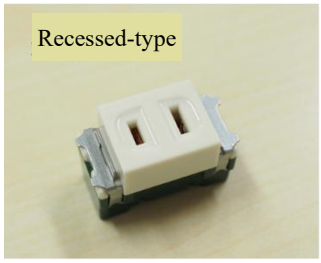


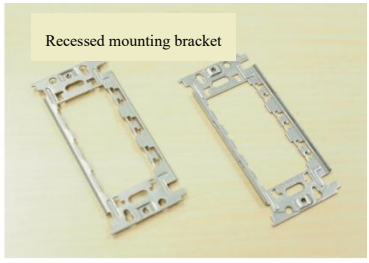
[VVF stripper] A tool to strip the outer and core insulation of VVF cables.

[Kadenryu shadanki] (circuit breaker) A safety device that automatically shuts off the power supply to a device when an excessive current flows through an electric circuit. Also called breaker. Today, no-fuse breakers (NFB) are used for wiring.



[Konsento] (outlet) A socket on a wall, with a single-phase 100 V outlet for general households. There are various types, including recessed and exposed. Recessed types are mounted on a recessed mounting brackets.





5.1.3 Telecommunications Work

[Closure] A box for connecting cable core wires in overhead wiring. It is installed on a utility pole.

[Cable kuridashiki] (cable feeder) A cable feeder that uses pulleys. The cable can be easily pulled out from the cable reel.

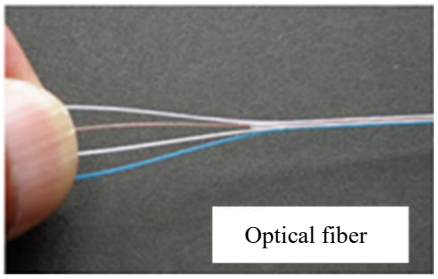

Cable feeder

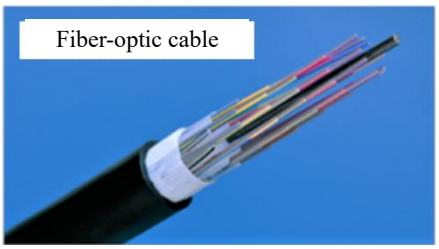
[Tsuri sen] (suspension wire) In overhead wiring, this wire is used to prevent tension from being applied to the cable. Also called messenger wire.

[Seiryuki] (rectifier) A device that converts alternating current to direct current.

[Chikudenchi] (storage battery) A device that can charge and store electricity.

[Hikari fiber] (optical fiber) Optical fiber is made of two types of quartz glass with different refractive indices. The center part that transmits light is called the core and the surrounding part is called the clad (cladding). It is further surrounded by a nylon membrane. It has the advantages of being thin and light, having high transmission capacity, low loss, and non-inductive, with the disadvantage of being susceptible to scratching, bending, and dirt.

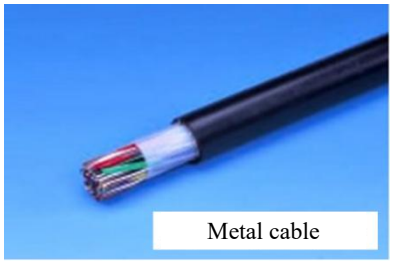

Optical fiber


Fiber-optic cable

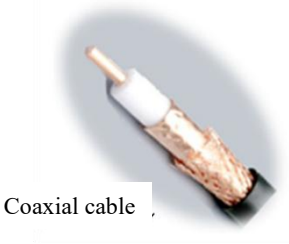
[Hikari fiber cable] (fiber-optic cable) A cable formed by bundling optical fibers together. There are various types, such as 20-core, 100-core, and 400-core.

[Metal cable] A cable using copper for the core wire. Communication is performed by electrical signals. Includes coaxial cables, twisted pair cables, etc.

[Dojiku cable] (coaxial cable) A cable with a structure in which an insulator is placed around a conductor that transmits signals, and covered with another conductor. Coaxial cable is used for TV antenna cables.



Metal cable



Coaxial cable

[UTP twist pair cable] (UTP twisted pair cable) A cable made by pairing two conductors and twisting them together. It is cheaper and softer than a coaxial cable. These cables are categorized by maximum transfer rate. They can be used for phone calls or for networking, depending on the category.

[Jiko shiji cable] (self-supporting cable) A cable with an integrated support wire for supporting the cable. It can be mounted directly onto the utility pole. It is used for overhead wiring.

[Hikari fiber yuchaku setsuzokuki] (optical fiber fusion splicer) A machine used to melt the tips of two fiber-optic cables to connect them together. This connection method is called *yuchaku setsuzoku* (fusion splicing). Other connection methods include mechanical splicing and connection via connectors.

[Fiber hogo sleeve] (fiber splice protection sleeve) A sleeve used to protect the joint when fusion splicing is performed. It is shrunk by heat to be fastened to the cable. Beware that it must cover the cable before fusion splicing, because it may not be possible to cover the joint after splicing.

[Fiber cutter] A tool used to cut fiber-optic cables. When making fusion splices, a special tool is provided to cut the cross-section of the cable perpendicularly.

[Hikari connector] (optical connector) A component for connecting fiber-optic cables. It has the advantage of being easy to insert and remove by hand. Types of connectors include SC connectors, FC connectors, LC connectors, and MU connectors.

SC connector

[Hikari power meter] (optical power meter) A device used to measure the intensity of light used for

optical fiber communications.

[Hikari pulse tester] (optical pulse tester) This tester can measure the line length of optical fiber cores and whether there are any abnormalities such as loss or reflectance due to splicing. It is called an OTDR (Optical Time Domein Reflectometer).

[Router] A device that connects multiple different networks. Routers can be used to separate multiple networks.

[LAN tester] A device used to check the eight wires between the modular plugs attached to both ends of a LAN cable to ensure that the wires are not crossed or disconnected.

5.1. 4 Plumbing Work

[Haikan/duct] (pipe/duct) What passes water and gas is called a pipe, and what passes air is called a duct. There are two types of ducts: rectangular ducts, which are rectangular in shape, and circular ducts (also called spiral ducts), which are round in shape.

[Pipe manriki] (pipevise) A tool used to hold pipes in place when cutting or joining pipes.

[Pipe nejikiriki] (pipe threader) A machine used to cut threads in pipes.

[Tube cutter] A tool used to cut thin-walled tubes made ofiron, steel, brass, copper, aluminum, etc.

[Tube bender] A tool used to bend copper tubes.

[Pipe cutter] A tool used to cut**pipes**made of steel, brass, copper, wrought iron, and lead. It can cut thicker tubes than tube cutters.


Pipe cutter

[Expander] A tool used to expand the ends of copper pipes to connect them. Also called *kakukanki*.

[Flaring tool] A tool used to flare the ends of soft pipes such as copper pipes.

[Mentoriki] (deburring tool) This tool removes burrs from metal and PVC pipes to smooth out the surface.

[Suiatsu shikenki] (water pressure tester) This meter is used for water pressure testing of water supply pipes and hot water pipes. Also called test pump.

[Seal zai] (sealant) Material used to prevent fluid leakage inside a pipe when the pipe is screwed in. There are liquid sealants as well as sealant tapes.

[Enka-vinyl jushiyo secchakuzai] (adhesive for polyvinyl chloride resin) Material used to prevent fluid leakage inside polyvinyl chloride pipes when joining them.

[Haikan'yo tansoko kokan] (carbon steel pipes for piping) This steel pipe is widely used for steam, water, oil, gas and air piping. There are *shirokan* (white pipes, with plating) and *kurokan* (black pipes without plating) depending on whether they are plated or not. Also called gas pipe or SGP.

[Koshitsu poly-enka vinyl kan] (rigid polyvinyl chloride pipe) A pipe made of rigid polyvinyl chloride resin. There are VU *kan* (thin-walled pipes) and VP *kan* (thick-walled pipes). It is gray in color and is also called *enbi* pipe and *enbikan* (PVC pipe). It has the advantages of having a very smooth inner surface, low frictional resistance, light weight, and being easy to process. On the other hand, the disadvantages include being vulnerable to external shocks and heat.

[Suidoyo koshitsu enka vinyl lining kokan] (rigid polyvinyl chloride-lining steel pipe for water supply) A lined steel pipe for water supply in which the inner surface of the steel pipe is lined with rigid polyvinyl chloride. It has excellent corrosion and chemical resistance. Also called lining *kan* or VLP.

[Neji gauge] (thread gauge) This gauge is used to inspect threads used in connection of pipes, pipe fittings, etc.

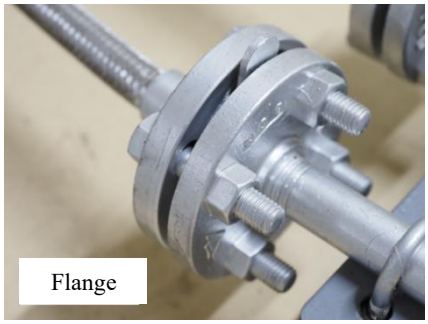
[Gas cock] (gas valve) A valve that opens and closes the gas supply pipe. There are end-of-line valves used when connecting gas appliances such as gas stoves and gas water heaters, and mid-line valves used in the middle of piping to open and close gas lines.

[Gas more keihoki] (gas leak alarm) A device that sounds the alarm when there is a gas leak to warn of danger.

[Reibaiyo dokan] (copper pipe for refrigerant) A pipe used to pass refrigerant while circulating between the outdoor and indoor units of an air conditioner. Seamless pipes made of copper and copper alloys are used.

[Pump] A machine used to give energy to water in pipes to carry it farther or lift it from low to high places.

[Flange] A ring-shaped device that is attached to the end of a pipe.


Flange

[Sleeve] A conduit that is attached to the walls, floors, beams, etc. of a building to carry piping and ducts. It is embedded before concrete is placed.

[Tsugite] (pipe fitting) A member that splits or bends a pipe. There are elbows that change the direction of flow and tees that make branches.


45 degree elbow


Tee

5.1.5 Freezing and Air Conditioning Apparatus Work

[Air filter] A filter used to remove dust and small debris from the air.

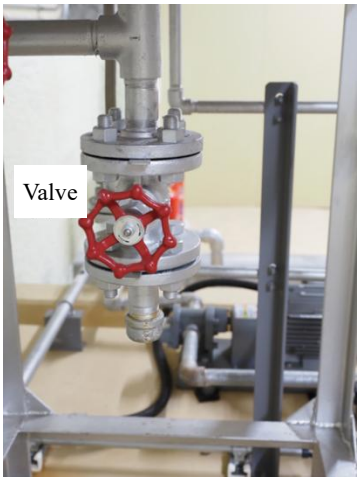
[Reikyaku coil] (cooling coil) Used to cool the air temperature by bringing the air into contact with a tubing through which cold water is passed, and is used for cooling the room.

[Onsui coil] (hot water coil) Used to warm the air temperature by bringing the air into contact with a

tubing through which warm water is passed, and used for heating the room.

[Kashitsuki] (humidifier) A device that adds moisture to dry air. Mainly used when heating the room.

5.1.6 Water Supply, Drainage, and Sanitation Facilities Installation



[Eisei setsubi] (sanitation facilities) Short for water supply and drainage sanitary facilities, which includes water supply facilities, drainage facilities, sanitation fixtures, hot water supply facilities, gas facilities, and fire extinguishing facilities.

[Eisei kigu setsubi] (sanitation facilities) Facilities that produce, store, and discharge cold and hot water, such as faucets, toilet bowls, urinals, wash basins, baths, and sinks.

[Ben/damper] (valve/damper) A device (also called a valve) that stops or adjusts the amount of water in a pipe. What stops or adjusts the amount of air in a duct is called a damper.

5.1.7 Heat/Cold Insulation Work

[Glass wool ho'onzai] (glass wool insulation) Glass (mainly recycled glass) is melted at high temperatures to form thin fibers. It is widely used as an insulator that combines the flexibility of fiber with heat resistance and nonflammability. There are insulation tubes, insulation strips, and insulation panels.

[Rock wool ho'onzai] (rock wool insulation) Basalt and andesite are melted at high temperatures and converted into fiber by centrifugal force. Because it is made from rock, it is more fire-resistant than glass wool material and is used as a firestop sealant of fire partitioning. There are insulation tubes, insulation strips, and insulation panels.

[Polystyrene foam ho'onzai] (polystyrene heat insulation) Polystyrene with added foaming agent (non-fluorocarbon) and flame retardant is foamed by steam heating, dried, and then steam heated again for molding. Available in tubular or plate form. Polystyrene is often used in water supply and drainage pipes because it cannot be used at temperatures above 70°C.

5.1.8 Construction of Fire Fighting Facilities

[Shoka setsubi] (fire extinguishing equipment) Equipment used in the event of a fire to extinguish the fire and guide people to safety.

[Shokaki] (fire extinguisher) A portable device that extinguishes fires in the very early stages of a fire.

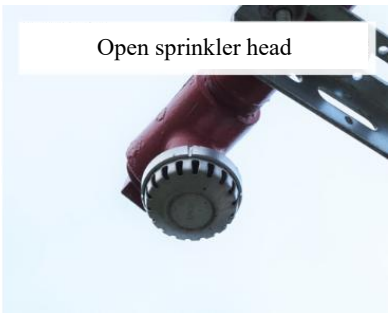
[Okunai shokasen setsubi] (indoor fire hydrant system) A system operated by people for the purpose of fire extinguishing in the initial stage of a fire.

[Okugai shokasen setsubi] (outdoor fire hydrant system) A system installed outdoors to extinguish fires in the initial stages and to prevent the spread of fire to adjacent buildings. It is intended to extinguish fires on the first and second floors of buildings.


Outdoor fire hydrant system

[Sprinkler setsubi] (sprinkler system) A system that is attached to fire extinguishing piping and sprays water from the ceiling in the event of fire. Sprinkler heads include closed sprinkler heads, open sprinkler heads, and high-flow sprinkler heads.


Closed sprinkler head


Open sprinkler head

[Halogen kabutsu shoka setsubi] (halide fire extinguishing system) A system that uses halide fire extinguishing agents. Halogen elements (fluorine, chlorine, and bromine) stop combustion by inhibiting combustion reactions, cutting off the air supply, and lowering the oxygen concentration in the air. Suitable for oil fires, fires involving energized electrical equipment, computers, books, important works of art, etc.

5.2 Common Tools, Machines, Materials, and Measuring Instruments

5.2.1 Power Tools

Power tools can be cordless types that use rechargeable batteries or corded types that use AC power.

[Drill driver] This electric screwdriver can be used for screwing and drilling by changing the bits. Rotation speed and torque can be adjusted.

[Impact driver] An electric screwdriver that can tighten screws using the impact from the built-in hammer. It has more power than a drill driver. Rotates at a constant rotation speed and torque.

Drill driver

Impact driver

[Disk grinder] (angle grinder) This power tool can cut, grind, and remove paint from metal pipes and concrete by changing the disc (a round, flat grinding stone for grinding and cutting) attached to the end of the tool. The high speed torque type is suitable for metal cutting, while the low speed torque type is suitable for grinding.

[Marunoko] (circular saw) A power tool for cutting plywood and other materials in a straight line. Hand-held and fixed types are available. The hand-held type, when it touches the material to be cut, may move in an unexpected direction due to a force (called kickback) that lifts it away from the material. This leads to many accidents, and in some cases, they can be serious, life-threatening accidents. Before use, make sure that the safety cover is working properly.

[Kosoku setsudanki] (high-speed cutter) An electric tool that cuts metal pipes, rebar, light steel sections, etc. by rotating a grinding stone for cutting.

[Recipro saw] (reciprocating saw) A power tool that cuts materials by moving a long, thin blade back and forth.

5.2.2 Digging/Leveling/Compacting

[Ken sukoppu] (spear head spade) A tool used for digging in the ground by placing the foot on the top of the head. It is also called *kensuko* for short. Do not use as *teko* (lever).

[Kaku sukoppu] (square head spade) A tool used to scoop and carry soil, asphalt, etc. It is similar

to a spear head spade, but the blade edge is straight to make it easier to scoop soil and other materials. Also, the top is rounded and does not allow for foot placement. Do not use as *teko* (lever). It is also called *kakusuko* for short.


Spear head spade


Square head spade

[Rammer] A machine used to compact the ground. The weight of the rammer and the force of the impactor, which moves up and down, compact the surface. It has strong striking power and is suitable for strong compacting. There are engine- and electric-powered types.


Rammer

5.2.3 Layout Marking/Marking Tools

[Sumitsubo] (line marker) A tool used for marking long straight lines on the surface of a material.

[Sumisashi] (ink pot) The flat part of the ink pot is used for drawing lines, and the round part (*ho*) is used in the same way as a brush.


Line marker

[Laser marker] A machine that emits laser beams onto walls, ceilings, and floors to produce horizontal, vertical, and other reference lines for construction. Laser beams are available in red and green. Green is relatively easier to see in bright locations. Protective goggles for laser work are worn to prevent the laser beam from directly entering your eyes.


Laser marker

[Punch] This tool can be used to make small indentations in metal surfaces by tapping with a hammer, or to make round holes in cloth, leather, etc. The center punch is used to mark metal surfaces


Punch

(this is called marking).

5.2.4 Measuring/Inspecting

[Level] A leveling device used to determine the height necessary for the work. Mounted on a tripod, the device is manually leveled by balancing the built-in bubble vial. A level with an automatic leveling mechanism is called an auto-level.


Level

[Laser level] An instrument for level surveying by laser and is used to determine the height necessary for the work.

[Transit] An instrument that measures the vertical and horizontal angles based on the viewpoint supporting a small telescope. It is used on a tripod. These days, a digital display type of device called theodolite is often used.


Transit

[Suiheiki] (level) A tool used to check whether a construction surface or object is level with the ground. The level is checked by looking at the air bubble in the vial. Some use the needle to check the level, and some are digital levels. Levels with a built-in inclinometer are also used in residential installations.


Level

[Sagefuri] (plumb bob) A weight with a pointed conical tip used to check the verticality of a pillar or other objects. The verticality is checked by hanging it from a plumb bob holder fixed to a post using a thread and checking if the distance between the surface to which the holder is attached and the thread is constant.


Plumb bob

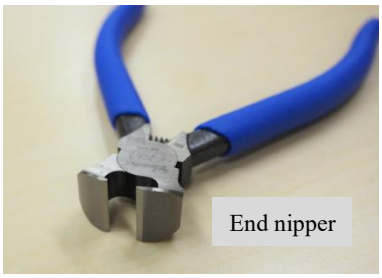
[Measure] (tape measure) A tape-like tool for measuring length. Sometimes referred to as *makijaku* (tape measure). Available in steel and vinyl.

[Convex] (retractable steel measuring tape) A measure with a thin metal tape that measures length.

[Jogi] (ruler) A tool used for measuring length and drawing straight lines. Materials include aluminum, stainless steel, and bamboo. To avoid damaging materials such as fittings, bamboo rulers are used.

5.2.5 Cutting/Bending/Breaking

[Kuikiri] (end nipper) A tool used to cut objects between the blades. Used for processing tiles, cutting wires, etc. It can also cut the head of a nail.



[Cutter knife] (box cutter) This knife can maintain its sharpness by breaking off the tip of the blade.

[Penchi] (pliers) A tool for bending, cutting, etc. There is a part for gripping with fine grooves to prevent slipping and a part with blades for cutting

5.2.6 Tapping/Pulling

Example of a hammer (for ringlock scaffolding)

[Hammer] A tool used to strike things. The material of the striking head can be metal, rubber, or wood, depending on the intended use. Those with a metal head is sometimes called kanazuchi.

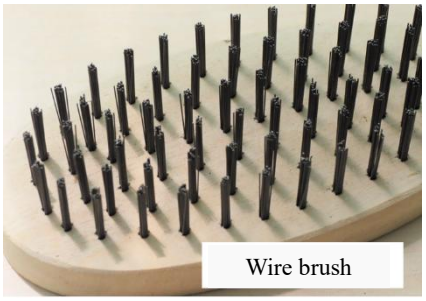
Crowbar

[Bar] (crowbar) A metal tool that can be used as a lever. The L-shaped tip has a groove for removing nails. The tip is inserted under the nail head, and the nail is removed using the principle of leverage. The other side is either a claw or flat like a spatula. In addition to pulling out nails, a large crowbar can be used to lift heavy objects. It can also be inserted into a gap for twisting and prying. A large crowbar is used in the dismantling of the formwork.

5.2.7 Filing/Polishing/Boring

[Toishi] (grindstone) A tool for cutting and polishing metals, rocks, etc. The small rectangular-shaped tools are used to sharpen the blades of *nomi* (wood chisels) and *kanna* (Japanese hand planes).

[Wire brush] A stiff brush made of metal wires. It can be used to remove rust from metal, peel off paint, and clean file grooves.

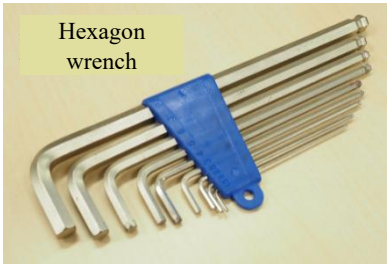


Wire brush

Wire brush

5.2.8 Tightening/Fixing

[Monkey Wrench] A wrench that has a mechanism that opens and closes. The width between the upper and lower jaws can be changed to match the diameter of the bolt or nut. The upper jaw is integrated with the grip, so the force should be applied to the upper jaw when turning. Because the tip is open, this tool is classified as spanner, but it uses the word "wrench" as an exception.



[Rokkaku wrench] (hexagon wrench) This tool has a hexagonal hole and is used to turn bolts. Also called *rokkaku bo* wrench.

[Screwdriver] A tool used to turn screws. There is a Phillips-head and a flat-blade screwdriver to fit the grooves on the heads of the screws. It is important to use the correct size to avoid breaking the groove of the screw head (called *nameru* (stripping)). The shape of the grip is also important. For example, the grip of a screwdriver for electrical work is round and large so that the hand can easily wrap around it.

5.2.9 Kneading/Mixing


Concrete mixer

[Concrete mixer] A mixer designed for concrete, with more strength than mortar mixers.

[Torobako] (mortar box) A sturdy box for mixing materials to make concrete or mortar. Also known as *torobune* or *fune*. The ingredients in the mortar box are kneaded using a stirring machine or a kneading shovel.

5.2.10 Curing/Prepping


Horizontal safety net

[Hisan boshi net] (anti-scattering net) A mesh-like sheet for scaffolding that covers the entire building. It is also used to prevent construction materials accumulated on site from scattering, and cargo from falling off the rear decks of transport vehicles.

[Suihei yojo net] (horizontal safety net) A net used at construction sites to avoid humans and materials from falling from heights.

5.2.11 Scrubbing

[Wes] (rag) Cloth used to wipe off stains from machine oil and other liquids.

[Bucket] A container with a handle for holding and carrying water. For construction purposes, sturdy buckets made of galvanized steel sheets are used.

[Hishaku] (ladle) A tool with a handle for ladling water.

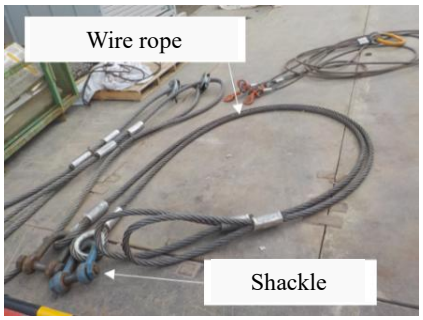
5.2.12 Carrying Objects

[Daisha] (wheeled platform) A platform with four casters, used to carry objects. Some have handles and some do not. A wheeled platform with brakes is also available.

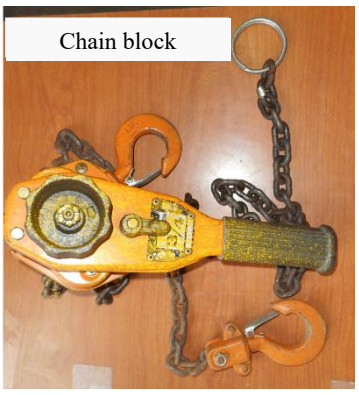
[Forklift] A vehicle equipped with forks that move up and down using hydraulic pressure. Objects placed on the fork are raised to or lowered from high places.

5.2.13 Hanging/Lifting/Pulling

[Winch] A machine that winds up a rope. Also called *makiageki*.



[Wire rope] Several high-tensile-strength steel wires are twisted together to form a strand, and then several strands are twisted together again to form a rope. It has high tensile strength, excellent impact strength, and flexibility for easy handling. Those with processed ends are used for slinging. There are also ropes for anchoring.



[Chain block] A machine that can raise and lower heavy objects by applying the principles of lever and pulley. It is used by attaching it to a tripod, etc.

[Oyazuna kinchoki] (main rope tensioner) A device that can keep the tautness of the main rope to which the hook of the safety belt is attached. It is used when working at heights, such as scaffolding work.

[Jakki] (jack) A device for lifting heavy objects with a small amount of force. The lifting mechanism includes screws, gears, and hydraulic pressure.

5.2.14 Work Platforms/Ladders

[Kyatatsu] (stepladder) A tool that is a combination of two ladders. When opened, it can be used as a ladder. When using it as a stepladder, do not sit or stand on the top. Also, do not work while straddling the top with legs on either side, as this may upset the balance and be potentially dangerous.

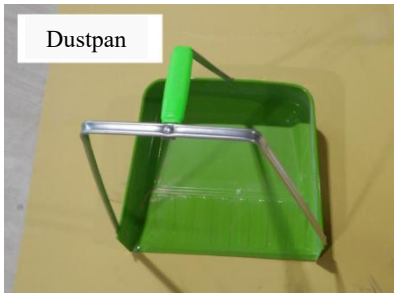
[Kahanshiki sagyodai] (portable elevated work platform) A tool with a platform between two legs that extend and retract. Also known as *nobiuma*. There are handrails on top of the work platform. Leaning outward or pushing against a wall may cause loss of balance and falling.

[Kosho sagyosha] (aerial work platform) A vehicle equipped with a device that can raise and lower a man basket to a height of 2 m or more.

5.2.15 Cleaning

[Hoki] (broom) A tool for cleaning by sweeping. Bamboo branches, bundles of plants or synthetic fibers are attached to the end of a stick.

[Chiritori] (dustpan) A tool for collecting dust and debris swept with a broom.



Chapter 6: Knowledge of Construction Site Work

6.1 Matters Common to Construction Sites

Construction sites are home to technicians from many job categories. Although the work they perform may appear to be different from each other, experienced technicians are always aware of certain matters. This realizes high quality and safety. This section describes matters that all technicians should know.

6.1.1 Characteristics of Construction Work

(1) Construction work is on a build-to-order basis.

The term build-to-order refers to the manufacturing of a single product designed from scratch to meet the customer's requirements, rather than the repeated production of the same design in factories, as in the case of automobiles. Construction work is conducted on a build-to-order basis. They are diverse, from large-scale to small-scale projects, and although some may appear to be similar, each individual project has different characteristics and conditions. It is important to have the intention of building-to-order for each customer.

(2) Construction work is subject to location constraints.

The majority of construction work is built in accordance to the unique requirements of the location for each property, which means that a project will never be repeated under the same conditions.

(3) Construction work is subject to nature.

Construction work is often conducted outdoors and subject to uncertain factors, such as topography, seasons, weather and other natural conditions.

(4) Construction work is subject to social constraints.

Construction work is local production, and therefore is subject to social constraints on the site. It is important to manage the site based on safety measures for the surrounding area and environmental

preservation measures. Applicable laws and regulations and the surrounding social environment differ depending on the location of construction, and construction work is expected to conform to these constraints.

(5) Quality is created through safe process.

It is also true in construction work that the quality of the finished structure is created through the entire safe construction process.

6.1.2 Construction Plan

A construction plan is a plan for the construction project based on the terms and conditions of the construction contract, drawings, specifications, site descriptions, and other design documents. The construction plan is prepared considering the following points.

□ Planning within various social constraints, such as relevant laws and regulations.

□ Comprehensive planning of management methods for quality, construction budget, process, safety, and environmental preservation.

□ Planning to efficiently combine construction methods to achieve good quality at minimum cost that is completed within the construction period.

□ Planning for accident-free and disaster-free project that considers environmental preservation.

□ Planning using the 5Ms of Construction Management. The 5Ms of Construction Management refers to Manpower, Materials, Methods, Machinery, and Money.

□ Conducting sufficient preliminary investigation to understand the local/on-site conditions, etc., and planning measures and management methods prior to and during construction.

6.1.3 Construction Management

Construction management is the management necessary for the contractor to complete the

construction target in the prescribed quality in accordance with the construction plan. Construction site work is conducted under five management indicators: Quality, Cost, Delivery, Safety, and Environment (called "QCDSE").

6.1.4 Pre-Construction Preparations

（1） Main considerations for the construction procedure manual

In order to ensure high quality in construction work for the day, it is necessary to check and correctly understand the construction details.

□ Review and understand the terms of the construction contract.

□ Review and understand the contents of the contracted construction (terms and conditions of the estimate) and the scope of work.

□ Review and understand the blueprints and construction drawings.

□ Review and understand the site construction conditions and site rules.

□ Review and understand the work schedule with other contractors and connections with constructions before and after the project.

□ Confirm the construction procedures, allocate workers, and prepare materials and equipment.

□ Confirm possession and carrying of the Career Up Card and licenses required for the work.

□ Identify and understand safety issues.

(2) Pre-work inspection

When working on a construction site, workers use a variety of tools and machinery. Common accidents for workers occur when handling tools and equipment. Be sure to conduct the following as pre-work inspection.

□ Pre-work inspection of the machinery

□ Checking of equipment, tools, and instruments

□ Confirmation of work procedures

□ Confirmation of safety

6.1.5 Layout Marking (Marking Out)

Sumidashi (sumitsuke) (layout marking (marking out)) refers to marking the location and height of the structure or component to be constructed on the construction site. In the entire construction process from beginning to completion, this is the very first step. It is the most important work that requires quality (accuracy). Precise reference marking and reference level, axis line as per blueprints, etc. are marked for correct positioning. For layout marking, a tool called a *sumitsubo* (line marker) is used, but nowadays a laser illuminator is used to emit a laser beam to mark along the laser.

6.2 Knowledge regarding Pipe Processing

This section describes basic matters in the processing of carbon steel pipes for piping, rigid polyvinyl chloride pipes, and rigid polyvinyl chloride-lining steel pipes for water supply.

6.2.1 Processing of Carbon Steel Pipes for Piping

Typical joining methods for carbon steel pipes for piping include screw, welding, and mechanical joining methods.

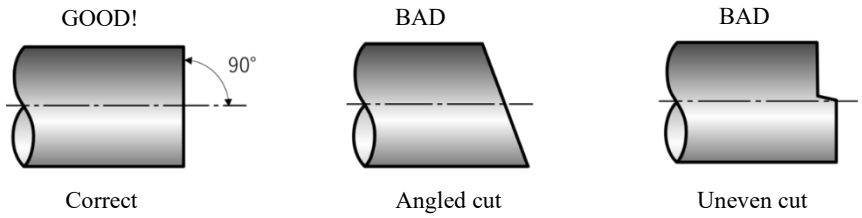
(1) Screw joining method

This is a common joining method that has been used for a long time. Mainly used for 15A to 100A. A represents the diameter of the pipe and is called A designation. The unit of measurement is in mm. There is also B designation, which uses inches for the unit of measurement. The procedure is as follows.

(1) Pipe cutting

A band saw pipe cutting machine is used to fix the pipe horizontally, and to make a cut that is

perpendicular to the pipe axis. If the cut is not made perpendicularly, it may result in angled cuts or uneven cuts. Angled cuts of 1.0 mm or more or uneven cuts can cause water leakage.



Correct and incorrect cutting of steel pipes

(2) Threading (thread cutting)

After the steel pipes are cut, the die head is attached to the pipe threader (with automatic die head) and the pipes are threaded. Wearing work gloves when threading may cause the hands to get entangled in the threader. Never thread while wearing work gloves. After the threading is completed, the accuracy of the threading is inspected with a thread gauge.

(3) Preparation before screwing in

Once the steel pipes are threaded, the screwing-in process begins. Insufficient cleaning and degreasing of screw joints can also cause water leakage, so the following preparatory work is necessary before screwing in.

After the preparatory work is completed, the pipes are screwed in, but before they are screwed in, a sealant is applied to the screw threads. There are two types of sealants: liquid sealant and sealant tape.

(4) When using liquid sealant

Before applying the liquid sealant, thoroughly wipe off any moisture, oil, dust, etc. on the joint surfaces once again. Stir the sealant well before use. Apply the required amount with a brush to the entire threaded portion of the pipe and fitting. Apply carefully and evenly.

(5) When using the sealant tape

The sealant tape is wrapped around the side to be screwed in. Since the direction of screwing is clockwise, the sealant tape is also wound clockwise.

(6) Screw-in

After the sealant is applied or wrapped, the joints are screwed in. Fix the piping properly onto the bench vise, and first, screw it into the fitting by hand. After it cannot be tightened any further by hand, use a pipe wrench with an appropriate diameter to screw it in further. Be careful not to screw in so hard to the point of destroying the threads.

(2) Welding joining method

Welding joining methods for carbon steel pipes for piping include welding and mechanical joining. The welding joining method is often chosen for large-diameter pipes and is a reliable joining method in terms of joint strength, but it requires a high degree of skill. There are two types of welding joining methods: gas welding joining and shielded arc welding joining.

[Gas welding joining method]

There are three methods to weld metals using heat from gases: oxyacetylene welding, oxyhydrogen welding, and air-acetylene welding.

[Shielded arc welding joining method]

The shielded arc welding joining method, along with gas welding joining methods, is widely used in piping work. The shielded arc welding method uses a welding rod coated with a solvent called flux to minimize weld oxidation and other disturbances as much as possible. The combustion of the flux shields the molten metal from air during welding. For either welding method, the process is as follows.

(1) Pipe cutting and processing of the cut

As with the screw-in method of pipe joints, steel pipes are cut perpendicularly to the pipe axis. However, when welding joints, it is necessary to chamfer the pipe ends after cutting to improve the weld quality. Without chamfering, insufficient fusion occurs, affecting weld quality.

(2) Temporary welding

Before the main welding, a temporary welding is conducted to fix the welds in the correct mutual

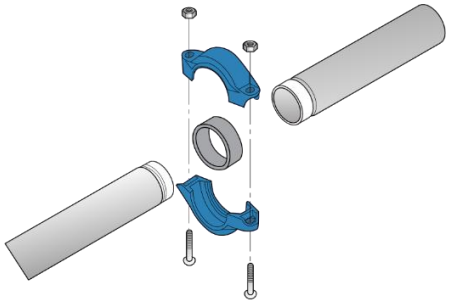
position and to prevent misalignment of the bevel due to distortion of the weld.

(3) Main welding

The work to weld the entire circumference of the piping, performed after temporary welding. Welding operations are performed by welders under a variety of conditions. To consistently achieve good results, it is important to have sufficient experience in welding operations and to avoid creating welding defects.

(3) Mechanical joining method

Also called mechanical joining method. Pipes are joined using housing pipe fittings, bend fittings, coupling fittings and no-hub fittings.



Example of a housing pipe fitting

6.2.2 Processing of Rigid Polyvinyl Chloride Pipes

Rigid PVC pipes are processed in the following steps.

(1) Pipe cutting

Pipes are cut perpendicularly to the pipe axis.

(2) Chamfering

Once the pipe is cut, both the inner and outer parts are chamfered with a box cutter so that it can be easily inserted into the fitting.

(3) Marking the insertion depth

To confirm that the pipe is fully inserted into the fitting, mark the depth of insertion on the pipe side.

(4) Applying an adhesive to the pipe and the fitting

Wipe off any moisture or dirt from the surfaces to be coated, and apply the adhesive to both the pipe and the fitting.

(5) Inserting the pipe into the fitting

Align the pipe with the mouth of the fitting and insert it all the way in one go, applying force. Once the pipe is inserted up to the mark, continue to apply force inward for about 10 seconds until the adhesive dries.

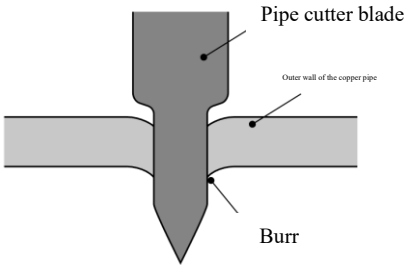
(6) Wipe off the excess adhesive

Wipe clean any adhesive that is pushed out after insertion.

6.2.3 Processing of Rigid Polyvinyl-Chloride Lining Steel Pipes for Water Supply

(1) Pipe cutting

Same as with other pipe materials, these pipes are cut perpendicularly to the pipe axis. Pipe cutters such as a band saw or metal saw are used to cut the pipe.



Example of burr

(2) Deburring

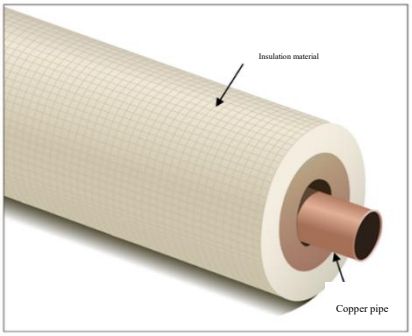
After the pipe is cut, deburr the inner wall of the pipe using a deburring reamer for line pipes or a scraper.

(3) Threading

Threading is done in the same manner as for carbon steel pipes for piping, but if the pipe has an outer resin coating, threading is performed using a jig and tool that will not damage the outer resin coating.

6.3 Freezing and Air Conditioning Apparatus Work

6.3.1 Processing of Coated Copper Pipes for Refrigerant



Coated copper pipe for refrigerant

Between the outdoor and indoor units of an air conditioner, refrigerant, which transfers heat, circulates through pipes. Coated copper pipes for refrigerant are used for this purpose. Plumbing for freezing and air conditioning apparatus work requires the following processing and joining of coated copper pipes for refrigerant.

(1) Cutting the insulation material

The insulation material is cut perpendicular to the copper pipe using a box cutter.

(2) Copper pipe cutting

Set the pipe cutter at a right angle on the copper pipe, and rotate it around the pipe while gradually tightening the hold to cut the pipe without deforming it.

(3) Deburring

Copper pipe cut with a pipe cutter will have *makuri* (burr) on the inner wall. Smoothing this out allows smoother flaring process. Make sure to use designated tools such as reamers and scrapers for this operation.

(4) Correcting roundness

After deburring, be sure to correct the roundness with a sizing tool for refrigerant pipes or other means.

(5) Bending

Coated copper pipes for refrigerant are bent to site specifications. Bending can be done by hand or by a bender. The three points to keep in mind when bending are: do not let the pipe flatten, buckle, or wrinkle.

[Bending by hand]

Place both thumbs on the inner side of the bend location, and bend it while gradually shifting the thumbs toward the ends of the pipe. Flattening or buckling will occur if the pipe is bent too fast and too much, or below the minimum bending radius.

[Bending by a bender]

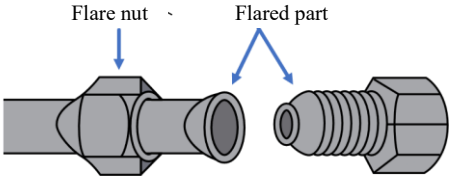
To make the bend radius small and clean, use a bender appropriate for the quality and wall thickness of the copper pipe. The minimum bending radius can be as small as 4 times the outside diameter of the copper pipe.

6.3.2 Connection of Refrigerant Pipes

Two types of refrigerant pipe connection are flare and brazed connections.

(1) Flare connection

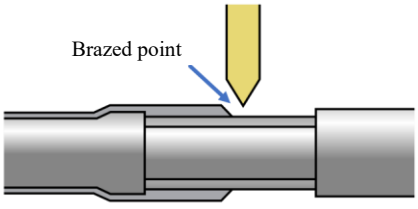
Flaring is a process that widens copper pipes into a trumpet shape. By tightening the flare nut, the flared portion is crimped and acts as a seal.



Flare connection

(2) Brazed connection

This is a method of connecting by melting wax and blending it into the faces to be connected.



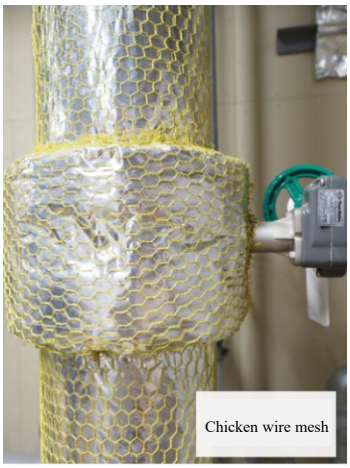
Brazed connection

(3) Connecting the insulation material

The insulation material shrinks in the longitudinal direction (). Since condensation from gaps caused by shrinkage of insulation material may lead to accidents, measures should be taken to prevent gaps. Once the connection surfaces are prepared, butt the insulation material end faces together so that there are no gaps between them, and wrap insulation tape with the joint at the center line of the tape.

6.4 Heat/Cold Insulation Work

6.4.1 Shapes and Types of Insulation Material



Insulation material is available in various shapes of heat-retention tubes, heat-retention strips, and heat-retention plates. Plates and strips are used for ducts, and tubes are used for piping. In addition, it consists of exterior materials such as colored steel plates and aluminum glass cloth, and auxiliary materials such as steel wire, chicken wire mesh, adhesive tape, and tacks.

6.4.2 Example of Heat/Cold Insulation for Piping

(1) Concealed areas such as above the ceiling

Since appearance is a non-issue above the ceiling or inside the pipe shaft, no finishing materials are used. The insulation tube is wrapped in aluminum glass cloth (ALGC) or aluminum craft paper (ALK) and fixed to the pipes.

(2) Piping exposed indoors

For exposed piping indoors, such as in rooms and corridors, pipes are generally covered with synthetic resin covers or lagging materials.

(3) Machine rooms, garages, warehouses, etc.

The insulation tubes are wrapped in aluminum glass cloth (ALGC) or aluminum craft paper (ALK). In the case of water supply and drainage piping, polystyrene foam insulation (PS) is used as insulation material.

(4) Piping exposed outdoors

Since high weather resistance is required for outdoor exposed areas, the insulation tube is covered with lagging material made of thin steel sheets processed by sheet metal work.

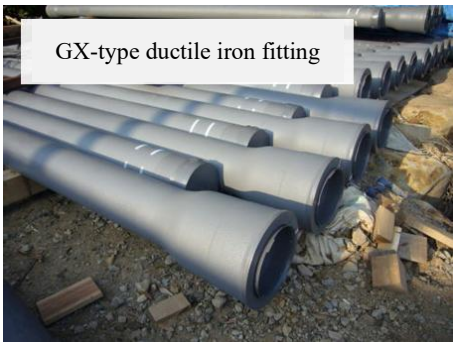
6.4.3 Example of Heat/Cold Insulation for Ducts


Insulated ducts

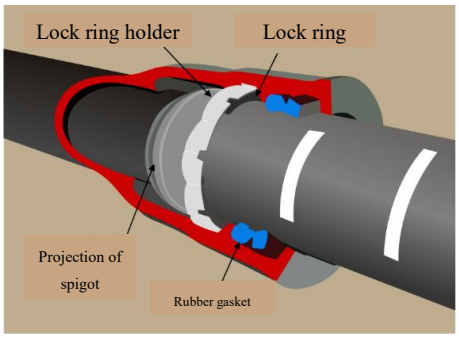
Heat and cold insulation work for ducts is done to prevent heat dissipation from the ducts and to prevent the air in the ducts from being heated by heat from the outside. Wrapping ducts with insulation material can increase the efficiency of heating and cooling, saving energy. For heat and cold insulation of ducts, insulation panels with coated aluminum and craft paper or insulation panels with aluminum glass cloth are fixed to ducts with tacks, aluminum glass cloth adhesive tape or chicken wire mesh. In outdoor exposed areas, ducts should be covered with a frame made of stainless steel plate or the like, if necessary.

6.5 Lifeline Infrastructure Plumbing Work

6.5.1 Waterworks—Ductile Iron Pipe Installation


GX-type ductile iron fitting

Japan experiences frequent earthquakes. Therefore, ductile iron pipes, which can protect pipes against earthquake damage, are used. There are various types of ductile iron pipes, but GX-type ductile iron fittings are used relatively frequently in Japan.



Cross-sectional view of GX-type ductile iron fitting

Ductile iron pipes are joined as follows.

(1) Pipe installation

Gently lower the suspended pipe with the manufacturer's mark on the top side.

(2) Pipe cleaning

Remove any foreign matter from the groove of the socket, the area approximately 30 cm from the spigot edge, and the socket circumference. In addition, wipe off any water from the surface where the

rubber gasket is to be attached.

(3) Checking the lock ring and lock ring holder

The lock ring and lock ring holder are pre-set. Check visually and by touch to see if they are properly located in the specified groove of the socket.

(4) Setting the rubber gasket

Be sure to check that the rubber gasket is labeled for GX type and of the correct nominal diameter. Clean the rubber ring and place it inside the socket with the angled portion facing forward. Then, attach it in place while pressing it by hand or a plastic hammer to ensure that there are no gaps. After installation, tap the rubber gasket with a plastic hammer to let it settle into the inside of the socket.

(5) Applying lubricant

Use the lubricant specifically made for ductile iron pipe fittings. Apply the lubricant evenly to the tapered inner surface of the rubber gasket and the outer surface of the spigot, from the white line hear the pipe end to the end of the pipe.

(6) Inserting the spigot

Suspend the pipes by a crane, etc., and lightly place the spigot at the mouth of the socket. At this time, make sure that no stones, pieces of wood, or other foreign objects stick to the rubber gasket or the spigot. Operate the lever hoist and slowly insert the spigot into the socket.

(7) Checking the rubber gasket position

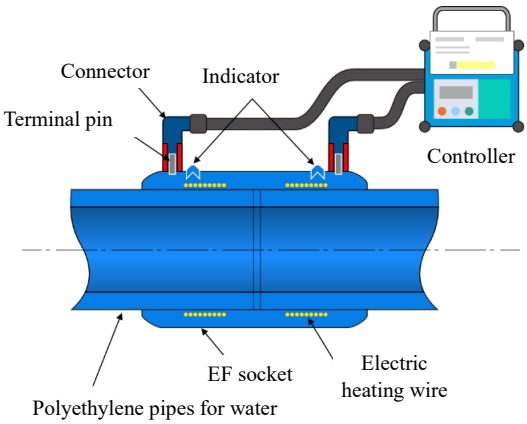
Check the rubber gasket position using a special check gauge. A special check gauge is used to measure the amount of penetration over the entire circumference of the gap between the socket and the spigot to confirm that everything is within the acceptable range.

(8) Procedure to bend piping

Straight pipe fittings can be bent to the allowable bending angle after joining. After verifying that the joint is correct, bend the fitting slowly, within the allowable bending angle.

6.5.2 Waterworks and Gas—EF Connection

Polyethylene pipes for water and gas distribution are lightweight, flexible, corrosion resistant, and hygienic pipes used for water and gas piping. In addition, this pipe material demonstrates durability during emergencies such as earthquakes and land subsidence. Pipe material and fittings are blue for water and yellow for gas.



EF connection of polyethylene pipes

In joining polyethylene pipes, there are two methods: electrofusion (EF) joining and mechanical joining. EF joining is a joining method in which the electric heating wire is heated to melt and fuse the inner wall of the pipe fitting and the resin on the outer wall of the pipe into a single piece. After setting a pipe (spigot) into a pipe fitting (socket) with an electric heating wire embedded in the face to be joined, the controller energizes the wires to heat them.

EF joining is performed in the following steps.

(1) Pipe cutting

Cut the pipe so that the end of the pipe is perpendicular to the pipe axis.

(2) Preparing the EF socket

Inspect the pipe for damage, then wipe off any soil or dirt from the pipe with paper towels or a clean rag. Measure from the end of the pipe and draw a marker line at the specified insertion length.

(3) Scrape

Using a scraper, scrape the surface of the pipe from the end of the pipe to the marker line.

(4) Cleaning of fusion surface

Clean the entire scraped surface of the pipe and the inner wall of the EF socket with a paper towel soaked in ethanol or acetone.

(5) Marking

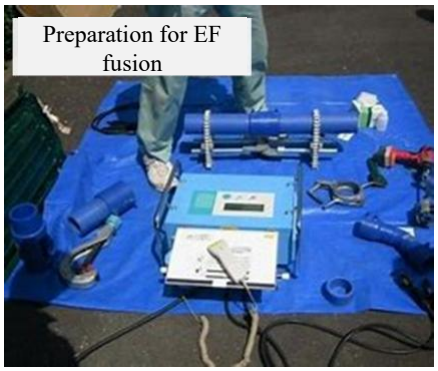
Insert the scraped and cleaned pipe into the socket and mark the pipe along the circumference of the socket end.

(6) Inserting and joining the pipes and the fitting

Insert both pipes into the EF socket to the marked line. Then, use clamps to secure the pipes to the EF socket.

(7) Preparing for fusion

Connect the controller power plug into an electrical outlet. Turn on the switch. Then, connect the output cable to the terminals of the fitting. Use the barcode reader attached to the controller to read the fusion data.



Preparation for EF fusion

(8) Fusion

Press the start button on the controller to start energizing. Energization stops automatically.

(9) Inspection

Check that the EF socket indicators, both left and right, are pushed up. Confirm the controller display that it has finished the process successfully.

(10) Cooling

After fusion is completed, leave the product for a predetermined amount of time to cool.

6.5.3 Precautions in Telecommunications Work

(1) Underground conduit

Where expansion or contraction of the conduit is anticipated, use fittings that expand and contract, or other means to make connections.

(2) Cabling

Route the cable so that there is extra length of cable at the handhole near the cable pull-in and pull-out ports.

(3) Optical cable underground wiring

At the handhole, secure enough length of optical cables at both the connection and pull-through sections to prevent disconnection caused by cable kinks when the cables are moved during a disaster or similar events.

6.5.4 Precautions for Underground Piping Work

(1) Damaging or cutting existing underground pipes during excavation

During underground piping work, care must be taken to avoid damaging or cutting existing underground pipes. Accidents involving damaging or cutting underground pipes, such as water, sewer, gas, communication, and electric conduit pipes, disrupt the lives of residents not only at the construction site but also over a wider area. Accidents involving damaging or cutting underground pipes can be caused by the following.

□ Failure to follow instructions

□ No/inadequate exploratory survey

□ The location of the underground pipe differed from the drawing

□ Insufficient confirmation of ledgers, etc. before commencing work

□ There was no entry in the road ledger

□ Failure to check the shape of piping bends, risers, etc.

□ It was an underground pipe in a shallow area

□ Failure to mark buried objects on the road

It is important to exchange information among the respective contractors to accurately determine the location of existing underground structures. Prior to the start of construction, a thorough exploratory survey will be conducted. During excavation, a steel pipe and cable detector will be used

to detect the location of existing underground pipes and conduits. If a backhoe or other machine is used for excavation, excavation should be done by hand within 50 cm around the existing underground pipes.

_(2) Disasters related to manholes

Many disasters related to work in manholes are caused by anoxia and sulfide poisoning. Persons who can enter manholes are those who have completed Class I and Class II skill training courses for oxygen deficient danger operations supervisors or special education for work at the place of an oxygen-deficient danger. Measure oxygen and hydrogen sulfide concentrations, and ventilate the work area so that the oxygen concentration is at least 18% and the hydrogen sulfide concentration is less than 10 ppm. Falling accidents from ladders also occur due to lack of oxygen. In areas where there is a possibility of oxygen deficiency, even if the height is less than 2 meters, fall arrest devices should be worn. Because construction and work related to manholes often take place on busy roads, accidents with passing vehicles can also occur. Enclosures (manhole shields) and other security facilities will be installed around manholes, and flaggers will be posted around the manholes.


Inside a manhole

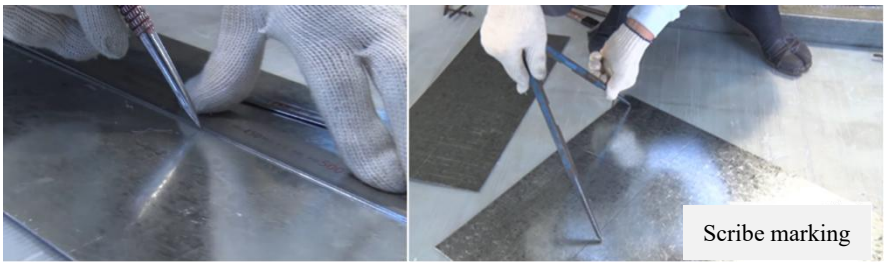
6.6 Architectural Sheet Metal Work

6.6.1 Sheet Metal Processing

Architectural sheet metal work involves cutting, bending, punching, welding, and otherwise processing thin metal sheets to create components that meet the intended use and install them. This work is needed in a wide range of areas, including plumbing and roofing. The basic operations required to process steel plates are scribe marking, cutting, bending, and welding. When making products with complex shapes, a technique called hammering is required.

(1) Scribe marking

Scribe marking is done in a single step as much as possible, using scribing needles, dividers, and metal rulers. When making several of the same item, gauges are made



Scribe marking

(2) Cutting

The sheet metal is cut carefully, lifting the part to be retained by hand so that the scissors can easily enter. Cut edges are smoothed with a metal file.

Cutting

(3) Bending

Using *kage tagane* (wide chisel) and a hammer, the sheet metal is tapped from the back side along the scribe line. This way, the surface can be bent slightly in the desired direction. Next, using an anvil or the corner of a platform called surface plate as dollies, the piece is gradually bent to the required angle by tapping it with a hammer.

Bending

(4) Welding

The welding method most commonly used in sheet metal welding is the fusion welding method, in which a filler metal (welding rod or wire) is melted to make the joint.

6.6.2 Duct Connection Method

(1) Connection of square ducts

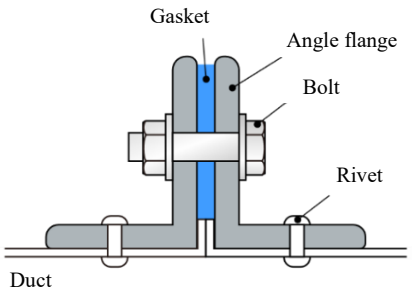
Angle flange and slip-on flange methods are available for connecting square ducts.

[Angled flange method]

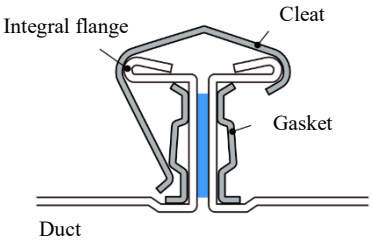
Because of its superior connection strength and airtightness, it is often used for smoke exhaust ducts, etc.

[Integral flange method]

A portion of the duct is bent to make a flange (integral flange), the integral flanges are joined together, and the four corners of the duct are secured with special clips. Compared to the angle flange method, this method requires less work to make flanges and is easier to install, and this is why it is often used for ducts other than smoke exhaust.



Angle flange method



Integral flange method

[Slip-on flange method]

A pre-made flange is inserted into the duct and spot-welded, then tightened with bolts and nuts at the four corners, and the flange is held together with special hardware called cleats. It is stronger than the integral flange method and can be considered an intermediate method between the integral flange method and the angle flange method.

(2) Connection of round ducts

Connection methods for spiral ducts and other round ducts include the flange method and the nipple connection method.

[Flange method]

A flange collar is inserted into the spiral duct, and the flanges are fixed to each other with bolts and nuts. This method is suitable for connections that require high strength.

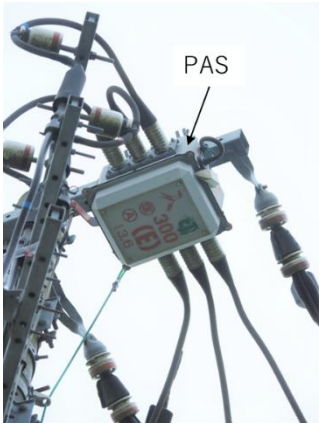
[Nipple connection method]

A spiral duct is connected by inserting a special fitting called a nipple into the duct, securing it at two or three points with steel plate screws (self-drilling screws), and wrapping duct tape around it from the outside.

6.7. Electrical Work

The scope of work for electrical work technicians is broad and includes piping, wiring, installation of fixtures, and installation of electrical equipment. This work characteristically uses many different types of tools and equipment. Be careful to avoid electric shock and leakage current while working.

6.7.1 Precautions in Working with High-Voltage Substations



6600V electricity drawn from the power company, etc. is supplied to cubicles installed on the premises, in the basement or on the roof of the building via PAS (Pole Air Switch, a high-voltage air-insulated switch) installed on the poles (in the case of overhead wiring). In cubicles, the received 6600V is converted to 100V or 200V. Inside, there are disconnectors and circuit breakers to shut off electricity. To prevent industrial accidents when working with high-voltage substations, it is fundamental to open the PAS and work while de-energized, including cubicles. When a disconnector or circuit breaker is opened, electricity is still flowing to the primary side of the open section. It is very

dangerous to work with an active wire (energized) on the primary side, as it may cause a direct electric shock or an electric shock accident due to electrical discharge.

6.7.2 Short-Circuit, Ground Fault and Leakage Current

A short circuit (also called a short) is when two or more wires from two- or three-phase circuit come in contact with each other, bypassing the load. Short-circuit occurs when the wire is cut while live. Also, wiring errors and metal parts of tools such as screwdrivers may cause short circuits.

A ground fault is when the electric current flows to the ground.

Leakage current occurs when the current, flowing through the intended circuit, also flows to where it should not. This can cause electric shocks to people, fires, etc.

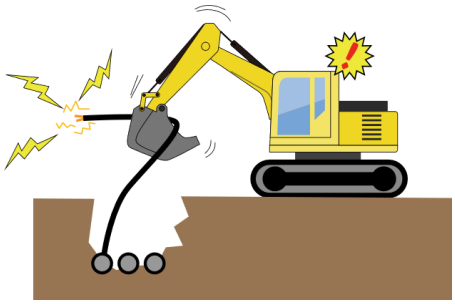
6.7.3 Precautions in Crimping Wires

Poor crimping of wires can lead to accidents caused by heat or sparks. Using a crimping tool, firmly crimp the center of the sleeve of the crimp terminal. Also, make sure to use crimp terminals that are compatible with the wire thickness. Note that not only the wire but also the crimp terminal itself has an ampacity rating.

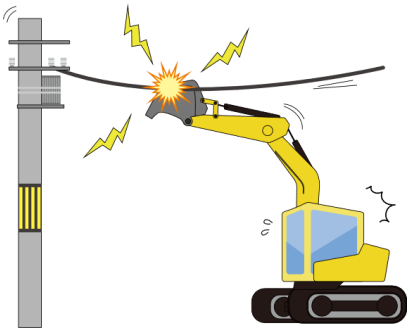
6.7.4 Damage to or Disconnection of Existing Underground Pipes and Overhead Wiring

(1) Cutting of existing underground pipes during excavation of a cable trench

A cable trench is a facility for housing above-ground utility poles and overhead power lines in an underground space. Preliminary investigation and temporary work is required for the construction of the cable trench because of the possibility of accidental cutting of existing lifeline infrastructure such as water, sewer, gas, communication, and electrical conduit pipes. For precautions in construction, refer to 6.5.4 Precautions for Underground Piping Work.



(2) Accidental cutting of overhead wires



There are examples of accidents involving cutting of overhead wiring by construction machinery boom movements, raising the dump truck bed, and when loading and unloading construction machinery from construction machinery hauling vehicles. You may be asked by other contractors to install cable covers to protect overhead cables.

6.7.5 Precautions for Road Use

When working on the road, pay attention to relevant laws and regulations. General precautions are as follows.

□ The person in charge of the work will carry a road use permit. In addition, the conditions of the permit (working hours, working conditions, etc.) should be observed.

□ Security facilities are set up at the construction site to prohibit the entry of people who are not involved in the construction.

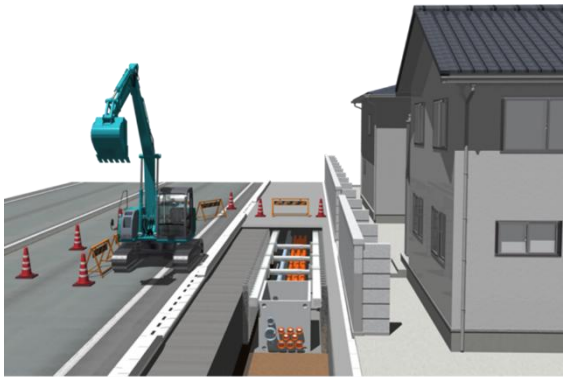
□ Traffic control personnel will be positioned to ensure that the flow of traffic is not impeded.

□ Measures will be taken to ensure safe passage for pedestrians.

□ Efforts will be made to minimize noise, vibration, and other impacts on nearby residents.

□ When workers leave the site, excavated surfaces should not be left as they are; they must be backfilled or covered. If holes are to remain as they are, security fences will be installed.

□ When temporarily placing objects on the road, secure them or install security facilities around them to prevent them from being scattered or moved.



Construction work to eliminate utility poles

□ Caution lights should be placed to indicate the width and height of the installation site at night.

6.8 Telecommunications Work

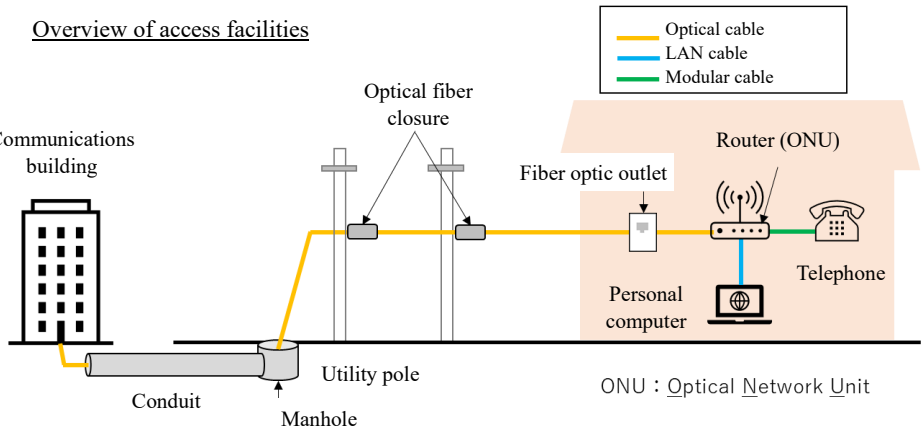
6.8.1 Types of Telecommunications Facilities

Telecommunications facilities are divided into wired communications facilities, wireless communications facilities, telecommunications civil engineering facilities, switching transmission facilities, and power facilities for communications. This section describes wired communication facilities and telecommunication civil engineering facilities.

(1) Wired communications facilities

A network of wired transmission lines to provide telecommunications services is called access *setsubi* (access facilities).

Access facilities are divided into outdoor and indoor, and outdoor facilities are further divided into overhead and underground. Overhead facilities are facilities attached to utility poles. The following facilities are installed.



[Hikari fiber cable] (fiber-optic cable) These cables pass optical signals.

[Metal cable] Cable used in communication equipment. Fiber-optic cables communicate using optical signals, while metal cables communicate using electrical signals.

[Closure] A box-shaped device installed at the splices or branching points of fiber-optic or metal cables. Closures may be color-coded with gray for fiber-optics and black for metal cables.

[Hikikomisen] (service cable) This is the cable that draws communication lines into homes.

There is required ground clearance for overhead facilities to ensure safety. When it is over a road, a minimum of 5 meters must be maintained.

***Procedure for erecting poles**

The poles are erected according to the following procedure.

1) Identify the location where the pole will be erected.

2) Check for buried objects by hand-digging or using a probe stick.

3) Excavate by hand and a pole-setting truck.

4) Erect the pole.

5) Backfill.

(2) Telecommunications civil engineering facilities

Telecommunication civil engineering facilities include these.

[Kanro] (conduit) This conduit connects manholes, handholes, cable tunnels, and riser poles. As a general rule, this refers to a pipe that has been drawn in and laid so that one section of cables can be pulled in or out without excavation.

[Manhole] A structure to provide underground access from above ground for cable pull-in, pull-out, and connection work.

[Handhole] A small manhole provided at the junction of underground piping. Cable maintenance is performed without people going inside.

[Todo] (cable tunnel) A tunnel to house various cables for telecommunications.

[Kyodoko] (joint trench) An underground structure in the form of *todo* (cable tunnel) where two or more facilities such as telecommunications, electricity, gas, water, and sewage are accommodated.

[C.C.BOX] (cable trench) U-shaped structure to house communication and power cables as well as power supplies for information transmission, broadcasting, road management, etc.

6.8.2 Installation of Underground Conduits

(1) Soil cover thickness and slope of the conduit

The soil cover thickness of a conduit is the distance from the surface of the road to the top of the conduit. The Order for Enforcement of the Road Act stipulates that, as a general rule, the thickness should not be less than 0.8 m under roads and 0.6 m under sidewalks. The slope is set so that water and sediment can flow inside the conduit without stagnation.

(2) Clearance distance from underground facilities managed by other agencies

The standard clearance distances between conduits and electric, gas, water, and sewage lines are determined by the laws and regulations.

(3) Various tests after conduit installation

After conduit installation, the following two tests are performed.

[Mandrel tsuka shiken] (mandrel test) A test to inspect whether the conduits are completely connected. It is conducted by passing through a stick called a mandrel.

[Kimitsu shiken] (airtightness test) The pressure in the conduit is set to 49 kPa and left for 3 minutes to confirm that the pressure drop is less than 1.96 kPa.

6.9 Furnace Installation

Furnace construction refers to the construction of the inside of the incinerators, annealing furnaces, cremation furnaces, melting furnaces, electric furnaces, etc., where high temperatures are generated, using refractories. The bricks used in the furnace are refractory bricks and refractory insulating bricks. The mortar used to bond the bricks is also different from ordinary mortar; mortar made for refractory insulating bricks.

The work proceeds in the following order: layout marking, temporary enclosure erection, and brickwork. Laying refractory bricks (brickwork) requires the highest level of skill among furnace materials. When laying bricks, there are six things that must be observed.

□ Use materials correctly.

□ Make sure the dimensions are accurate.

□ Apply enough mortar and make the joints uniform.

□ When laying bricks to create a flat wall, make sure to stagger them.

□ Do not use small bricks broken into 1/4 or less of the normal length.

□ Brickwork should always be based on level and perpendicular references.

6.10 Fire Fighting Equipment Installation

Part of the fire pump equipment

Firefighting facilities are not operated in normal times; it is mostly used only during emergency situations. For water-based hydrants,. a pump primer, overflow piping to prevent water temperature increase, and performance test equipment are installed.

(1) Installation of a pump primer

If there is no water in the pump itself or if there is an air pocket, the pump will not be able to pump water even if it is operated. If the water source is lower than the pump, install a pump primer to prevent this.

(2) Installation of overflow piping to prevent water temperature increase

If the pump is operated when the pump discharge is closed, the pump continues to just rotate. If left to rotate, the pump will overheat and stop. To prevent this, an overflow piping to prevent water temperature increase is installed.

(3) Installation of performance test equipment

Performance test equipment is installed to determine if the pumps are capable of performing as specified.

(4) Material used for piping

Piping may also be subject to high temperatures from flames when there is no water in the pipe. Metal pipes lined on the inner wall should not be used because the lining material may melt and harden, making it impossible to deliver water.

Chapter 7: Safety during Construction Work

7.1 Fatalities in Construction Work

A variety of industrial accidents occur at construction sites. Among the various types of industrial accidents that occur, fall from heights, accidents involving construction machinery and cranes, and crumbling/collapsing are the three major accidents in the construction industry, accounting for 40-70% of all accidents. Most of the struck-by and caught-in/between/entanglement cases in the table below are accidents involving construction machinery and cranes.

The most common of the three major disasters is fall from heights, occurring while working in high places. Aside from the three major disasters, the most common type of accident is traffic accidents that occur while traveling on public roads. Chapter 7 describes the types and causes of accidents that occur on lifeline infrastructure/equipment installation worksites, as well as countermeasures and how to be mentally prepared.

	Fall from heights	Slipping/tripping/falling/tipping over	Crashing	Flying/falling	Crumbling/Collapsing	Struck-By	Caught-In/Between/Entanglement	Drowning	Contact with hot/cold objects	Exposure to hazardous substances, etc.	Electric shock	Traffic accident (road)	Traffic accident (other)	Total
Civil engineering work	19	5	1	4	13	11	15	9	4	3	2	10	1	102
Tunnel construction	0	0	0	0	1	0	0	1	0	0	0	1	0	3
Bridge Construction	1	0	0	0	2	0	1	2	0	0	0	0	0	6
Road Construction	3	0	1	1	2	1	2	0	1	0	0	5	0	17
River engineering work	1	3	0	0	1	1	1	2	0	1	0	0	0	10
Erosion-control work	2	0	0	0	0	1	0	0	0	0	0	1	0	4
Harbour/coastal	0	1	0	0	0	0	1	2	0	1	0	0	1	6
Other civil engineering	9	0	0	2	4	8	8	2	3	1	2	1	0	44
Building work	71	0	0	5	15	7	6	0	6	5	2	9	0	139
Steel frame and reinforced concrete houses	23	0	0	3	5	2	0	0	3	4	0	5	0	48
Wooden-frame house construction	12	0	0	0	1	1	0	0	0	0	1	1	0	19
Building equipment installation	8	0	0	0	2	0	0	0	0	0	1	2	0	16
Other building work	28	0	0	2	7	4	6	0	3	1	0	1	0	56
Other constructions	20	0	0	1	3	1	6	1	1	1	4	6	0	47
Telecommunications work	4	0	0	0	1	0	2	0	1	0	2	2	0	13
Machinery and equipment installation	4	0	0	0	1	0	0	0	0	0	0	0	0	6
Other constructions	12	0	0	1	1	1	4	1	0	1	2	4	0	28
Construction industry subtotal	110	5	1	10	31	19	27	10	11	9	8	25	1	288

Table 7-1 Fatal Industrial Accidents in the Construction Industry in 2021 by Major Accident Type

(Compiled from the Ministry of Health, Labour and Welfare's Workplace Safety Website)

7 .1 .1 Numbers of Fatalities in Construction

[Tsuiraku/tenraku] (fall from heights) Industrial accidents caused by falling from high places, falling down shafts during construction, or falling down a hole during excavation.

[Tento] (slipping/tripping/falling/tipping over) Industrial accidents caused by tripping over objects or losing one's balance and falling.

[Gekitotsu] (crashing) Industrial accidents caused by a violent collision with something.

[Hirai/rakka] (flying/falling) Industrial accidents caused by loads being lifted by a crane falling, or tools or materials falling from a high place.

[Hokai/tokai] (crumbling/collapsing) These are industrial accidents that occur when a scaffold crumbles or a building under demolition collapses.

[Gekitotsusare] (struck-by) Industrial accidents caused by being struck by heavy machinery that is running, by a circling bucket, etc.

[Hasamare/makikomare] (caught-in/between/entanglement) Industrial accidents caused by being caught or entangled in machinery.

[Yugaibutsu tono sesshoku] (exposure to hazardous substances) Industrial accidents that occur when hazardous substances, such as chemicals, come into contact with the human body.

[Kanden] (electric shock) Industrial accidents caused by electric current flowing through the body, for example, by cutting an energized wire or touching a leaking device.

[Kasai] (fire) Industrial accidents caused by being caught in a fire started by a variety of factors.

[Kotsu jiko (doro)] (traffic accident (road)) Industrial accidents that occur while commuting to and from construction sites, and industrial accidents that occur when a worker is involved in a general automobile accident during construction work next to a road.

[Obore] (drowning) Industrial accidents that occur by falling into water in places where water is handled, such as oceans, rivers, and sewerage works.

7.1.2 Types of Fatal Accidents

(1) Fall from heights

To ensure safety when working at heights on steel towers, there is full-harness fall protection gear.

Overhead wiring uses aerial work platforms that provide a stable working platform, but leaning over the railing can cause loss of balance and falling.

Fatalities from falling from heights include falling into excavated holes. Falling can occur due to loss of balance, slipping, etc.

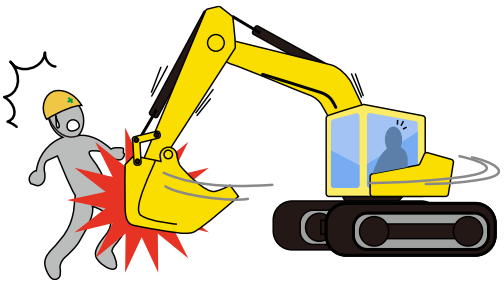
(2) Traffic accidents (road)

Fatalities resulting from automobile accidents are a common occurrence in the construciton industry as a whole. Many traffic accidents occur while commuting to construction sites. Another type of accident that tends to occur is being hit by another vehicle while loading or unloading goods on a public road.

When working on public roads, such as in pipe laying, it is easy for accidents involving ordinary vehicles to occur. To prevent passing vehicles from entering the worksite, security equipment such as enclosures, fences, and guards will be provided and flaggers will be posted. It is also important that workers do not work outside the scope of the worksite.

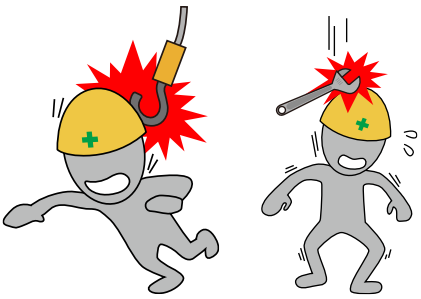
(3) Struck-By/Caught-Between

In work performed on public roads, such as pipe laying, be careful of backhoe accidents. These are accidents such as collision between the circling bucket and a person, or a person getting caught between the bucket and an object. In addition, backhoe tipping accidents are more likely to occur when loading and unloading backhoes onto and off trucks, etc.



(4) Flying/falling

Flying and falling accidents are caused by flying or falling objects. For example, being struck by the object carried by a crane or becoming trapped under a falling suspended load. Insufficient slinging, moving suspended loads, etc. can cause accidents. The important thing is not to place yourself under the suspended load.



(5) Crumbling/Collapsing

In electrical work, accidents include temporary poles breaking and collapsing, or poles on trucks tumbling down and trapping people underneath.

(6) Electric shock

An electric shock is a strong shock that occurs when electricity passes through a person's body. Electric shock can also be caused by touching a wire or device that has voltage running through it,mistakes such as touching leaky equipment or short-circuiting an electrical circuit. To prevent electric shocks, do the following.

> Work with protective equipment such as antistatic protective gear, rubber gloves to prevent electrical hazards, insulating clothing, and rubber boots to prevent electrical hazards. Even when wearing protective equipment, parts of the body not covered by the equipment may come in contact. Choose proper protective equipment, and consider working under de-energized conditions whenever possible.

>Inform people who are not involved in the work, and take steps to prohibit entry to the worksite.

> Ensure that work is performed under de-energized conditions.

> Electric shock accidents can also occur by falsely believing that the worksite is de-energized. test for electrical current before work is performed in order to confirm de-energization.

(7) Oxygen deficiency in manholes

Fatalities from oxygen deficiency and anoxia due to sulfide poisoning have occurred when working inside manholes. In situations where oxygen deficiency occurs, fatal accidents have also occurred to

rescuers entering the site without using an air respirator.

7.1.3 Characteristics of Lifeline Infrastructure/Facility Installation Work with a High Number of Fatalities

(1) Characteristics of and accidents in electrical work

Because electrical equipment installation deals with electricity, a fatal accident called electrocution can occur. Replacement of high-voltage lines and overhead wiring work is performed at heights, and therefore there is also a risk of falling accidents.

An electric shock accident can occur when cutting wires with a cable cutter. Such an accident is the result of failure to check for de-energization, failure to use protective gear to prevent electric shock, etc.

Falling accidents occur when working at heights, such as installing cables on utility poles. Whenever possible, prepare a stable working platform, such as an aerial working platform.

Work on an aerial working platform

(2) Machinery installation

When installing large machines, accidents can occur when the machine tips over and traps people underneath.

(3) Water and sewage works

In water and sewer works, excavation work involves digging trenches in the ground to pass pipes. There are several accidents associated with this excavation work. For example, there have been accidents in which the people inside the excavated hole were buried alive when the excavated soil collapsed. If the depth of excavation is more than 1.5 m, as a general rule, steel sheet piles are used for soil retaining. Falling accidents can also occur due to tripping over pavement ridges, sinking around shuttering boards, cables, hoses, etc.

Because excavation work involves the use of backhoes, accidents related to backhoes are also likely to occur. Examples include contact accidents caused by circling booms or being run over when backing up. A full-time flagger is assigned to communicate with the backhoe operator in order to ensure the safety of those working in the trench. The backhoe itself is also at risk of tipping over or falling into a ditch.

Sewer manhole construction

7.2 Safety Activities at Construction Sites

7.2.1 Cycle of Safety in Construction

By continuing the cycle of safety in construction, we can make worksites less prone to industrial accidents. The cycle of safety in construction is to achieve the following aims.

a. Integrate construction procedures and safety.

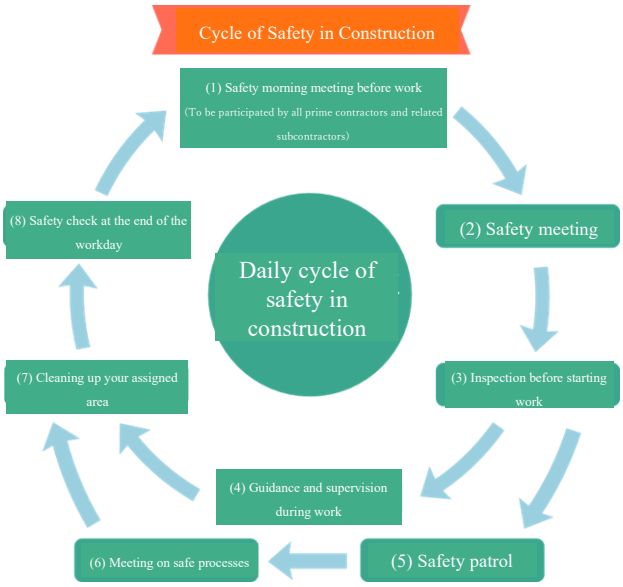
b. Facilitate cooperation between the prime contractor and other related subcontractors.

c. Make safety and health activities a habit.

d. Be inventive in taking preemptive safety measures.

e. Inform everyone of construction and safety requirements.

Various safety activities should be incorporated into daily operations at construction sites.



(1) Safety morning meeting before work

All prime contractors and related subcontractors participate in the meeting, which includes a presentation on the results of the safety patrol conducted on the previous day by the worksite managers, instructions regarding work safety for the day's work, and radio calisthenics.

(2) Safety meeting

Discussions will be led by the foremen, by job category. The training includes reviewing the results of the previous day's work process, hazard prediction (KY) activities related to today's work process, and newcomer education.

(3) Inspection before starting work

Before starting work, safety inspections are conducted, including inspections of the machines and tools used, checking the work content, etc.

(4) Guidance and supervision during work

Site supervisors (foreman, operations supervisor, etc.) provide guidance and supervision to workers.

(5) Safety patrol

Safety patrols are conducted by the worksite manager and subcontractors, and instructions and

guidance are given to each foreman, etc.

(6) Meeting on safe processes

The prime contractor and each specialty contractor will communicate and coordinate with each other regarding work on the following day, and discuss work methods, etc.

(7) Cleaning up your assigned area

Every worker is to organize, tidy, clean, and sanitize the area he/she worked in.

(8) Safety check at the end of the workday

The prime contractor and the person in charge of specialty contractor will confirm measures to prevent fire, theft, public disaster, etc.

7.2.2 Safety and Health Education for Newcomers

Safety and health education for newcomers is provided when a business hires new workers. The implementation of safety and health education for newcomers is required by the Ordinance on Industrial Safety and Health.

[1] Matters related to danger or harmful effect of machines, etc., or raw materials, etc., and those related to methods of handling thereof

[2] Matters related to performance of safety devices, harmful substance control devices, or personal protective equipment and matters related to methods of handling thereof

[3] Matters related to operation procedures

[4] Matters related to inspection at the time of commencement of work

[5] Matters related to the causes and prevention of diseases which workers are susceptible regarding the work

[6] Matters related to keeping the workplace in order and maintenance of its sanitary conditions

[7] Matters related to emergency measures and evacuation at the time of an accident

[8] Beyond what is set forth in each of the preceding item, matters necessary for maintaining safety

and health related to the work

7.2.3 Newcomer education

A worker who newly enters a construction site is called a newcomer. Nearly half of all construction site fatalities occur within one week of newly entering a site. For this reason, the Ministry of Health, Labour and Welfare has mandated newcomer education.

[Implementation of newcomer education]

In case of newly assigning any employees to work at a construction site, the related subcontractors shall instruct their foremen, etc., to inform such workers of the following matters based on the characteristics of said construction site before they commence work at the site, and shall report the results to the master employer.

[1] Conditions concerning locations where work is conducted by a mixed workforce that consists of both the master employer's employees and the related subcontractors' employees

[2] Locations that pose a danger to workers (dangerous and harmful places and no-entry zones)

[3] Relationship between work processes conducted at mixed work sites

[4] Evacuation methods

[5] Command structure

[6] Contents of the work involved and industrial accident prevention measures

[7] Rules on safety and health

[8] Plans that prescribe the basic policy and goals of safety and health management at the construction site and other basic industrial accident prevention measures

The above will be implemented as follows.

(1) Before work on the day the contractor first enters the site to begin work

The person in charge from the construction company (builder), the foreman, and the health and safety officer will conduct the training.

(2) Before work on the day a newcomer is added to the contractor's workforce

The foreman and the health and safety officer will conduct the training.

The training will take place in a conference or meeting room in the field office for about 30 minutes.

7.2.4 Safety Gear for Work

The photo below shows the safety gear for work. Full harness fall protection gear (1), helmet (2), hooks (3), and safety shoes (4) are the basic gear.


[Full-Harness gata tsuiraku boshiyo kigu] (full-harness fall protection gear) The full-harness fall protection gear prevents falls. From January 2, 2022, it is mandatory to wear it if the height of the


working platform exceeds 6.75 m. However, in the construction industry where falling accidents occur frequently, the use of full-harness fall protection gear is required even when working at heights exceeding 5 m.

[Hogo megane] (protective eyewear) These glasses are designed to protect the eyes from metal and wood dust, sparks, heat, smoke (including toxic gases), lasers and other harmful rays generated at construction sites and material processing sites.

[Hogo mask] (protective mask) A mask used to protect against dust and other debris. There are disposable masks and those with replaceable filters.

[Tebukuro] (gloves) Used to protect hands when performing machine/hand cut processing, painting work, various types of installation work, and work involving chemical substances. However, gloves (work gloves) should not be used when using rotating blades such as circular saws, drilling machines, chamfering machines, pipe threading machines, etc., because gloves (work gloves) can get entangled in rotating blades and result in accidents.

[Shield-mentsuki helmet] (welding helmet) A helmet with a shield attached to it, protecting the entire face. Mainly used for welding work.

7.2.5 Prevention of Heat Strokes

Summer in Japan has many *manatsubi* (hot day) with temperatures exceeding 30°C and *moshobi* (extremely hot day) with temperatures exceeding 35°C. Work performed in hot temperatures can cause the workers to have heat strokes. Heat stroke can cause dizziness and fainting, muscle pain and stiffness, profuse sweating, headache, mood discomfort, nausea, impaired limb movement, high body temperature, and other symptoms that not only make it impossible to continue working but can also cause death. To reduce WBGT values, site managers install large fans, shading nets, dry mist systems, rest areas, air conditioning equipment, water supply equipment, refrigerators, ice machines, drinking watervending machines, etc. On extremely hot days, work start and end times may be moved up.

Workers should try to rest in a cool place, such as an air-conditioned rest area, during allotted break times, and to drink water and consume salt before and after work. Also, wear breathable work clothes, safety vests that absorb heat easily, etc.

7.2.6 Marks Calling Attention to Work Safety

Marks with a green cross on a white background can be seen at various locations on the construction site. This mark is called *midorijuji* (green cross) and is a symbol of safety and health. It is often designed together with the words *anzen daiichi* (safety first) Helmets and *kyukyubako* (first aid kit) containing medicine and tools for first aid in case of injuries are also marked with the green cross. Sometimes the safety and health flag, combining the green cross with *shirojuji* (white cross) which represents *eisei* (health), is used.

Example of the green cross

Examples of the safety and health flag

7.2.7 Understanding Human Error

Mistakes caused by humans are called human errors. Human errors occur because we are human. This includes not only mistakes caused by carelessness, but also those caused by *tenuki* (cutting corners), skipping procedures that should have not been skipped. To avoid getting involved in or causing accidents on construction sites, it is important to be conscious of possible human errors. In addition, human errors not only cause accidents involving people, but also affect the quality of the completed construction as well as cause delays in the process. It is said that there are 12 different

causes of human error.

(1) Cognitive errors

It is a human error caused by assumptions. For example, the assumption that “such and such instructions will be given in this situation” can lead to misreading the actual instructions and cues given.

(2) Lack of attention

It is a human error caused by lack of attention. Concentrating on one particular task can reduce attention to one's surroundings and lead to accidents. For example, there are cases where a person is so focused on the work in front of him that he fails to notice the hole behind him and falls in.

(3) Attention lapse and diminished awareness

Attention lapse and diminished awareness can occur especially when engaged in simple and repetitive tasks. When simple tasks are repeatedly performed, workers stop thinking about those tasks but instead perform them unconsciously.

(4) Inadequate experience/knowledge

It is a human error caused by lack of experience and ignorance. This can result in improper use of tools, incorrect understanding of the work process, or inability to anticipate accidents that may be associated with the work. KY activities before commencing work are an opportunity for seasoned technicians to share their experience in predicting hazards. Workers can learn what to look out for, even when engaging in the task for the first time.

(5) Complacency

Humans tend to gain confidence through familiarity and, as a result, tend to be less careful or skip steps compared to when they were beginners at that task. Accidents are more likely to occur when workers become complacent and relaxed.

(6) Group errors

It is a human error that occurs in groups. For example, when it seems that meeting the construction

deadline is unlikely, it is easy to for the overall atmosphere to lean towards condoning unsafe conduct.

(7) Shortcuts and omissions

This is a human error caused by omitting necessary actions and procedures out of the desire to work efficiently.

(8) Communication errors

This is a human error that occurs because the instructions are not clearly conveyed. Working without understanding the instructions can lead to accidents and construction delays.

(9) Behavior based on situational instinct

It is an action that we unintentionally take when we are in a certain situation. Especially when people are focus on one point, they become oblivious to their surroundings. For example, when a person is about to fall from a stepladder, he/she would throw his/her tools in order to hang onto the stepladder. An accident occurs if those tools hit another worker.

(10) Panic

Sudden surprises or panic can easily lead to spontaneous unsafe behavior or giving inappropriate directions.

(11) Decline in physical and mental functions

What was possible when younger may no longer be possible due to aging. In particular, reduced function in the legs and hips and vision impairment are difficult to notice because they occur gradually. It is important to be aware of this so that you do not try uncomfortable actions or postures.

(12) Fatigue

Accumulated fatigue reduces alertness, and this can lead to accidents. It is important to take good care of your health on a daily basis, including proper sleep and nutrition.

“Have a safe day!”