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.

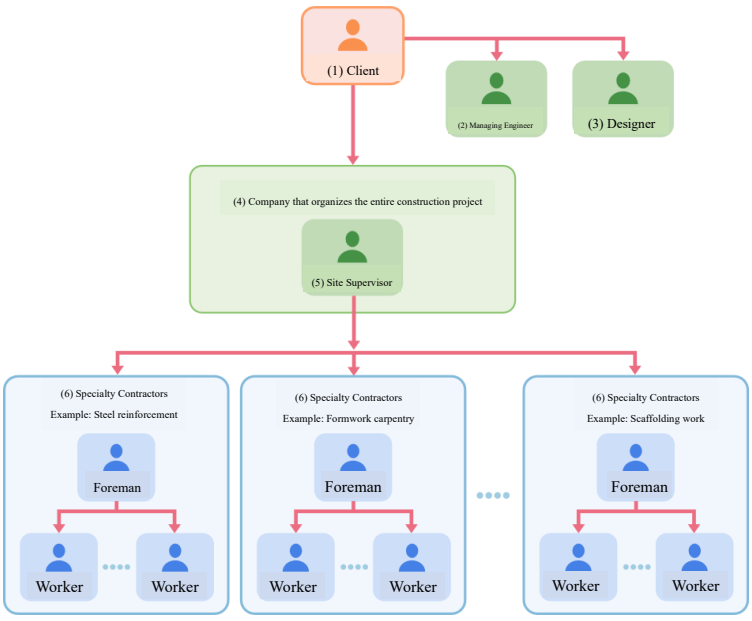


Fig. 1-1 Example of a work assignment

[(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.

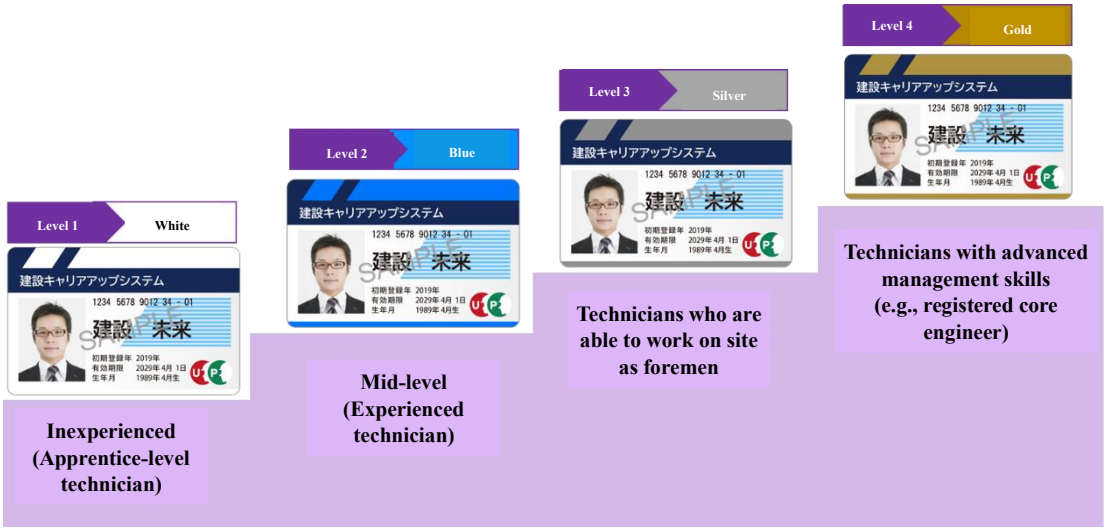


Figure 1 -3 Career Up System levels and colors of cards

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

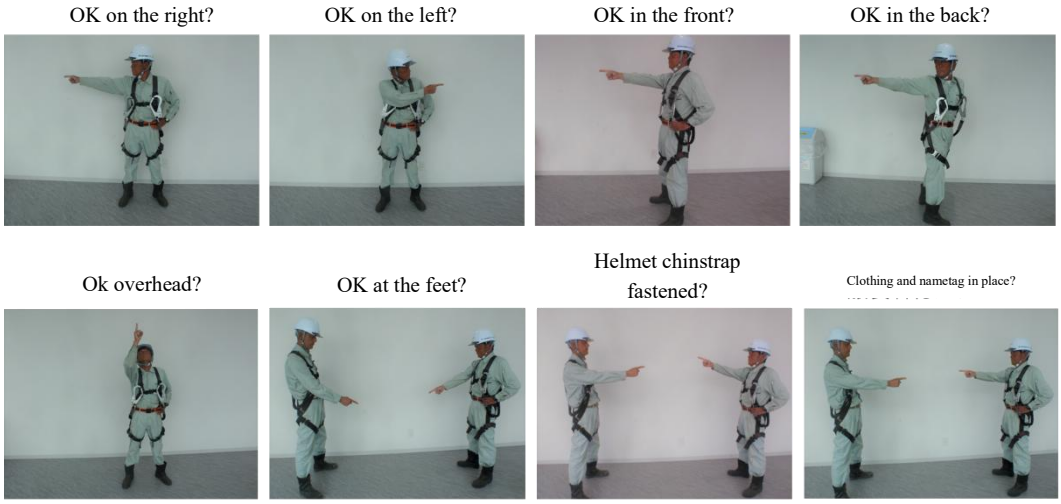
loudly and clearly to state your name, the company to which you belong, etc.

(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

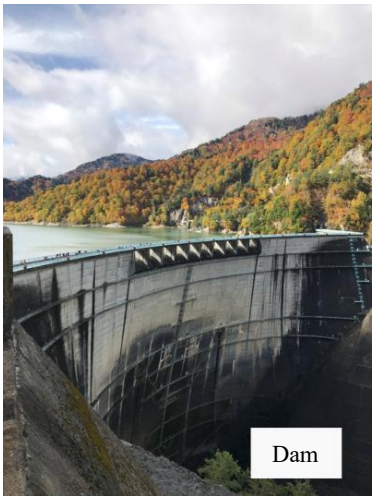
The Parking Lot Act is the law regarding the development of facilities for automobile parking in cities. Its purpose is to facilitate road traffic, thereby contributing to public convenience and maintaining and promoting the functions of the city by stipulating matters necessary for parking facility 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

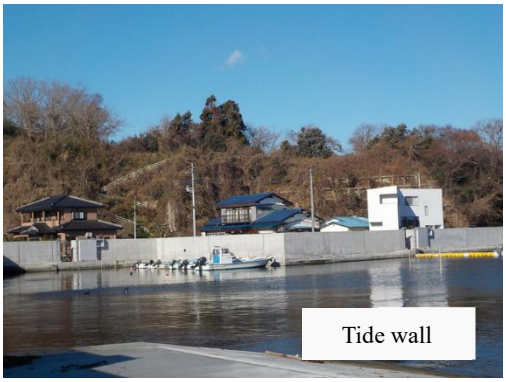
3.1.1 Civil Engineering Work

[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.

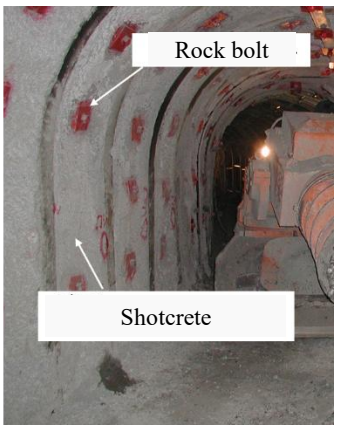

Road construction

[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

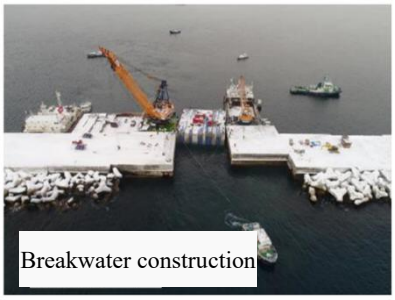
[Kaisaku tunnel] (the open-cut method) Method of excavating from the ground surface using earth-retaining shoring to prevent the ground from collapsing. This is called *kaisaku koho* (the open-cut method). The tunnel is constructed in the excavated space. In this method, the area outside the tunnel is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

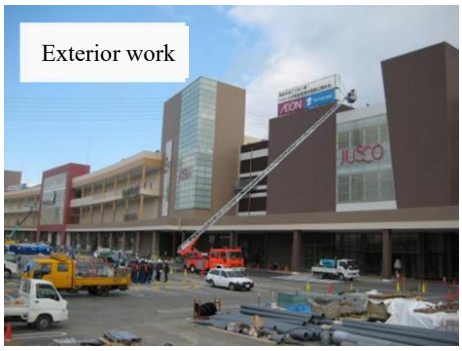
[Chika kutai koji] (underground frame construction] The structural part of a building consisting of foundation, columns, beams, walls, floors, etc. is called *kutai (*the frame). After completion of the earthwork, the underground frame will be constructed. From here on, various specialty contractors 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

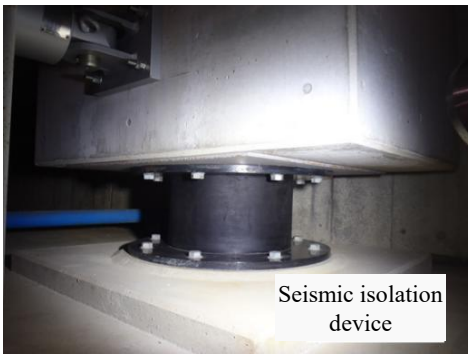
[Taishin koji] (seismic work) Seismic work makes buildings more resistant to earthquake shaking, thereby preventing them from collapsing. Seismic work includes improving seismic resistance, vibration control, and seismic isolation.

- 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.

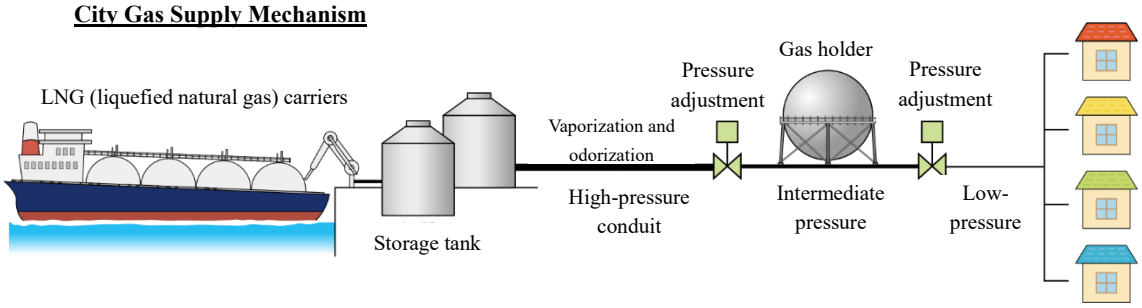
3.1.3 Lifeline Infrastructure/Equipment Installation

(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.

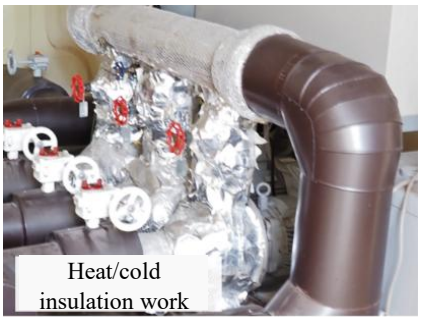

Cooling water circulator

[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

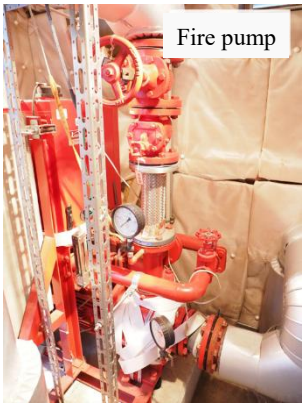


Heat/cold insulation work

【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.

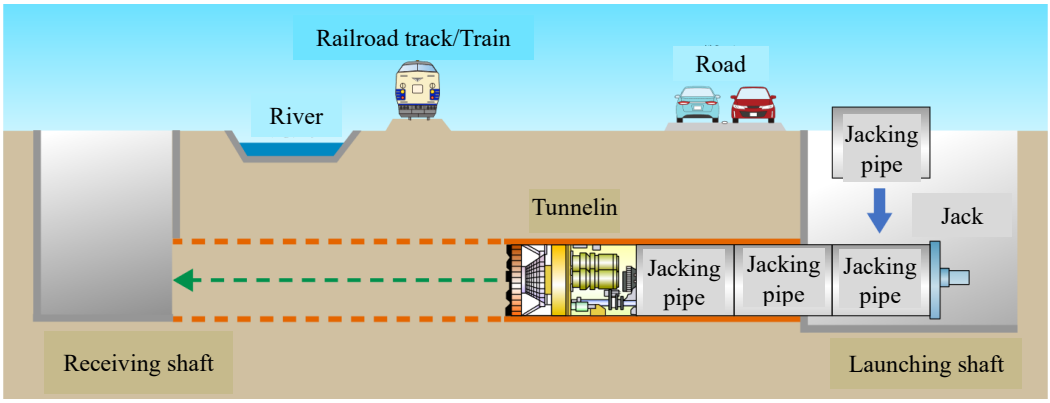
[Suichu pump no secchi to haisui] (installation and drainage of submersible pumps) On sites where a lot of water comes out, submersible pumps or similar devices are installed to pump out the water.

[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

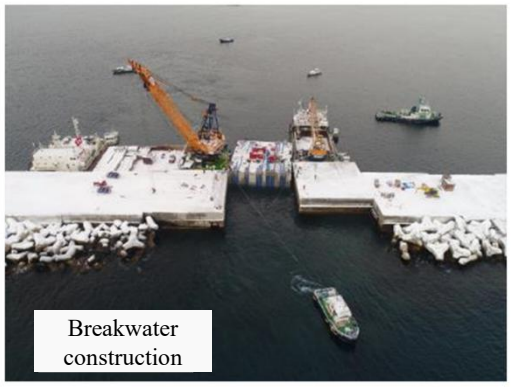
The following are typical examples of marine civil engineering projects that involve the construction of port facilities and offshore structures.

[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.

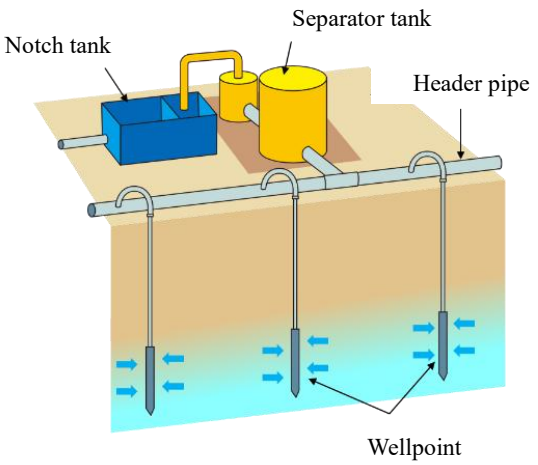
[Suigensei koji] (water source well work) Work to access and pump up groundwater.

[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.

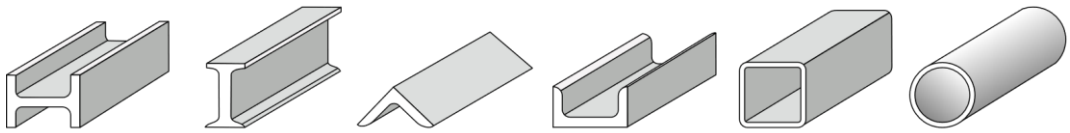
[Machiba-tobi] (local building steeplejack) *Machiba-tobi* builds scaffolding for local buildings, especially houses and condominiums.

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

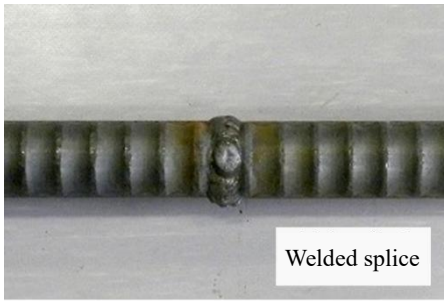

Rebar bending

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.

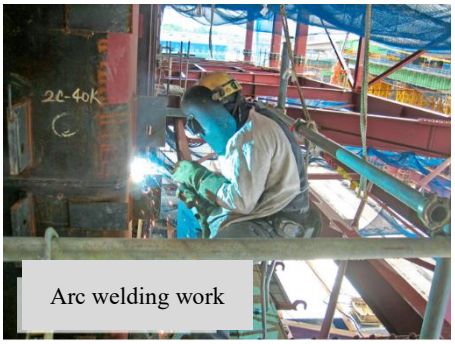
[Kasane tsugite] (rebar lapping) A method used with thin rebars. The portion where the rebars overlap each other (the joint portion) is joined as one by some method, such as arc welding. Where the reinforcing bars intersect in slabs, the rebar lapping method is used, after which they are joined

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.

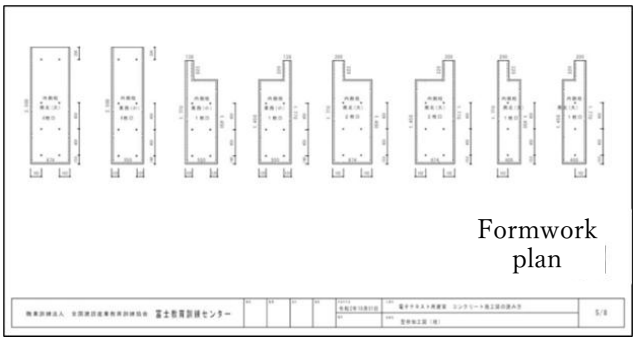
[Rosetsu] (soldering) A welding method in which a filler that has a lower melting temperature than the base metal is melted to act as an adhesive to join the materials.

3.2.14 Formwork Carpentry

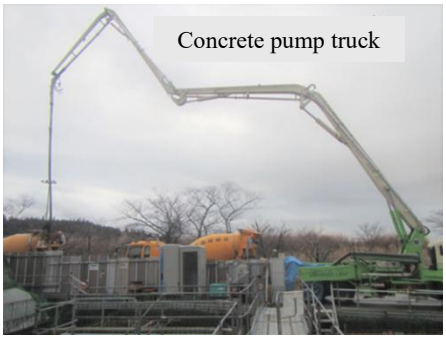
Katawaku koji (formwork carpentry) is the process of building the formwork that cover the reinforcing steel bars installed by rebar work.


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

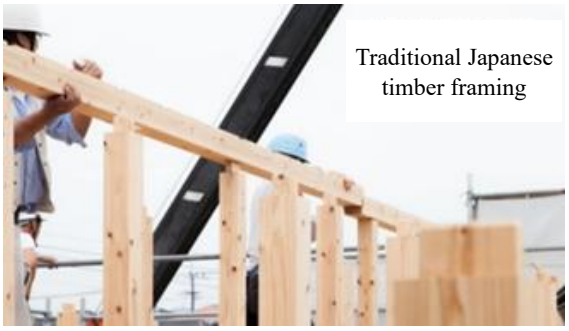
Materials used include wall clay, mortar, Japanese plaster, normal plaster, and fibers. In particular, wall clay and Japanese plaster are materials that have been used in Japan since the old times. Because plastering is often done on the exterior walls and interiors of buildings, workmanship is especially 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.

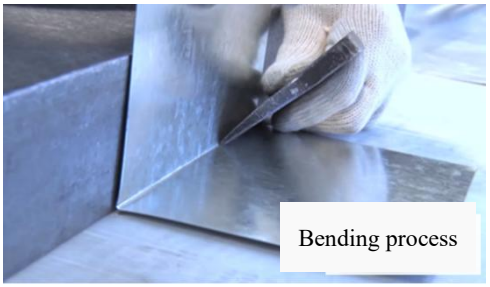

Gutters in need of repair

[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.

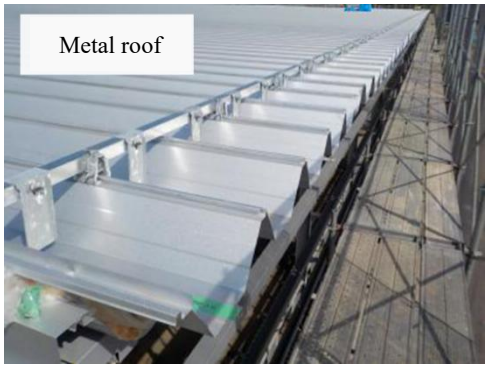
3.2.21 Architectural Sheet Metal Work

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.

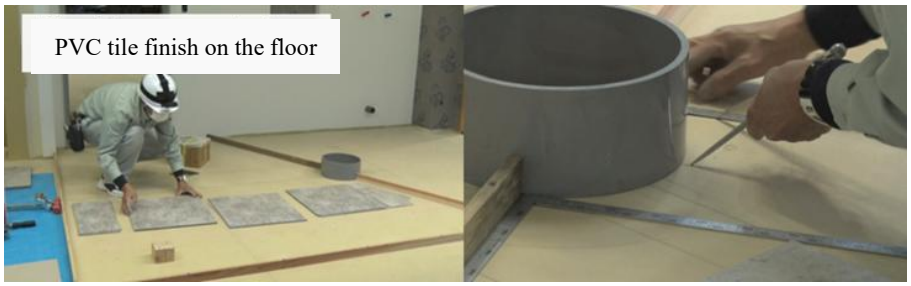
[Cloth bari] (wallpapering) Hanging wallpaper, the wall finishing material, over the plasterboard base.

[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

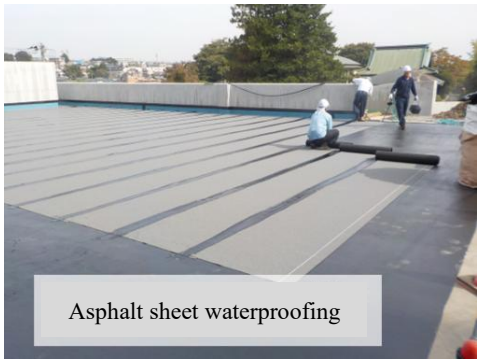
3.2.28 Waterproofing Work

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

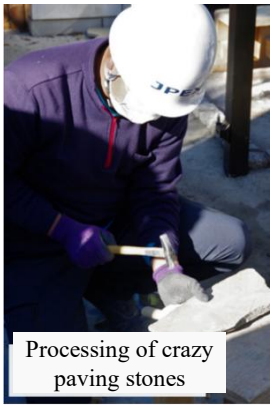
3.2.29 Masonry Work

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.

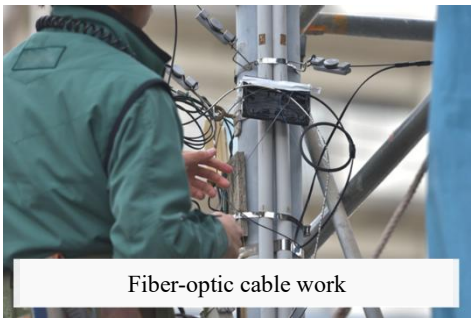
- Grounding work to prevent electric shock and electrical leakage
- Installation of substations
- Installation of power equipment
- Installation of power storage facilities
- Installation of power generation equipment
- Installation of distribution boards
- Supplying power to heating and cooling equipment
- 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*.

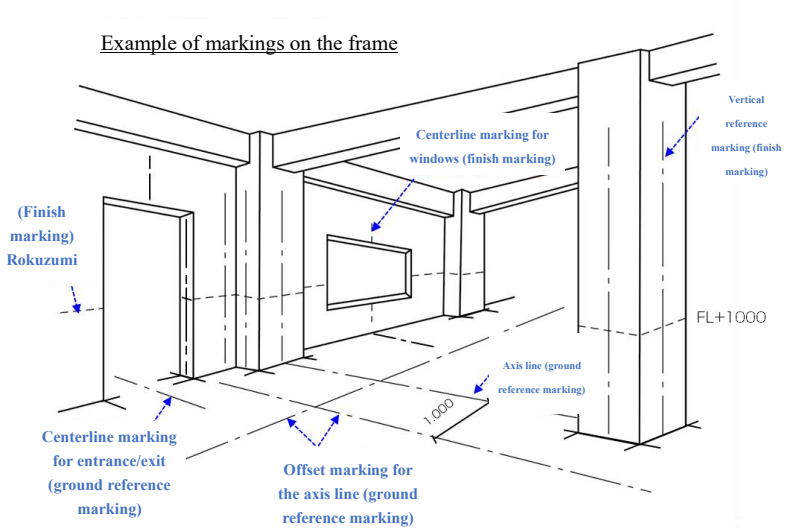
[Nigezumi] (offset marking) A line drawn when a reference marking cannot be drawn due to obstructions. It is also called *kaerisumi*. The line is drawn parallel to or as an extension of the reference marking. The distance from the reference marking is written down for future information.

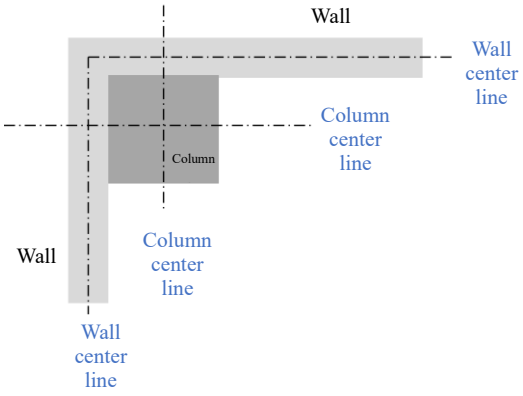
[Rokuzumi] (level marking) Horizontal lines to indicate the standard height, also called *rikuzumi*. Also called *koshizumi*, *mizuzumi*, and *suiheizumi*.

[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

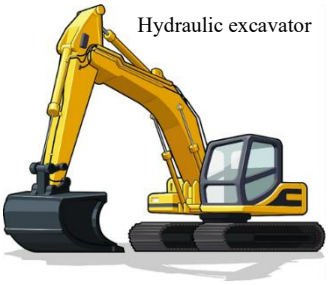
Always clean up after work completion. Clean up afterwards with the intention of setting up and preparing for the next day's work. If you used fire, make sure it is extinguished.

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

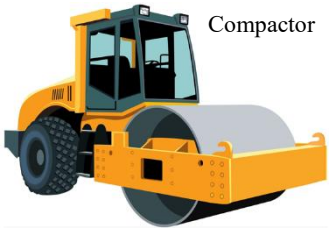
5.1 Tools, machines, materials, and measuring instruments specific to job categories

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

[Ten'atsuki] (compactor) A machine that compacts by weight. There are several types, depending on the material and shape of rollers and their combination.


Compactor

[Road roller] A compactor with steel rollers. It is used to compact subgrade layers and aggregate base layers in pavement construction.

[Tire roller] A compactor with rubber rollers. It is suitable for ordinary soil that is easy to compact and for crushed stones for aggregate base layers of pavements. It is also used for machine-compacting asphalt mixtures.


Tire roller

[Wheel loader] A loading and carrying machine that run on wheels, with a large bucket in front of the body. By moving the vehicle forward and operating the bucket and boom, the machine scoops up various materials such as earth, sand, and quarry stones and loads them onto dump trucks or other vehicles.


Wheel loader

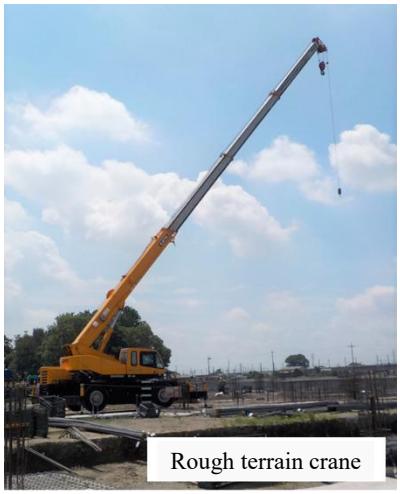
[Dump truck] A vehicle used exclusively for transporting earth, sand, rocks, etc., and is capable of unloading soil (dumping) by tilting the bed of the truck. Often used in combination with hydraulic excavators and wheel loaders.


Dump truck

[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.

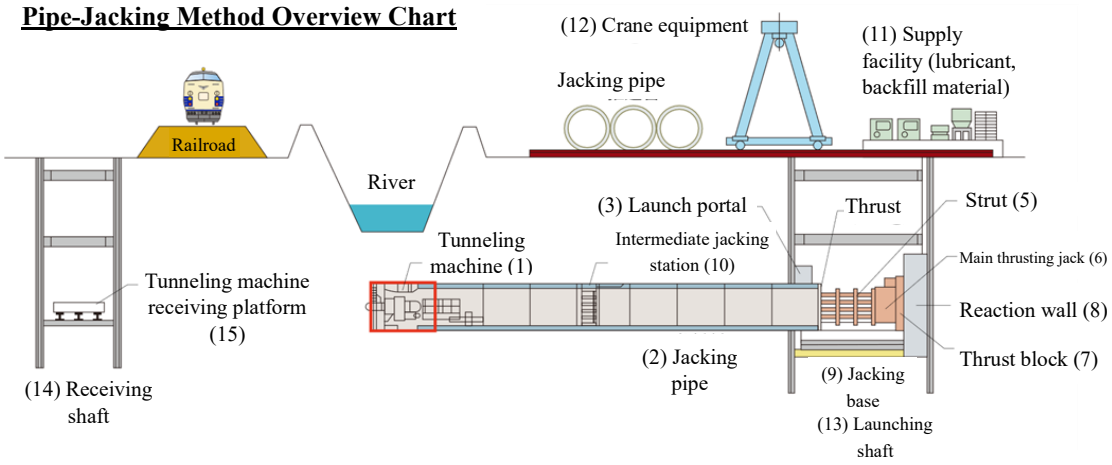
[Rough-ter crane] (rough terrain crane) A type of construction machine with a crane mounted on a truck.

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


Rough terrain crane


Crawler crane

5.1.2 The Pipe-Jacking Tunneling Method



[(1) Kusshinki] (tunneling machine) A machine that digs soil. There are various types of machines, depending on the type of soil to be dug and the method of transporting the excavated soil.

[(2) Jacking pipe] Pipes used in the pipe-jacking method.

[(3) Hasshin koguchi] (launch portal) The opening where the jacking pipe is pushed out of the launching shaft and into the ground.

[(4) Oshiwa] (thrust ring) The thrust ring prevents breakage of the jacking pipe by evenly transmitting the force of the main thrusting jack to the jacking pipes.

[(5) Strut] Struts are used to assist the lack of stroke of hydraulic jacks and as auxiliary struts to transmit the jacking force.

[(6) Moto'oshi yuatsu jack] (main thrusting hydraulic jack) The hydraulic force of the thrusting hydraulic jack pushes the tunneling machine and jacking pipes into the ground.

[(7) Oshikaku] (thrust block) The thrust block distributes the reaction force of the jack and transfers it to the support wall.

[(8) Shiatsuheki] (reaction wall) The reaction wall evenly transmits and supports the reaction force of the main thrusting jack to the ground behind the jack.

[(9) Suishindai] (thrust frame) A thrust frame is a frame used to guide jacking pipes to a specified

height and direction.

[(10) Nakaoshi setsubi] (intermediate jacking station) The intermediate jacking station places a hydraulic jack in the middle of the tunnel to compensate for the lack of jacking force of the main thrusting jack.

[(11) Chunyu setsubi] (supply facility) This facility supplies materials (e.g., lubricant and backfill material) necessary for jacking.

[(12) Crane setsubi] (crane facility) This facility lifts jacking pipes and other objects and moves them down the shaft.

[(13) Hasshin tateko] (launching shaft) A shaft used to push the tunneling machine and jacking pipes into the ground. In the launching shaft, equipment such as the main thrusting jack is installed and the jacking pipes are connected.

[(14) Totatsu tateko] (receiving shaft) A shaft used to remove equipment such as tunneling machines after the tunnel is completed.

[(15) Kusshinki ukedai] (tunneling machine receiving platform) This platform is used to push out and retrieve the excavator after it arrives to the destination.

5.1.3 Marine Civil Engineering Work

[Pump shunsetsusen] (pump dredger) A work vessel that lowers a rotating machine called a cutter head, which is attached to the end of the vessel, to the seabed and digs the seabed while sucking up both the dug sand and soil and sea water.

[Kijukisen] (crane vessel) A work vessel with a crane that lifts, carries, and installs heavy structures such as large blocks and caissons.

Pump dredger

Crane vessel

[Yobyosen] (anchor handling vessel) A work vessel that uses a winch attached to the top of the vessel to hoist the anchors of other work vessels or throw them into the sea.

Anchor handling vessel

[Ikari] (anchor) A weight placed on the seabed to secure the ship's position. It has claws, which are inserted into the seafloor to hold the ship in position.

[Fuhyo] (buoy) Equipment placed around construction sites to notify non-construction vessels of the construction site. Some of them glow at night.

Buoy

[Koyaita] (steel sheet piles) Made of thin sheets of iron. Both sides of a single steel sheet pile have hooks called interlocks that connect the steel sheet piles to each other. They are interlocked to form a wall that keeps the soil from crumbling.

[Kokankui] (steel tube pile) A pile in the shape of a tube made of rounded thin plates of iron. Steel tube piles come in a variety of sizes, ranging from 40-50 cm to over 1 m in diameter.

Caisson

[Caisson] A large box made of concrete used to build breakwaters, quays, and other marine structures. Larger ones are more than 20 meters in length, width, and height.

5.1. 4 Well Drilling Work

[Boring machine] (drilling machine) Machines for digging relatively small-diameter holes in the ground. It is used to dig wells as well as for geological surveys. Excavation is performed by rotational and percussive forces. There are rotary drilling machines, percussion drilling machines, rotary percussion drilling machines, etc.

[Boring pump] A pump used to pump up groundwater from the boreholes. It is used in combination with boring machines.

5.1.5 Wellpointing

[Wellpoint] A collection pipe fitted with a mesh for filtration. It is attached to the end of a water supply pipe called a riser pipe.

[Casing kan] (casing pipe) The outer pipe in a double-pipe wellpoint, with the riser pipe inside. A vacuum pump is used to create a vacuum inside the casing pipe to forcefully collect pore water around the well.

[Rotary percussion drill] A machine that drills holes in the ground by rotation and percussion. In the wellpointing method, it is used to drill holes for large-diameter wellpoints.

5.1. 6 Paving Work

[Asphalt] Material used in paving. It is made from the residue left over from producing gasoline or diesel oil. It hardens at room temperature and becomes liquid at higher temperatures.

[Asphalt finisher] A machine used to spread and level asphalt.

[Distributor] A machine used to spread asphalt emulsifier on roads.

[Hand guide roller] A small hand-pushed road roller.


Hand guide roller

5.1.7 Piling Work

[Earth drill kussakuki] (earth drilling machine) A machine used in the cast-in-situ concrete piling method that drills holes for piles. The ground is excavated by rotating the drilling bucket. Soil accumulates in the bucket and is discharged to the ground when full. This method is called the earth drill method.

[Zenshukaiten kussakuki] (full slewing excavator) A machine used in the cast-in-situ concrete piling method that grasps a steel tube called a casing (or casing tube) and pushes it into the ground while rotating it 360 degrees. This method is called the all-casing method.

[Hammer grab] This bucket is used to grab up earth and sand in the casing tube and discharge it to the ground. Used in conjunction with a full slewing excavator in the all-casing method.

5.1. 8 Scaffolding Work

[Kusabi kinketsushiki ashibayo buzai] (ringlock scaffolding members) *Kusabi kinketsushiki ashiba* (ringlock scaffolding) is a type of scaffolding that uses scaffold members designed to be assembled and disassembled with a single hammer. Basic members include jacks, posts, handrails, scaffold planks with hooks, brackets, cross braces, steel stairs, guardrails, and wall jacks. Basic members are galvanized to resist rust and provide durability.

[Wakugumi ashibayo buzai] (frame scaffold members) *Wakugumi ashiba* (frame scaffold) is a type of scaffolding in which basic members such as jacks, cross braces, and steel scaffold planks with hooks are assembled around portal frames. Basic members include formwork, jacks, cross braces, joint pins,

scaffold planks, wall tie anchors, handrails, ledgers, and toe boards.

[Tankan ashibayo buzai] (tube scaffolding members) *Tankan ashiba* (tube scaffolding) is a type of scaffolding that is assembled using clamps to bind circular hollow sections made of 48.6 mm-diameter steel tubes. The scaffold shape can be flexibly changed, allowing it to be used for scaffolding in tight spaces. It is inferior to frame scaffolding in terms of strength and safety, and is mainly used as scaffolding for painting low-rise exterior walls. Basic members include circular hollow sections, foot plates, clamps, circular hollow section brackets, scaffold boards, and joints.


Ringlock scaffolding


Frame scaffolding


Tube scaffolding

[Sujikai] (cross brace) A member used to prevent scaffolding from collapsing due to wind or other factors. It is placed diagonally between the posts.

[Ashibaita] (scaffold board) Boards that serve as working aisles and platforms in scaffolding.

[Nunoita] (scaffold plank with hooks) A member that serves as the working platform of scaffolding. Unlike scaffold boards, it has hooks to secure it to the beams attached to the upright circular hollow section.


Scaffold plank with hooks

[Tankan bracket] (circular hollow section bracket) A member used to support the scaffold board from below. The horizontal portion onto which the scaffold plank with hooks is supported at an angle.

[Habaki] (toe board) Board material attached to the outer edge of the scaffold board. Attached to

prevent objects from falling.

[Bansen] (thick wire) The thick wire used to assemble scaffolding is called *bansen*. To make it stronger than ordinary wire, the iron is treated with heat and then allowed to cool slowly.

[Chino] A curved tool with a pointed tip. It is used for tying and tightening of thick wires.

[Chino tsuki ryoguchi ratchet wrench] (double-ended ratchet wrench with chino) One end of the grip is pointed, allowing tightening of thick wires, etc. The pointed end is called *shino* (chino). The other end with a hole allows tightening and loosening of bolts. It is used in scaffolding and rebar construction. The size mainly used by steeplejacks is 17 x 21 mm.

5.1.9 Steel Framing Work

[Borushin] (drift pin) A tool used to align bolt holes in steel section joints by tapping into the bolt holes when they are misaligned.


Spanner

[Wrench, spanner] A tool used to tighten and loosen bolts and nuts by rotating them. In American English, it is called wrench, and in British English, spanner. They both mean the same thing in English, but in Japan, they refer to different tools. The wrench has a hexagonal tip and captures the bolt at six points, while the spanner has an open tip and captures the bolt at two points.

[Impact wrench] A power tool for turning and tightening hexagonal bolts using the impact from the built-in hammer.

5.1.10 Steel Reinforcement Work (Rebar Work)


Stationary rebar bender

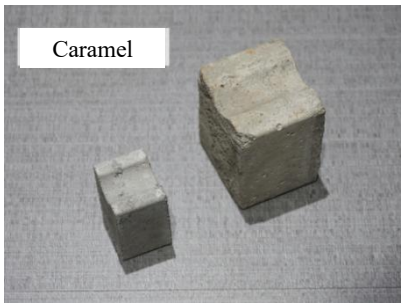
[Tekkin cutter] (rebar cutter) A tool used to cut reinforcing steel bars. There are four types: manual, manual hydraulic, electric hydraulic, and electric circular saw with a tipped blade.

[Teichishiki tekkin mageki](stationary rebar bender) Stationary-type rebar bender mainly used in rebar processing plants.

[Spacer] A member to secure space (space between the rebar and the formwork) of the rebar. Spacers for the sides are called donuts, and the members that hold the top and bottom of the slab or beam are called bar supports.

[Donut] Donut-shaped spacers fitted to rebars to secure space for the correct concrete cover thickness in columns, beams, and walls.

[Caramel] Dice-shaped mortar blocks placed under the floor rebars to secure space for the correct concrete cover thickness of the floor.

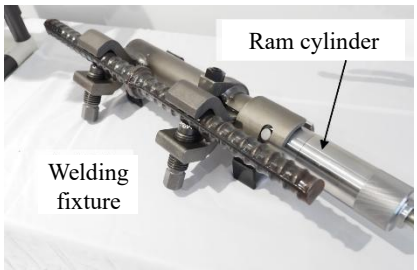


[Kessokusen] (binding wire) A mild steel wire (generally No. 21 in thickness) used to connect rebars.

[Hacker] Rebars are tied together to secure them. The tool used to twist and tighten the binding wire used for tying rebars is called a hacker. It is the most important tool for a rebar worker. There is a hacker case to store the hacker.

5.1.11 Rebar Splicing Work

[Kaatsuki] (pressure system) The section consisting of a hydraulic power unit, a high-pressure hose, and a ram cylinder, which generates the hydraulic pressure necessary for pressure welding.

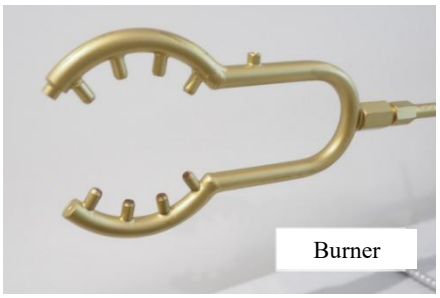


[Assetsuki] (welding fixture) The section in which two rebars to be pressure-welded are set. It is driven by hydraulic pressure generated by a pressurizing pump.

[Ram cylinder] A device used to transfer the hydraulic pressure to the pressure system.

[Dendoshiki kaatsusochi] (electric pressurizer)

A hydraulic pump that can set the pressurizing power as desired. Pressurization can be turned on and off with a switch at hand.

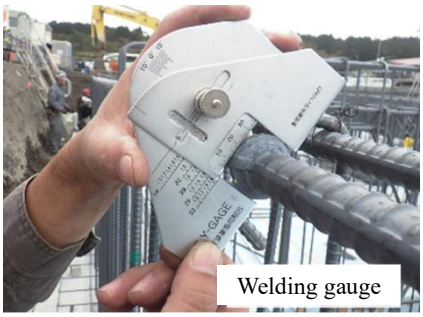

Burner


Electric pressurizer

[Burner] (welding torch) The section that emits flames to heat the pressure-weld joint. There are several different shapes.

[Gaikan sokuteiyo kigu] (welding gauge)

An inspection tool to measure the diameter and width of the bulge of the pressure-weld joint.


Welding gauge

[Cho'onpa tanshoki] (ultrasonic flaw detector)

An inspection device that detects internal defects by applying ultrasonic waves to the pressure-weld joint.

5.1.12 Welding Work

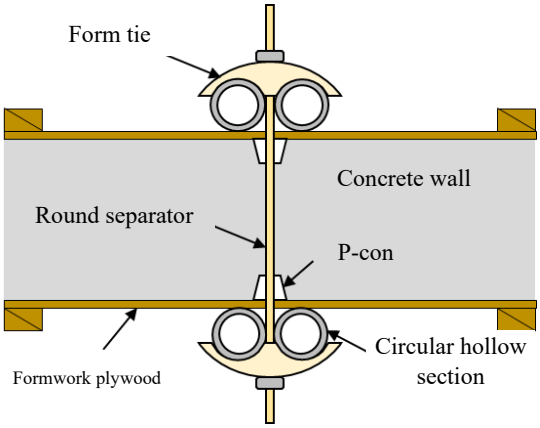
[Hifuku arc yosetsuki] (shielded arc welding machine) A welding machine that uses a welding rod with a metal core covered with a coating material (called "flux"). This type of welding machine is often used at work sites. Welding with a shielded arc welding machine is sometimes called *teyosetsu* (manual welding) because it is done entirely by hand.


Shielded arc welding machine

[Shield-mentsuki helmet] (welding helmet) A helmet with a shield attached to it, protecting the entire face. Mainly used for welding work.


Helmet with a face shield

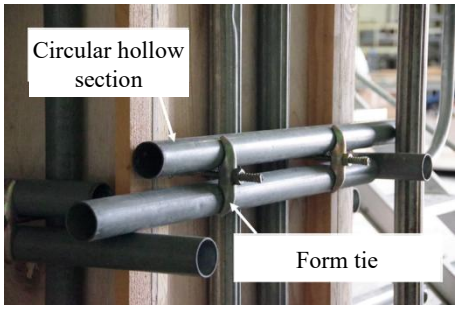
5.1.13 Formwork Carpentry



[Form tie] A tool attached to separators to keep the formwork spacing constant, improve passage, and prevent deformation of the formwork due to lateral pressure from the concrete. It is used to bind the tubes.

[Maru separator] (round separator)

A tool commonly called *sepa* or *marusepa* that is placed between formwork facing each other to ensure that the thickness of the concrete will be as indicated in the construction drawings.



[Tankan pipe/kokan pipe] (circular hollow section, steel tube) A material used to increase the strength of the formwork. Circular hollow sections are round whereas steel tubes are square-shaped.

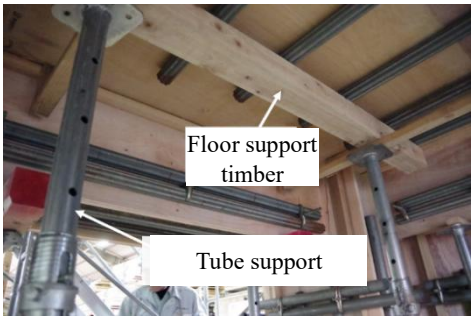
[Sangi] (batten) A 25 x 50 mm piece of wood used together with plywood. It is used at joints between panels and to supplement the strength of the formwork.

[Sekiita] (formwork plywood) Plywood used to make formwork. Generally, 12 mm thick *conpane* (formwork plywood) is used.

[Panel katawaku] (panel formwork) A panel-shaped formwork made by nailing pieces of batten onto plywood to


Panel formwork

create a panel. Panel formwork is intended for repeated use.

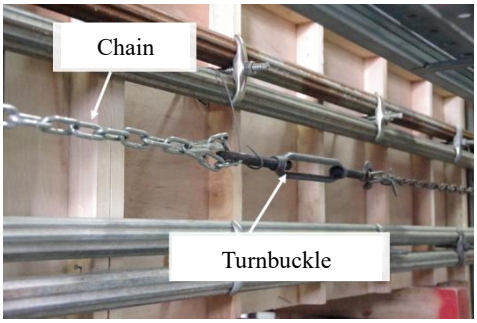


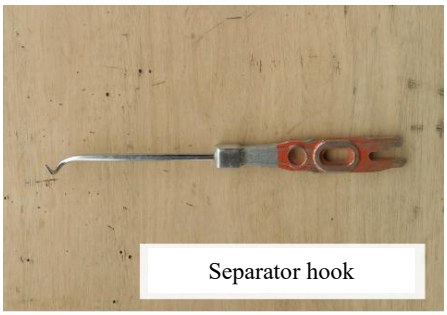
[Batakaku] (floor support timber) Square timber with a width of 90 mm or 105 mm. It is used to erect tube supports and to support the circular hollow sections for the floor framework. It is also used as a platform on which to place heavy objects.

[Pipe support] (tube support) A member used for the bottom plate of beams and as supports for floor formwork. It bears the compressive forces. It is called *sapo*, *sappo*, support, etc. for short.

[Turnbuckle/chain] Used to prevent collapsing of the formwork and to adjust the verticality (i.e., to accurately level and straighten the columns and beams) by pulling.

[Separator hook] A tool used to guide the separator into the hole drilled in the formwork.





5.1.14 Concrete Pumping Work

[Agitator] A device that agitates pre-mixed concrete to prevent it from hardening. Trucks equipped with this function are called truck agitator (concrete agitator trucks) or *nama-consha* (ready-mixed concrete trucks).

[Concrete pump] A machine that uses hydraulic or mechanical pressure to feed ready-mixed concrete (concrete made at a factory that has not hardened yet) brought in by concrete agitator trucks into the

formwork. There are two types of pumps: *piston shiki* (piston type), which has high pressure and can pump over long distances, and *squeeze shiki* (squeeze type), which has low pressure and limited pumping distance. A device in which a concrete pump is mounted on a vehicle is called a concrete pump truck.

[Hopper] (concrete hopper) A part that receives ready-mixed concrete from a concrete agitator truck. A screen is attached to the concrete hopper to prevent people and foreign objects from falling into the hopper.

[Boom sochi] (boom) Equipment used to bring the delivery pipe to the location where the concrete is to be placed. Booms can be folding, telescopic, or a combination of these types.

[Senkai sochi] (boom manipulator) A device that moves the boom up and down and swivels it.

[Kadai sochi] (superstructure) A structure for attaching boom and outrigger devices to the vehicle body. It consists of a sub-frame and a boom pedestal.

[Outrigger sochi] (outrigger) A device that extends outward from the body of the vehicle to maintain the stability of the concrete pump truck.

[Yusokan] (delivery pipe) A pipe used to deliver concrete from the concrete pump truck to the location where the concrete is to be placed. It consists of straight pipes, elbow pipes, tapered pipes, a placing hose, etc.

[Cement] Material used to make concrete. It has the property to harden when mixed with water.

[Kotsuzai] (aggregate) Sand or gravel that is mixed with cement when making concrete or mortar.

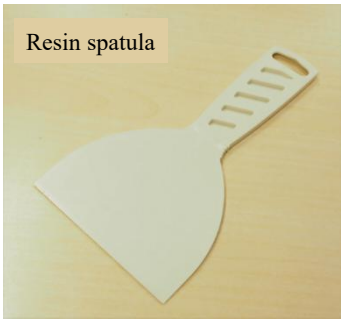
[Slump cone] A formwork for conducting a slump shiken (slump test) to check the quality of ready-mixed concrete. After pouring the ready-mixed concrete into the slump cone, the slump cone is removed in order to check the change in height of the ready-mixed concrete. A slump test is always performed prior to placing concrete.

5.1.15 Painting Work

[Hake] (brush) A tool for painting with bristles attached to the end of a wooden or plastic handle. There are various types of brushes, including bristle brush, rubber brush and flat brush, depending on the area to be painted and the type of paint, such as oil-based or water-based.


Brush

[Pate] (putty) A paste-like material used to eliminate unevenness and flatten the surface of a substrate (called *pate shori* (puttying)).


Resin spatula

[Jushibera] (resin spatula) Used for mixing putty, filling putty, spreading adhesives, and pressure bonding masking tapes. There are different types depending on the hardness (bendability), and they are used for different purposes.


Wool roller

[Wool roller] A roller used for efficient painting of wide surfaces. Used in combination with roller handles. Longer bristles allow the paint to soak in better and are suitable for painting large surfaces. The shorter ones leave less hair trails and create a cleaner finish.

[Scraper] A tool used to remove stuck-on paint and dirt. The process of scraping off rust and other debris from surfaces before painting is called *keren sagyo* (scraping work), and a scraper is used in this process. Larger ones, also called *kerenbo* (scraping sticks), are used not only for the scraping work but also for removing P-tiles from the floor.


Skiving knife

[Kawasuki] (skiving knife) The tool was originally used to skive skins, but because of its sharp blade, it is also used for *keren sagyo* (scraping work) in the painting process.

[Masking tape] A tape used to protect certain areas from paint. It is applied to the border between the painted area and the area to be protected. It can be easily peeled off. To prevent paint from seeping in through the gaps, press the tape down well with finger so that there are no lifted areas.

5.1.16 Landscaping Work

[Karikomi basami] (trimming shears) Scissors used to cut the leaves and branches to shape the hedges and low garden trees.

[Sentei basami] (anvil shears) Scissors for cutting thick branches.

[Karibaraiki (8)] (mower) A tool for cutting weeds.

5.2 Common Tools, Machines, Materials, and Measuring Instruments

5.2.1 Power Tools

[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.

[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.

Circular saw

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


High-speed cutter

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.

[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


Line marker

[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.


Laser 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.


Punch

[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 (this is called marking).

5.2.4 Measuring/Inspecting


Level

[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.


Transit

[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.


Level

[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.


Plumb bob

[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.


Convex

[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.

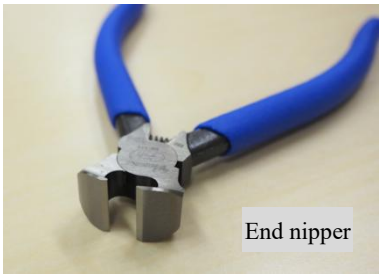
[Jogi] (ruler) A tool used for measuring length and drawing straight lines. Materials include aluminum, stainless steel, and bamboo. To avoid damaging materials such as fittings, bamboo rulers are used.


Aluminum ruler


Stainless steel ruler


Bamboo ruler

5.2.5 Cutting/Bending/Breaking


End nipper

[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.

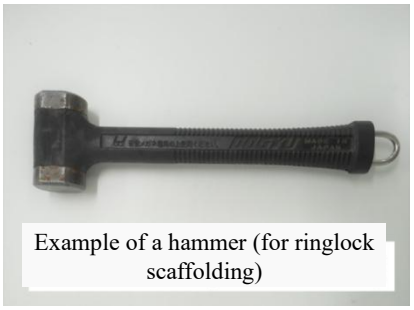

Pliers

[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.


Box cutter

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*.

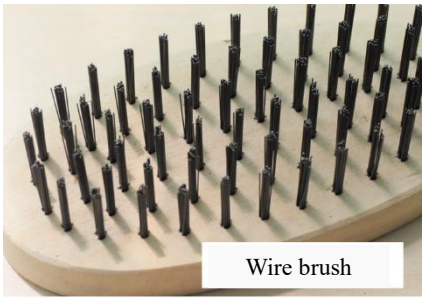
Crowbar

[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.



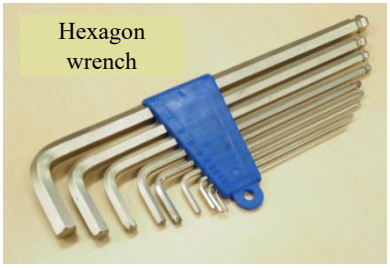
Wire brush

Wire brush

5.2.8 Tightening/Fixing


Monkey wrench

[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.


Hexagon wrench

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


Screwdriver

[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

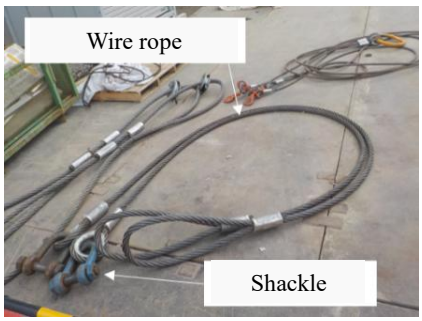

Wheeled platform

[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

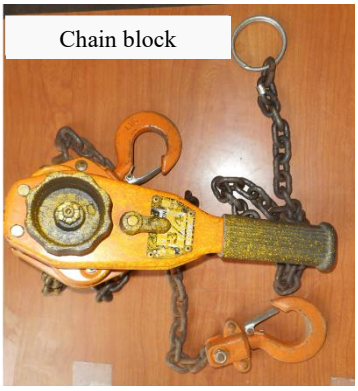
[Forklift] A vehicle equipped with forks that move up and down using hydraulic pressure. Objects placed on the fork are raised to or lowered from high places.

5.2.13 Hanging/Lifting/Pulling



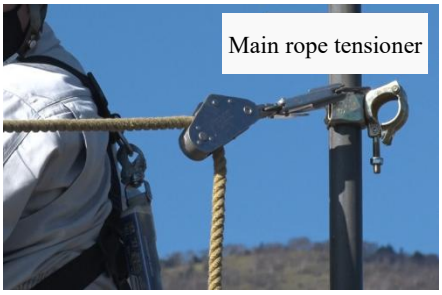
[Winch] A machine that winds up a rope. Also called *makiageki*.

[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


Stepladder

[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.


Portable elevated work platform

[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.

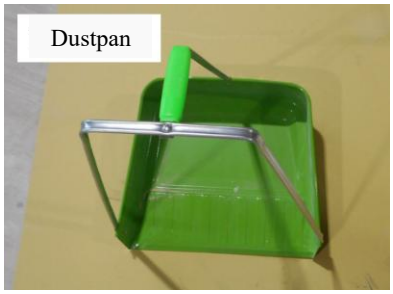
[Kosho sagyosha] (aerial work platform) A vehicle equipped with a device that can raise and lower a man basket to a height of 2 m or more.

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.


Broom


Dustpan

Chapter 6: Knowledge of Construction Site Work

6.1 Matters Common to Construction Sites

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. C

(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 a pre-work inspection.

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 Construction Knowledge of Each Specialty Work

6.2.1 Earthwork

(1) Excavation work by hand

First, check the excavation site. For example, unstable stones on the untouched ground can fall and cause accidents, so check to see if there are any. Also check for cracks, water content, the presence of springs, and changes in freezing conditions. After heavy rain or earthquakes, these factors are inspected again because the conditions may have changed. Also, use lighting when working in dark areas.

Digging into the lowest part of a near-vertical face is called *sukashibori* (undercutting). Undercutting should never be done because of the danger of collapsing.

A pickaxe is a tool used for excavation. The pickaxe is a dangerous tool because it has a pointed tip. Before use, make sure the handle is securely fastened to the head. Also, taking big swings can be very dangerous because you could hit someone behind you. When two or more people are excavating, make sure to work at a distance. Instead of staying apart vertically, stay apart in the horizontal direction. Instead of taking big swings, use the pickaxe's own weight for excavation.

(2) Backfilling, compaction, and machine compaction work

It is important that during backfill, the soil is sufficiently compacted. Remove any material left over from the previous work in the area to be backfilled. Water, if present, should also be removed before the work is done. For backfilling, use materials that have been predetermined. Backfilling is done by a depth of 30 cm or less at a time, using a hand roller or other compaction machine to repeatedly compact the soil.

A rammer is used for compaction of ditches and other narrow areas. When machine-compacting a large surface, a tool called a plate is used, which compacts by vibrating a plate with a large surface. A rammer is a tool used to compact the ground with the weight of the equipment and the impact caused

by the up-and-down movement of the ram plate. Always operate the rammer with the rammer in front, slowly pushing to move it forward. Its impact is very heavy, so be careful not to hit your own feet. Also, when using a rammer with a power cable, pay attention to the cable routing.

(3) Embankment and cutting soil by hand

First, the slope and finished thickness of the slope are determined by surveying and marking with stakes or other means as reference for the work location. If there are tree roots or water in the area to be embanked or cut, remove them beforehand. To prevent accidents, do not place heavy objects on top of the slope (the edge of the plane above the slope). Also, pay attention to soil falling down from the slope of the cut soil while working. Check the shape of the embankment and cut soil daily.

(4) Handling water

Handling water is an especially important task in earthwork. If it rains, leave a smooth surface after the work is done to prevent soil from being washed away by the rain. It is also necessary to take measures to prevent rainwater from seeping in by covering it with a sheet or other means. In addition, make sure that the construction surface is sloped for drainage, and create a drainage path. If facing a road, install drainage pipes.

(5) Slope protection work


Spraying a sloped surface

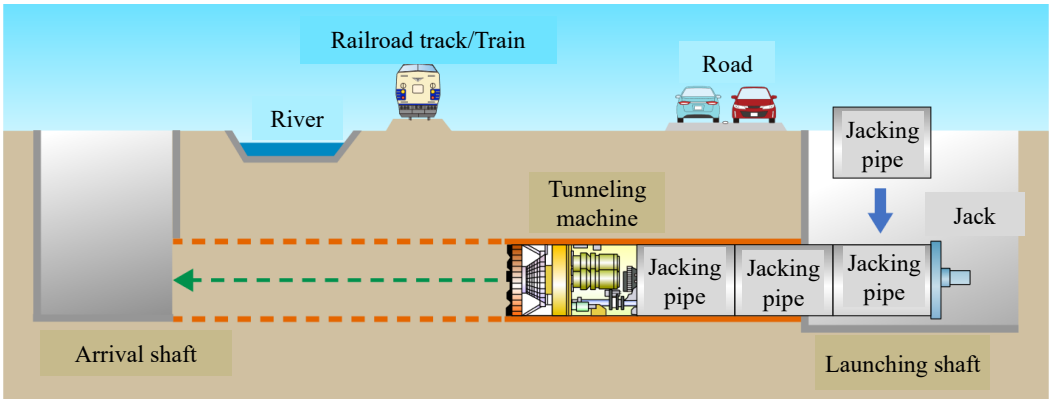
When spraying mortar on to prevent the slope from collapse, spray from top to bottom. The spraying work should be carried out perpendicularly to the construction surface, and with even thickness. The top of the slope is sprayed along the natural ground to prevent rainwater infiltration. When spraying on bedrock, remove unstable rocks, muddy soil, and debris beforehand. If the sprayed surface is earth or sand, care should be taken to prevent the pressure of spraying from scattering the earth or sand.

When spraying seeds, soil, and other materials, use specialized machines and make sure to achieve

an even thickness. Turf delivered to the site should be placed as soon as possible. Watering on sunny days should be done in the morning or evening, avoiding midday.

6.2.2 The Pipe-Jacking Tunneling Method

There are various methods of tunnel construction, depending on the geological characteristics of the site to be excavated. This section describes the pipe-jacking method of tunneling, where tunneling machines are used to excavate underground and construct a tunnel.



(1) In pipe jacking, a shaft is first constructed at the starting point of the tunnel to serve as the tunneling base and a connection to the ground level. The shaft is used to transport materials required for tunnel construction down, and send excavated earth up to the ground. Heavy materials and equipment are carried in and out from within and the top of the shaft.

(2) After the shaft is constructed, the jack to push the jacking pipes into the ground and other temporary equipment are installed, and the tunneling machine is brought into the shaft.

(3) When the tunneling machine is ready, it is launched from the launching shaft (starting point side) and the tunnel excavation begins. In the pipe-jacking tunneling, factory-made pipes are connected to the tunneling machine and pushed into the ground with the jack installed in the shaft. Excavation is continued by repeating this process until the arrival shaft is reached (end of the tunnel).

(4) Once the tunneling machine has reached the arrival shaft, the tunneling machine, the jack, and other temporary equipment are dismantled and removed. If manholes or other structures are designed into the shaft, they are usually constructed after this step.

Matters to be considered in the pipe-jacking tunneling method are as follows.

□ Inside the tunnel, be aware of the possibility of oxygen depletion and toxic gases. Carbon monoxide and carbon dioxide are colorless and odorless, so their presence or absence and concentration must be measured using a detector. Toxic gas measurements must be taken at the beginning of each work shift to ensure safety. In addition, ventilation must be provided in the shaft and inside the tunnel.

□ Pipe-jacking tunneling is often used for sewer and water piping construction with small pipe diameters, often 0.2 to 3 m in diameter. In addition to the various temporary equipment required for pipe-jacking tunneling, excavated earth and sand are carried out through the shafts. Take care to avoid being caught-between, hit by flying/falling objects and falling from heights.

6.2.3 Marine Civil Engineering Work

At marine civil engineering worksites, many different types of work vessels gather to work. This is called a fleet. The fleet leader, who organizes the fleet, gives instructions to each work vessel to perform the work. In addition, each work vessel will be directed by a person called the captain or deck officer.

Fleet (breakwater construction)

(1) Preparation of the construction site

Place a buoy to mark the construction site on the sea. This prevents other vessels from coming in

during construction.

The work vessels used for construction are moved from the work vessel's base port (the port where the vessels are anchored when not working) to the construction site using a tugboat.

At construction sites, anchors at the four corners of the work vessel are lowered and secured using an anchor handling vessel to prevent the work vessel from being moved from the construction site due to waves or wind.

(2) Work performed on/by work vessels

The work vessels perform various types of construction work such as dredging, breakwater construction, and quay wall construction. The following tasks will be performed on the work vessel or at the site at sea

[Tamagake sagyo] (slinging) Attaching and detaching wires to loads when lifting them with a crane. In marine civil engineering work, crane vessels are used to load and unload concrete blocks, stones, and other materials.


Slinging

[Crane sagyo] (crane operation) Crane operation involves lifting heavy objects, moving them from place to place, and lowering them to a different location. The cranes on the work vessels are used for dredging, dumping in uniform riprap, and installing blocks.


Crane operation (dumping in uniform riprap)

[Winch sagyo] (winch operation) A winch is a machine that can wind up and send out wires. When moving or securing the work vessel, the winch of the anchor handling vessel is operated. Also, in breakwater construction, caissons are installed by winch operation.


Winch operation

(3) Safety of marine civil engineering work

Marine civil engineering work cannot be performed when

there are large waves, as the work vessels will be greatly disturbed. When doing construction, it is always necessary to know the weather and wave forecast.

Marine civil engineering works are performed near the sea, on the sea, and on working vessels. When working, there is a danger of slipping and falling or falling into the water. Also, work vessels are very narrow and have various machines on them, making it very easy for workers to bump into or trip over them, which is very dangerous.


Example of a life vest

□ When working on the sea, always wear a life vest. When worn correctly, life jackets are designed so that when a person falls overboard, his or her mouth will be maintained above water.

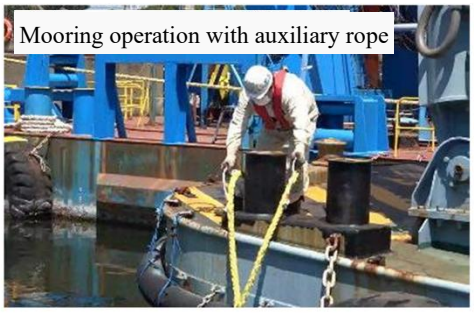
□ The ropes on work vessels are dangerous. Do not place your foot among the ropes on the deck, or step on them. If the boat moves and the rope suddenly shifts, the rope can wrap around your leg and cause injuries.


Example of using an installed ladder

□ Boarding and disembarking the work vessel can result in falling into the sea. Do not jump on or off. Climbing to the wharf from a small boat should be done where there are stairs or ladders installed, or use a portable ladder.

□ When carrying cargo between vessels, a wide *ayumiita* (gangplank) is set up. Only one side of the gangplank is secured to the boat.

□ When mooring a work vessel, the eye (the looped part at the end of the rope) is hung on a short post called a bollard, and when doing so, always use an auxiliary rope to prevent fingers from being caught in.


Mooring operation with auxiliary rope

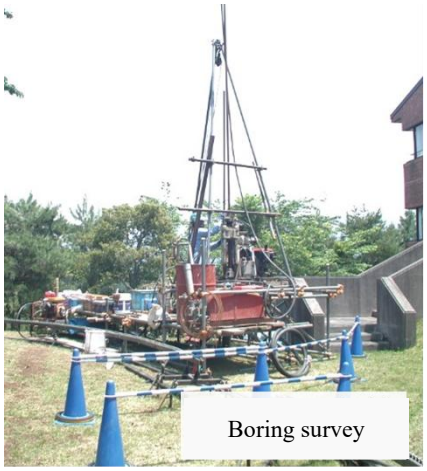
□ When moving around on a work vessel, only pass through designated areas and do not enter restricted

areas. Comply with the signs on the working vessel.

□ Always keep the work vessel deck organized and tidy. Also, wipe up any oil spills, as they can cause slipping and falling.

6.2.4 Well Drilling Work

Small wells are for general household use, and water is pumped manually. Medium-scale wells are installed at evacuation sites, etc., and water is pumped up using an emergency generator. Wells used for drinking water must allow drawing water of good quality.



Boring survey

(1) Preparatory temporary structure

Determine the scope of construction and clear the site. After clearing the site, the drilling machine is assembled.

(2) Drilling

A boring machine is used to drill straight through to the water-bearing stratum (called *taisuiso* (aquifer)), making sure not to collapse the stratum. Use the appropriate drilling equipment to excavate in the shortest time possible, according to the strata. The drilled hole is filled with drilling mud mad of melted clay to prevent collapsing and to keep the digging debris afloat. Digging debris is removed by a device called a bailer. The drilling and removal process is repeated until the aquifer is reached.

(3) Selection of the aquifer

Once the planned depth is reached, the resistance of the stratum is checked using a method called *denki kenso* (electrical logging), in which an electric current is passed through the hole to determine if the layer is suitable as a water source. Resistance is lower in clay layers, and higher in sand and gravel layers with good groundwater flow. Once the aquifer is determined, a device called a screen is installed to extract groundwater at this location.

(4) Gravel filling

Connect and insert the casing pipes into the hole. The area between the drilled surface and the casing is filled with sorted gravel or silica sand. This is to control sand, secure the screen and casing, and prevent collapsing of the borehole wall. The depth of the fill, the size of the gravel grains to be used for filling, and other factors are important, affecting the quality of the finished well.

(5) Finishing

Muddy water in the well is pumped out to allow groundwater to flow out.

(6) Water shielding

Water from the ground surface or aquifers of poor water quality is prevented from entering the well.

(7) Pump installation

A pumping test to determine the amount of water to be pumped and a water quality test to determine the quality of the water to be pumped are conducted, and the pump is installed.

6.2.5 Wellpointing Work


Wellpointing work

When the ground is being excavated for building foundation work, if groundwater flows into the excavation, earth and sand will flow out of the sides of the excavated area and interfere with the construction work. Wellpointing is performed to lower the groundwater level in close proximity to the stratum in which construction is taking place to create a strong foundation. Pumping will continue until the necessary construction is completed. Once the foundation work is complete and pumping is stopped, groundwater will return to the level natural to the local environment prior to construction. The wellpointing method is suitable for pumping up water at a depth of 2 m to 7 m. For greater depths, the deep-well method is used.

(1) Investigation and determination of construction details

Investigate how far the groundwater level should be lowered. Based on the results of the survey, a projection of the drainage volume is made to determine the spacing and number of wellpoints to be installed.

(2) Preliminary jetting

Using a jetting pipe, a hole is jetted to the required depth using pressure water from a jet pump attached to the pipe.

(3) Installing wellpoints

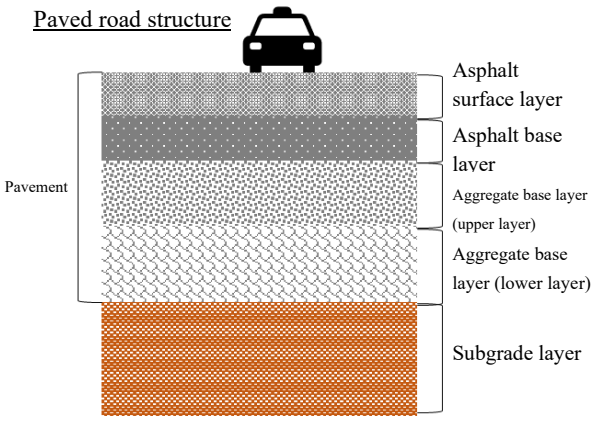
A wellpoint is attached to the end of a riser pipe, and inserted into the previously jetted hole. This process is repeated at pre-determined intervals.

(4) Connection to the header pipe and installation of the vacuum pump

Connect multiple wellpoints to a header pipe. The header pipe connects to a vacuum pump for pumping out water.

6.2.6 Paving Work

If a road to be worked on already exists, it is subject to general vehicular and human traffic and requires safety measures as specified for traffic safety facilities, such as the placement of flaggers, safety cones, security fences, and road construction signs. A paved road is composed of four layers. The construction will be divided into four processes, one for each layer.



(1) Subgrade layer work

The lowest level of the road is called *rosho* (subgrade layer). When thick, it can be about 1 m deep.

A backhoe or bulldozer is used to dig into the ground. Because different operations are performed simultaneously over a short distance, such as excavating with a backhoe, loading excavated soil onto a dump truck, compacting with a hand roller, spreading and compacting gravel with a bulldozer, and compacting with a road roller, be mindful of avoiding accidents including collisions with heavy equipment, entanglement, and being crushed.

(2) Aggregate base layer construction

The aggregate base layer is the middle layer of a paved road, divided into upper and lower layers. Crushed stone or other materials are placed over the subgrade layer to disperse loads and impacts. Although not seen at worksites, a machine called jaw crusher is used to crush stones into small pieces, which is brought in and used. Crushed stones are scooped up from dump trucks with a backhoe or excavator buckets and spread on the subgrade layer. Workers leveling crushed stones with rakes are often working at the same time, so care must be taken to avoid accidents.

(3) Asphalt base layer construction

The asphalt base layer is the layer above the aggregate base layer. The heated asphalt is spread and leveled with an asphalt finisher. The asphalt finisher is a machine that discharges asphalt in the hopper from the back. The edges of the road are leveled by hand using a tool called *tonbo* (asphalt rake). The spread asphalt is compacted with a macadam roller or other machinery, and further compacted with a tire roller. By using two different machines, it is possible to compact not only the surface but also the interior.

(4) Asphalt surface layer construction

The asphalt is spread using the same method as for the base layer construction. The asphalt used in this process differs in nature from the asphalt used in the base layer construction, having high water resistance and non-slip properties.

6.2.7 Mechanical Earthwork

Mechanical earthwork is earthwork performed using construction machinery. If multiple machines or workers will be working on the same construction site, make sure there are no other vehicles or people around before commencing work. When getting in and out of vehicles, be sure to turn off the engine and lock the safety lever. In addition, during machine cutting operations, the direction of the machine's undercarriage should be oriented at a right angle to the cutting edge as a general rule.

When transporting machinery to the construction site, a vehicle dedicated to machine transfer is used. A ramp called *tohan yogu* (loading ramp) is installed on the transfer vehicle for loading and unloading. The ramp should be securely attached to the loading bed with a slope of 15 degrees or less. Since tipping over a machine can cause a fatal accidents, the surrounding area must also be kept off-limits.

Because mechanical earthwork often generates noise and vibration, measures such as using *teishindogata kensetsu kikai* (low-vibration construction machinery) that have been designated as low-vibration/noise construction machinery according to the regulations of the Ministry of Land, Infrastructure, Transport and Tourism, are taken.

In order for the construction work to be carried out as planned, machines must function properly without malfunctioning. At the end of the day's work, park in a safe place, and lower buckets and other attachments to the ground. Once the safety lever is in the locked position, allow the machine engine to idle for about five minutes while stepping off the machine and check for oil leaks, coolant leaks, etc.. Abnormalities are to be reported to the person in charge of maintenance, and the results of daily maintenance are recorded in the inspection chart. Even though inspections are performed after work is completed, it is required by the Occupational Health and Safety Law that brakes and clutches be inspected before commencing work.

6.2.8 Piling Work

(1) Preliminary investigation of underground objects and facilities

Before piling work begins, a survey of the buried objects is required. For example, if there are buried gas, water, or power lines in the area where the holes are to be dug, it could cause a major accident. Presence of large rocks and hard bedrock requires specific methods of excavation and machines. If important archaeological sites or cultural assets are buried, archaeological excavation and other research will be required.

(2) Geotechnical survey

In addition to investigating underground objects and facilities, a geotechnical survey of soil quality, soil strength, and groundwater level is also required. A boring machine is used to dig deep holes and collect soil samples for investigation and determination.

(3) Safety precautions

Foundation construction involves the use of large machinery, which can pose a variety of hazards. Most accidents are caused by errors in work procedures, unstable machine locations, falling machines or materials due to loss of balance, slipping/tripping or falling into openings due to careless stepping or backward movements, or being caught-between by entering an area that is off-limits. To avoid accidents, it is important to check above and around, pay attention to moving machinery, and alert other workers.

- Danger of falling objects

Incorrect procedure when using a pile driver, such as removing the wire before inserting the pin, could result in the screw detaching from the joint and falling off. Also, when using a vibro hammer to drive in or pull out H-beams or sheet piles, the H-beams or sheet piles could fall.

- Danger of being caught-between

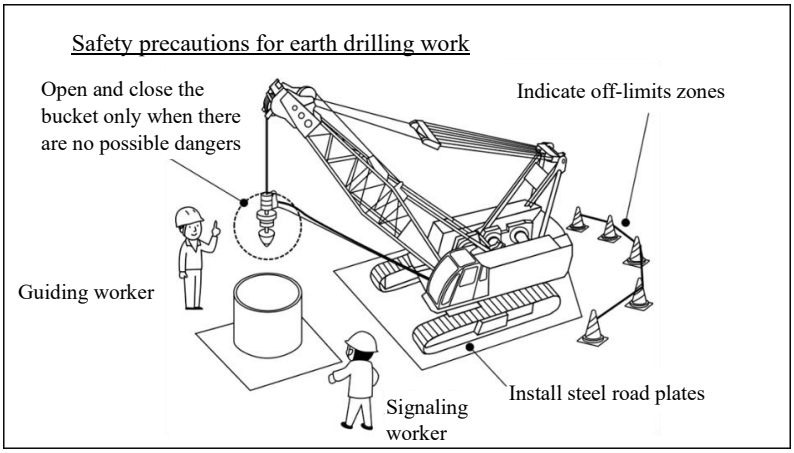
When a pile driver or crane is in motion, if the machine is operated incorrectly or if a worker enters an off-limits area, there is a risk of being caught between the suspended H-beams, sheet piles, the

leader, etc. and other surrounding objects.

- Danger of tipping over

Depending on the location of large machines, they may lose their balance and tip over.

- Danger of falling from heights



Although foundation work is not performed at height, and thus there is little risk of falling from heights, falling into excavated holes due to inattentive backward movement and falling from machinery such as when performing joint work on a pile driver leader are possible accidents. In addition to wearing non-slip shoes, it is important to receive work instructions from the work supervisor.

6.2.9 Scaffolding Work

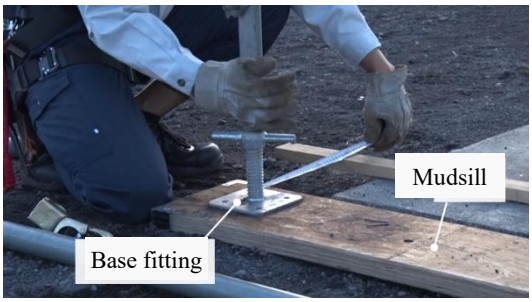
As explained in Chapter 3, there are many different types of scaffolding work. This section describes scaffolding construction. There are several types of scaffolding, including timber scaffolding, tube scaffolding, framed scaffolding, and ringlock scaffolding, but there are some construction tips that are common to all types of scaffolding work. It is to make sure that the footing is secure, then assemble it so that it is vertical and level, and diagonally brace it to keep it straight. To prevent the entire scaffold from collapsing, when there is a building, it is secured to the building with *kabetsunagi* (wall tie anchors). When there is no building, it is braced with circular hollow sections or other means.

(1) Foundation of scaffolding

The ground on which the scaffolding is erected is compacted for strength. If even one upright tube sinking can cause the entire scaffold to collapse. In addition, the ground is made as flat as possible so that there are no gaps between the mudsill and the ground.

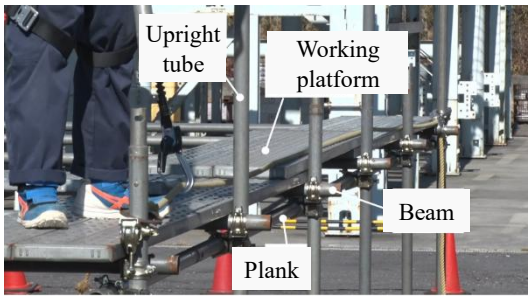
(2) Fixing the legs

The base fitting is nailed to the mudsill laid on the ground.



(3) Installation of upright tubes and planks

Upright tubes are erected vertically, and planks should be attached perpendicular to the upright tubes. The footings of the upright tubes are connected to each other by horizontal members to secure them.



(4) Installation of beams and working platform

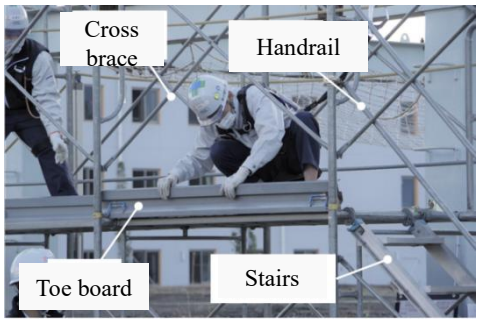
Connect the upright tubes on the front side (the building side) and the rear side (the outside) using braces, and attach the scaffold board (working platform) on top of it.

(5) Installation of stairs, handrails, middle and lower ledgers, and toe board.

Install handrails for workers, middle and lower ledgers for fall prevention, and toe boards to prevent tools and other items from falling. Handrails are also installed for stairs.

(6) Installation of cross braces

Install large cross braces to keep the entire scaffold vertical and level.



(7) Installation of wall tie anchors

To prevent the entire scaffold from collapsing, it is secured to the side of the building with wall tie anchors. If there is no building, diagonal supports (*yarazu*) are installed using circular hollow sections or similar members.

6.2.10 Steel Framing Work

In steel framing work, steel sections are assembled to complete the framework of a building. It is performed in the order of steel section fabrication, foundation frame construction, and steel section erection.

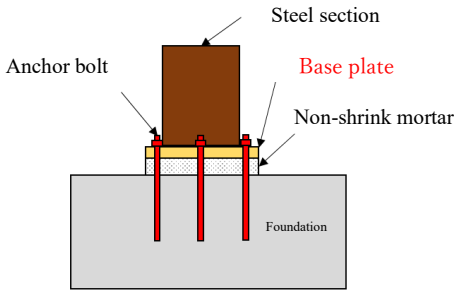
(1) Steel section processing

The steel sections are fabricated in the factory. A construction plan is drawn, and the steel sections are cut accordingly. The cut steel sections are assembled and welded, and the welds are inspected by ultrasonic testing. After inspection, they are coated with rust-proofing paint and transported to the construction site.

(2) Foundation frame construction

Anchor bolts are secured to the nonstructural concrete with anchor bolt stands or other means. This is followed by the placement of the underground beams and foundation reinforcement, foundation formwork, and foundation concrete pouring.

(3) Steel frame erection



Fixing steel frames with base plates

Steel columns and anchor bolts fixed to the foundation are joined to each other by a member called a base plate. Foundation work in steel construction is just as important as that in scaffolding construction. For example, foundation heights may vary slightly, which, if not adjusted, will affect the accuracy of the overall building finish. Check the height of the foundation and match the base plate height of all columns using non-shrink mortar or layers of thin steel plates. After making sure the mortar has set, check the orientation and bolt the columns in place.

There are two methods of fastening the upright members to the beam: bracketed and non-bracketed. In the bracketed method, the beam is divided into three sections, and the two ends of the beams and the columns that cross those ends are bracketed together by welding or other means at the factory. The non-bracketed method is a construction method in which columns and beams are joined directly on site.

The intersection of columns and beams are bolted and then welded. If the holes for the bolts do not match, a tool called a drift pin is used to align them before securing the bolts. At this stage, the nut is temporarily fixed.

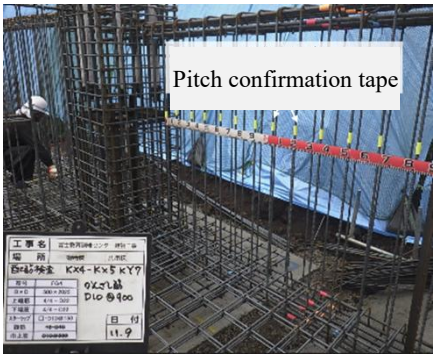
By adding beams, the columns will be pulled and will not be able to maintain their verticality. The

frame is pulled with wires to re-align the steel frames, then the nuts are tightened properly, and then the intersection is welded (stud welding).

6.2.11 Steel Reinforcement Work (Rebar Work)

Concrete is resistant to compressive forces but weak against tensile forces. Because of its tensile strength, rebar can be placed in concrete to compensate for the weakness of concrete.

Rebar can oxidize and rust. Concrete is alkaline, which protects the rebar from rust, but over time it will become more and more neutral. If neutralization progresses to the rebar, the rebar will rust. Therefore, when placing the reinforcement, it is important to ensure a certain distance from the surface of the concrete, or *kaburi* (concrete cover thickness).



In order to maintain strength, it is necessary to use rebar of a specified thickness and to distribute the rebar with proper spacing between the rebars. Tape is wrapped around the rebar to make it easier to check the pitch.

In the case of thin slab rebars, the bars are joined by a method called rebar lapping. This joint method gains strength from the concrete's adhesion to the rebar, but because the strength of the concrete affects the strength of the joint, make sure to secure a sufficient length of overlap and secure the bars with binding wires.

Rebar work is involved throughout the entire construction in a typical RC structure building. In particular, it is closely related to formwork carpentry, and the processes need to be coordinated with each other. In addition, meetings with electric technicians will be necessary for piping and wiring work for electricity and equipment, and with plumbing technicians for water supply and drainage. Rebar work is performed in the following order: rebar fabrication, foundation reinforcement, and floor slab

reinforcement.

(1) Rebar processing

Construction drawings are based on structural drawings calculated by a structural design specialist. From the construction drawings, the required shapes and sizes of rebar and the required number of each are calculated, and a reinforcement detailing is created. Rebar is cut, bent, or otherwise processed according to the reinforcement detailing. In addition, bar tags are created based on the reinforcement detailing. Bar tags are attached to the fabricated rebars and are used for sorting and receipt inspection at the time of delivery.

Rebar cutting


Rebar bending

(2) Foundation reinforcement


Foundation beam reinforcement

Rebar delivered from the processing plant is inspected upon receipt and organized for ease of retrieval in subsequent operations. The foundation reinforcement work begins by layout marking the exact location of the foundation onto the nonstructural concrete. After layout marking is complete, embedded beam bearing brackets are lined up to keep the main beam bars of the foundation at a level height, and secured with nails or anchors for nonstructural concrete. Spacer blocks are used to lift the base reinforcement to ensure cover thickness. After the base reinforcement, the column reinforcement is placed. A column consists of a main rebar placed perpendicular to the ground and hoop rebars surrounding the main rebar. Hoop rebars are installed to reinforce against shear and to prevent the main bar from shifting due to shaking caused by earthquakes and other shocks. Once the column rebar and hoop rebars are bound, spacers

are installed to secure the cover thickness. After the column rebars, the beam rebars are placed. After all the foundation reinforcement is completed, the formwork is erected and the foundation concrete is poured.

(3) Reinforcement of *doma* (ground under the house)

Typically, pipe burial and backfilling are performed prior to *doma* reinforcement. *Doma* reinforcement is placed in the following order: main rebar placement, distribution rebar placement, and installation of spacers. After completing the *doma* reinforcement, the *doma* concrete will be poured.

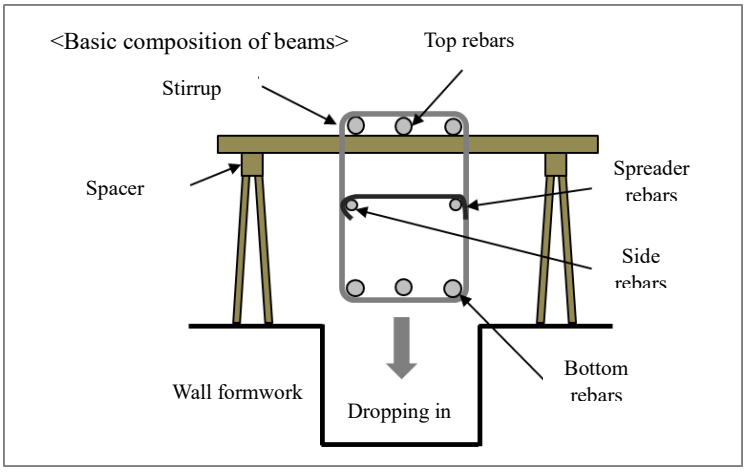
(4) Frame reinforcement

The frame provides the reinforcement for the walls, beams, and slabs.

Wall reinforcement is placed in the following steps: checking the cover thickness, checking the internal/external relationship of longitudinal and transverse reinforcement, allocating the pitch and placing reinforcement, placing reinforcement for openings reinforcement, placing spreader rebars, and placing spacer blocks.

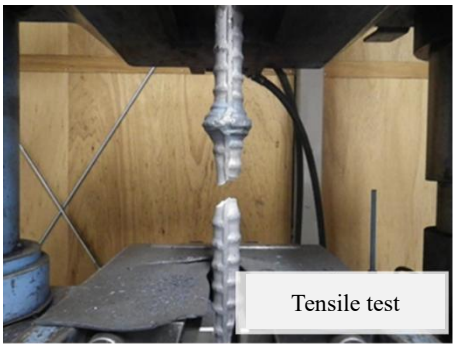
Beam reinforcement is placed in the following order: placement of bottom rebars, temporary placement of hoops at the ends, placement of top rebars, placement of bottom and top rebars of small beams, pressure welding, placement of stirrups and tying to top rebars, placement of side and spreader rebars, dropping into the formwork, and placement of spacers.

The slab shall be doubly reinforced with bottom and top reinforcement consisting of main rebars and distribution rebars.



6.2.12 Rebar Splicing Work

There are several types of rebar splicing methods, but no matter which method is used, the spliced joint must have strength equal to or greater than that of the base rebar. For example, the splice cannot be detected when viewing a cross-section of a perfectly executed gas pressure welded splice, and when a tensile or bending test is performed, the splice does not break, but instead the base rebar does. The following steps are used to check the process while performing pressure welding.


Tensile test

(1) Checking rebar butts

Check for bends in the rebar.

(2) Processing of rebar butts

Rebars are cut by push-cutting at steel construction sites, and therefore their butts are unsuitable for pressure welding as they are. Since the cut surface oxidizes over time, the rebar is cut using a cold-cutting, right-angle rebar cutter on the same day that pressure welding is performed.

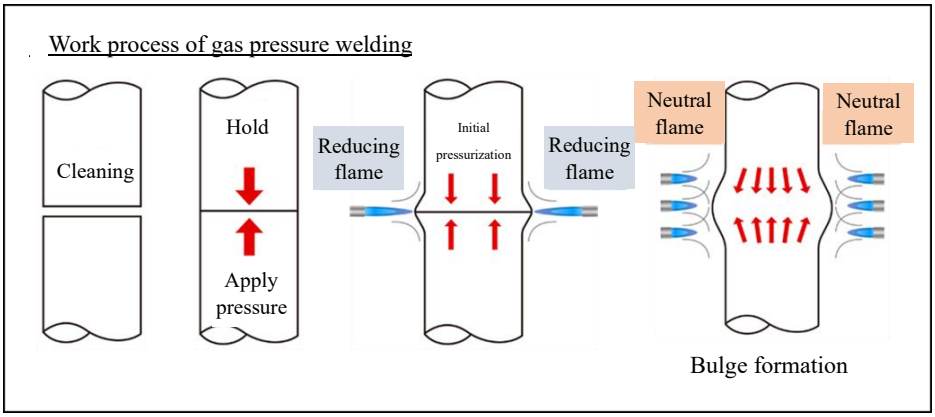
(3) Mounting onto the welding fixture

Make sure the welding faces of the rebars are clean before setting them to the welding fixture using

bolts. Because high pressure is exerted onto the rebar during the pressure welding process, the bolts should be securely fastened so that they do not loosen during the course of the work. When fixing, check the size of the gap between the butts to be pressure welded.

(4) Heating and pressurizing

First, the part where the rebars are butted together is heated with a burner, and the heated portion is gradually expanded to the left and right. The approximate range to be heated is about twice the diameter of the rebar. Simultaneously with heating, pressure is applied to press the butts together. The butts will gradually bulge out, and the work is finished when they reach a predetermined size.



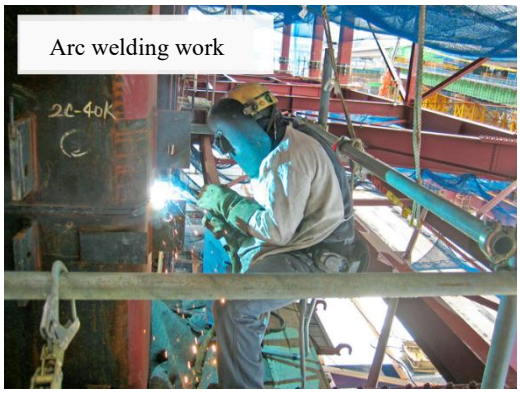
(5) Inspection

The size, length, shaft misalignment, bending, cracks and dents on the exterior, and bulkiness of the bulge are all inspected.

Examples of bad bulging

6.2.13 Welding Work

Arc welding is a necessary technique in many areas of construction work. If the current is too low, proper welding cannot be performed. If the current is too high, the member will melt and create a hole. Proper and constant distance should be maintained between the welding rod and the material to be welded, without getting too close. A proper weld will produce a weld scar that looks like a line of shells. Welding is an easy task for anyone to do once the basics are mastered, but it is important to take precautions against physical effects and accidents.



Arc welding work

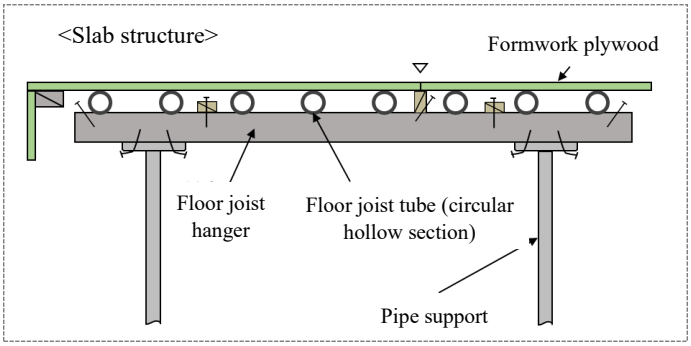
Arc welding uses electrical power to weld metals together, so avoiding electric shocks is the priority. Even more important is the prevention of effects on people. Inhalation of fumes from welding (metal vapors cool and solidify in the air and become individual particles floating in the air, which appear like smoke) can cause symptoms such as headaches, fever, chills, muscle aches, thirst, and fatigue. Dust masks should be worn to prevent fume inhalation. Also, wear light-shielding glasses or welding face shield to protect your eyes from harmful rays. The welded area is polished with a grinder, at which time metal dust adheres to gloves and hands. Avoid rubbing your eyes polishing, as rubbing your eyes can damage them.

6.2.14 Formwork Carpentry


Formwork carpentry


Tightening form ties

When fresh concrete is poured into a formwork, the formwork is subjected to several times the pressure of the same volume of water. Insufficient reinforcement of the formwork can lead to accidents where the formwork breaks (blow-out) and ready-mixed concrete flows out. In order to prevent blow-outs, the formwork must be adequately reinforced to withstand the pressure of the concrete. Also, since placing concrete from height may result in a blow-out, a detailed discussion is held with the concrete pumping contractor regarding the concrete placement method.



The formwork should be erected in the correct position, vertically and leveled, and should be assembled so that it can withstand loads, lateral pressure, vibrations, impacts, etc., without significant deformation or damage.

Wall formwork should be made from materials such as separators, form ties, and P-Con to ensure that there are no misalignments or errors. Form ties can also be tightened through circular hollow sections to make them stronger.

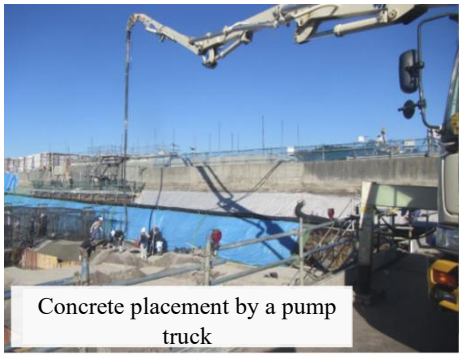
The slab is supported vertically from below because the weight of the concrete will be applied directly in the vertical direction. The materials used are, from the bottom, pipe supports called shoring, floor joist hanger, and floor joist, on top of which formwork plywood (also called *sekiita* in formwork carpentry) is attached.

A sufficient number of pipe supports are required to support the slab. To prevent the shoring from sliding, the footings are connected in two horizontal directions by pipes called *negarami*. If the pipe support is longer, horizontal joints are installed using every 2 m or less in height using circular hollow sections. Finally, the chain, turnbuckle, and support are used to push and pull while checking the verticality and the axis line as adjustments are made.

6.2.15 Concrete Pumping Work

Concrete pumping work involves pouring ready-mixed concrete delivered by truck agitators into formwork using pump trucks. The ready-mixed concrete brought in undergoes acceptance inspection (slump value, air content, and chloride content) based on the ready-mixed concrete delivery note, and a test piece for compressive strength inspection is prepared at the same time.

Acceptance inspection



Concrete placement by a pump truck

An important thing to do before starting the pouring work with the pump truck is to prepare the ground to put out the outriggers that secure the pump truck so that it will not fall over. To prevent the outriggers from sinking into the ground due to vibration, the outriggers' jacks are supported by the receiving wood on solid ground, and on softer grounds, the pump truck is installed by laying a steel plate and then opening the outriggers to their maximum width. In addition, tire stops should be securely inserted.

During construction, care must be taken to avoid contact with or cutting power lines due to boom movement. In the case of high-voltage wires, even without direct contact, the spark discharge may cause electricity to flow and cause electric shocks. Check and observe the safety clearance distance (distance away from the wire).

It is also important to inspect the delivery pipes and check connections. If a delivery pipe ruptures, ready-mixed concrete will flow out, leading to an accident. It should be inspected on a daily basis by tapping (checking the sound when tapped) or ultrasonic thickness gauge.

6.2.16 Painting Work

There are many different types of painting work. The important thing common to all types is to make sure that the paint adheres well to the painted surface. If the work is not done properly, problems such as the paint film cracking or peeling and loss of luster will occur after one to three years.

Painting is basically divided into three processes: primer, middle coat, and top coat. It is important that appropriate amount of time is passed between each step of the process in order to let the paint dry, which is called the process interval period. The time between painting processes must be at least as long as specified for each coating, and the coating must be allowed to dry thoroughly before moving on to the next painting process. Process interval periods vary depending on a variety of conditions, including temperature, insolation and humidity, and the worker must be able to assess the situation in proceeding with the work. Construction should not be performed when the humidity is 85% or higher, such as during rainy weather.

Before starting priming, make sure the painted surface is free of debris. This process is called *keren* (scraping). If the exterior walls are to be painted, dust and dirt should be removed by high-pressure washing or other methods, and cracked areas (cracks) should be repaired.

The primer coat is applied to improve adhesion between the substrate and the middle-coating material. Sealer, primer, filler, and other priming materials are chosen for different purposes.

The middle coat smooths out surfaces that have become uneven due to scratches or cracks in order to achieve an even finish. It can also reinforce and enhance adhesion of the topcoat material.

The top coat is the final stage of the painting process, and its finish demonstrates performance in weather and stain resistance as well as design for aesthetic purposes. The performance of the painting work is determined by three layers of paint (primer, middle coat, and top coat), but is generally evaluated based on the performance of the top coat paint. In spray painting, the surface usually receives two coats.


Spray painting

Paint should be applied only where necessary, and therefore, do not forget to cover the areas that do not need to be painted. Cover the floor with a polyethylene sheet, apply masking tape to the border of the area to be painted, and use masker tape to cover large surfaces such as walls. In addition, in exterior wall painting, paint can splatter onto cars, etc., causing problems. The entire building should be covered, and automobiles and other vehicles within the area where paint is likely to splatter are also covered with sheets.


Covering work

6.2.17 Landscaping Work

Landscaping is the designing of space through placement of natural stones, trees, plants, and flowers. Landscape architects, sometimes called *niwashi* (gardener), create gardens and residential yards based on traditional Japanese landscaping culture. In recent years, landscaping techniques have also been required for the greening of building rooftops, wall surfaces, and artificial grounds. Landscape architects are required to have not only knowledge and skills in planting, diagnostic for plants and planting substrates, and transplanting, but also artistic and design capabilities. In particular, pruning trees in the garden affect the finished landscape, and therefore must be discussed in detail with the

client in order to avoid complaints. It is also important to know that different trees have different pruning timing. Pruning at the wrong time can cause the plant to die or not bloom.

Landscaping requires a lot of work at heights. Working on an unstable ladder or stepladder can cause falling accidents. Choose a stepladder location for stability without wobbling, and take measures to prevent it from falling over, such as by tying and securing the stepladder to the trunk of a tree. Working on top of a branch can result in a falling accident when the branch breaks. If the height exceeds 2 m, use a safety belt.

Crane trucks are used to move plants and garden stones, and drag shovels are sometimes used for excavation work. Take ample care to prevent the machinery from tipping over. There have been accidents such as being entangled in self-propelled mowers, being trapped under a falling tree when felling trees with a chainsaw, and receiving direct hits to the head.

Pruning

6.2.18 Demolition Work

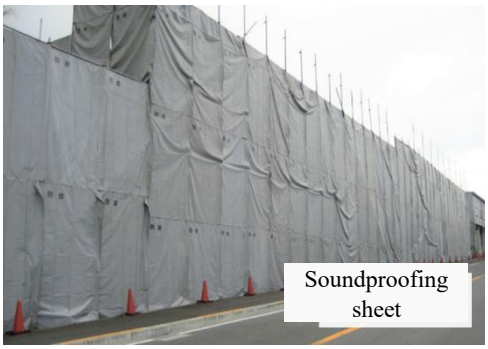
Demolition work is performed on structures of all sizes. There are two methods of building demolition: block *kaitai koho* (floor-by-floor demolition) and *happa kaitai koho* (blast demolition). Here, the floor-by-floor demolition will be explained. Demolition will begin only after confirming that all lifeline infrastructure (electricity, telephone, fiber optic cable, cable TV, gas, water, sewage, etc.) are shut off. For example, demolition with active gas, water, and sewage lines can lead to major accidents. The demolition work will proceed in the following steps.

(1) Demolition of exterior areas

Remove items from around the building to make the work easier. It is necessary to confirm what is to be demolished, as there may be items on the property that are not subject to demolition.

(2) Installation of scaffolding and soundproofing panels

Install scaffolding for the demolition workers. The entire surface is covered with soundproofing panels, soundproofing sheets, etc. to prevent noise and scattering of dust from demolition.



(3) Demolition of the building interior

Remove fittings, plaster boats, sashes, and various equipment by hand. At this time, separate recyclable material. In order to utilize resources through recycling and to curb illegal dumping of waste, the Construction Material Recycling Act establishes standards and penalties for demolition of buildings with a floor area of 80 m^2 or more.

(4) Drilling holes in floors on each floor

Drill holes in the floor to allow the demolished walls and structural debris to be dropped down.

(5) Installation of support for heavy machinery

Walls and columns are dismantled by hoisting heavy equipment upward. Provide supports to withstand the weight of heavy equipment.

(6) Demolition of walls and structure, excavation and demolition of the foundation

Because digging up foundations is an underground construction process, vibration is inevitably generated. It is important to choose the right time of day to conduct this work.

(7) Disposal of waste, removal of debris from the ground surface, land clearing, and street cleaning

Recyclable materials are taken to a disposal site, and the ground is cleared of debris. The

surrounding streets dirtied by the work are also cleaned and restored to their original condition.

The above is a method of demolishing from the top, but there is also a method of demolishing from the first floor while supporting the severed columns with jacks. Not only does it eliminate the need for support installation work in (5), it also allows for efficient removal and sorting of demolition materials.

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 civil engineering construction sites, 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 Fatalities and Injuries in Construction

Table 7-2 shows the number of fatal accidents involving foreign workers in all industries in FY2020 and FY2021, as compiled by the Ministry of Health, Labour and Welfare. Table 7-3 shows that the construction industry has the highest numbers.

[Tsuiraku/tenraku] (fall from heights) These are 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.

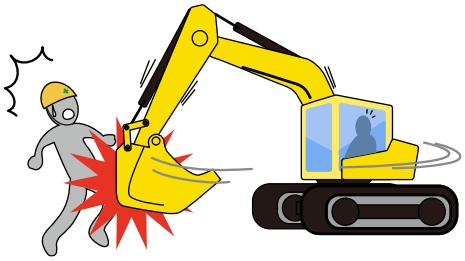
[Obore] (drowning) Industrial accidents that occur by falling into water in places where water is a part of the work, such as oceans, rivers, and sewerage works.

7.1.2 Types of Fatal Accidents

(1) Fall from heights

Fatalities from falling from heights do not always occur in crashes from extreme heights, but can also occur in lower places, such as falling from the back of a dump truck. There have also been accidents of falling into excavated holes. Since falling often occurs due to loss of balance or slipping, full-harness fall protection gear should be worn properly at high altitudes.

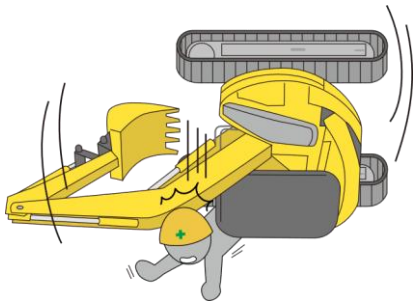
(2) Struck-By/Caught-Between



Civil engineering work is prone to heavy equipment disasters because the work often involves the use of large construction machinery. Accidents involving being run over or caught-between by construction machinery, as well as tipping over and falling of construction machinery, are common. Backhoes have caused accidents such as collision between the circling arm/bucket and a person, or a person getting caught between the bucket and an object.

An accident also occurred when a flagger of another vehicle failed to notice a dump truck backing up and got caught-between. In addition, accidents have also occurred, such as a dump truck flicking up the mudsill laid out on the site's loading ramp and hitting a flagger.

A backhoe tipping can result in fatal accidents when someone is crushed by it. In addition, backhoe tipping accidents are more likely to occur when loading and unloading backhoes onto and off trucks, etc.



Falling and tipping over of construction machinery can also occur while traveling on a ramp or by falling off the shoulder of a road. Paths for construction machinery should be wide enough to prevent the shoulder from crumbling. Tipping over can also occur when trying to lift heavy objects with a backhoe. Construction machinery, including but not limited to backhoes, should not be used for purposes other than those for which they were originally intended.

(3) Traffic accident (road)

Fatalities from traffic accidents, not limited to construction work, are also common in construction, equipment, and lifeline infrastructure projects. Many traffic accidents occur while commuting to construction sites, and some traffic accidents occur when construction vehicles are traveling on public roads. Accidents include being hit by another vehicle while loading or unloading goods on a public road, or a dump truck carrying a load of surplus soil driving too fast and overturning on a curve.

(4) Flying/falling

A flying/falling accident occurs when a person is hit by a flying or falling object. 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 ever go below suspended loads. Accidents have also occurred due to falling tools and components to be installed.

(5) Collapsing/Crumbling

Because civil engineering work involves dealing with nature, accidents due to landslides and falling trees have occurred. Accidents can occur especially in excavation work, where the soil wall can collapse.

7.1.3 Work with A High Number of Fatalities

(1) Characteristics of and accidents in road construction


Paving work

The photo on the right is of road paving work. Behind a line of several construction machinery moving forward, several workers are leveling asphalt. Road construction accidents include collision with rollers and being hit by dump trucks backing up. Accidents also occur during paved road repair work by colliding with backhoe arms and buckets. Road construction is characterized by construction machinery and people working in close proximity. Flaggers are assigned to ensure the safety of the workers by signaling with the operators of the construction machinery, but the workers themselves must also be constantly aware of the safety situation of their surroundings.

(2) River engineering work


River engineering work

The most common accidents that tend to occur in river engineering work are those related to construction machinery and vehicles. At these construction sites, accidents such as backhoes tipping over from slopes or people being run over by moving vehicles can occur. Large blocks are often used, and accidents can occur during lifting and moving operations of crane-type backhoes.

(3) Bridge construction


Bridge construction

Bridge construction often involves working at heights. As a result, accidents due to falling from heights and being hit by flying/falling objects are more likely to occur. As a result, accidents due to falling from heights and being hit by flying/falling objects are more likely to occur. Accidents also occur when a worker's foot is caught on a circular hollow section temporarily fixed at the upper part of a bridge, causing the formwork to come loose and fall down. Such an accident was caused by an attempt to climb up using a passageway other than the one provided. The general rule in fall prevention is to wear and reliably use the full-harness fall protection gear. Falling can also be caused by tripping and losing one's balance. In addition to watching your step, it is also important not to place unnecessary objects in the passageways.

(4) Tunnel construction

there are a variety of tunneling methods that can be used depending on geological and environmental conditions. The geology, construction machinery used, and temporary facilities necessary differ by method, so there are some differences in safety considerations, but there are also many similarities. In tunnels, excavated soil is removed and materials are transported by railway equipment and dump trucks in a narrow, dark environment, and many vehicles drive through the tunnel as workers work. As a result, many accidents involving heavy machinery occur. Although the geology differs, fragile geology such as sandy earth and weathered rocks are also excavated, which can lead to collapses of strata disturbed by the excavation work, resulting in rockfall accidents. In tunnel excavation, it is important to carefully observe the geological conditions near the tunnel face and plan excavation work suitable for the geological conditions.

This section describes matters to be considered when conducting the pipe-jacking tunneling method.

> Inside the tunnel, be aware of the possibility of oxygen depletion and toxic gases. Carbon monoxide and carbon dioxide are colorless, odorless, and difficult to predict from where they will originate. Therefore, their presence or absence and concentration should be measured using a detector. Toxic gas measurements must be taken prior to the beginning of each work shift to ensure safety. Recently, many tunnel construction sites install automatic measuring devices to continuously take measurements 24 hours a day.

> If flammable gases are likely to be generated, fire is strictly prohibited.

> Pipe-jacking tunneling construction is often used for small-diameter sewer and water pipeline construction, often with a diameter of 0.8 to 3 meters. In addition to the various temporary equipment required for pipe-jacking tunneling, excavated earth and sand are carried out through the shafts. Take care to avoid being caught-between, hit by flying/falling objects and falling from heights. Measures such as prohibiting entry into the shaft during excavated soil removal are necessary.

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.

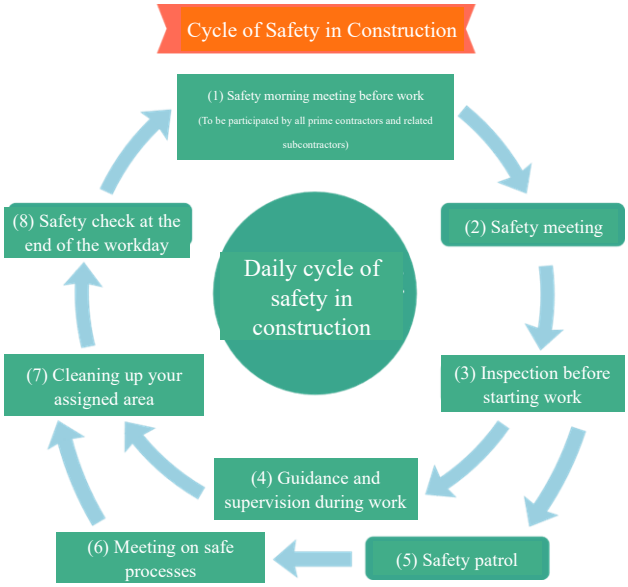
b. Facilitate cooperation between the prime contractor and other related subcontractors.

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. the use of protective masks is mandatory.

[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. 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!”