

厚生労働省委託事業

車両系建設機械（解体用）運転技能講習 補助テキスト

**Vehicle-type construction machine (For demolition)
Driver Technical Training
Supplementary Text**



厚生労働省 労働基準局 安全衛生部

英語版 English Version



本補助テキストは、建設業労働災害防止協会のご協力の下、「車両系建設機械運転者教本[解体用]技能講習テキスト」(建設業労働災害防止協会発行、平成30年4月26日第3版2刷)を基に、令和2年度厚生労働省委託事業において作成した対訳による抜粋版です。外国人労働者に対する教育効果を高める等の目的で作成されたものです。

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2021年3月



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1. Basic Knowledge about vehicle-type construction machinery

Classification of construction machinery (Appended Table 7 of the Order for Enforcement of the Industrial Safety and Health Act)

- ①Machines for leveling transporting and loading (bulldozers, tractor shovels, etc.)
- ②Excavation machinery (drag shovels, etc.)
- ③Machines for foundation work (pile-drivers, pile-extractors)
- ④Sand rammer machines (rollers, etc.)
- ⑤Concrete placing machinery (concrete pump truck, etc.)
- ⑥Demolition machines, breakers, steel frame cutting machines, concrete crushers, demolition grippers)

1.1. Types and applications (characteristics) of demolition machines (p. 2 of textbook)

(1) Breakers

These machines are equipped with a breaker unit (impact breaker) as an attachment driven by hydraulic or pneumatic pressure. They are used for demolition of reinforced concrete (tekkin konkurito kozo) buildings. (See Figure 1-1)



Figure 1-1 Breaker

(2) Steel frame cutting machines

These machines are equipped with a scissor-like attachment for cutting steel frames, etc. (including structures of non-ferrous metals). They are used for demolition of steel (tekkotsu kozo) buildings. (See Figure 1-2)

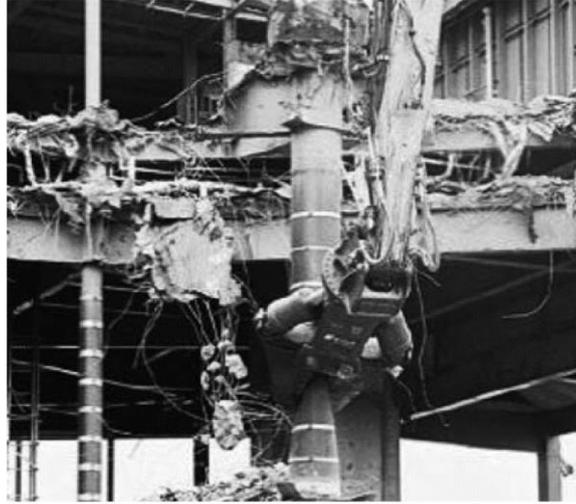


Figure 1-2 Steel frame cutting machine

(3) Concrete crusher

These machines (including those with the added function of cutting rebars) are equipped with scissor-like attachments for crushing concrete structures (including machines with steel cutting function addition). They are used for the demolition of reinforced concrete (tekkin konkurito kozo) buildings. (See Figure 1-3, Figure 1-4, and Figure 1-5.)

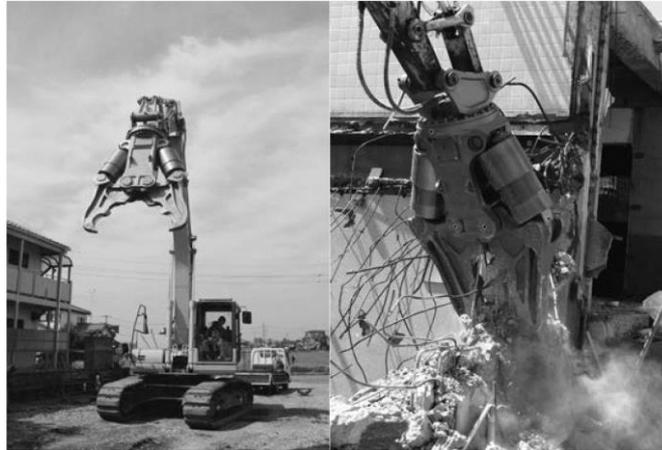


Figure 1-3 Concrete crusher



Figure 1-4 Concrete crusher for large parts



Figure 1-4 Concrete crusher for large parts

(4) Demolition grippers

These machines are equipped with a fork-shaped gripping tool as an attachment for dismantling wooden structures (moku kozo) or grabbing and lifting dismantled objects. They are used for dismantling wooden houses, grabbing up demolished objects, and loading them onto trucks. They are also used to pick up demolition materials from structures. (See Figure 1-6)



Figure 1-6 Gripper

1.2. Types of attachments for demolition machines (p. 5 of textbook)

The names of the parts of the attachments to be installed on demolition equipments are shown below.

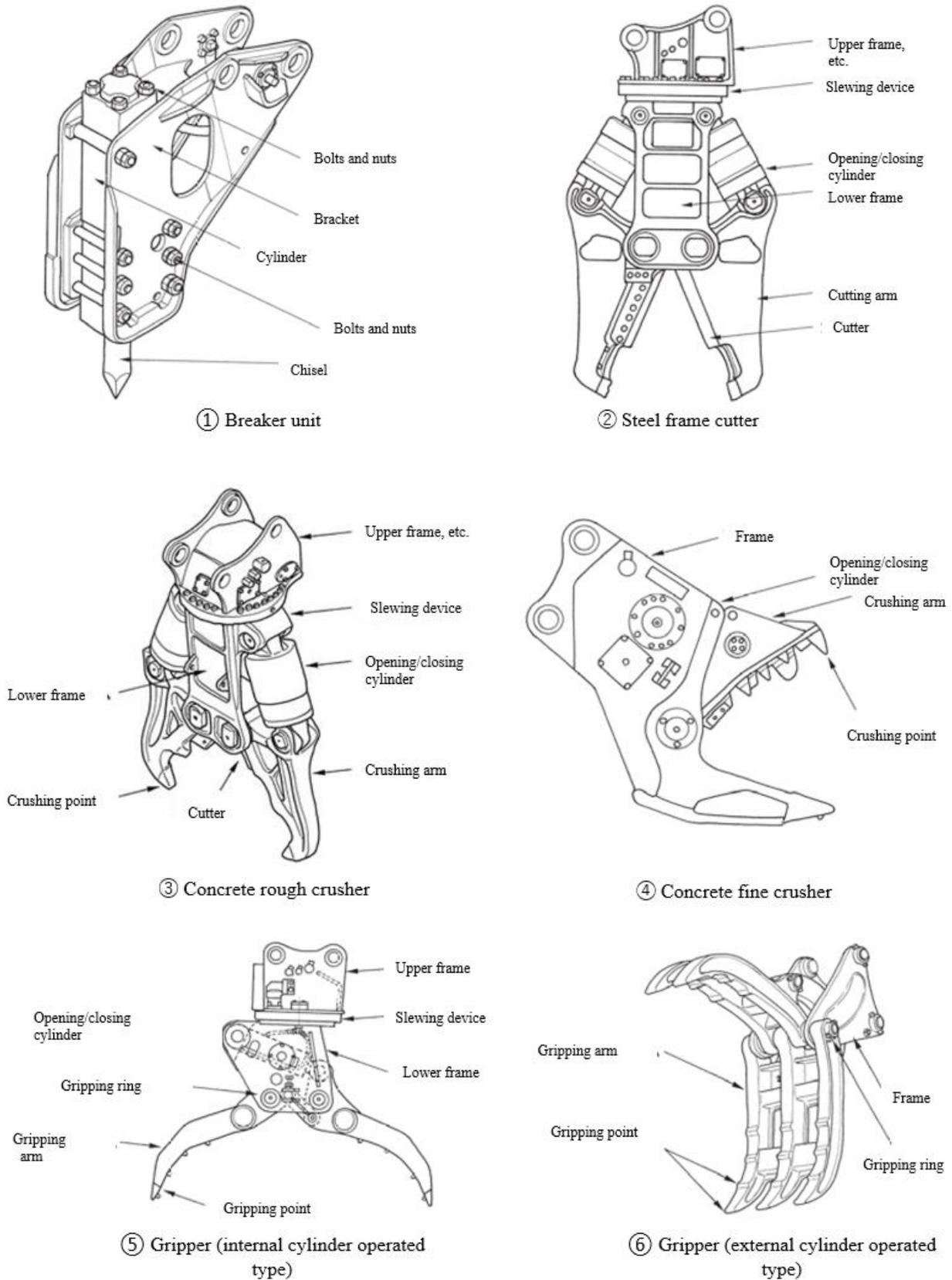


Fig. 1-1 Names of the parts of the attachments

1.3. Base machine for demolition (p.6 of textbook)

(1) Work device

Work device refer to equipment used for demolition, excavation, land preparation, etc., including attachments, buckets, blades, etc., and the booms and arms that support them.

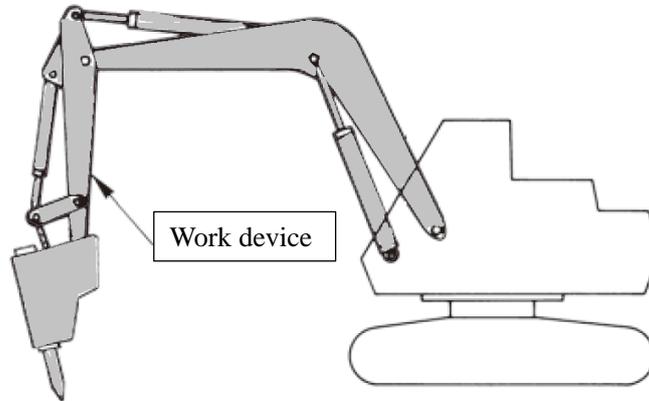


Figure 1-2 Work device

(2) Machine body mass

The airframe mass is the dry mass (mass without fuel, oil, water, etc.) of the vehicle-type construction machine, excluding the Work device; that is to say, it refers to the mass of the machine itself.

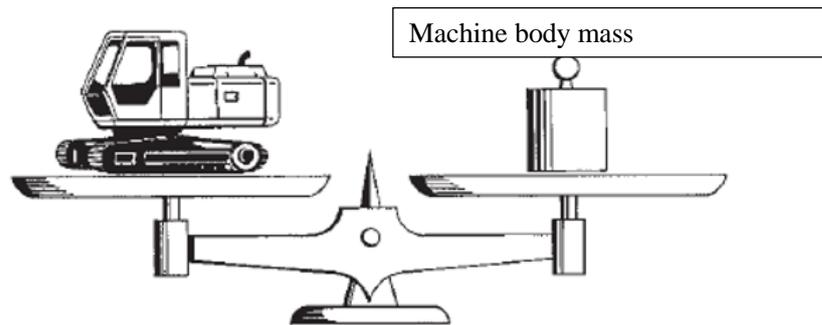


Figure 1-3 Machine body mass

(3) Machine mass

Machine mass refers to the mass of the vehicle type construction machine with the necessary work device installed and the wet mass (mass containing fuel, oil, water, etc.) when the bucket, etc. is not loaded with earth or sand (unloaded state).

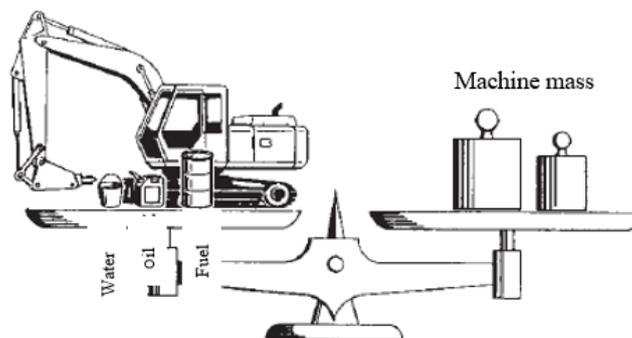


Figure 1-3 Machine mass

(4) Gross vehicle mass

The gross vehicle mass is the sum of the machine mass, the maximum loading mass, and 55 kg/person multiplied by the seating capacity.

(Note) The masses (2) to (4) above and the gravitational acceleration are the base machinery mass, machine mass, and the vehicle gross mass.

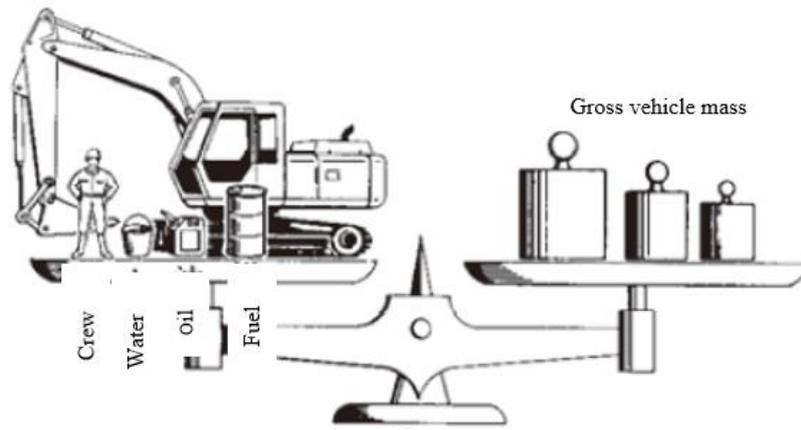


Figure 1-5 Gross vehicle mass

(5) Stability

Stability is the degree to which a vehicle-type construction machine does not fall over up to a certain angle. The greater the stability, the less likely it is to fall over.

It should be noted that the machine's stability is calculated on the assumption that the machine is on a level and solid surface. In real construction sites, it is necessary to discount the machine's stability due to poor environmental conditions.

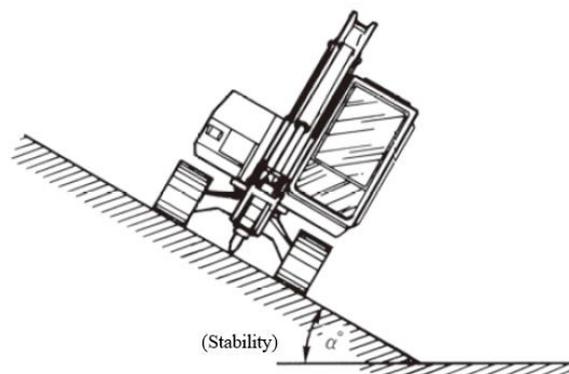


Figure 1-6 Stability

(6) Gradeability

Gradeability is the maximum slope climbing capacity of a vehicle-type construction machine, calculated based on the capacity of the prime mover, etc. It is generally represented as an angle (α°) or inclination (%).

It should be noted that in reality, it is usually not possible to climb up to that angle due to slippage between the crawlers (crawler belts) or tires and the surface soil.

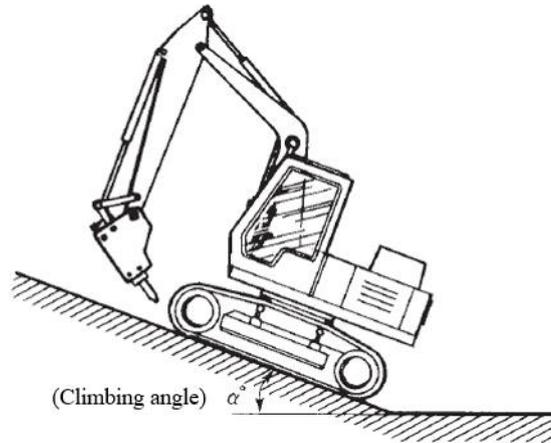


Figure 1-7 Gradeability

(7) Average contact pressure

The average contact pressure indicates the force exerted on the ground by the vehicle type construction machine, and is generally expressed by the following equation.

$$\text{Average contact pressure (heikin setchi atsu)} = \frac{\text{gross vehicle mass} \times 9.8}{\text{Total ground contact area}} \quad (\text{kN/m}^2)$$

① In the case of crawler type, the value is obtained by dividing the "gross vehicle mass" by the total ground contact area (sosetchi menseki) of the crawler. In this case, the crawler's ground contact length (kurora) is the length of L as depicted in Figure 1-8.

$$\text{Average contact pressure} = \frac{W \times 9.8}{S} = \frac{W \times 9.8}{2B \times L} \quad (\text{kN/m}^2)$$

W : Gross vehicle mass (t)

S : Total ground contact area $2B \times L$ (m^2)

L : Center distance between idler (idler wheel) and sprocket (sprocket wheel) under gross mass condition (m)

B : Width of crawler (m)

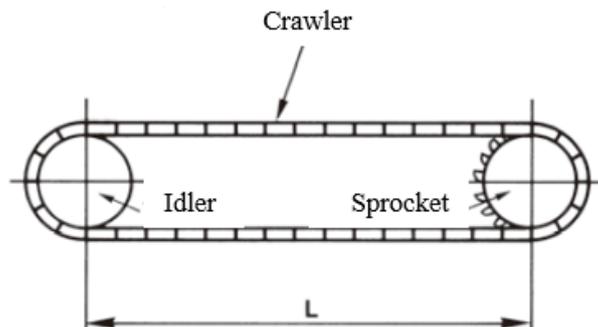


Figure 1-8 Relationship between L and B

② In the case of the wheel type, the value is obtained by dividing the axial load of the front or rear wheels, which are calculated from the gross vehicle mass, by the sum of the apparent ground contact areas of the front or rear wheels (see Figure 1-9), respectively.

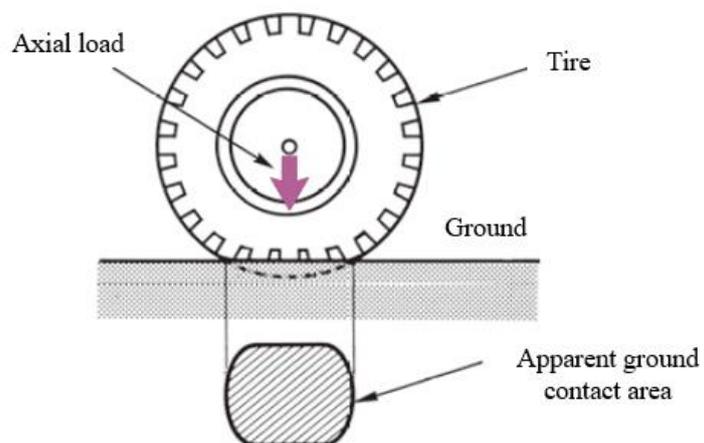


Figure 1-9 Apparent ground contact area

2. Prime mover and hydraulic system of vehicle type construction machines

2.1. Prime mover (textbook p.11)

A prime mover is a device that transforms various types of energy into mechanical work. Typical prime movers used in machinery include internal combustion engines such as diesel and gasoline engines, etc. and motors such as a electric motors.

In general, diesel engines are mainly used as prime movers for vehicle type construction machines. Gasoline engines are used in some small and special types. In addition, there are construction machines that employ electric motors instead of internal combustion engines.

Table 2-1 Comparison between diesel engine and gasoline engines

Item \ Type	Diesel engine	Gasoline engine
Fuel type	Diesel fuel	Gasoline
Type of ignition	Self-ignition by air compression	By electric spark
Engine mass per horsepower	Heavy	Light
Price per horsepower	High	Cheap
Thermal efficiency	Good (30~40)	Bad (22~28%)
Operating cost	Low	High
Fire danger level	Low	High

※ Be careful not to use the wrong type of fuel (diesel fuel (keiyu) or gasoline).

2.1.1. Structure of a diesel engine (textbook p.13)

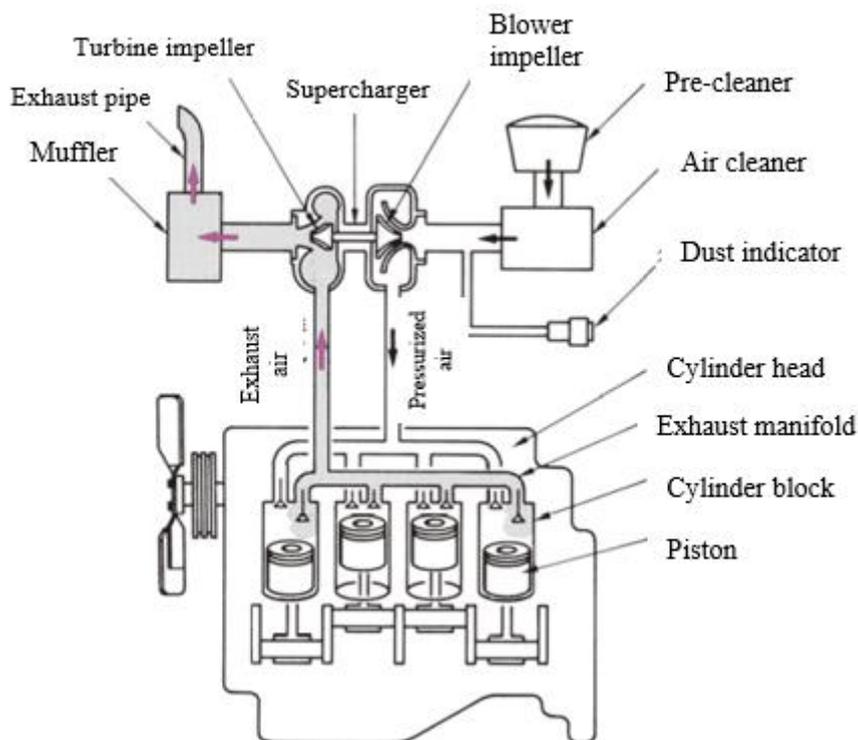


Figure 2-3 Example of air intake and exhaust system

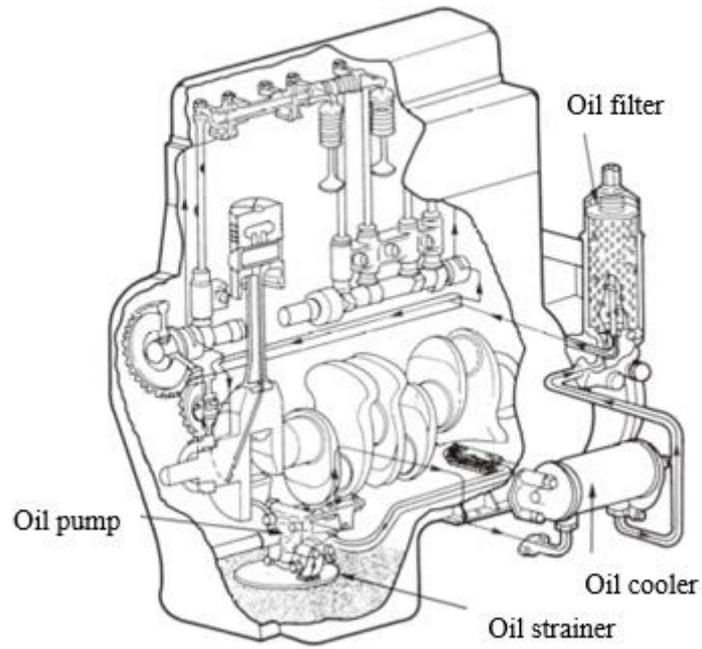


Figure 2-4 Example of lubrication of equipment system

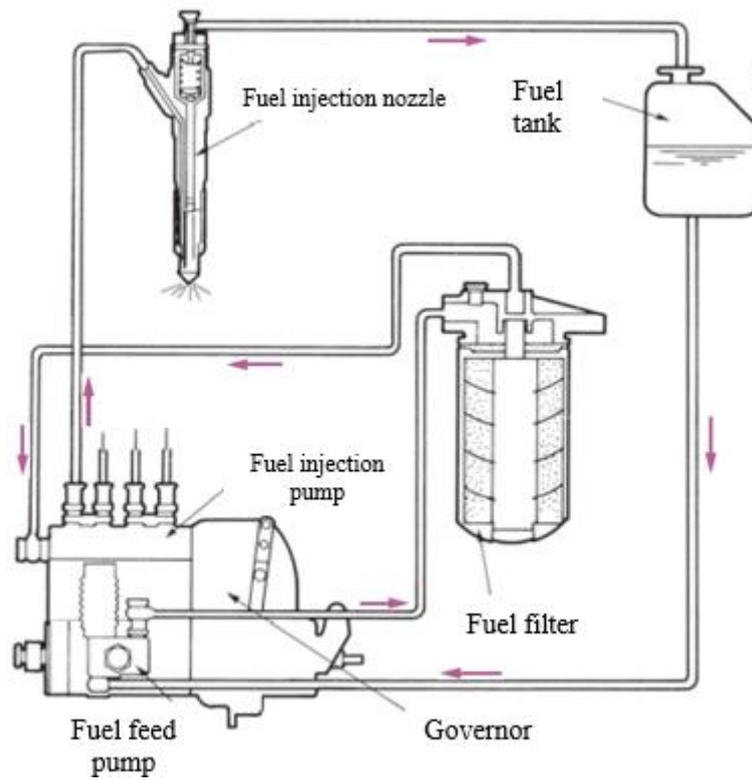


Figure 2-5 Example of a fuel system

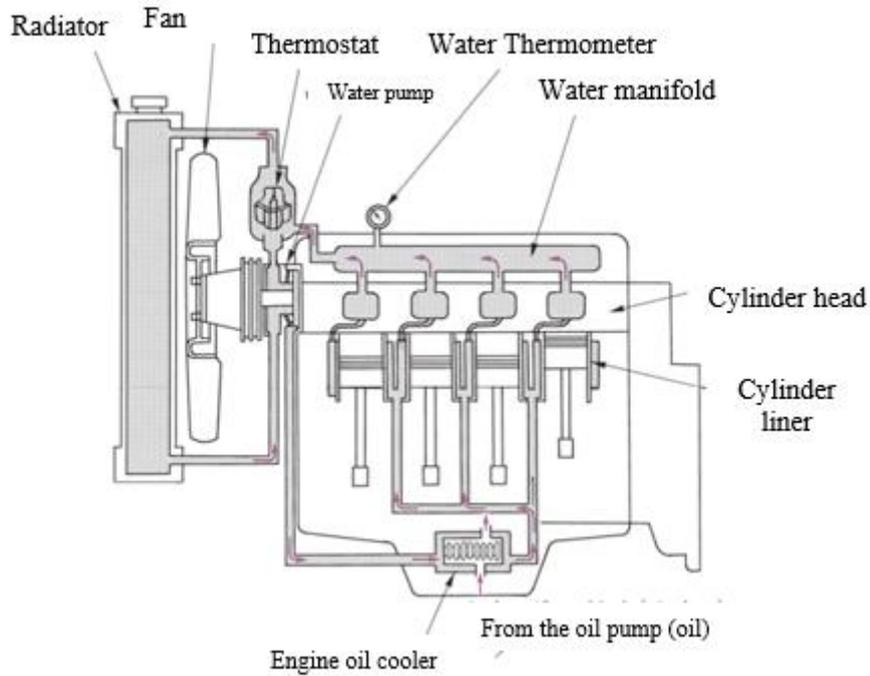


Figure 2-6 Diagram of a cooling device for a water-cooled engine system

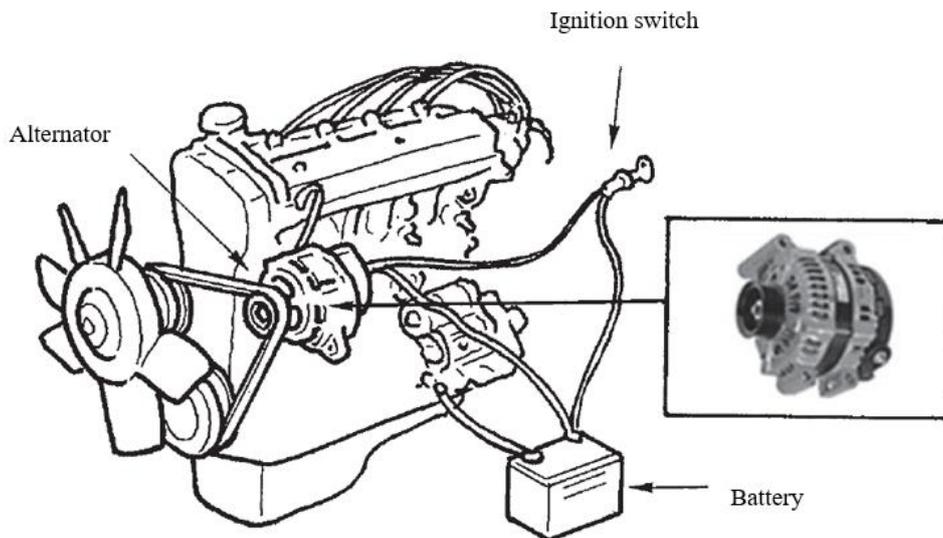


Figure 2-7 Example of alternator

2.1.2. Fuel and engine oil (textbook p.18)

Engine oil has the following functions: (1) lubricating, (2) cooling, (3) sealing, (4) cleaning, and (5) rust prevention. Although there are many different brands for engine oil, it is necessary to use the standard specified in the instruction manual of the construction machine.

2.2. Hydraulic system (textbook p.18)

2.2.1. Hydraulic system (textbook p.19)

Note that a pump is a precision machine, and dirt, sand, etc., can cause wear and scratches, which may not allow the pressure to rise. The filter performs the hydraulic oil filtration in the hydraulic circuit and removes dirt. Note that if the filter gets clogged, the pressure will not rise.

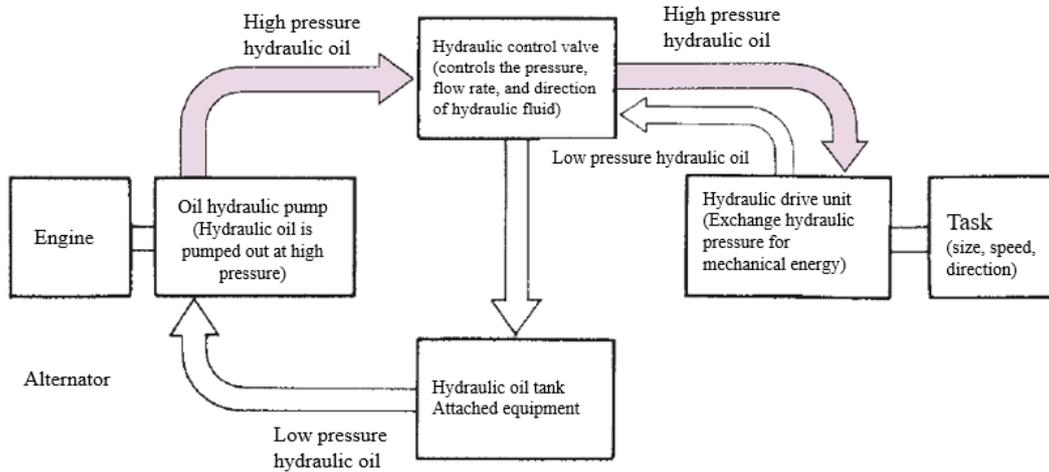


Figure 2-9 Overview of the hydraulic system (yuatsu sochi) mechanism

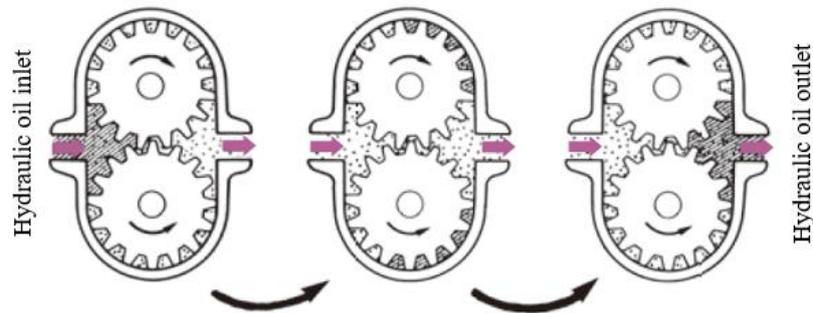


Figure 2-10 Overview of the working principle of a gear pump

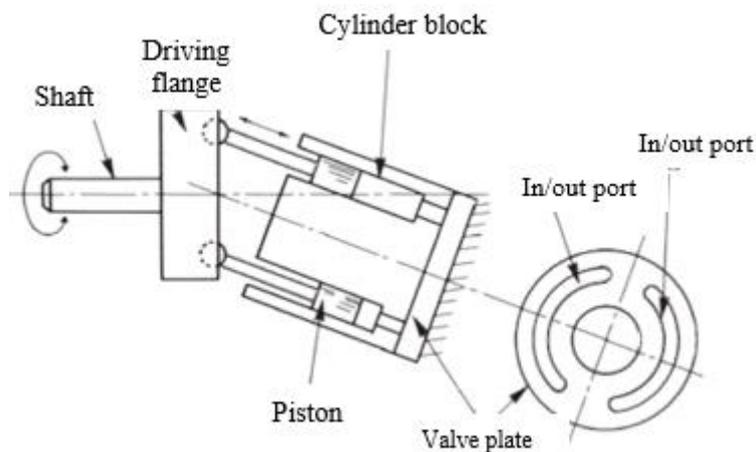


Figure 2-11 Example of bent axis type

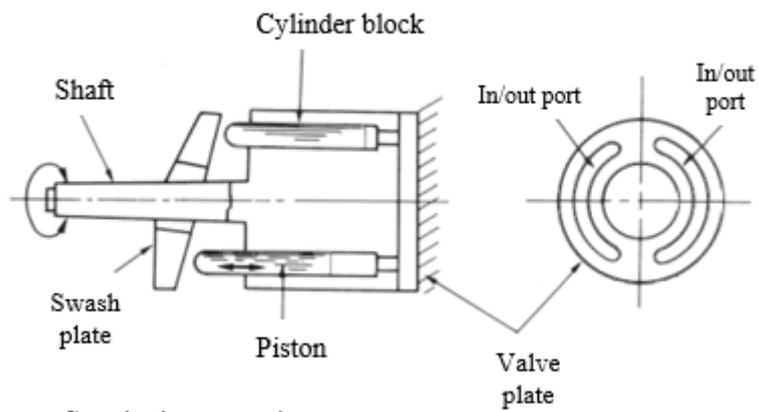


Figure 2-12 Example of swash plate type

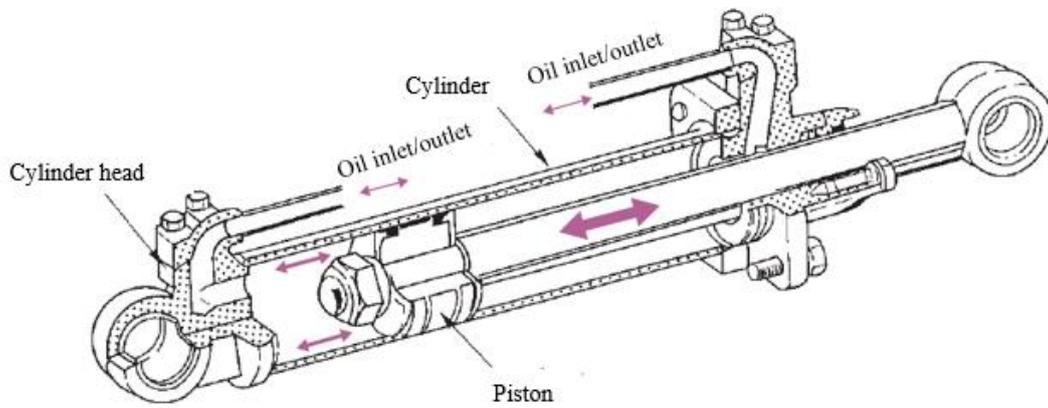


Figure 2-13 Example of hydraulic cylinder

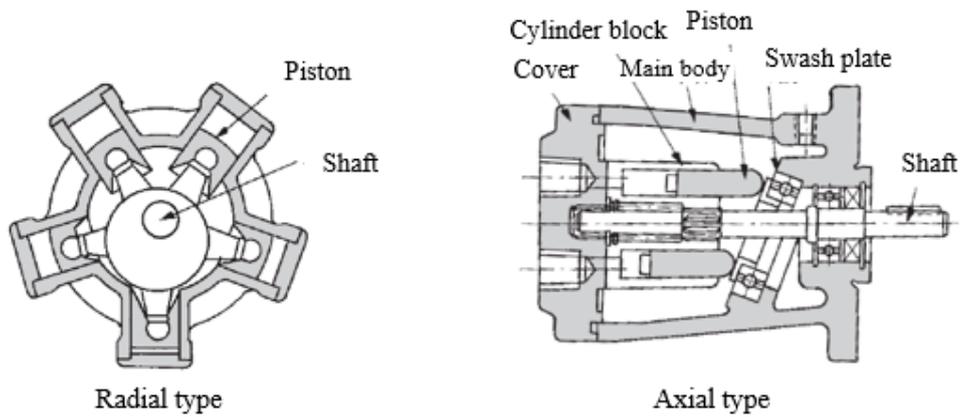


Figure 2-14 Example of piston motor

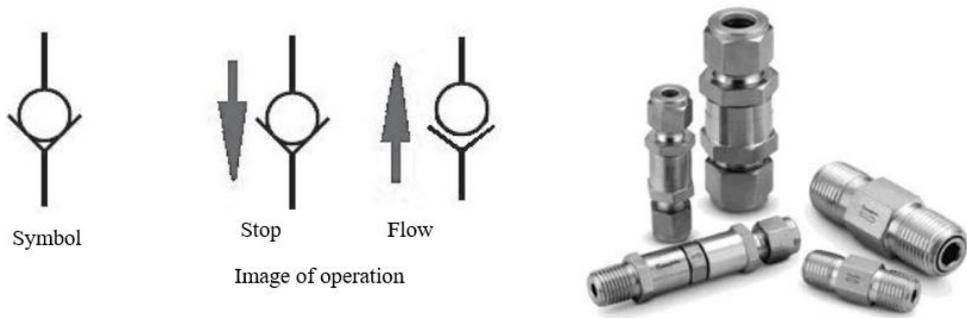


Figure 2-15 Image of operation of a non-return valve

Figure 2-1 Example of non-return valves

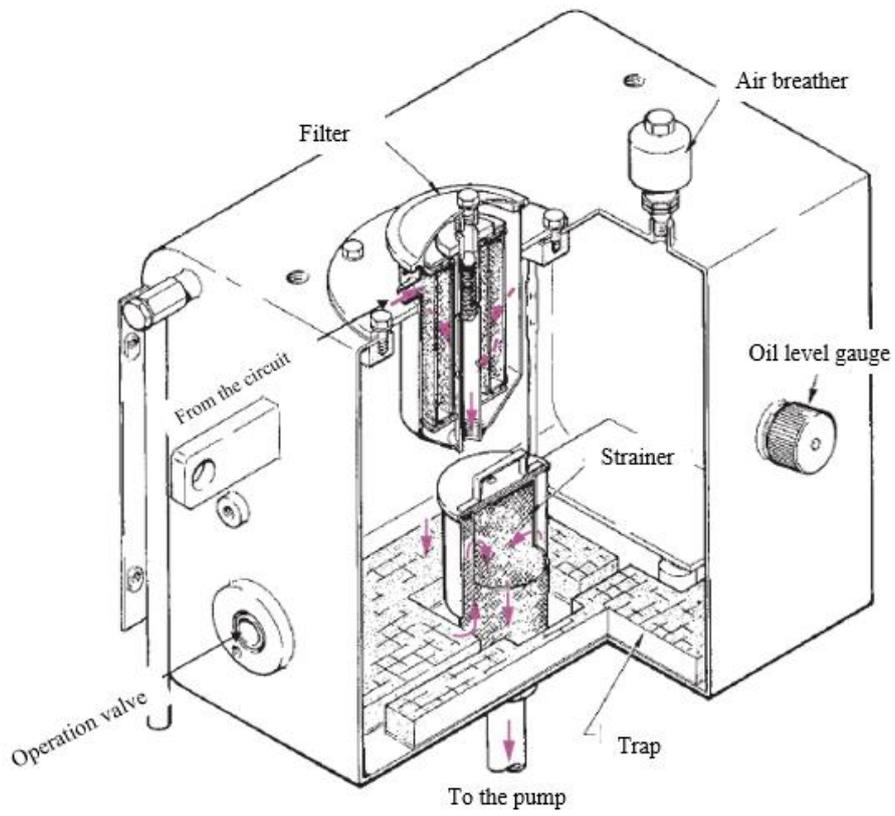


Figure 2-16 Example of hydraulic oil tank

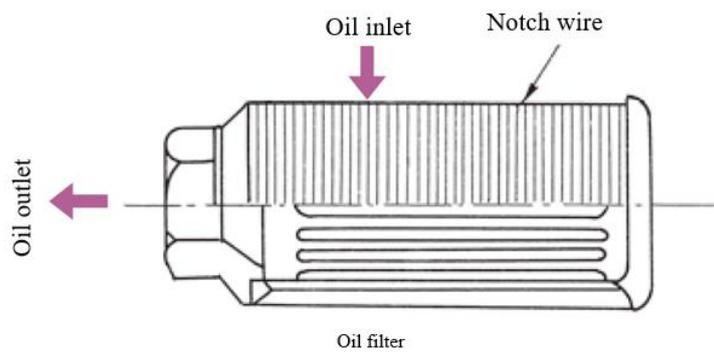


Figure 2-17 Example of suction filter

3. Structure related to the running of demolition machines.

3.1. Traveling device structure of crawler type dismantling machine (textbook p.28)

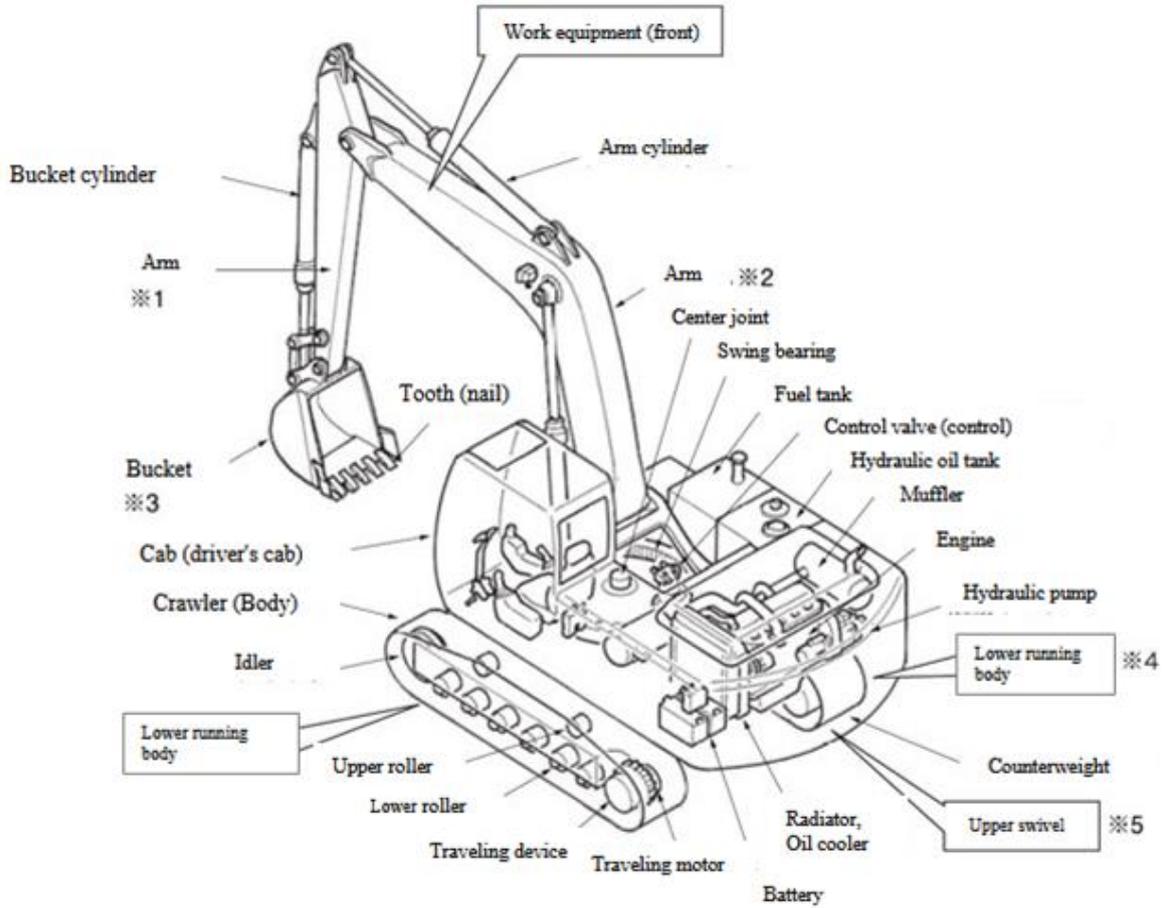


Figure 3-3 Hydraulic crawler mechanism

※1-3 Work equipment (front)

※ 3 Attachment (working tool)

※ 4-5 Base machine

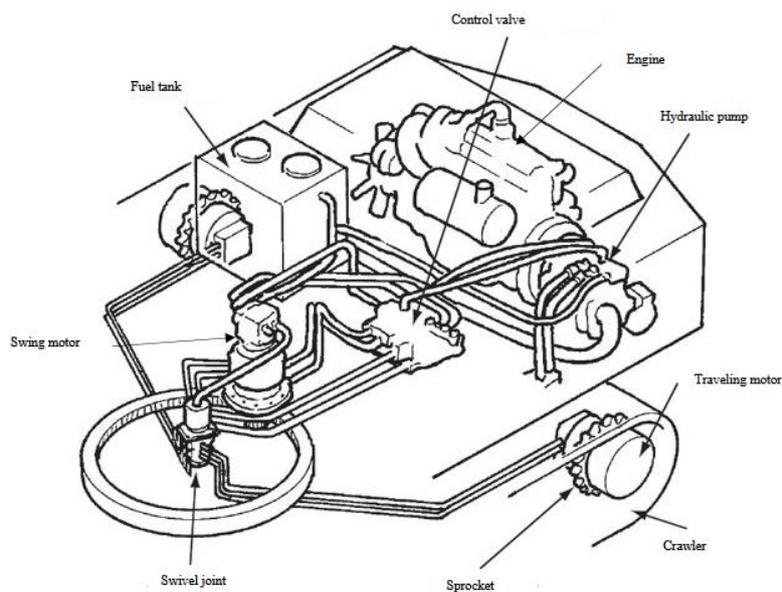


Figure 3-4 Example of power transmission system device

3.1.1 Undercarriage device (textbook p.33)

The crawler type has a lower ground pressure than the wheel type and can work on rough or soft terrain, but the running speed is as slow as 2 to 6 km / h.

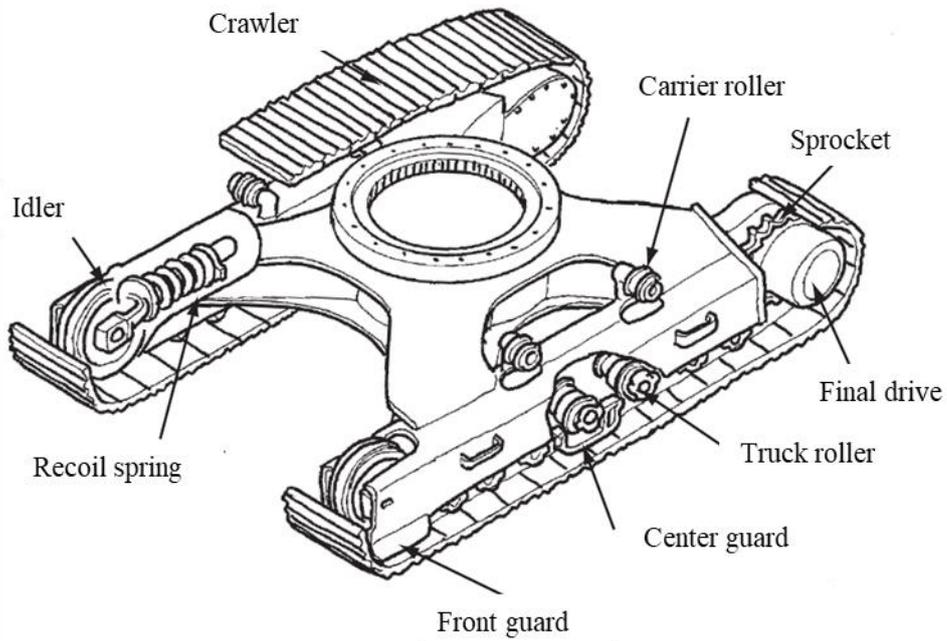


Figure 3-8 Undercarriage device example

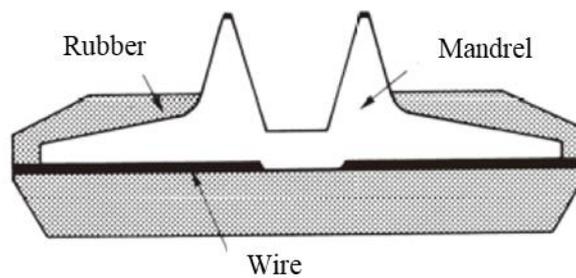


Figure 3-9 Example of cross section of rubber crawler

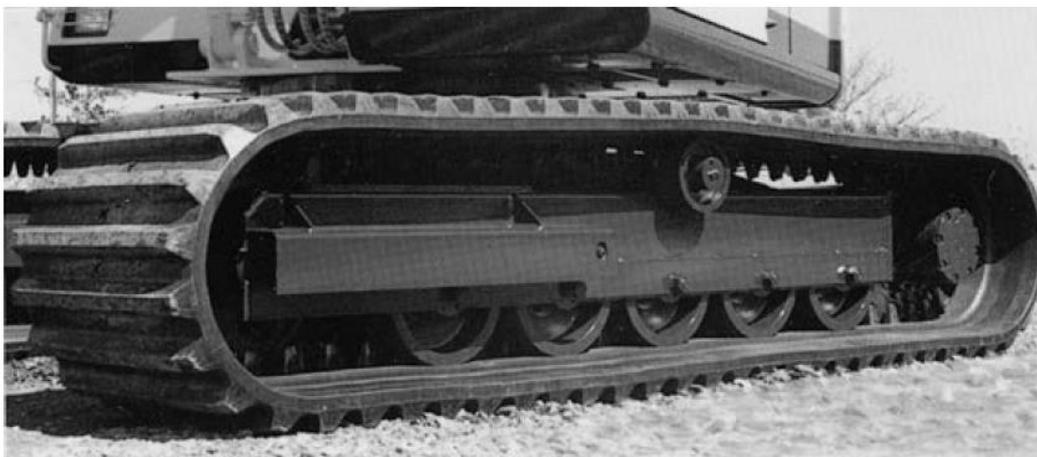


Figure 3-3 Rubber crawler example

3.2. Traveling device structure of the wheel type machines for demolition (textbookp.35)

3.2.1. Power transmission system device (textbookp.35)

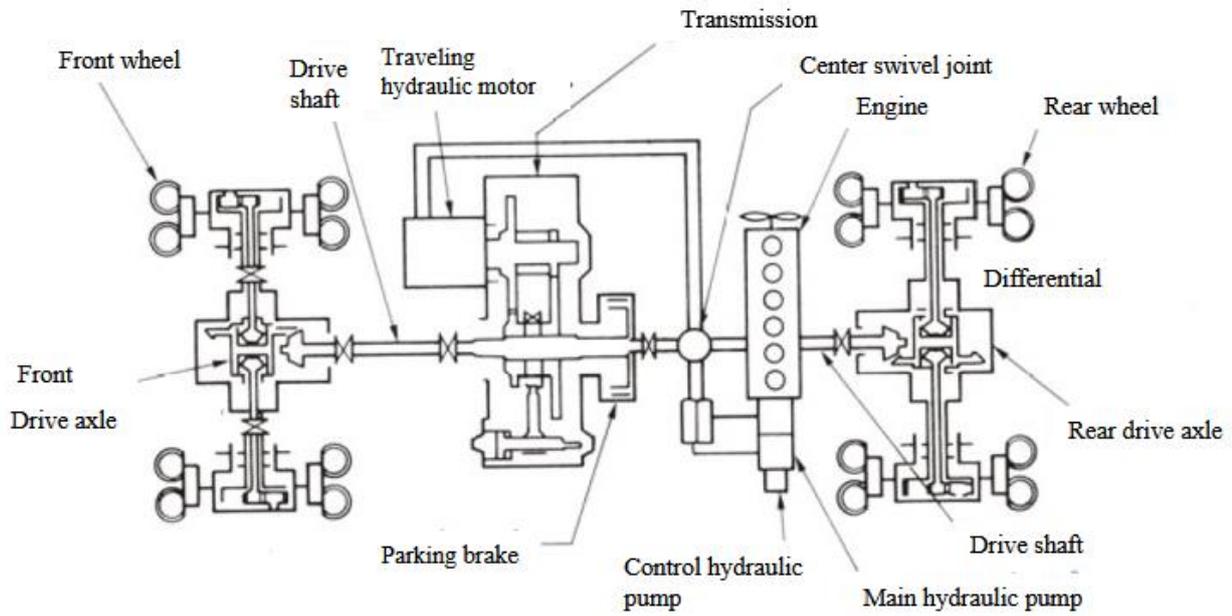


Figure 3-10 ② Example of power transmission system device

3.2.2. Undercarriage device (textbook p.38)

The undercarriage device consists of a chassis frame (lower frame), tire outriggers and so on. Wheel type runs with pneumatic tires, compared to the crawler type, the running speed is as fast as 15~35 km /h.

(1) Lower frame

The lower pedestal is a solid chassis frame that supports turning and is supported by the running wheels and starting wheels. (See Figure 3-13)

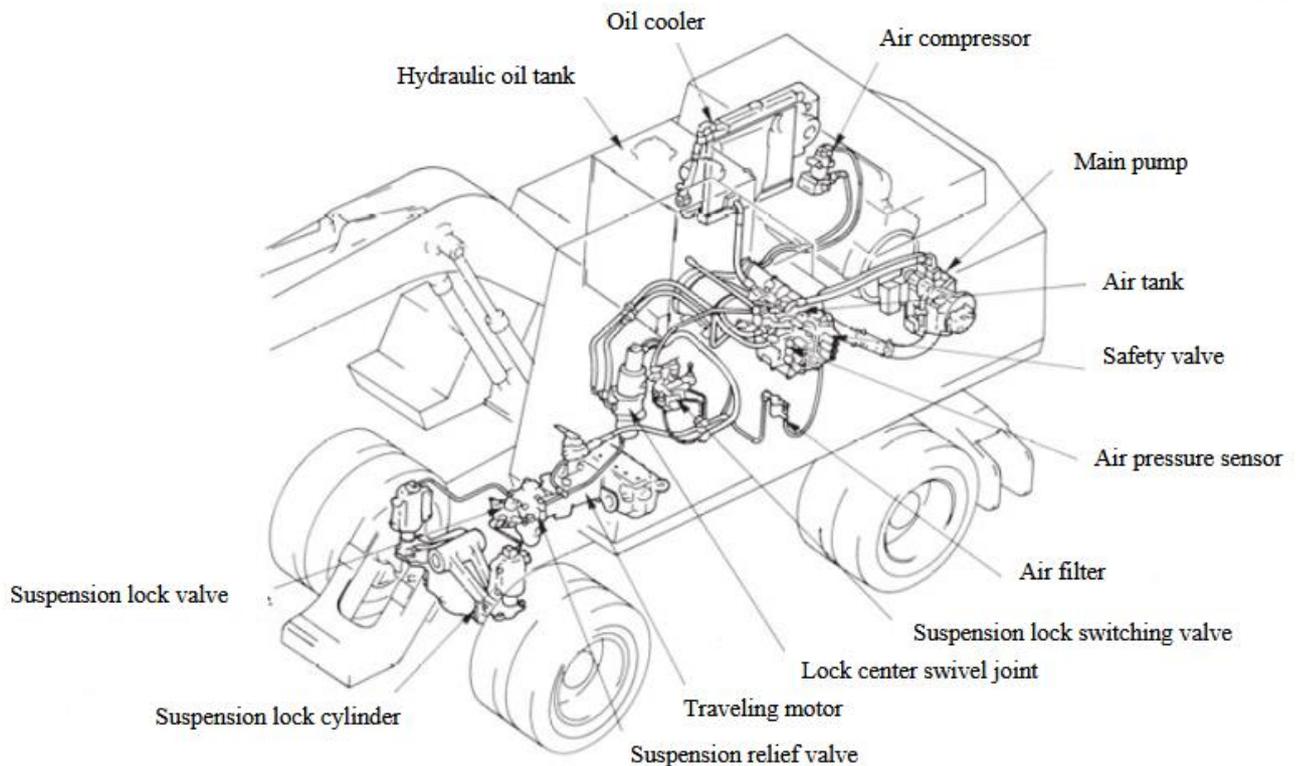


Figure 3-13 Example of suspension fixed piping

(2) Tire

As shown in Table 3-1 for tires, it is important to adjust the air pressure because the air pressure condition affects workability and tire life.

Whether or not the air pressure is appropriate is determined by measuring with a tire gauge.

Table 3-1 Tire pressure

If the air pressure is too low	If the air pressure is too high
① The tires are crushed and deflected. This generates the considerable heat and causes peeling	① The central part of tire only touches the ground, and this part will wear quickly.
② Both edges of the tire will touch the ground and this part will wear quickly	② On the soft areas, tire digs deep into the soil and reduces the traction.
③ On solid road surface, the resistance will increase and the traction will decrease	③ Even small edges of stone will scratch easily

3.3. Safety devices for dismantling machines, etc. (textbook p.41)

(1) Alarm device (horn)

An alarm device (horn) is installed that gives a sound warning to related workers to ensure safety during driving and work.

(2) Safety lock lever, etc.

Various safety lock levers are installed to prevent the base machine moving unexpectedly or the attachment moving when the machine is inspected, maintained, or when work is stopped. (See Figure 3-5)



Figure 3-5 Example of the safety lock lever

(3) Monitoring system

The system alerts the driver by a lighting lamp and a buzzer in case of abnormality. It allows the driver to check the machine condition required for safe driving during operation. At this time, it is necessary to immediately stop driving and perform inspection, repair, etc.

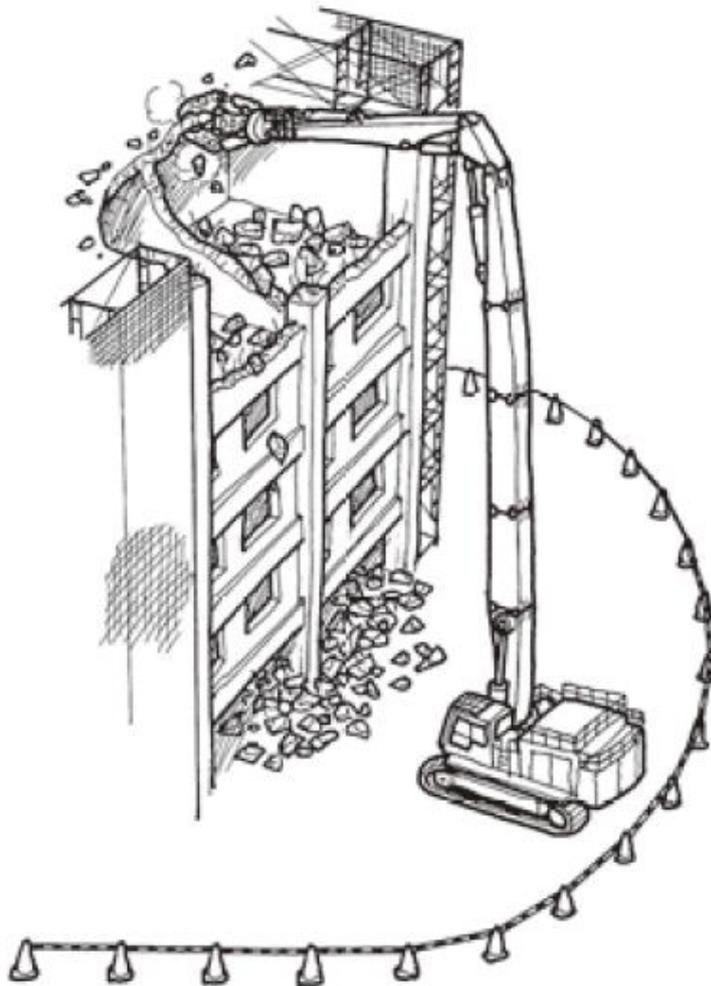
Table 3-2 Example of monitoring system

Display	Display items	Display range	Display state	Measure
	Brake fluid amount	Below low level	When the engine is stopped and the starter switch is on, the display light turns off when normal and blinks when abnormal (lights).	Supply the specified brake fluid
	Engine oil amount	Below low level		Supply the specified engine oil
	Radiator water level	Below low level		Supply water to radiator
	Charge(Charge amount)	When charge is bad		Inspection, repair, replacement of charging system (alternator, belt wiring, etc)
	Amount of fuel	Below low level		Supply the fuel
	Transmission oil is clogged	Above the specified differential pressure		Transmission oil, oil filter element replacement
	Engine oil is clogged	Above the specified differential pressure		Engine oil filter element replacement
	Air filter is clogged	Above the specified differential pressure		Air filter element cleanup or replacement
	Hydraulic oil filter is clogged	Above the specified differential pressure		Hydraulic oil filter element replacement
	Engine V belt cutting	When chutting V belt		Belt replacement
	Main steering malfunction	When main steering circuit cannot be steered		Main steering inspection, repair
	Brake line failure	When overstroke (Brake oil pressure drop)		Inspection and repairs of brake system
	Engine oil pressure	Above the specified differential pressure		Inspection and repair around engine
	Radiator water level	Below low level		After checking and repairing for water level
	Air pressure	Above the specified differential pressure	Check for air leak and wait until the specified pressure rises after repair	
	Engine water temperature	More than 120 °C	Stop the vehicle, set the engine to low idling and wait until light off	
	Torque converter oil amount	More than 120 °C	Stop the vehicle, turn the engine at medium speed with no load, and wait the light off	
	Parking brake	At the time of operation	When the starter switch is ON, the display lights up when operating	
	Work light, headlight	At the time of operation		
	Transmission cut off cutting	At the time of operation		
	Engine pre-heat	When preheating circuit is energized	When the starter switch is ON, the display lights up when pre-heating	

(4) Specific dismantling machinery (demolition machine with the total length of boom and arm that is more than 12m)

When working with a specific dismantling machine, the operator shall not work if there is a risk of the base machine tipping over or falling in an unstable location such as a sloping ground. If it is unavoidable, the topography and geology stabilization is performed, such as by solidifying the ground.

There are cases when the specific dismantling machine works in an unstable state with a long boom; it is important to do not exceed the work turning specified by the manufacturer. When the working range is exceeded, it uses a machine type equipped with a work range alarm device (warning device) to alert the driver or a device for stopping the Work device's operation.



(5) Mirror, etc.

A mirror such as side mirrors are attached to the dismantling machine to reduce blind spots on the rear and driver's side

Also, there is recently a model in which a camera is installed behind the base machine, and an operator can work while checking the rear on the LCD monitor. (See Figure 3-6)



Rear camera



Monitor

Figure 3-6 Example of rear view monitor

(6) Headlights, etc.

When using a dismantling machine at night, headlights are provided to ensure the illuminance for safe work. However, if the lighting equipment installed in the work area has the required illuminance, the work can be carried out safely, so it is not necessary to establish a headlight. (See Figure 3-7)

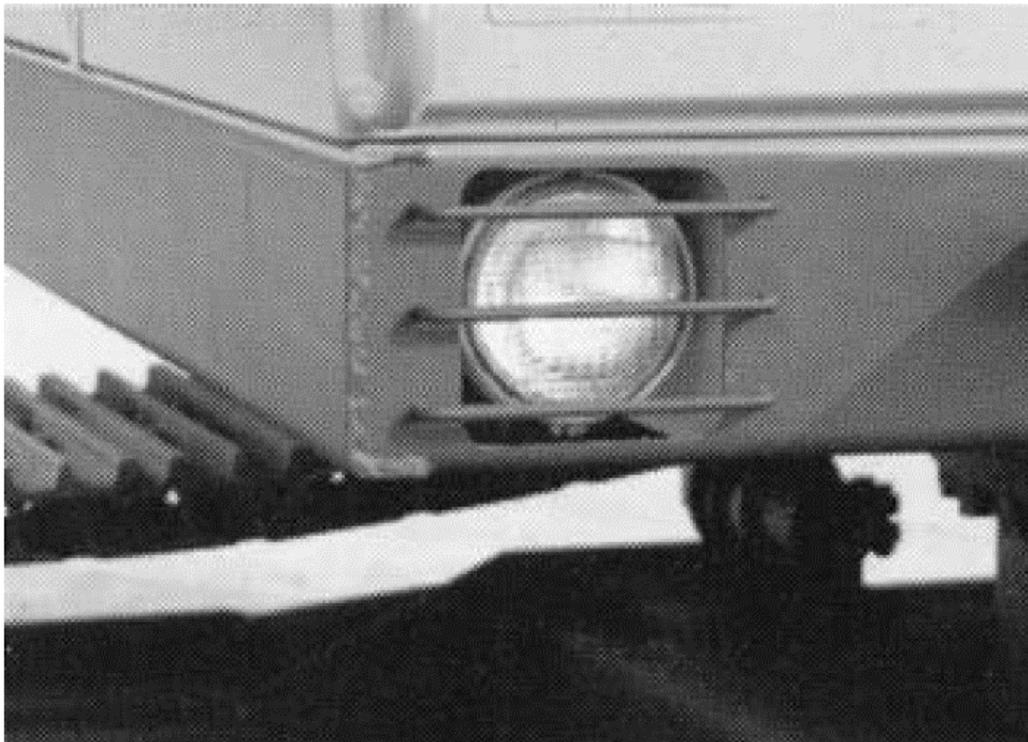


Figure 3-7 Example of headlights

(7) Head guard

When using a dismantling machine in a place where there is a risk of falling debris, rocks, and so on to the driver. It is necessary to attach a solid head guard to the driver's seat. (See Figure 3-17)

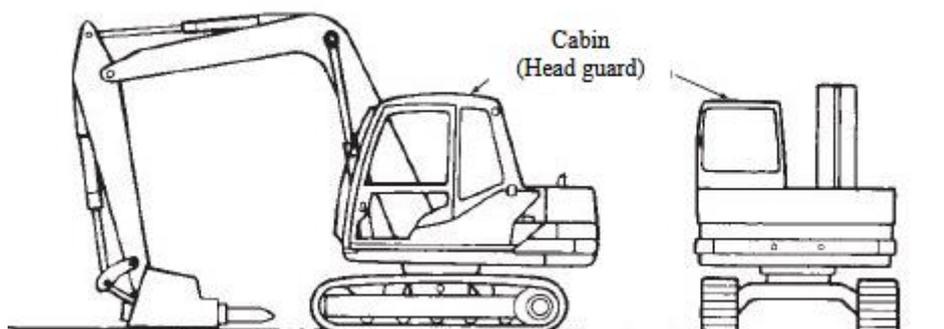
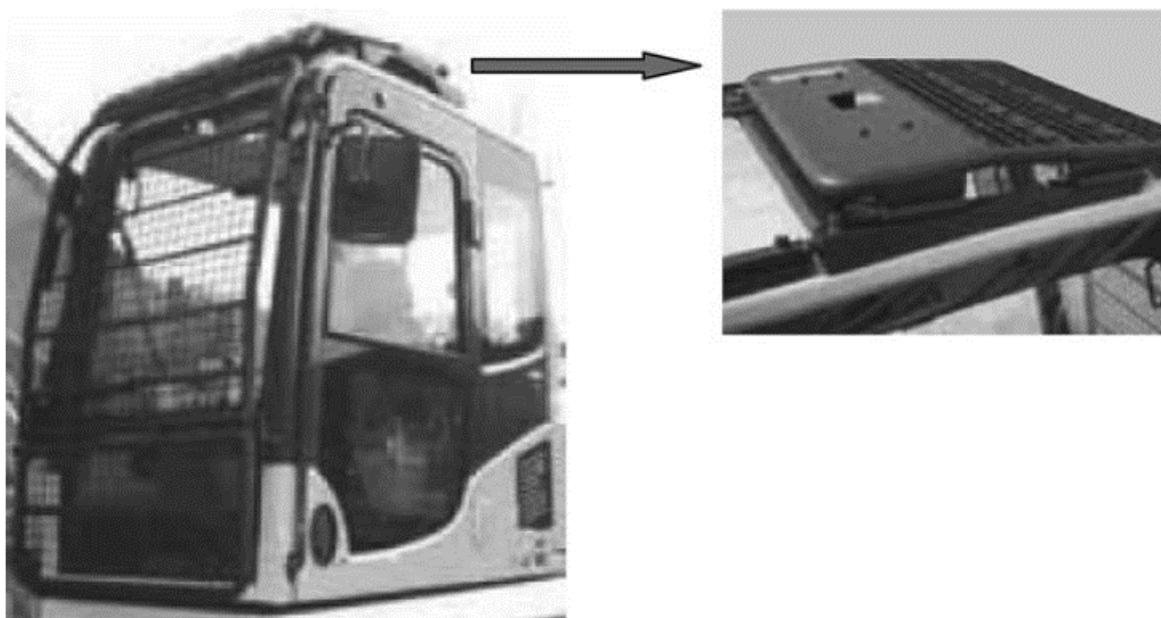


Figure 3-17 Example of head guard

(8) Safety glass and flying object protective device

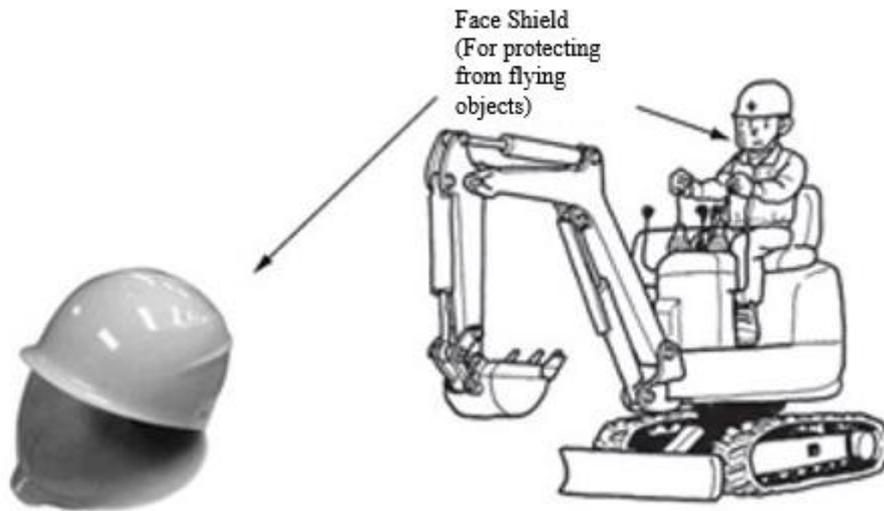
The cab of a demolition machine must use safety glass on the front side or be equipped with protective equipment such as wire mesh to prevent danger from flying debris. (See Figure 3-8)



Picture 3-8 Example of protective equipment installation

(9) Small vehicles machines for dismantling without a cab

Depending on the situation such as flying objects, an operator uses effective protective equipment such as a face shield or use devices to prevent danger.



(10) Rollover protective structure (ROPS), Tip over protective structure (TOPS)

When an operator uses a vehicle-type construction machine in an area where there is a risk of falling or tipping over inclined ground, road edges, try to ones having Rollover protective structure (ROPS) or Tip over protective structure (TOPS) that depending on the place of use. In this case, the driver is required to use a seat belt.



Figure 3-9 Vehicle-based construction machinery with a fall protection structure



Figure 3-18 Example of using a seat belt

4. Handling of equipment regarding operation with demolition attachments, etc.

4.1. Structure, types, and operation of breaker (textbook p.47)

4.1.1. Selection and installation of breaker (textbook p.47)

①The size of the breaker is decided according to the material to be crushed. At this time, the type of chisel should also be decided based on the application. (See Figure 4-1)

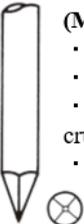
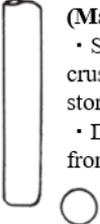
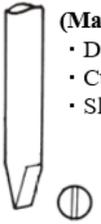
Demolition point	Flat end	Flat
 <p>(Main applications)</p> <ul style="list-style-type: none">• Concrete crushing• Bedrock crushing• Hard bed soil crushing• Road construction	 <p>(Main applications)</p> <ul style="list-style-type: none">• Secondary crushing of crushed stone• Delamination from cement paste	 <p>(Main applications)</p> <ul style="list-style-type: none">• Ditch excavation• Cutting of sprues• Slope crushing

Figure 4-1 Example of chisel types

②Select a base machine suitable for the required oil amount, hydraulic pressure, and weight of the breaker unit.

③The hydraulic source for the breaker unit is taken from the hydraulic circuit of the base machine, and the hydraulic circuit for the breaker unit is installed through the hydraulic pump, boom and arm. At this time, depending on the base machine, it may be necessary to add hydraulic valves, relief valves, etc. In addition, a control device (control pedal, etc.) for striking the breaker unit shall be installed in the driver's seat.

④The breaker unit is installed on the arm of the base machine using a pin, and a hydraulic hose connects the breaker unit to the hydraulic circuit for the breaker on the arm.

⑤Perform a trial drive to check the breaker unit's operating state, etc.

⑥To restore the original state of the base machine, replace the breaker unit, bucket, etc., in the reverse order of installation of ④.

4.1.2. Characteristics of breaker (textbook p.48)

In breaker, the piston impacts the chisel, and the impact force generated at that time is concentrated on the chisel tip to crush the object. For this reason, it has a strong crushing force and can be used for various crushing operations, such as bedrock crushing, concrete crushing, and delamination of cement paste, etc.

Since the breaker uses the base machine's hydraulic pressure, it has good mobility and can easily perform detailed work, resulting in high work efficiency. (See Figure 4-2).

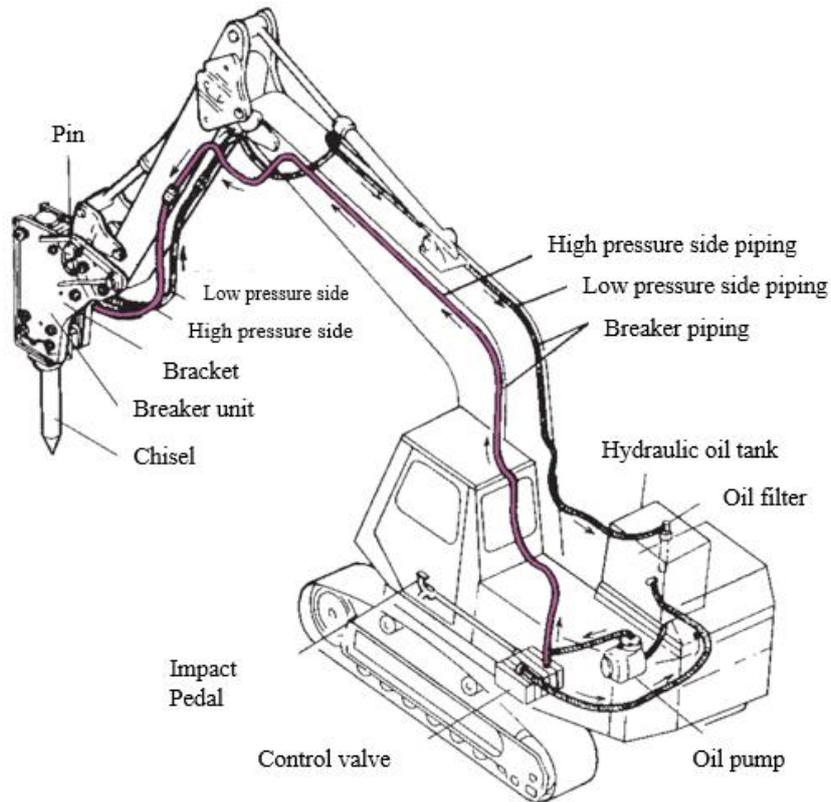


Figure 4-2 Hydraulic breaker

4.1.3. Name and function of each part of the breaker unit (Text p.49)

The breaker unit consists of a cylinder, piston, a valve, a chisel, bracket, etc. (See Figure 4-3)

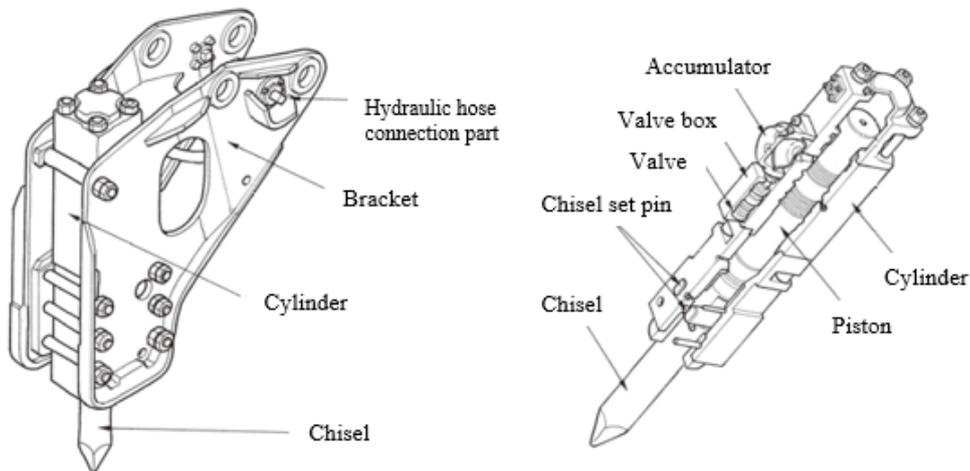


Figure 4-3 Example of breaker unit unit part names

In addition, the circuit for the breaker unit operation consists of an IN-side circuit from the hydraulic pressure extraction section to the breaker unit and an OUT-side circuit from the breaker unit to the return section. (See Figure 4-4.)

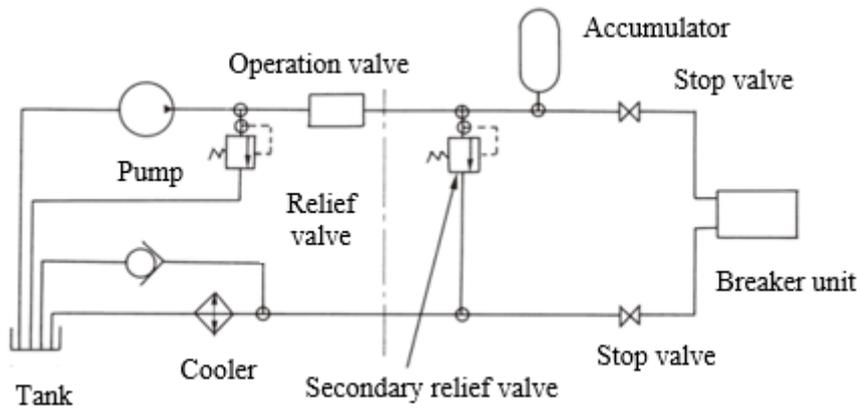


Figure 4-4 Example of hydraulic piping circuit

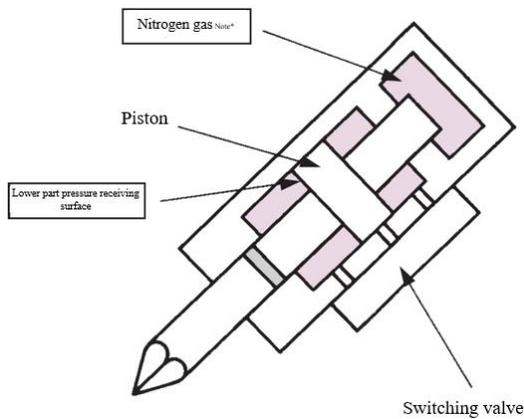
4.1.4. Type of breaker (textbook p.50)

The types of breaker unit actuation methods are listed below.

- Repulsive hydraulic regeneration type
- Direct-acting hydraulic system type -----(a) Piston upper surface high/low-pressure switchable type
|----- (b) Piston lower surface high/low-pressure switchable type

① Repulsive hydraulic regeneration type (see figure 4-5)

The operation method uses high-pressure hydraulic pressure acting on the lower part pressure receiving surface of the piston to lift the piston and compress the nitrogen gas sealed in the upper part of the piston. When the piston reaches the top dead point, the switching valve changes the lower part pressure receiving surface of the piston to low pressure, and the expansion of the compressed nitrogen gas causes the piston to descend at a rapid rate to strike the chisel.



Note: Do not use any other gas than nitrogen gas.

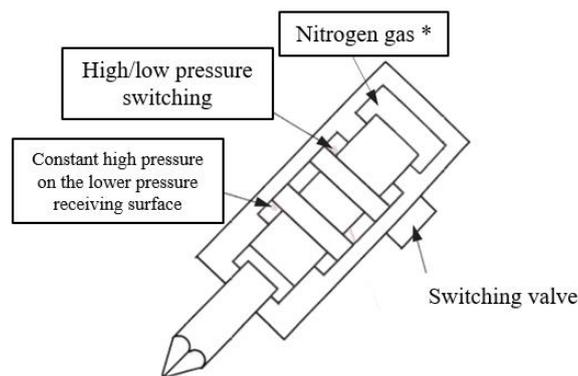
Figure 4-5 Example of diagram of the operation of Repulsive hydraulic regeneration type

② Direct-acting hydraulic system type

There are two main categories of operating methods; in one method, the lower part pressure receiving surface of the (a) piston is always applied with high pressure, and the upper part pressure receiving surface of the piston is switched between low pressure and high pressure to operate the piston (When the upper pressure receiving surface gets high pressure, the area difference between the lower and upper pressure-receiving surfaces makes the piston descend. See Figure 4-6) and the opposite method in which the upper pressure receiving surface of the upper piston (piston) is always subjected to high pressure, and the lower pressure receiving surface of the piston is switched between high and low pressure to operate the piston. (When the lower part pressure receiving surface reaches high pressure, the area difference between the lower and upper part pressure-receiving surfaces raises the piston. See Figure 4-8).

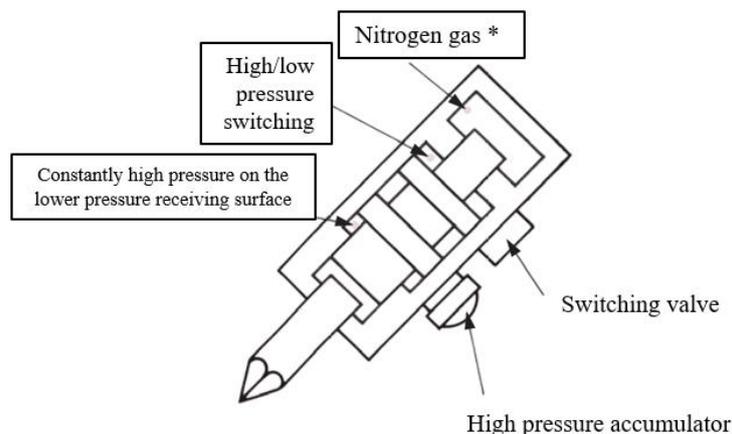
In some models, nitrogen gas is enclosed in the upper part of the piston, and the blow is made by hydraulic pressure and the expansion of the compressed nitrogen gas. (See Figure 4-6 and Figure 4-7)

In models with a high-pressure accumulator attached to the main unit of the breaker unit, the blowing is performed by both the hydraulic pressure supplied by the pump and the hydraulic pressure discharged from the accumulator. (See Figure 4-7 and Figure 4-8)



Note: Do not use any other gas than nitrogen gas.

Figure 4-6 Example of operation diagram of Direct-acting hydraulic system type (a)



Note: Do not use any other gas than nitrogen gas.

Figure 4-7 Operation diagram of Direct-acting hydraulic system type(a) Example of use of nitrogen gas and high-pressure accumulator

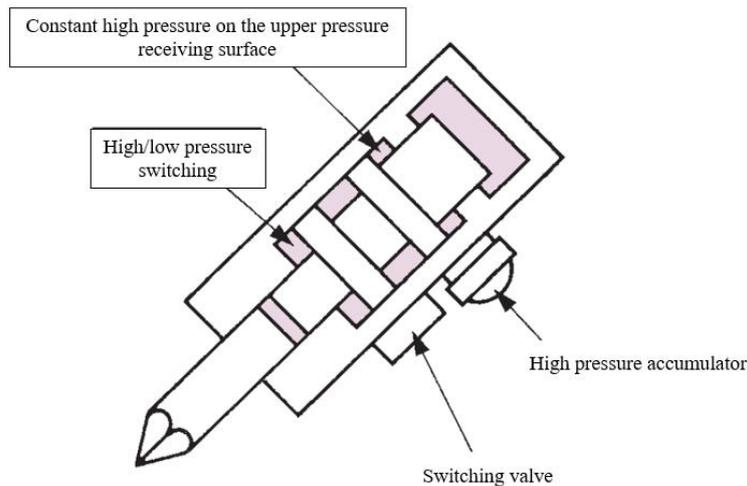


Figure 4-8 Example of operation diagram of Direct-acting hydraulic system type (b)

4.1.5. Breaker operation, etc. (textbook p.52)

The basic operations of the breaker include raising and lowering the boom and the arm, extending and retracting the breaker unit, rotating and striking the breaker unit. Except for the breaker unit's striking action, the operation is the same as the operation of a hydraulic shovel.

As for hydraulic excavators, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) decided to promote the use of machines with a standardized operation method and made their use mandatory in principle for construction projects under the direct control of MLIT from 1991. When this regulation was first established, the former Ministry of Construction determined and designated whether or not the construction equipment in question was based on the standard operation method. However, since April 1998, the Japan Construction Mechanization Incorporated Association has been determining and certifying the standard operation method based on manufacturers' application documents.

This operation system is in line with the JIS (Japanese Industrial Standards) established in 1990.

Also, a designation label (see Figure 4-9) is attached to this operating system.



Figure 4-9 Designation label

4.1.6. General work methods for breaker (textbook p.53)

Breaker can perform the task of demolishing structures and crushing rocks, but the breaker unit should be compatible with the capabilities of the base machine.

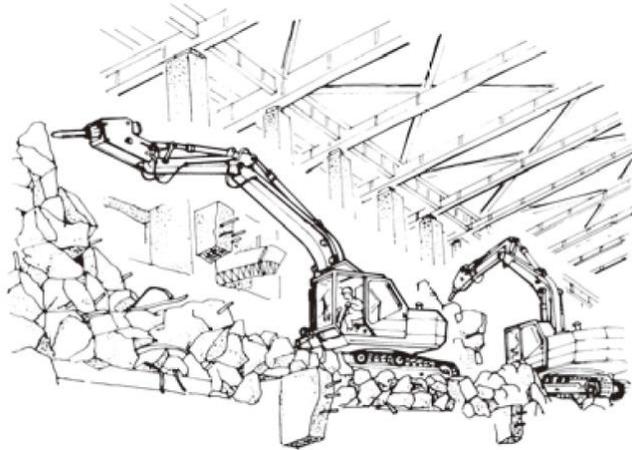


Figure 4-10 Demolition of concrete structures in buildings

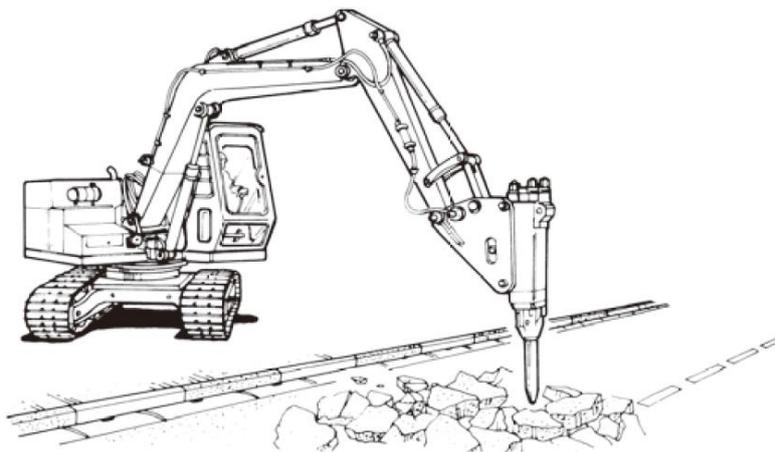


Figure 4-11 Demolition of road paving panel



Figure 4-12 Rock crushing

The following are some basic precautions for demolition or crushing operations with breaker.

- ① When working with breaker, the breaker's grease injection points must be greased five to six times at least twice a day.
- ② In the breaker operation, the chisel must be placed at a right angle to the surface to be crushed, and then apply a pushing force to start the striking. While striking, the pushing force must be applied continuously, and the pushing force must be in the direction of the chisel.

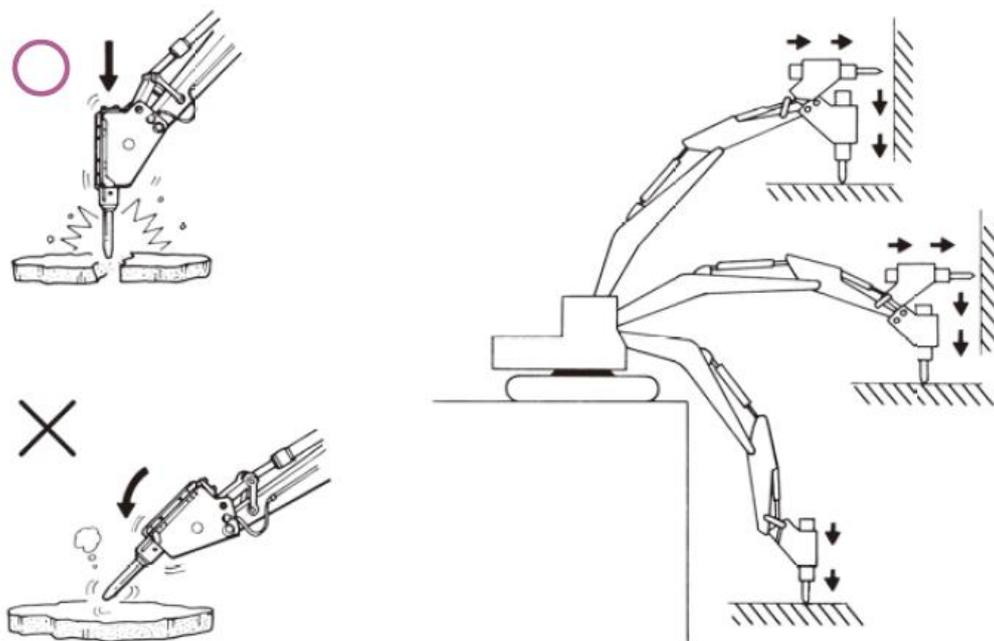


Figure 4-13 Press the breaker unit at a right angle and hit

③ Always press the chisel against the object to be demolished or crushed before striking it. In case the object to be crushed breaks, stop the hitting immediately. Do not blank fire, as it may cause the oil temperature to rise, loosen the bolts, or even fractures.

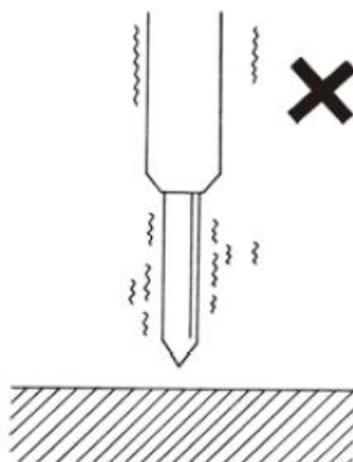


Figure 4-12 Do not blank fire (karauchi)

④ Do not pry (kojiru) with the chisel. If you pry (kojiru) and break a rock, etc., it will cause breakage of bolts and chisels and wear on bushes. Be careful as there have been cases where the chisel was broken due to hitting while prying (kojiru), resulting in accidents, and cases where crushed fragments flew in unexpected directions, resulting in injuries.

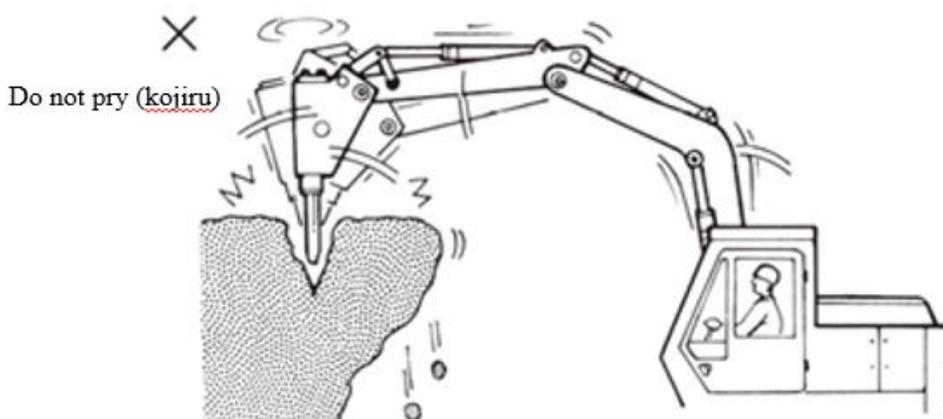


Figure 4-15 Do not pry (kojiru) with the chisel

- ⑤ If the chisel does not penetrate the same part after hitting it for one minute, change the part to be hit.
- ⑥ As for large, hard objects, hit them in order, starting with the place that is easiest to break (grain of rock (ishime), edges, etc.).

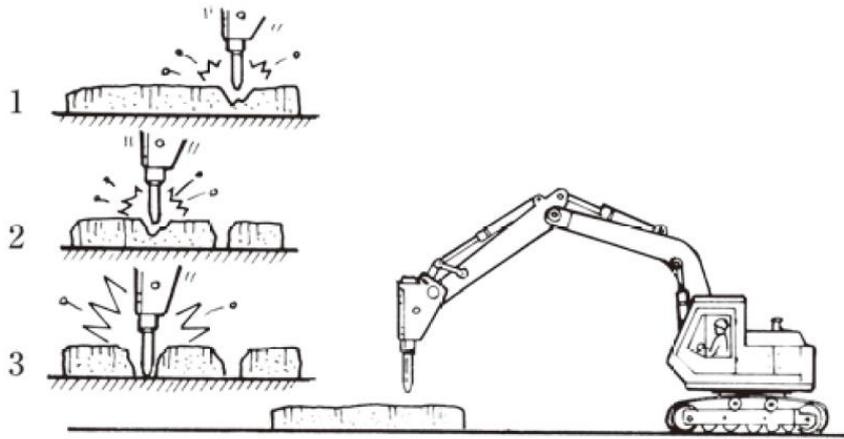


Figure 4-16 Start with the part that is easy to break

- ⑦ Do not break the breaker unit by dropping (knocking down) it. It may cause damage to the breaker unit, arm, boom, main body, or other machine parts.
- ⑧ Do not use the breaker unit to sweep rocks or other objects to be crushed.
- ⑨ Do not strike the breaker unit when fully extended or fully loaded (stroke end).

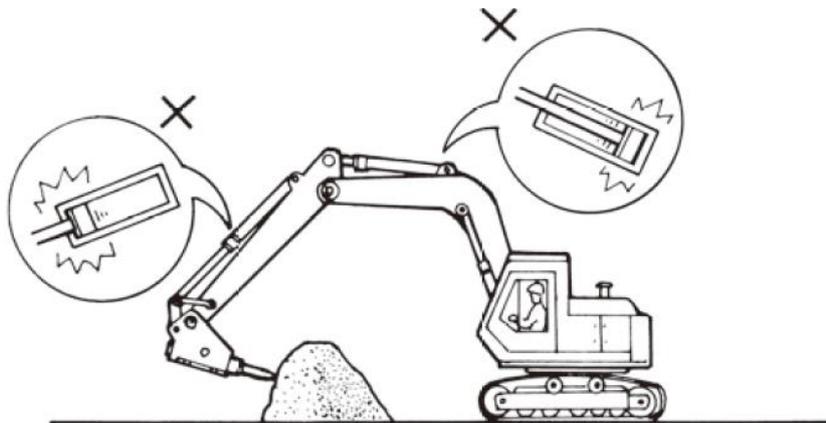


Figure 4-17 Do not hit with the stroke end

⑩ Do not use wires or other objects to hang onto the breaker unit's brackets or chisels.

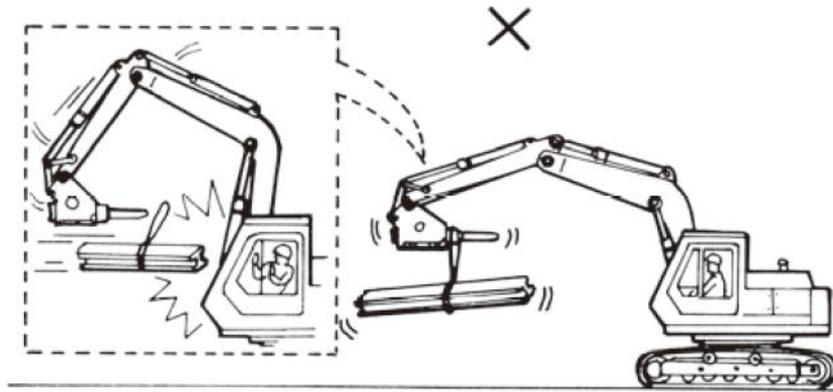


Figure 4-18 Do not use breaker to hang things

⑪ Do not work with the breaker unit submerged in water. Work underwater shall be limited to the chisel portion. In the case of underwater work, you must use a breaker unit with specifications for underwater work.

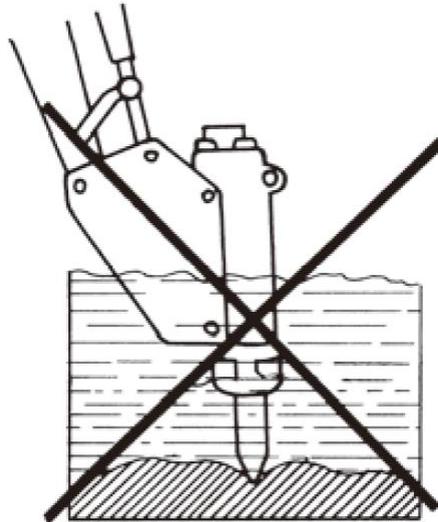


Figure 4-19 Do not work underwater

- ⑫ If the hydraulic oil piping of the breaker shakes abnormally, stop the work and inspect it.
- ⑬ During the work, the area where crushed debris may be dispersed should be prohibited from entry.

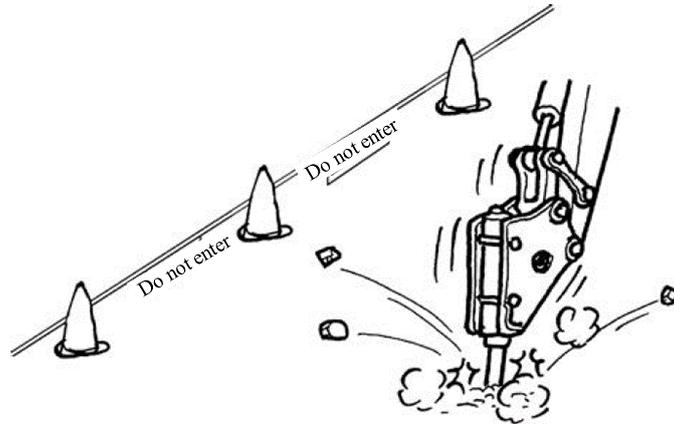


Figure 4-20 Prohibited entry to areas with flying fragments

- ⑭ In case of bad weather is expected, the work shall be suspended.
- ⑮ Do not work under or on a cliff. The vibration of the breaker may cause a landslide or falling rocks.

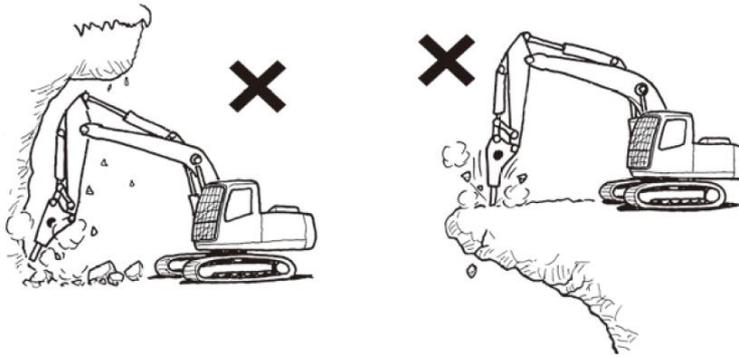


Figure 4-21 Be cautious of landslides, falling rocks, etc.

- ⑯ Do not work on soft ground, on concrete blocks, or in other unstable places where the base machine may fall over. Especially, do not work on an inclined ground.

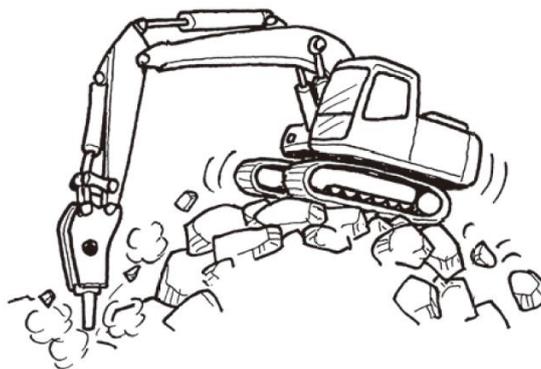


Figure 4-22 Be careful not to fall down

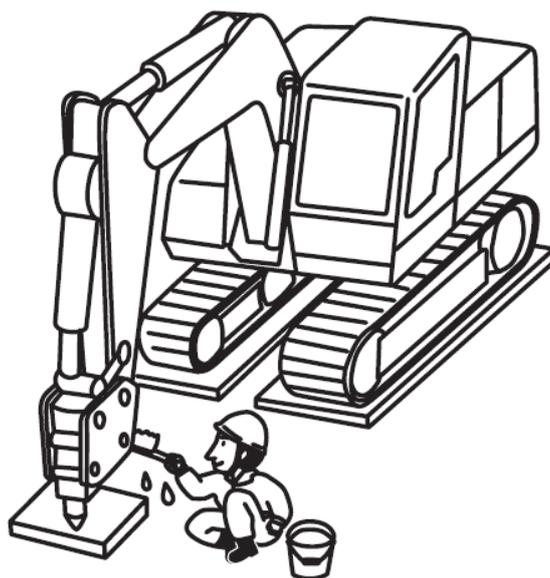
- ⑰ Do not perform simultaneous operations such as driving while working. The breaker and base machine may get affected by an abnormal force and may be damaged.
- ⑱ When the machine is used as a breaker, the hydraulic oil deteriorates incredibly quickly compared to when it is used as a shovel (shoberu) system, so it is necessary to replace the filter and hydraulic oil early.

4.1.7. Precautions after finishing work (textbook p.58)

(1) Breaker unit

- ① Park the base machine with the breaker unit attached on a hard, dry, flat surface. Place the breaker unit in a vertical position and put the chisel's tip on the ground.
- ② Wipe off any mud, etc., adhered to the breaker unit, check for oil leaks and abnormalities in the chisel, etc.
- ③ When removing the breaker unit from the arm, do so only after the temperature of the hydraulic oil has dropped as much as possible. Also, put dust caps on the pipes and hoses.
- ④ When connecting and disconnecting hydraulic hoses, etc., take great care not to allow foreign matter to enter the hydraulic oil.
- ⑤ Store the disconnected breaker unit indoors. In case of storing it outdoors, place it on a sleeper and cover it with a sheet to keep out rainwater.

Be careful not to let rainwater enter through the chisel insertion part of the breaker unit.



(2) Base machine

Remove mud and water from the base machine. Clean the area around and inside the driver's seat, such as the undercarriage and raising and lowering equipment, in preparation for the next operation. Also, perform lubrication, etc.

It is necessary to pay special attention to cleaning the hydraulic cylinder rod surface, as mud, etc., may be carried along with water drops into the seal and may damage it.

4.2. Structure, type, and operation of steel cutting machines (textbook p.59)

4.2.1. Characteristics of steel cutting machines (textbook p.59)

Conventional gas welding machines had the risk of causing crash and fall accidents to workers performing cutting tasks at high places with these machines. However, with the use of a steel cutting machine, these risks are reduced. (As those hazards decrease, work can be done more safely.)

4.2.2. Name and function of each part of steel frame cutting tools(textbook p.59)

The steel frame cutting tool consists of a cutting arm, cutter, opening/closing cylinder, lower frame, swing bearing, and upper frame. (See Figure 1-1②)

4.2.3. Type of steel frame cutting tools (textbooks p.59)

Like household scissors, cutting tools press the cutter part against the steel frame to be cut while preventing it from slipping. Since the tip opening width can be increased, they are suitable for cutting steel structures and buildings that do not move when pressed. The anti-slip shape with a "V" shaped tip reduces the tip opening width. However, this cutting tool does not require the cutter to be pressed against it and is suitable for cutting steel scrap.

4.2.4. Selection and installation of steel cutting machine (textbook p.59)

The procedure for selecting and installing a steel cutting tool is shown below.

- ① Select the shape of the steel frame cutting tool according to the application and the object's size to be cut. At this time, the swivel type of the steel cutting machine can be selected according to the application, either the hydraulic swivel-type swiveled by the hydraulic motor or the free swivel-type) swiveled by lightly touching the object.
- ② Select a base machine suitable for the hydraulic pressure and weight according to the balance between the required oil volume and weight of the steel cutting tool.
- ③ Extract the hydraulic source of the steel frame cutting tool from the hydraulic circuit of the base machine and install the hydraulic circuit for the steel cutting tool through the hydraulic pump, boom and arm. At this time, additional hydraulic valves and relief valves may be required depending on the base machine.
- ④ Install the steel cutting tool on the arm of the base machine with a pin, and connect the steel cutting tool to the hydraulic circuit for the steel cutting tool on the arm with an oil hose.
- ⑤ Perform a trial run to check the operation of the steel cutting tool.
- ⑥ To restore the original state of the base machine, replace the steel cutting tool and basket, etc., in the reverse order of the installation in step ④.



Figure 4-1 Steel frame cutting tool

4.2.5. Operation of steel frame cutting machines (textbook p.60)

The standard operation method for base machines (JIS standard operation) is the same as "4.1.5 Operation of breaker, etc."

4.2.6. General work method for steel frame cutting machines (textbook p.60)

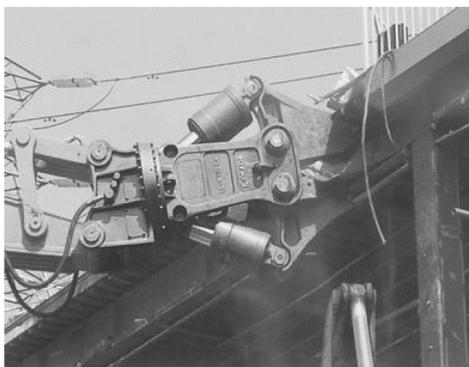


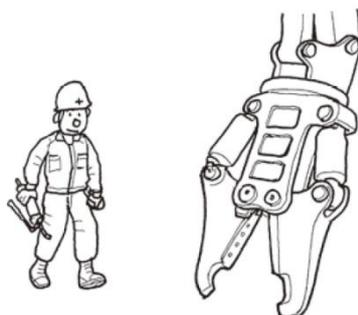
Figure 4-2 Demolition performed by a steel frame cutting machine

Perform warming of the hydraulic oil operation of the base machine and allow the oil temperature to rise slightly before starting the operation. The optimum range of oil temperature is specified in the instruction manual of each manufacturer.

At the beginning of using a new steel frame cutting tool, run it for about one hour with lower engine speed and lower cylinder opening/closing speed to get used to the sliding surface of each pin and bush.

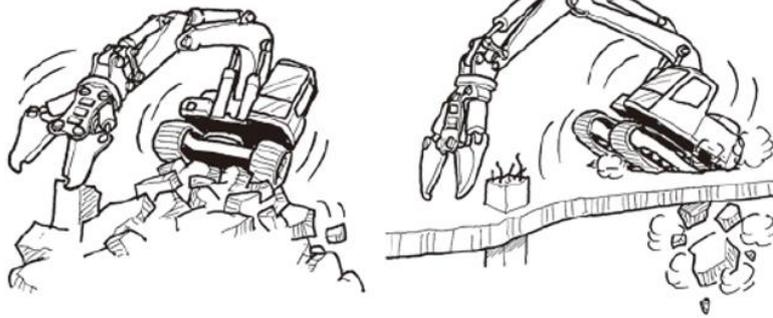
The following are the basic precautions for demolition work by steel frame cutting machines.

- ① Grease the grease injection points of the steel frame cutting tool 5 or 6 times at least twice a day.



② Do not work on soft ground, on concrete blocks, or in other unstable places where the base machine may fall over. In particular, do not work on inclined ground.

Operating in an unstable place is dangerous Check the strength of the floor surface

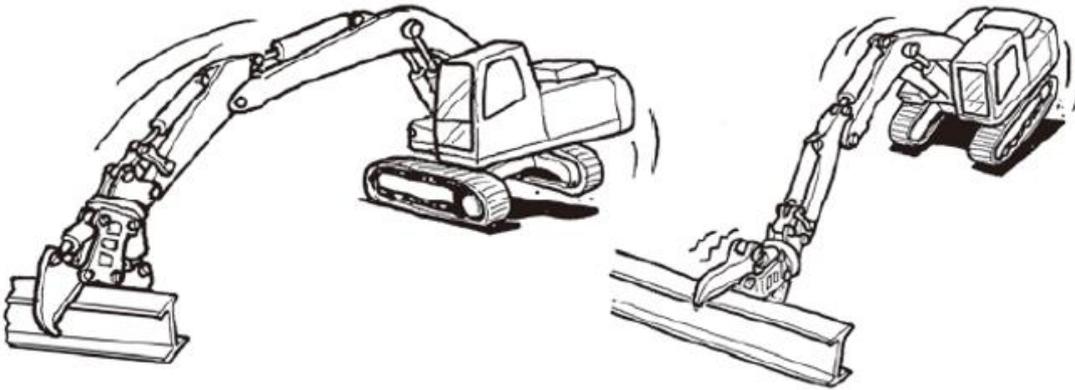


③ Performing an operation in the lateral direction to the crawlers (crawler belts) is more unstable than in the longitudinal direction, and there is a high risk of the main body of the machine lifting off the ground or falling over.

Even if working in the longitudinal direction, do not work in such a way that the machine lifts off the ground because it is dangerous.

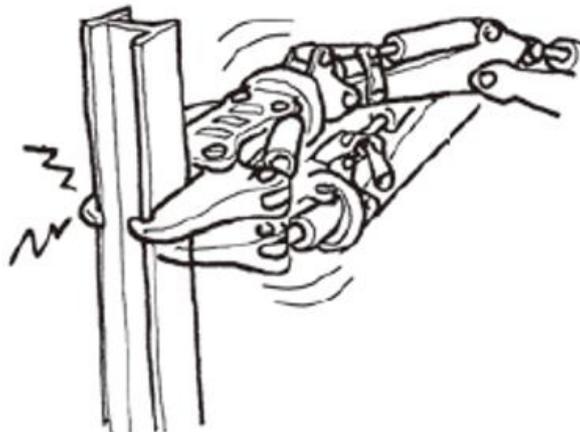
Be careful when working horizontally against the crawler belt

It is dangerous to work when the main part of the machine is floating



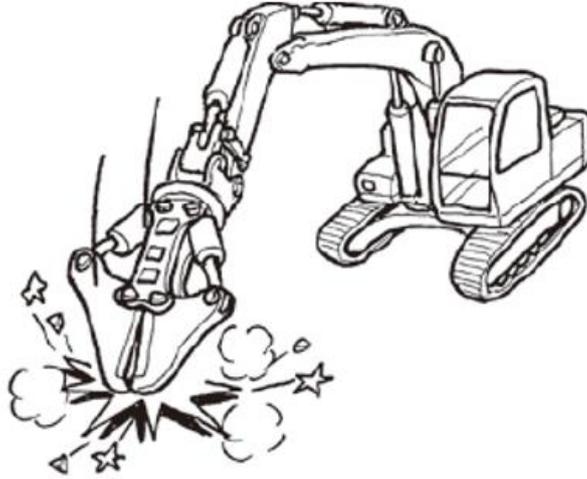
④ Do not pry (kojiru) when cutting, as it may result in damage to the cutter of the steel frame cutting tool, bending or breaking of the arm, and cause damage to the base machine.

Do not pry (kojiru)



⑤ Do not break concrete or other materials by dropping the steel frame cutting tool. Do not perform striking work.

Do not hit



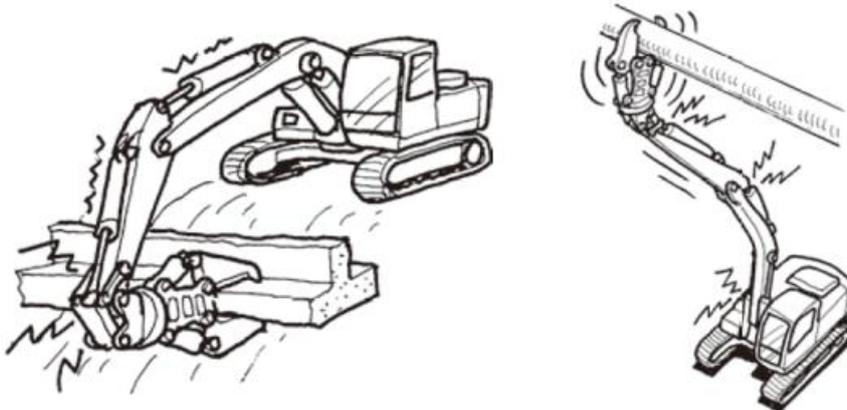
⑥ Do not transport crushed materials with the steel cutting machine. Do not perform horizontal sweeping operations.

Side sweeping is forbidden



⑦ Cutting work should be performed with a sufficient margin of stroke. If you operate at stroke end, the cylinder will be heavily stressed. (The same applies to striking at stroke end.)

Do not bite in a stroke end situation



⑧ Do not perform crane operations to move objects by hanging wires on steel frame cutting tools.

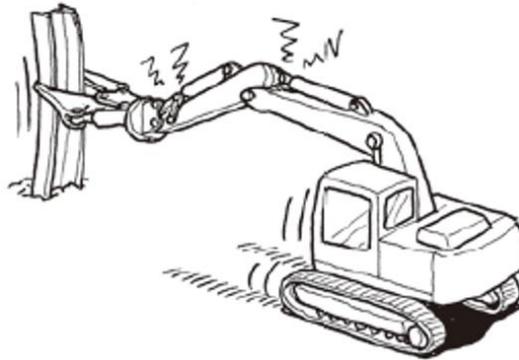
- ⑨ Do not work underwater or in contact with water.
- ⑩ During the operation, the areas where crushed fragments may flying around should be off-limits.

No entry within flying and falling material area



- ⑪ In case of bad weather is expected, the work shall be suspended.
- ⑫ Do not perform simultaneous operations such as driving while working. The steel cutting tool and base machine may get subjected to abnormal forces, which is dangerous.

Do not operate arm, boom or drive at the same time when working.



- ⑬ Do not open the arm of the steel frame cutting machine to cut. It may cause the failure of the steel frame cutting tool or the open/close cylinder.



⑭ Do not demolish concrete with the cutter blade section of the steel cutting tool because the blade may get damaged. Avoid biting hard, heat-treated bolts and other materials used in steel structures with the cutter section of the steel cutting tool. A chipped or broken cutter blade can be dangerous to the workers around it.

Do not bite concrete with the cutter blade



⑮ Do not change the base machine's direction by pushing the steel frame cutting tool against the ground. Do not do this as it will not only cause damage to the steel frame cutting tool and the base machine but also will make the base machine unstable.



4.2.7. Precautions after finishing work (textbook p.65)

(1) Steel frame cutting tools.

① Park the base machine with the steel frame cutting tool attached on a hard, dry, flat surface. (2) To protect the opening and closing cylinder rod, put the steel frame cutting tool on the ground in a stable position with the cutting arm extended.



② Wipe off any mud, etc., that may have adhered to the steel cutting frame tool, and check for oil leaks, loosen bolts, chipped or worn cutters, or any other abnormalities.

③ When removing the steel frame cutting tool from the arm, do so only after the temperature of the hydraulic oil has dropped as much as possible. Put dust caps on the pipes and hoses. To prevent the steel cutting tool from collapsing, place it horizontally on the ground.

④ When attaching or detaching hydraulic hoses, be very careful not to let foreign matter enter the hydraulic oil.

⑤ Store the removed steel frame cutting tool indoors or, if you store it outdoors, place them on top of sleepers and cover them with sheets to protect them from rainwater.

(2)Base machine

Remove mud and water from the base machine. Clean the area around and inside the driver's seat, such as the undercarriage and lifting equipment, in preparation for the next operation. Also, perform lubrication, etc.

It is necessary to pay special attention to cleaning the hydraulic cylinder rod surface, as mud, etc., may be carried along with water drops into the seal and may damage it.

4.3. Structure, type, and operation of concrete crusher machines (textbook p.66)

4.3.1. Characteristics of concrete crusher machines (textbook p.66)

Compared with the concrete building demolition method using a breaker, this method has lower noise and vibration and produces fewer scattered crushed fragments.

4.3.2. Name and function of each part of a concrete crusher (textbook p.66)

The Concrete crusher (rough crusher) consists of crusher arm, cutter, crushing point (assai point), opening and closing cylinder, lower frame, swing bearing, and upper frame. (See Figure 1-1③)

The Concrete crusher (fine crusher) consists of a crusher arm, cutter, crushing point (assai point), opening and closing cylinder, and frame. (See Fig. 1-1④)

4.3.3. Types of concrete crushers (textbook p.66)

The types of concrete crushers are as follows.

(1) Concrete crusher (rough crusher)

It is designed to crush and cut concrete structures and buildings into concrete blocks of a size that can be processed into small pieces. The crusher arm is shaped for easy crushing and cutting of concrete and has a swivel device for convenient demolition of structures and buildings. (See Figure 4-3)



Figure 4-3 Demolition of large sections of concrete structures and buildings

(2) Concrete crusher (fine crusher)

The fine crusher crushes the concrete blocks cut out by the rough crusher into smaller pieces and separates them into reinforcing steel and concrete pieces.

The crusher arm has a wide arm width to crush the concrete into smaller pieces, which can be easily separated from the steel bars. Most of the fine crushers do not have a swivel device because they mainly break concrete blocks and concrete products such as U-shaped gutter into small pieces after the primary crushing is done by the rough crusher. (See Figure 4.4)



Figure 4-4 Demolition of small pieces of concrete

4.3.4. Selection and installation of fine crushers (textbook p.67)

The steps for selecting and installing concrete crushing tools are shown below.

① Select the shape to suit the application and the size of the concrete crusher tool to suit the object to be crushed.

A) Rough crusher machine for splitting concrete structures and buildings to a size that can be processed by fine splitting. (See Figure 4-5)

B) A fine crushers that crush reinforced concrete lumps cut out by rough concrete crushers into small pieces and separates them into steel bars and concrete fragments. (See Figure 4-6)

At this time, the rotation of the rough concrete crusher can be selected according to use, whether it is the hydraulic swivel-type that rotates with a hydraulic motor or the free swivel-type) that rotates by lightly pressing against the object.

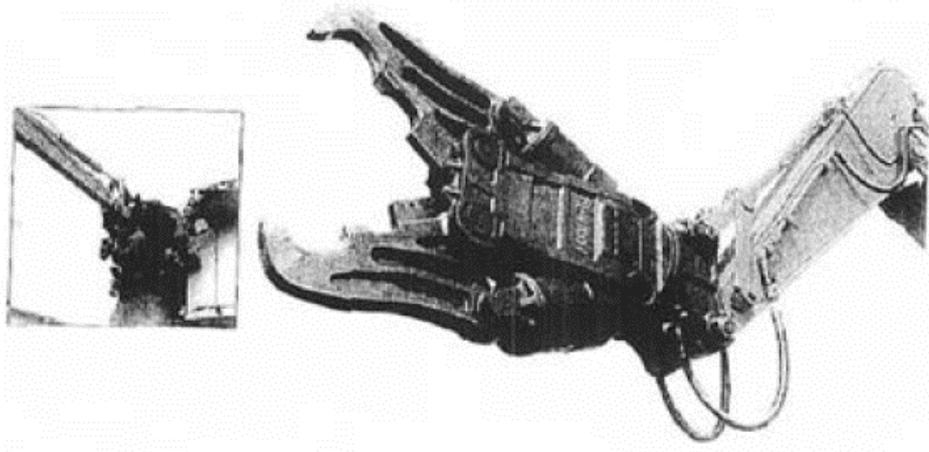


Figure 4-5 Example of rough crusher

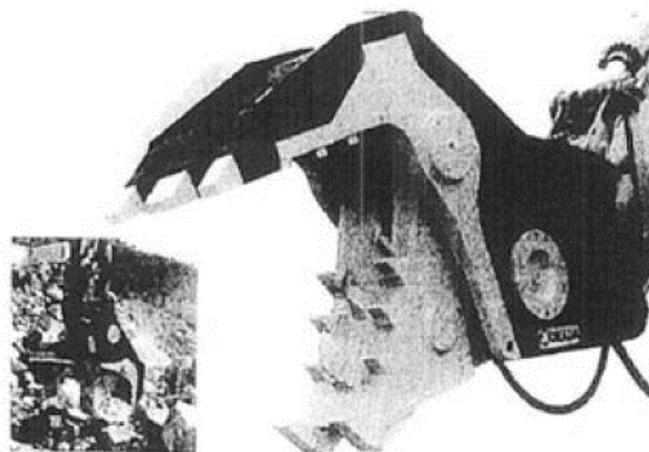


Figure 4-6 Example of fine crusher

② Select a base machine suitable for the hydraulic pressure and weight according to the balance between the required oil volume and weight of the concrete crusher tool.

- ③ Extract the hydraulic source of the concrete crusher tool from the hydraulic circuit of the base machine, and install the hydraulic circuit for the concrete crusher tool through the hydraulic pump, boom and arm. At this time, additional hydraulic valves and relief valves may be required depending on the base machine. Also, install a control device for the concrete crusher tool in the driver's seat.
- ④ Install the concrete crusher tool on the arm of the base machine with a pin and connect the concrete crusher tool to the hydraulic circuit for the concrete crusher tool on the arm with an oil hose.
- ⑤ Perform a trial run to check the operation of the concrete crusher tool.
- ⑥ To restore the original state of the base machine, replace the concrete crusher tool and basket, etc., in the reverse order of the installation in step ④.

4.3.5. Operation of concrete crusher machines (textbook p.69)

The standard operation method for base machines (JIS standard operation) is the same as "4.1.5 Operation of breaker, etc."

4.3.6. General work method for concrete crusher machines (textbook p. 69)

For concrete crushers, select a base machine and attachment suitable for the shape and size of the object to be crushed. (See Figure 4-5 and Figure 4-6.)

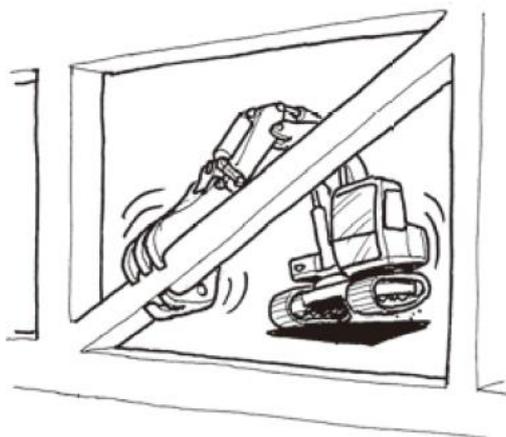
Perform the base machine's warm-oil operation and allow the oil temperature to rise slightly before starting the operation. The optimum range of oil temperature is specified in the instruction manual of each manufacturer.

At the beginning of using a new concrete crusher, run it for about one hour with lower engine speed and lower cylinder opening/closing speed to get used to each pin and bush's sliding surface.

The following are the basic precautions for demolition work by concrete crushers.

- ① Grease the grease injection points of the concrete crusher tool 5 or 6 times at least twice a day.
- ② Do not work on soft ground, on concrete blocks, or in other unstable places where the base machine may fall over. In particular, do not work on the inclined ground.
- ③ Performing an operation in the lateral direction to the crawlers (crawler belts) is more unstable than in the longitudinal direction, and there is a high risk of the main body of the machine lifting off the ground or falling over. Even if working in the longitudinal direction, do not work in such a way that the machine lifts off the ground because it is dangerous.
- ④ Do not pry (kojiru) during crushing work, as it may result in deformation of the crusher arm, breakage, burning or breaking of the pins, and damage to the base machine.
- ⑤ The crushing is performed by clamping the concrete. Do not break the concrete etc., by dropping the crusher tool. Do not perform striking work.
- ⑥ Do not transport crushed materials with the crusher tool. Do not perform horizontal sweeping operations.
- ⑦ Crushing work should be performed with a sufficient margin of stroke. If you operate the stroke end for this, the cylinder will be heavily stressed. (The same applies to striking with stroke end.)
- ⑧ Do not perform crane operations to move objects by hanging wires on crushers.
- ⑨ Do not work underwater or in contact with water.
- ⑩ During the operation, the areas where crushed fragments may fly around should be off-limits.
- ⑪ In case of bad weather is expected, the work shall be suspended.
- ⑫ Do not perform simultaneous operations such as driving while working. The crusher and base machine may be subjected to an abnormal force and may be damaged.
- ⑬ Do not open the arm of the concrete crusher machine. for the purpose of crushing. It may cause the failure of the crusher or the open/close cylinder.
- ⑭ Do not demolish concrete with the cutter's blade section of the rough crusher because the blade may get damaged.
- ⑮ Do not change the base machine's direction by pushing the concrete crusher tool against the ground. Do not do this as it will not only cause damage to the concrete crusher tool and the base machine and make the base machine unstable.
- ⑯ Do not crush natural stones such as paving stones or wall stones, which may cause damage to the crusher arm, frame, pins, cylinders, etc., of the concrete crusher machine.

⑰ Do not use a concrete crushing machine without a swivel device to crush beams and columns of structures and buildings diagonally, as it may cause damage to the base machine.



4.3.7. Precaution after finishing work (textbook p.70)

The following precautions should be taken after finishing work.

(1) Concrete crusher machine

① Park the base machine with the concrete crusher attached on a hard, dry, flat surface. (2) To protect the opening and closing cylinder rod, put the Concrete crusher on the ground in a stable position with the cutting arm extended.

② Wipe off any mud, etc., that may have adhered to the concrete crusher, and check for oil leaks, loosen bolts, chipped or worn cutters, or any other abnormalities.

③ When removing the concrete crusher from the arm, do so only after the temperature of the hydraulic oil has dropped as much as possible. Put dust caps on the pipes and hoses.

④ When attaching or detaching hydraulic hoses, be very careful not to let foreign matter enter the hydraulic oil.

⑤ Store the removed concrete crusher indoors or, if you store it outdoors, place them on top of sleepers and cover them with sheets to protect them from rainwater.

(2) Base machine

Remove mud and water from the base machine. Clean the area around and inside the driver's seat, such as the undercarriage and lifting equipment, in preparation for the next operation. Also, perform lubrication, etc.

It is necessary to pay special attention to cleaning the hydraulic cylinder rod surface, as mud, etc., may be carried along with water drops into the seal and may damage it.

4.4. Structure, type, and operation of demolition gripper machine, etc. (textbook p.72)

4.4.1. Characteristics of gripper machines (textbook p.72)

Gripper machines are used for demolition of wooden houses and debris disposal. When demolishing an object, they produce less noise and less scattering of demolished materials.

In debris treatment, it is more efficient to use a gripper machine instead of a bucket to classify and treat mixed materials of various weights, materials, and shapes. In particular, lightweight materials such as wood, long columns, steel frames, and soft materials such as fabrics can be easily grabbed, classified, and loaded.



Figure 4-7 Debris treatment

4.4.2. Name and function of each part of the gripper tool (textbook p.72)

The gripping tool consists of a gripper arm, a gripper link, an opening and closing cylinder, a lower frame, a swivel bearing, and an upper frame. (See Fig. 1-1⑤ and ⑥)

4.4.3. Types of gripper tools (textbook p.72)

The types of gripper tools are shown below.

(1) Internal cylinder-operated gripper tool with a swivel device

The swinging and hydraulic rotation by the internal cylinder allows free grabbing angle and delicate positioning.

(See Figure 4-23)

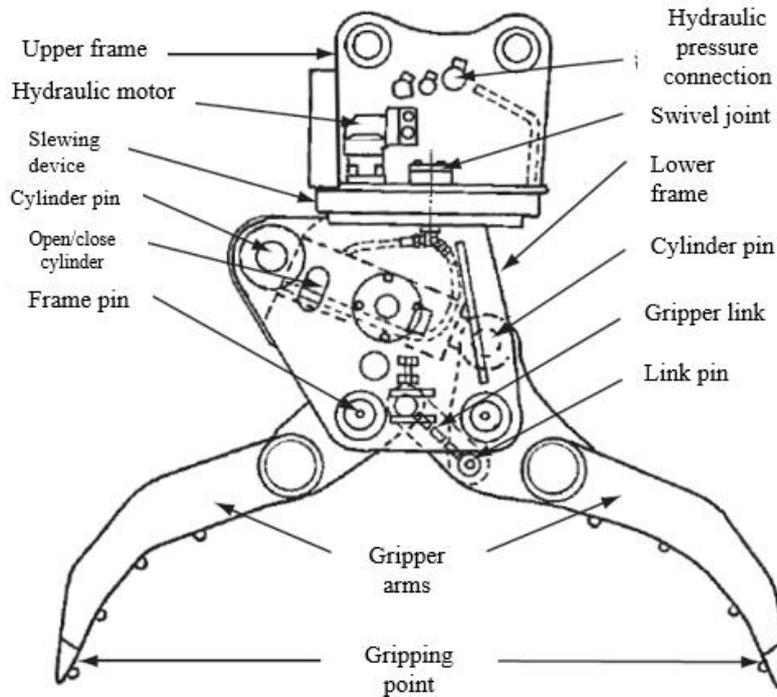


Figure 4-23 Names of each part of a gripper tool (with slewing device, internal cylinder operated type)

(2) Internal cylinder actuated gripper tool (naibu sado gata tsukamigu)

The gripping angle can be adjusted by swinging the internal cylinder. Since the gripper cannot be rotated, positioning is done by rotating the base machine and gripping points of the gripper. (See Figure 4-24)

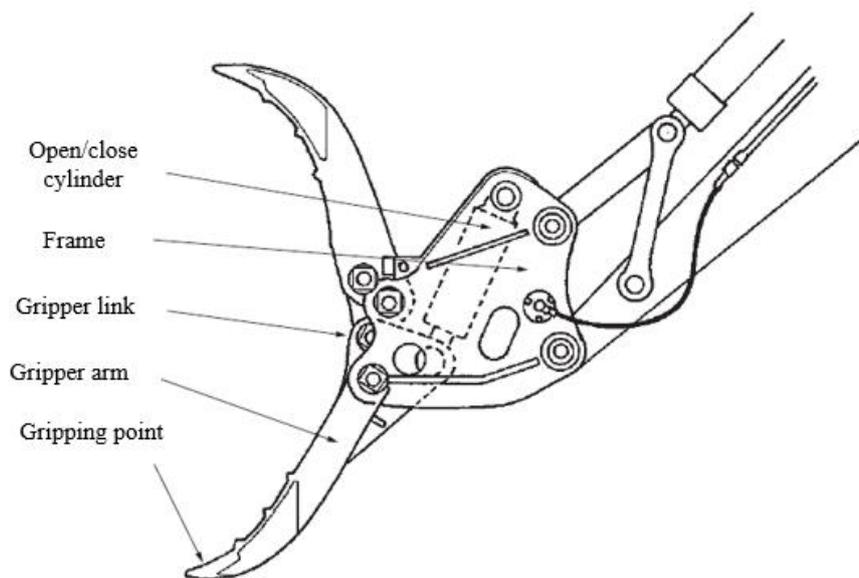


Figure 4-24 Example of internal cylinder type gripper tool (non-slewing type)

(3) External cylinder-operated gripper tool

The external cylinder operated type uses the cylinder of the base machine to open and close the gripper, which eliminates the need for hydraulic piping, but requires careful manipulation of the base machine to adjust the gripping angle because it has no swivel and cannot rotate.

It should be paid particular attention to loading into dump trucks.

Also, note that some combinations of grippers and base machines may require reinforcement of the shovel arm.

(See Figure 4-25)

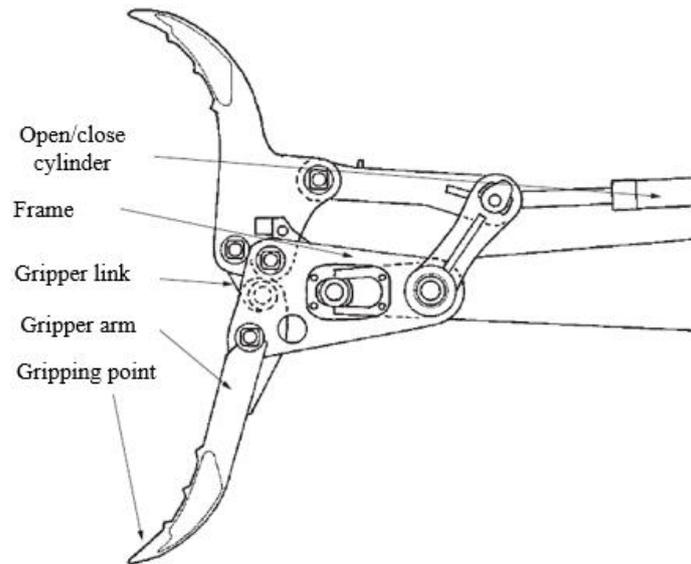


Figure 4-25 Example of external cylinder type gripper tool

4.4.4. Selection and installation of gripper tools (textbook p.74)

The steps for selecting and installing the grippers are shown below.

① Select the gripper's shape to suit the application and the size to suit the object to be gripped.

A) Internal cylinder-actuated gripping tool with a swivel device and a pivoting mechanism (see Figure 4-8)

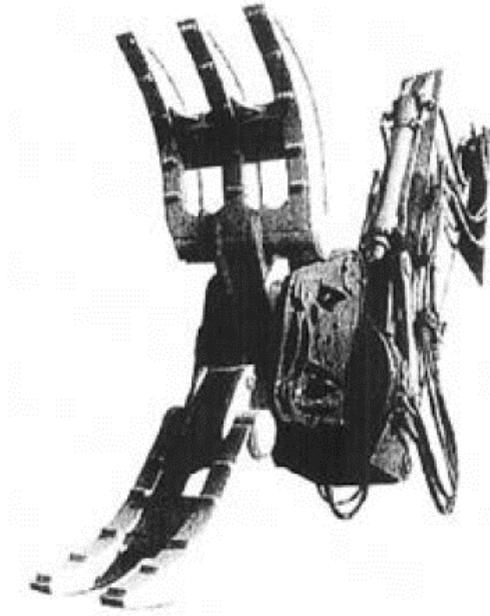


Figure 4-8 Example of internal cylinder operated type gripper tool with slewing device

B) Pivoting-type internal cylinder-operated gripper (see Figure 4-9)

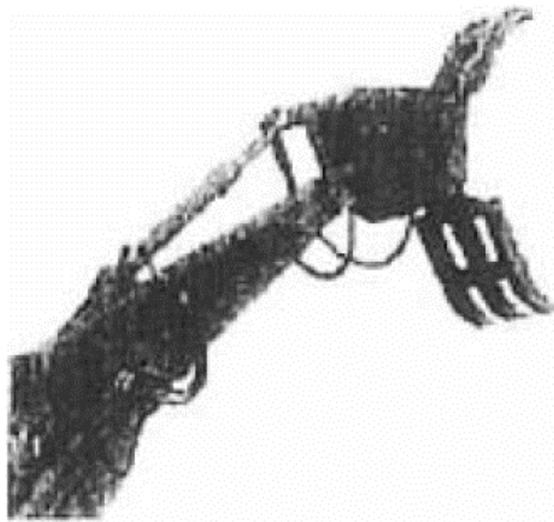


Figure4-9 Example of gripper tool (internal cylinder operated type)

C) External cylinder-operated grabbing tool that uses the bucket cylinder of the base machine to open and close the gripper arm (see Figure 4-10)

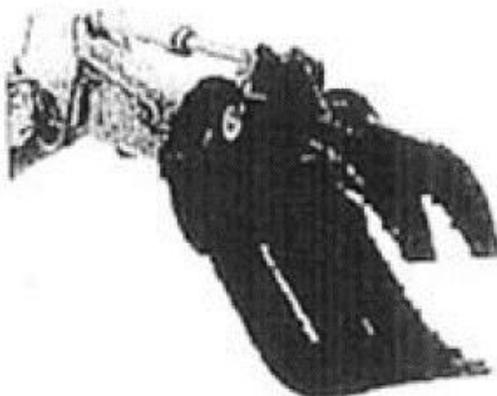


Figure 4-10 Example of Gripper tool (external cylinder-operated type)

② Select a hydraulic shovel suitable for the hydraulic pressure and lifting capacity by balancing the amount of oil required for the gripper and the main body's lifting weight.

③ Extract the hydraulic source of the gripper tool from the base machine's hydraulic circuit and install the hydraulic circuit for the gripper tool through the hydraulic pump, boom and arm.

At this time, additional hydraulic valves and relief valves may be required depending on the base machine. Also, install a control device for the gripper tool in the driver's seat if it is an internal cylinder-actuated type.

④ Install the gripper tool on the arm of the base machine with a pin, and connect the gripper tool to the hydraulic circuit for the gripper tool on the arm with an oil hose.

⑤ Perform a trial run to check the operation of the gripper tool.

⑥ To restore the original state of the base machine, replace the gripper tool and basket, etc., in the reverse order of the installation in step ④.

4.4.5. Operation of gripper machine (textbook p.75)

The standard operation method for base machines (JIS standard operation) is the same as "4.1.5 Operation of breakers, etc."

4.4.6. General work method of the gripper machine (textbook p.76)

For gripper machines, select a base machine and attachment suitable for the object's shape and size to be gripped.

Perform a warm oil operation of the base machine and allow the oil temperature to rise slightly before starting the operation. The optimum range of oil temperature is specified in the instruction manual of each manufacturer.

At the beginning of using a new gripper machine, run it for about one hour with lower engine speed and lower cylinder opening and closing speed to get used to each pin and bush's sliding surface.

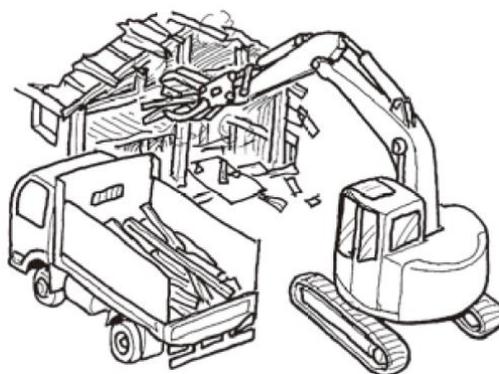
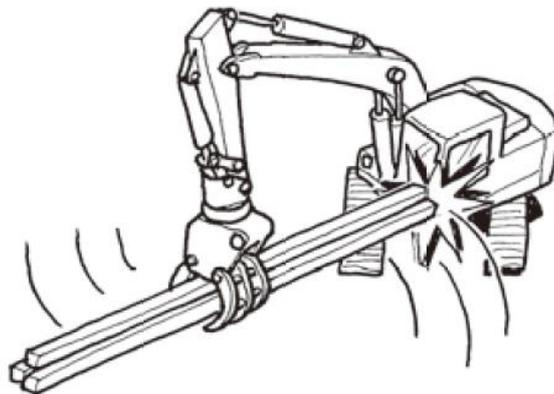


Figure 4-26 Demolition carried out by a gripper machine

The following are the basic precautions for demolition work by gripper machines.

- ① Grease the gripper tool's grease injection, points 5 or 6 times at least twice a day.
- ② Do not work on soft ground, on concrete blocks, or in other unstable places where the base machine may fall over. In particular, do not work on an inclined ground.
- ③ Performing an operation in the lateral direction to the crawlers (crawler belts) is more unstable than in the longitudinal direction, and there is a high risk of the main body of the machine lifting off the ground or falling over. Even if working in the longitudinal direction, do not work in such a way that the machine lifts off the ground because it is dangerous.
- ④ Do not pry (kojiru) during gripping work, as it may result in deformation of the gripper machine, breakage, burning or breaking of the pins, and damage to the base machine.
- ⑤ The gripper tool is used for grabbing objects. Do not break the concrete etc., by dropping the gripper tool. Do not perform striking work.
- ⑥ Do not transport crushed materials with the gripper tool. Do not perform horizontal sweeping operations.

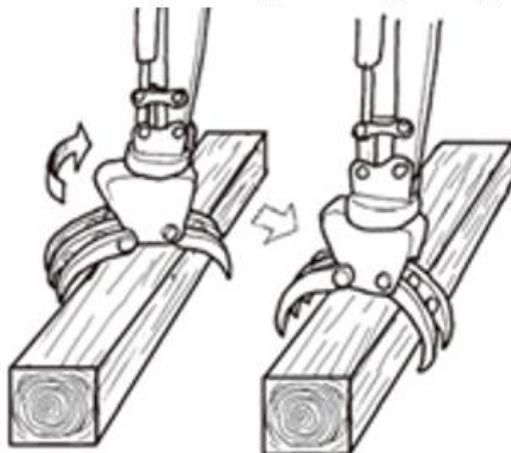
- ⑦ Gripping work should be performed with a sufficient margin of stroke. If you operate the stroke end, the cylinder will be heavily stressed. (The same applies to striking the stroke end.)
- ⑧ Do not perform crane operations to move objects by hanging wires on gripper tools.
- ⑨ Do not work underwater or in contact with water.
- ⑩ During the operation, the areas where crushed fragments may fly around should be off-limits.
- ⑪ In case of bad weather is expected, the work shall be suspended.
- ⑫ Do not perform simultaneous operations such as driving while working. The gripper tool and base machine may get subjected to an abnormal force and may get damaged.
- ⑬ Do not open the arm of the gripper machine for the purpose of gripping. It may cause the gripper tool's failure or the opening and closing cylinder.
- ⑭ Do not change the base machine's direction by pushing the gripper against the ground.
Do not do this as it will not only cause damage to the gripper tool and the base machine and make the base machine unstable.
- ⑮ Be careful when operating near the operator's seat, as the gripper tool may interfere with the operator's seat and the boom cylinder. Take care not to hit the operator's seat when turning while grabbing a long object.



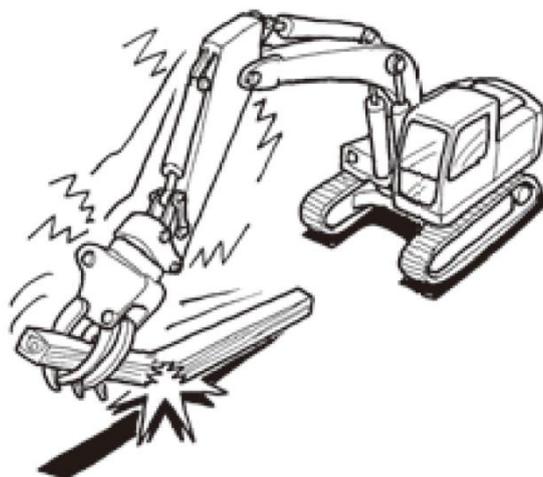
⑩ Do not grip objects diagonally with the gripper machine. Doing so may cause the grabbed object to make a sudden turn or loosen the grabbing force and cause the object to fall, which is dangerous and may also deform or damage the gripper arm and base machine.

For the swivel type, do not turn and changing the angle. In a gripper machine, turn the object with the arm's tip gradually to ensure that it is grabbed at the correct position.

Change the angle before grabbing



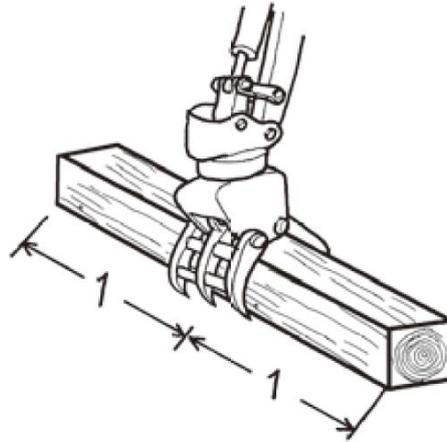
⑪ Do not break or bend objects by hitting them against the ground or a wall while gripping them with the gripping machine. Doing so may cause damage to the gripper and the base machine.



⑱ Grasp the center or center of gravity of long objects.

Grabbing one side of an object with a swivel-type gripper is dangerous because it may turn suddenly, and grabbing an object with a non-swivel-type gripper is dangerous because it may tilt or fall.

It may cause deformation or damage to the gripper arm, base machine arm, etc.



⑲ Do not leave the driver's seat while grabbing an object. It is dangerous because the grabbing force may loosen, and the object may fall.

When leaving the operator's seat, finish the gripping work, put the gripper arm's tip on the ground, stop the engine, and check the safety before exiting.

⑳ As a general rule, do not drive while grabbing an object. This is dangerous because the grabbing force may loosen, and the object may fall.

㉑ Grippers should not be used to demolish concrete foundations, etc., as this is not the intended use of the machine.

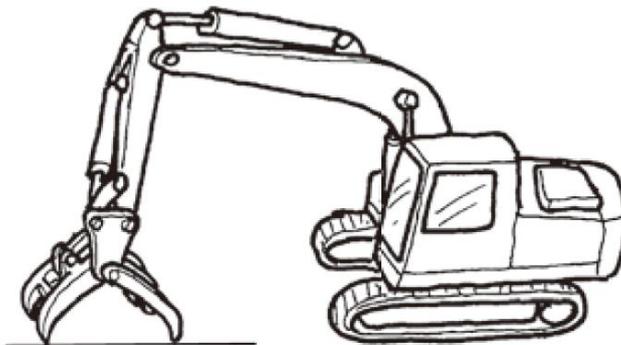
㉒ Do not use a gripper to demolish concrete foundations.

4.4.7. Precautions after finishing work (textbook p.78)

The following precautions should be taken after finishing work.

(1) Gripper tool

- ① Park the base machine with the gripper tool attached on a hard, dry, flat surface. For safety reasons, the arm of the Gripper should be left open.



- ② Wipe off any mud, etc., that may have adhered to the gripper, and check for any abnormalities such as oil leaks, loose bolts, or worn gripper arms.
- ③ When removing the gripper tool from the arm of the base machine, do so only after the temperature of the hydraulic oil has dropped as much as possible. Put dust caps on the pipes and hoses.
- ④ When attaching or detaching hydraulic hoses, be very careful not to let foreign matter enter the hydraulic oil.
- ⑤ Store the removed gripper tool indoors or, if you store it outdoors, place it on top of sleepers and cover it with sheets to protect it from rainwater.

(2) Base machine

Remove mud and water from the base machine. Clean the area around and inside the driver's seat, such as the undercarriage and raising and lifting equipment, in preparation for the next operation. Also, perform lubrication, etc.

It is necessary to pay special attention to cleaning the hydraulic cylinder rod surface, as mud, etc., may be carried along with water drops into the seal and may damage it.

4.5. Removal of attachments (textbook p.79)

(1) Precautions

- ① Attachment setting and removal shall be performed under the direct supervision of the operation supervisor.
- ② Install and remove attachments following the procedures specified in the instruction manual for the demolition machine.
- ③ Use a safety brace, safety block, etc., to prevent the arm, boom, etc., from falling.
- ④ Use a stand to prevent the attachment from collapsing.
- ⑤ Large attachments should be mounted or removed using a mobile crane or similar equipment. At this time, slinging (tamagake) of the work device should be done by certified personnel.
- ⑥ Tighten the bolts firmly so that there is no omission.

(Crane operation and slinging (tamagake) requires different qualifications)

Since crane work and slinging (tamagake) cannot be performed with the qualification of vehicle-type construction machine operation (for demolition), a separate qualification such as mobile crane qualification is required.

(2) Removal procedure

- ① Work on a flat surface free of obstacles and with the machine in a stable position where it will not fall, rotate or move.
- ② Close the stop valve located on the arm of the base machine (turn it OFF). (2) Close the stop valve on the arm of the base machine (turn it OFF), and disconnect the hydraulic hose connected to the attachment from the stop valve.
- ③ Put dust caps on the disconnected hydraulic hoses and stop valves to prevent sand, mud, etc., from entering the hydraulic piping. If sand or mud gets into the pipes, it may cause a malfunction.
- ④ Remove the two pins that connect the base machine to the arm and the attachment and replace them with the bucket.

(3) Removal of breaker unit

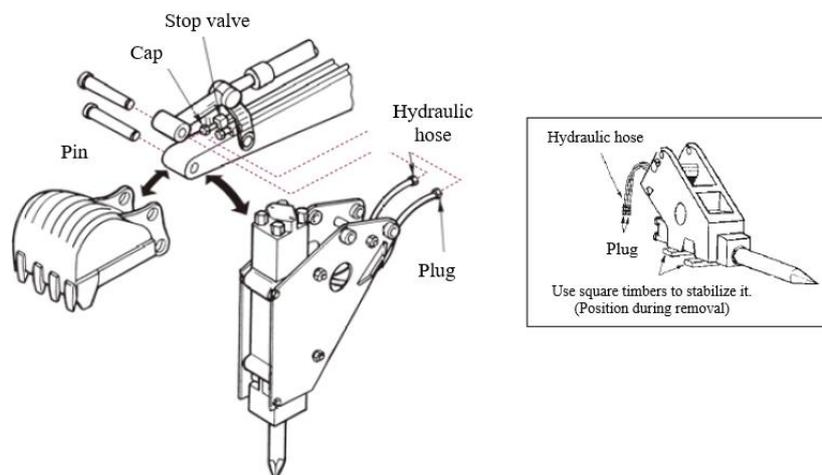


Figure 4-27 Example of removal of a breaker unit

(4) Removal of steel frame cutting tools

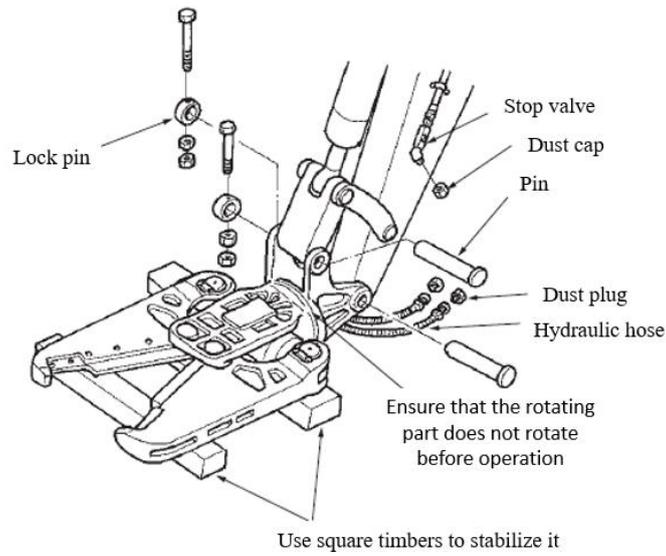


Figure 4-28 Example of removal of a steel frame cutting tool

(5) Removal of concrete crushers

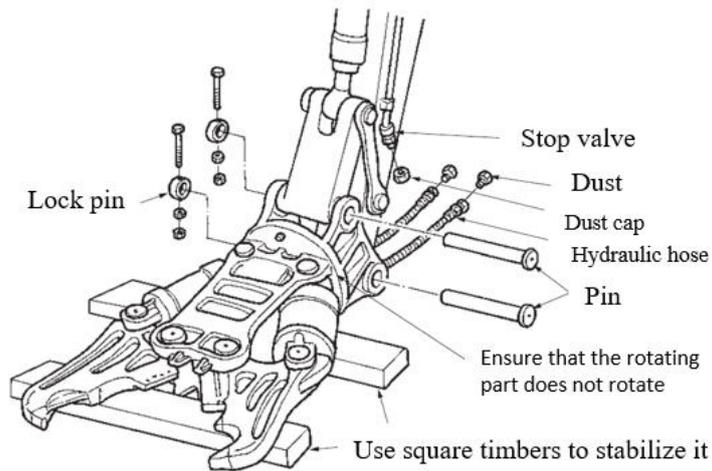


Figure 4-29 Example of a rough crusher removal

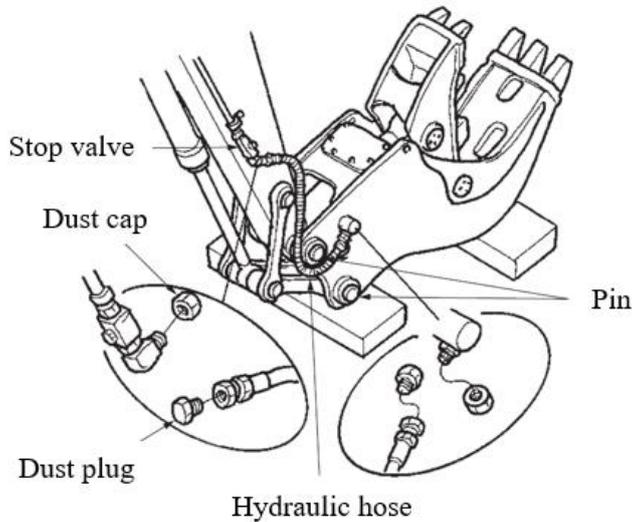


Figure 4-30 Example of a fine crusher removal

(6) Removal of gripper tools

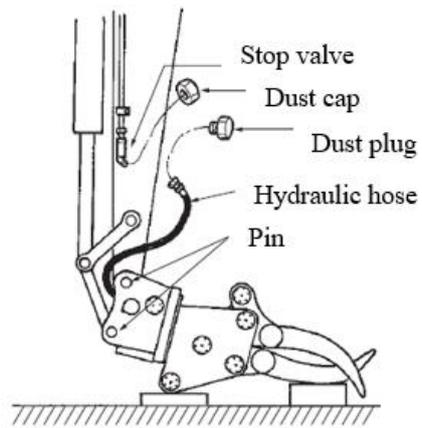


Figure 4-31 Example of gripper tool (internal cylinder actuated type)

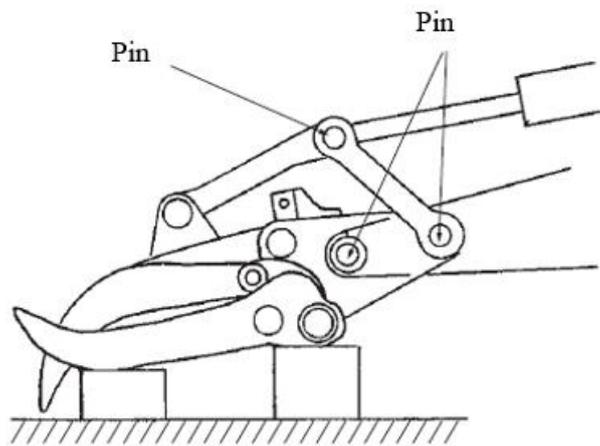


Figure 4-32 Example of gripper tool (external cylinder operated type)

(7) Changing to bucket

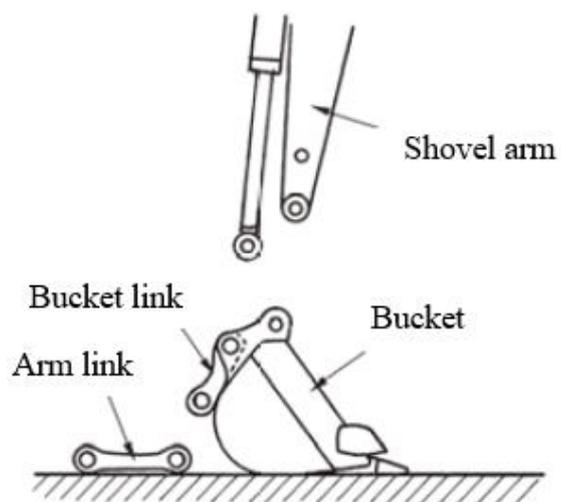


Figure 4-33 Example of bucket removal

- ① Remove the three pins that connect the shovel arm to the bucket. (See Figure 4-33)
- ② Attach the arm link and bucket link to the shovel (shoberu) and then install the bucket.

Note: The installation and removal of the bucket differ depending on the construction machine for demolition, so follow the respective instruction manual for details.

4.6. Transporting machinery for demolition (textbook p.83)

4.6.1. Loading and unloading (textbook p.83)

The following precautions should be taken when loading or unloading construction machinery for demolition onto or from trailers.

(1) General precautions

① To transport construction machinery for demolition by loading it onto a trailer or truck, use a vehicle specially designed for transporting construction machinery.

② Be careful not to exceed the following items specified in the Vehicle Restriction Ordinance regarding transportation.

- Width 2.5 m or less •Height 3.8m or less
- Gross weight 20t or less •Length 12m or less
- Shaft weight 10t or less • Minimum turning radius 12m or less
- Wheel load 5t or less

③ The loading and unloading of demolition equipment to be transported shall be carried out under the supervision of a designated work supervisor.

④ As a general rule, loading and unloading shall be carried out on the flat and solid ground, and vehicles used exclusively for transportation shall be parked with parking brakes and place brakes in the tires.

⑤ Use climbing tools (road boards) that can sufficiently support the mass of the demolition machinery to be loaded and unloaded to the transport vehicle, and use climbing tools with claws to prevent them from being detached from the load bed due to rotation of the crawlers or tires (see Figure 4-34 and Table 4-1).

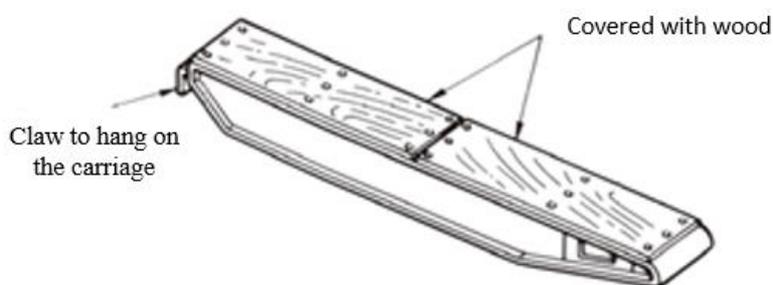


Figure 4-34 Example Climbing equipment with claws

Table 4-1 Example of relationship between mass of loading machine and climbing equipment

Mass of loading machine (t)	Climbing equipment		
	Material	Number of material used	Shape and dimension Length x Height x Width (mm)
40	Aluminium alloy	4	2,900 × 310 × 220
30	Aluminium alloy	4	2,900 × 310 × 175
15	Aluminium alloy	2	2,900 × 232 × 220

- ⑥ When loading and unloading with embankment (morido), do as follows.
- a The width of the embankment (morido) should be wide enough to accommodate the width of the demolition equipment.
 - b The slope of the embankment (morido) should be as gradual as possible.
 - c The embankment (morido) should be compacted sufficiently to prevent the slope from collapsing during loading of demolition equipment and causing the equipment to fall. In particular, take care to prevent the top of of slope from collapsing and reinforce it by placing piles if necessary.
 - d The height of the embankment (morido) should be the same as the height of the trailer bed.

(2) Loading and unloading of trailers and other equipment (using climbing equipment)

- ① Hold a meeting with all team members to discuss the methods and procedures for loading operations.
- ② Inspect the clutches and brakes of the loading machines and check the machines to be used.
- ③ Stop the trailer at the loading position, apply the brakes, and clamp the tires. (Pay attention to the level of the ground.)
- ④ Securely fasten the climbing tool to the load bed so that it will not come off and keep the climbing angle at 15 degrees or less.

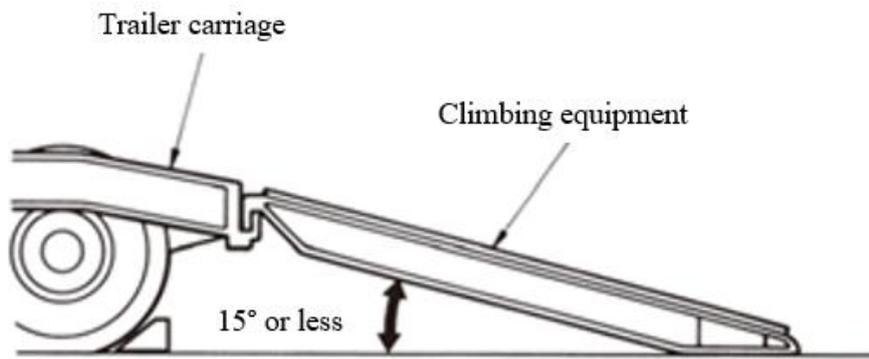


Figure 4-35 Example of use of climbing equipment

⑤ Make sure that the vehicle bed's centerline and the centerline of the demolition equipment to be loaded and the centerline of the climbing tool and crawler or tire is aligned. (See Figure 4-36)

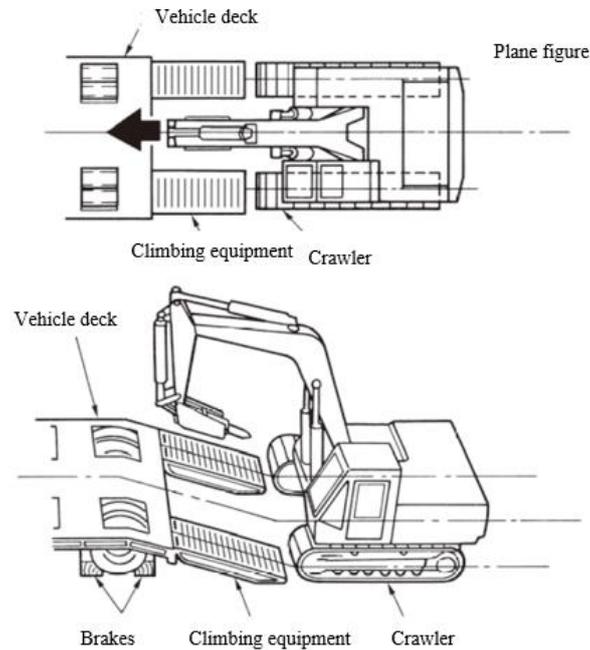


Figure 4-36 Example of loading position relation

- ⑥ When loading, check the surrounding area for safety and prohibit entry. Also, engage the swing lock to prevent swinging while loading.
- ⑦ Follow the leader's signal and drive at a low speed. If the vehicle has a speed switch function, set it to low speed (Lo). Stop about 1 m before the slope climbing equipment and reconfirm step ⑤.
- ⑧ On the way up a climbing tool, climb up at low speed without turning off the steering (if necessary to turn off the steering, get out to the ground and correct the direction).
- ⑨ After climbing up the climbing equipment, the front part of the crawler and the demolition equipment is likely to shake vertically, so land gently.
- ⑩ Use a foot stall if there is a big difference in the level of the trailer bed. (See Figure 4-37)



Figure 4-37 Example of foot stall use

- ⑪ Check that the loading machine does not exceed the width of the trailer bed.
- ⑫ Stop the trailer at the designated position on the load bed and apply the brake to lock it.
- ⑬ When turning the demolition equipment on the load bed, check the surrounding area's safety and take measures to prevent the load bed from tilting and the demolition equipment from sliding off. Also, after turning, apply the turning lock and stop the engine.

(3) Fixing after loading onto trailers, etc.

① Check that the trailer, etc., has been loaded correctly in the designated position and that the trailer, etc., is not tilted.

② After confirming that there is no abnormality in the trailer, etc., secure the demolition machinery to the trailer. Using gears, chains, wire ropes, etc., the machinery may move due to vibration during transportation. (See Figure 4-38.)

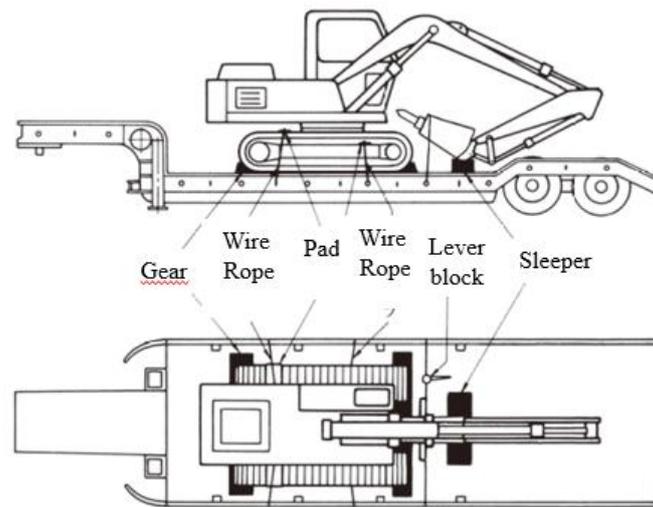


Figure 4-38 Example of fixing to a trailer

③ The loaded demolition construction equipment should be locked with each brake applied, the machine engine stopped, the power turned off, and secured.

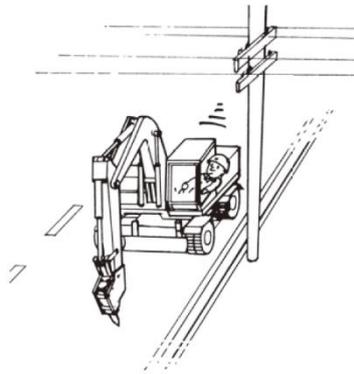
④ Lower the boom, arm, and other work equipment so that they do not exceed the height limit, and place the attachments on the floor of the trailer and fix them.

⑤ Check that the loading and securing conditions are perfect.

4.6.2. In the case of transportation by oneself (textbook p.87)

When it is unavoidable to transport construction equipment for demolition by oneself, it must comply with the Road Traffic Law, Road Transport Vehicles Law, Vehicle Restriction Ordinance, and other related laws and regulations, with particular attention to the following.

- ① When driving on soft road surfaces, pay attention to the road shoulders' collapse.
- ② When passing through unmanned railroad crossings or narrow sections, stop and ensure that it is safe before passing through. Do not force your way through.
- ③ When demolition equipment passes under railroad trolley wires, power lines, bridge girders, etc., make sure that the boom tip is far enough away so that it does not touch them.



5. Inspection and maintenance of construction machinery for demolition

To use construction equipment safely and efficiently, it is important to use well-maintained construction equipment. In addition to the daily inspection as indicated in the machine's instruction manual, it is necessary to inspect and maintain the construction machinery whenever any abnormality is detected during operation. The law stipulates that construction machinery should be subject to an annual voluntary inspection, a monthly voluntary inspection, and an inspection prior to the start of work. Besides, it also stipulates the inspector's qualifications, the period of storage of the inspection sheet, and the obligation to affix the inspection label.

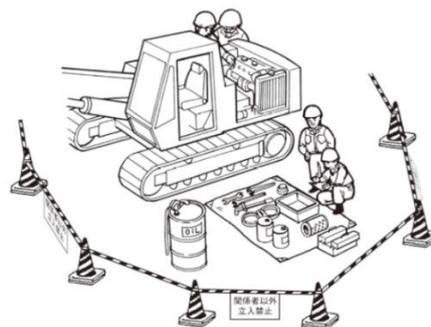
Table 5-1 Related law and regulations

Inspection classification	Article	Implementer / Qualification	Storage period of inspection check sheet
Operation before/after	Safety rules Article 170,171	Driver	During machine is in operation
Periodical self- inspection (once/month)	Safety rules Article 168,169,171	Person who is selected by the safety manager	Inspection check sheet 3 years
Specified self- inspection (once/year))	Safety rules Article 167,169, 169(2),171	Inspector	Inspection check sheet 3 years (posted inspected mark)

※ Although not required by law, it is recommended that the inspection report be stored for as long as the machine is in operation.

5.1. General precautions when performing inspections and maintenance (textbook p. 90)

- ① When carrying out inspections and maintenance at the site, stop the demolition machine on a safe flat surface. If it is unavoidable to perform the work on an inclined surface, make sure that the machine's undercarriage is secured with gears.
- ② Be sure to apply all operating devices, safety locks, and brakes of the demolition construction machine.
- ③ Always place the attachment down on the ground. If it is unavoidable to raise the attachment for inspection or repair underneath, use a safety brace or safety block to prevent the work equipment (attachment) from dropping unexpectedly.
- ④ The repair of the construction machine for demolition shall be carried out under the work supervisor's guidance.
- ⑤ Inspection and self-inspection should be conducted following the inspection sheet or check sheet for inspection, and the results should be recorded and stored.
- ⑥ No one other than related personnel should be allowed to enter the work area where inspections and maintenance are performed.



5.2. Daily Inspection Guidelines (textbook p.91)

5.2.1. Before starting the engine (textbook p.91)

Before starting the engine, inspect the following.

(1) Check for water and oil leaks

Inspect around the base machine to ensure that there are no water or oil leaks on the ground and that there are no leaks from the piping. In particular, check for leaks at the joints of high-pressure hoses, hydraulic cylinders, and around radiators.

(2) Checking and refilling the cooling water

① Open the radiator cap and check that it is fully filled with water up to the mouth.

② When refilling the radiator with water, pour it in gradually. If you fill it all at once, the air inside will not be able to escape, and it will become difficult to fill.

(3) Checking and refilling the Oil Level of Each Part

To measure the amount of oil in each part of the machine, place the machine in a horizontal position and check that the oil level is at the specified level using the oil level gauge.

① Checking and refilling the amount of oil in the hydraulic oil tank

If the amount of oil in the hydraulic oil tank is less than the prescribed amount, the oil temperature will increase abnormally. The oil will deteriorate quickly, or air will enter the tank will harm the machine.

The tank's oil level constantly rises and falls during operation, so if too much is added, the tank may swell abnormally and be damaged.

Do not remove the cap when the hydraulic oil is still hot, as the fluid may blow out, and you may get burned.

The appearance and odor of hydraulic oil may change depending on whether it is highly oxidized or contaminated with water, etc. Since it requires expertise to judge, replace hydraulic oil when it reaches the time specified in the instruction manual. In the case of construction machinery for demolition, the hydraulic oil deteriorates faster than that of hydraulic excavators, so replace it as soon as possible according to the instruction manual. However, if you see any of the conditions shown in Table 5-2, replace them immediately.

Table 5-2 Discrimination method based on the appearance of hydraulic oil

Appearance	Smell	Cause
Changed to milky white	good	Water is mixed
Changed to dark brown	bad	deteriorated
Small dark spot is appearing	good	contaminated
Bubbling up	-	Grease is mixed

② Checking the oil level in the hydraulic oil tank and posture when refilling

When checking and refilling the oil level, the demolition machine should be positioned in a certain way. (See Figure 5-1.)

If the work equipment is not set in a certain position, the oil level in the hydraulic oil tank will rise and fall due to the cylinder's expansion and contraction, and the correct amount of oil cannot be measured.

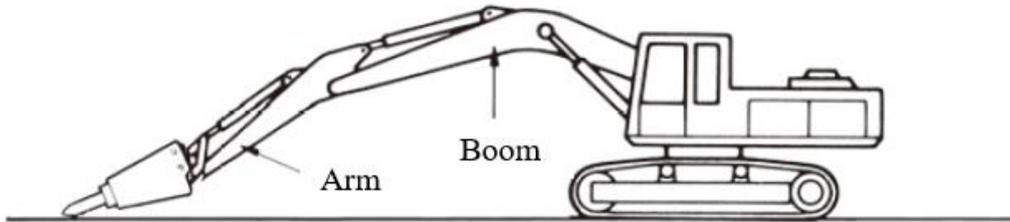


Figure 5-1 Example of oil inspection position of demolition machine

③ Checking, refilling, or replacing the amount of the engine oil and oils used in other places indicated in the instruction manual

Use the oil specified by the manufacturer when refilling. As mentioned in ①, replace any oil that contains different kinds of oil or foreign matter or that is oxidized or lacks viscosity.

④ Checking the brake fluid (wheel type)

If there is insufficient brake fluid, refill with the specified amount of brake fluid.

(4) Draining the fuel tank

Fuel should be refilled after the work is completed, and the water in the fuel tank should be drained before starting work. This is to allow water and impurities to settle while the vehicle is idle at night.

(5) Inspection and adjustment of fan belt tension (alternator drive belt)

Press the middle of the fan pulley and crank pulley (the center of the V-belt) with your finger, and inspect for a deflection of 10 to 15 mm.

Also, inspect the V-belt for abnormal wear or damaged parts and the pulley for damage.

(6) Checking tire pressure, etc. (wheel type)

Measure the tire pressure when the tires are cold before work and adjust the pressure according to the surface to be worked on (adjust the pressure slightly lower than standard for soft surfaces and slightly higher for hard surfaces). Adjust the inflation pressure equally for the left and right tires.

Simultaneously, checking the air pressure, check that the tires are not scratched or swollen, that there are no metal fragments stuck in them, and that they are not abnormally worn.

(7) Inspection of crawler tension (crawler type)

If the crawler tension is too loose, the pins and bushes will wear out quickly, and if it is too tight, it will cause failure (crawlers should be loosened on soft surfaces and tightened on hard surfaces).

The method of checking and adjusting crawler tension should be following each manufacturer's instruction manual.

(8) Inspection for looseness of bolts and nuts of each part

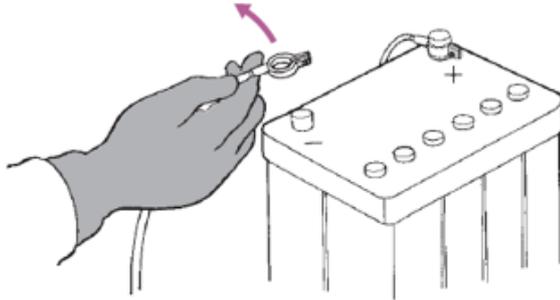
Use a hammer or similar tool to inspect each section's bolts and nuts for looseness and retighten them if they are loose. Carefully inspect the air cleaner, intake and exhaust pipes, muffler installation parts, and undercarriage parts.

(9) Inspection of electrical wiring for disconnection, short circuit, and looseness of terminals

Inspect the electrical wiring for broken wires and shorts.

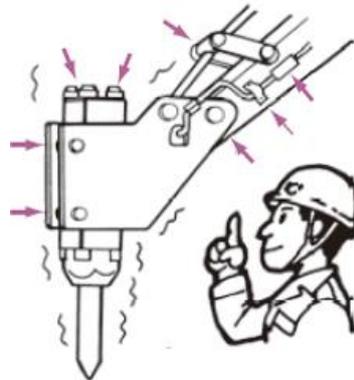
Also, check the battery terminals for looseness. Also, check the battery fluid, and refill with distilled water if it is insufficient.

Before maintaining the electrical system,
remove the (-) terminal of battery.



(10) Inspection of attachments

① Check the bolts and nuts for looseness, and if you find any looseness, be sure to retighten them. Using the machine with loose bolts and nuts will cause oil leakage, crushed threads, and broken bolts and lead to malfunction.



Check for loose bolt

② Grease up with a grease gun using a grease nipple.

Lubricate the grease gun according to the instruction manual for the equipment used.

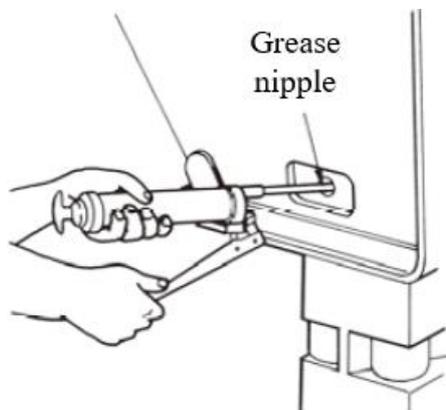


Figure 5-3 Example of greasing up using a grease gun

③ Inspect that there is no oil or gas leakage from each mounting part.

If the gap between the chisel and the bush becomes large, it will damage the bush, chisel, etc. Check that the bush's wear does not exceed the specified wear limit, as shown in Fig. 5-4. (For the wear limit, refer to the instruction manual.

Be also careful of the wear on the tip of the chisel.

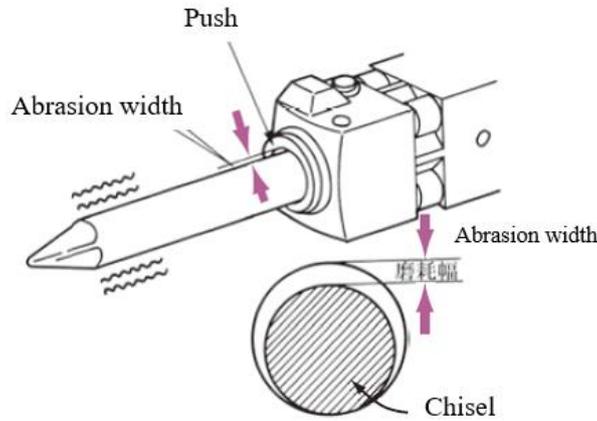


Figure 5-4 Example of wear limit

(11) Others

Check the horn and buzzer sounds, the position of the rear-view mirror, and that the operation lamps, front lights, etc. light up properly.

5.2.2. After starting the engine (textbook p.95)

After starting the engine, inspect the following in particular.

(1) Inspection of measure instruments operation and index levels.

After starting the engine, idle the engine sufficiently and inspect each gauge's operation

(2) Inspection of water and oil leaks from various parts

Even if there is no leakage when the engine is stopped, leakage may occur when the engine is started.

(3) Engine Condition

Check that there is no abnormality in the exhaust color, engine noise, exhaust odor, or vibration by changing the rotation speed from low idle, high idle to full stall. (See Table 5-3)

Table 5-3 Criteria of exhaust gas color

Color of exhaust gas	Criteria
Black	The fuel-air mixture is thick, incomplete combustion
Light yellow	The fuel-air mixture is thin
White + blue	Oil combustion
Grey	The fuel-air mixture is thick, and oil combustion
Colorless	The fuel-air mixture is appropriate, complete combustion

(4) Inspection of attachment operation

Check that the attachments, arms, booms, etc., move smoothly.

At this time, make sure that there is nobody around and that there are no obstacles.

(5) Inspecting the brake pedal (wheel type)

Check that there is not too much play in the brake pedal and that the brakes work properly.

If the brake linings are worn, the pedal play will increase, and the brakes will not work unless the pedal is pressed deeply.

(6) Inspection of operation of the driving handle and driving lever

Drive the demolition machine at a low speed and operate the handle and lever to check how well the machine runs and steers left and right.

Also, check that the driving lever stops quickly in the neutral state.

(7) Inspection of turning lever operation

Check that turning and stopping of turning are smooth.

Also, check that the turning lever stops quickly in the neutral state.

5.2.3. After finishing work (textbook p.97)

After the work is completed, take the following actions.

(1) Cleaning the machine

Wipe off any mud or oil on the floorboards, pedals, levers, etc., as they are slippery. Remove sand and dirt from the crawler section and clean the machine.

When washing with water, be careful not to splash water on the electrical equipment.

(2) Refueling

Stop the engine before refueling. Stop the engine before refueling. When refilling, be careful not to allow foreign matter or water to enter the tank (when refilling, take care not to spill fuel and contaminate the soil).

(3) Parking of the machine

① The parking area shall be a flat, designated area free from the danger of falling rocks, rising water, landslides, etc.

② If parking outdoors, covers it with a sheet (be careful not to let rainwater enter through the muffler).

③ Apply the parking brake and place the attachment on the ground.

④ Remove the engine key and store it in a designated place.

5.3. When an abnormality is observed during work (textbook p.97)

Suppose the demolition machine seems to be out of condition during work. In that case, it is necessary to immediately stop it on a flat surface, notify the person in charge of the defective part, and get it repaired before carrying out the work.

6. Matters related to the demolition work.

6.1. Construction plan (textbook p.99)

Industrial accident in demolition work is caused by non-compliance with the work plan such as “ignoring plans and procedures”, “unsafe actions”, and “shortcuts and omissions”.

(1) Precautions for creating a construction plan

① Preliminary survey

Check the current situation at the site when planning

- Survey of demolished buildings (including buried objects)
 - ※ Take appropriate measures for the harmful substances when dioxin, asbestos, etc., has been confirmed in the preliminary survey.
- Removal of infrastructure (gas, water, electricity, etc.)
- Survey around the site (buried objects • aerial wire)
- Carrying route for dismantling machines

Do not forget the procedures of various government offices required before the start of construction.

② Creating a demolition plan

Make a safe plan based on preliminary research

Consider pollution and general external disasters

- Selection of construction method suitable for demolition (Refer to Chapter 8 for the contents of each construction method)
- Selection of proper dismantling machine (ability • size)
- Creation of dismantling work procedure manual utilizing risk assessment
- Selection of curing method (yojo) (scaffolding, soundproof panels, sheets, etc.)

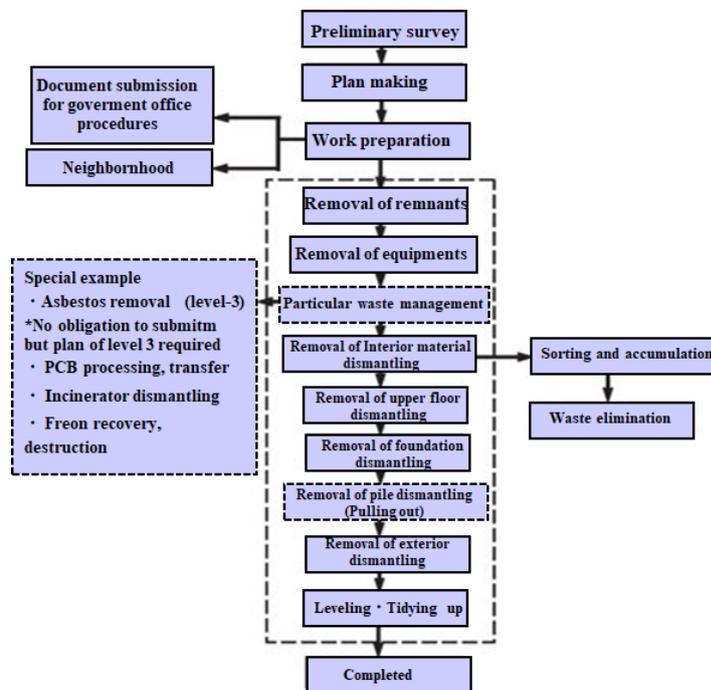


Figure 6-1 General flow of demolition work

(2) Precautions for construction

① Implementation of the construction plan

- Follow the established plans and procedures, and never do “ignoring plans and procedures”, “unsafe actions”, “shortcuts and omissions”, etc.
- In case the operation cannot work according to the plan and procedure. It will be stopped to review its contents. At that time, the meeting will be conducted to allow the related parties to reconfirm the changed contents, plans, and procedures.

② Precautions for construction

- Before starting work, all related parties should understand the work plan and procedure at the meeting.
- In order not to increase the risk of accidents, all related parties should not perform or force them to do unreasonable tasks.

(Beware of asbestos)

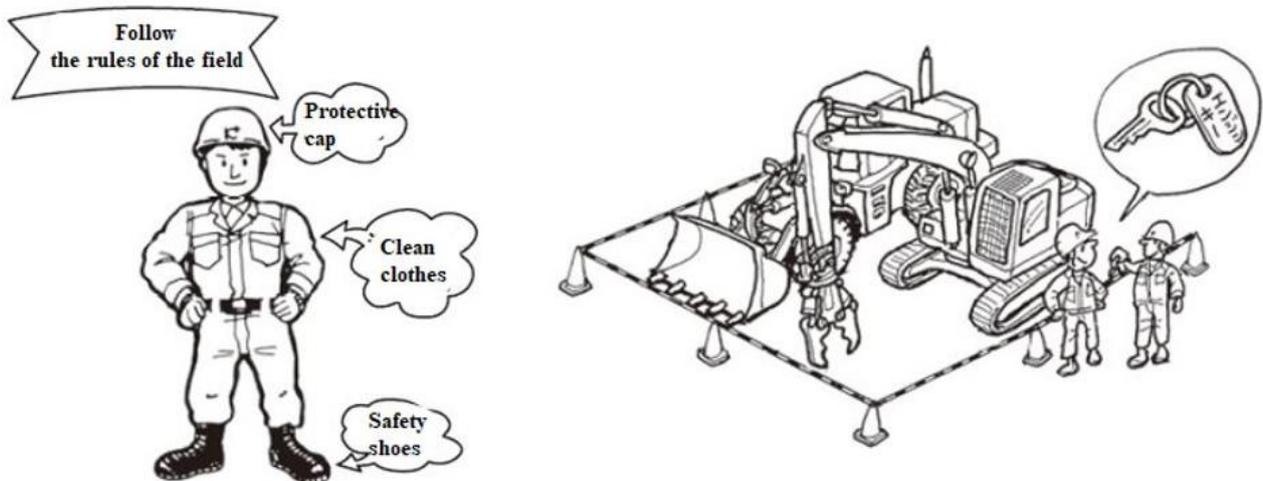
For the dismantling work of substances containing asbestos, it is necessary to strict anti-scattering measures and notifies various government offices before the construction, depending on the substance. The construction cannot be started without permission.

6.2. Rules for safe driving (textbook p.101)

The rules for the safe operation of dismantling machines are as follows

(1) General safety precautions

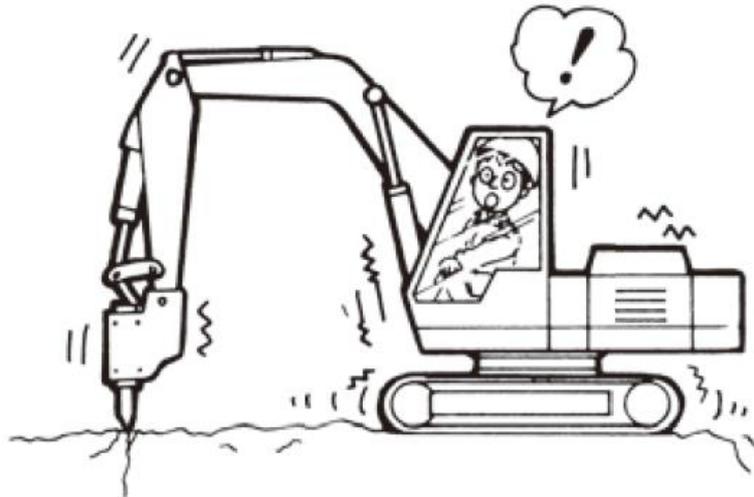
- ①The driver wears a safety cap and safety equipment, dresses up, and then drives.
- ②The driver wears a seat belt.
- ③The driver carries the qualification certificate when driving.
- ④Carry out an inspection before starting work and confirm that there are no abnormalities.
- ⑤Do not allow anyone other than the driver to sit in the driver's seat or other places.
- ⑥Use the built-in ramp handrail to get in and out of the driver's seat.
- ⑦Always keep the car clean and do not operate the lever with dirty hands such as oil.



- ⑧When the driver leaves the driver's seat due to work interruption, the driver needs to stop the engine, remove the key and store it.
- ⑨After stopping and finishing the work, lower the work equipment to the ground, lock the levers and pedals safely, apply the brakes securely and stop the engine, then remove the key and store it in the specified place.
- ⑩For the attachment replacement work, using breaker, steel frame cutting tools, and concrete crushing tools require skill, so check and comply with the work procedure.

(2) Safety tips during work

- ①Work is performed according to the instructions of the Supervisor.
- ②Before the work, the demolition work plan and procedure will be confirmed by all involved parties to start the work.
- ③Follow the specified work range, speed limit, work method, and operate.
- ④When approaching a dangerous area such as a workplace or a road shoulder, a guide should be arranged.
- ⑤The dismantling work will not be performed in bad weather such as strong winds, heavy rain, and heavy snow.
- ⑥Keep your eyes on the road.
- ⑦Do not drive unreasonably and recklessly.



⑧ Keep in mind to stop the operation immediately when a sudden situation occurs during driving.

⑨ Keep people out of the turning range and range that grabbed objects crush and fly.

To understand easily, display a barricade or rope on the work areas.

⑩ Stop work when people are nearby. When people approach, stop driving and warn with a horn.

⑪ When entering the turning range and the range where there is a risk of accidents due to the dismantled objects scattering, instruction must be arranged to guide the dismantling machine.

⑫ When moving the dismantling machine, make sure that there are no people around it and raise the alarm before moving it. Do not go in reverse until safety is confirmed. If there is a guide, be sure to follow the instructions.

⑬ Do not use work equipment as a brake except in an emergency.

⑭ Always consider the stability of the dismantling machine in the dismantling work. Prevent the collapse of debris during working on demolition debris.

Also, the longer arm and boom of the device are more unstable.

⑮ Keep away from dismantled openings. Also, stay away from cliffs (gakeppuchi), soft road shoulders, and top of a slope. Be careful of the collapse of the road shoulder after rainfall. Install handrails or displays to ensure safety.

⑯ Turning on an inclined ground uses lower the center of gravity. Do not turn on a steep slope as it is dangerous.

⑰ Be careful of the collapse of the work ground, concrete floors because of the breaker's vibration (bureka) itself or the impact of knocking down dismantled objects.

⑱ In the crushing operation, be aware of the scattering of crushed debris.

⑲ Crushing operation with walking must pay attention to the machine body's stability for demolition.

⑳ Breaker, steel frame cutting tools, concrete crushing tools, and gripping tools are suitable for using purpose according to the dismantled objects. Do not use it for any other purpose.

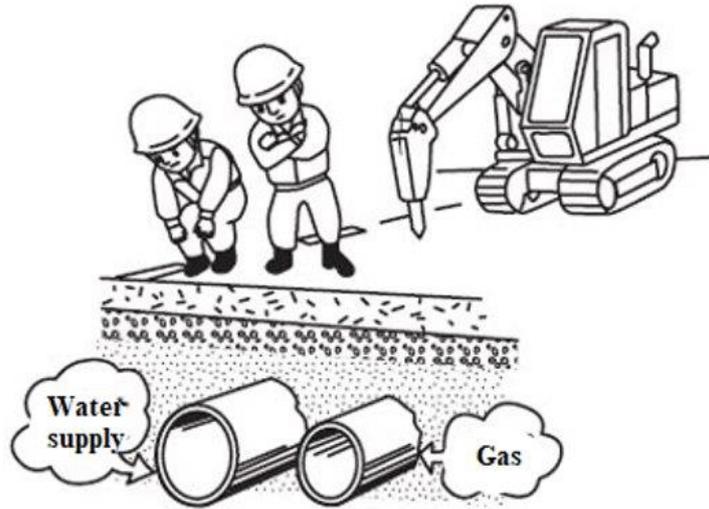
㉑ Grabbing the dismantled object with a gripper needs to be careful not to grab it too much, crush it, or slide down the dismantled object.

㉒ Poorly ventilated areas such as underground and basements make it be well ventilated. An exhaust gas purification device is used for diesel engine type dismantling machines and try to maintain their performance.

㉓ If there is a gasoline tank or a risk of explosion, stopping perform the crushing operation or explosion-proof measures will be applied.

④Working in urban areas will adopt construction methods and procedures suitable for preventing noise, vibration, and dust emission.

⑤Crushing operations in urban areas must check whether there are any buried objects.



⑥For working areas with electric wires or obstacles, a guide should be arranged to follow the instructions.

⑦Do not use for other purposes such as lifting the load with a rope or working devices etc.

⑧Installation, removal, and replacement of work equipment are carried out under the supervisor's direction according to the determined procedure.

⑨Installing or removing the work equipment must take measures that prevent the working device's fall, such as a stand for replacement.

(3) Precautions for using a rented dismantling machine or a dismantling machine operated by others

A dismantling machine that is rented or driven by others needs to be handled following items after confirming them in writing.

①Capability of each working device of the dismantling machine, maintenance status, etc.

②Unique peculiarity and weaknesses and of the dismantling machine

③Points to be careful of when driving, such as the brakes' operating status and clutch.

④Points to be careful of regarding operation routes, work methods, etc.

⑤Check whether there are any work equipment damage and abrasion. Also, check whether there are head guards, cabins, headlights, side mirrors, and examine its conditions.

In addition, confirm the maintenance status by checking the inspection record table about regular self-inspection and maintenance status.

6.3. Signals and guidance (textbook p.104)

When operating a dismantling machine, it must be done according to the guidance, signal, or the guide as a general rule.

For this reason, before working, it is necessary that the driver must sufficiently discuss with the inducer or guide other operator positions, the work position of other construction machines, the position of the dangerous place, and the signal method.

In addition, a specific person is assigned by the person in charge as the signaler or conductor. The driver will drive with the signal and guidance of that person.

It is also important to stop the work and check for unclear signals. Expected driving and driving without a signal must be avoided.

The conductor and driver should wear clothes that allow the operator to easily see their work position. The driver talks to the conductor and operator to not be a blind spot from the driver's seat.



<Signaled by whistle>

- Safety : 2 short whistle voices, repeat
- Stop : long whistle

<Signaled by spoken>

- Safety : All right (orai), all right (orai)
- Stop : stop (sutoppu)

7. Knowledge of mechanics and electricity

7.1 Force textbook p.107)

7.1.1. Moment of force (textbook p.110)

As shown in Fig. 7-8, when a nut is tightened with a spanner, the “rotational force” applied to the nut. When using a lever to move a heavy object, the “force” tries to move an object. This is called the “moment of force”.

The moment of force is represented by $M = P \times \ell$.

The unit of force magnitude P is N (Newton), and the unit of ℓ is cm. The unit of moment of force M is $N \cdot \text{cm}$ (Newton centimeter).

Therefore, when tightening the bolt, the position holding the spanner's handle is far away from the bolt; this generates a small force. When the position is closer to the bolt, this generates a larger force.

$$M_1 = P_1 \times \ell_1 \quad M_2 = P_2 \times \ell_2$$

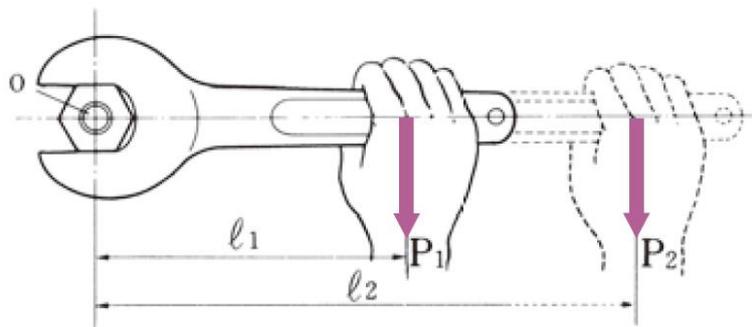


Figure 7—8 Moment of force ①

In the case of a breaker, when breaking rock in a tunnel, as shown in Fig. 7-9, the moment working to overturn the breaker is $W_1 \times \ell_1$. The moment due to the breaker's own weight is $W_0 \times \ell_0$. Therefore, if there is $(W_0 \times \ell_0) > (W_1 \times \ell_1)$, the breaker will not tip over.

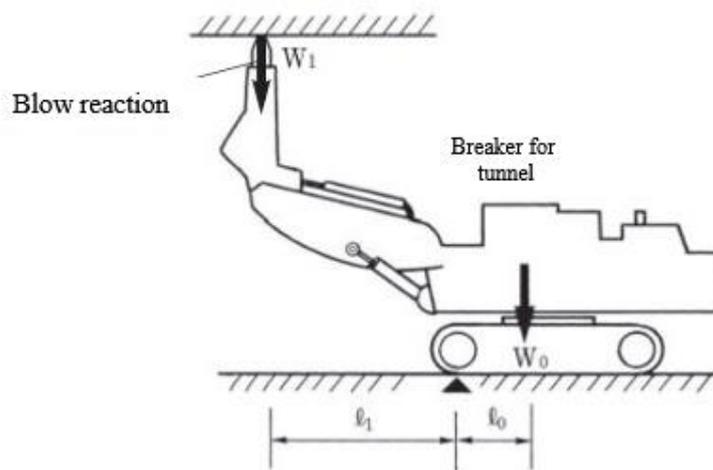


Figure 7—9 Moment of force ①

In the case of a gripping machine, when grabbing an object such as concrete debris (gara), as shown in Fig. 7-10, a moment acting to overturn the machine acts. The moment acting to overturn the machine acts.

When the weight of the grabbed object is W_3 , the moment for overturning the gripping machine is $W_3 \times \ell_3$, and the moment due to the weight of the gripping machine (including the gripping tool) is $W_2 \times \ell_2$. Therefore, if there is $(W_2 \times \ell_2) > (W_3 \times \ell_3)$, the gripper will not tip over.

When grabbing an object located away from the machine, the moment acting to overturn the machine increases, and the risk of the machine tipping over increases

Therefore, it is necessary to grab an object that is close to the machine as possible.

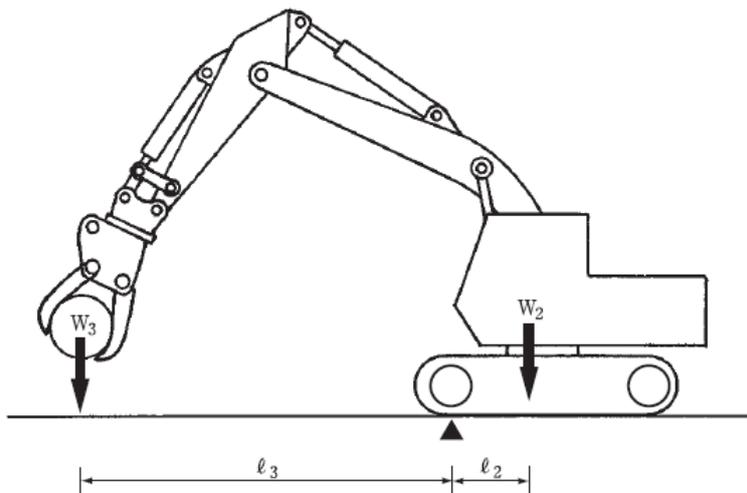


Figure 7—10 Moment of force ②

Depending on the boom angle, the stability of the dismantling machine becomes low. There is also a possibility of tipping over. Therefore, It is necessary to be careful not to exceed the maximum working radius specified by the manufacturer.

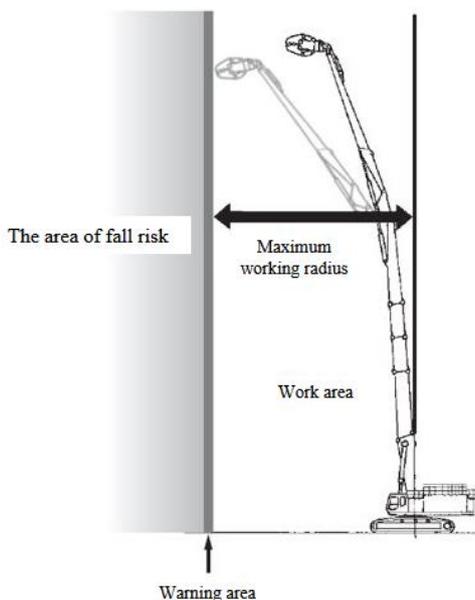


Figure 7—11 Precautions when working with a specific dismantling machine

7.2. Mass, the center of gravity (textbook p.115)

7.2.1. Mass and specific gravity (textbook p.115)

Due to using the measuring instrument, the mass of an object can be calculated from the object's volume and specific gravity.

It can say that The mass of the object = volume x specific gravity.

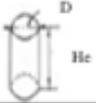
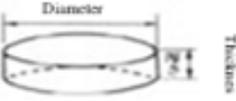
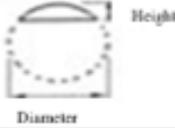
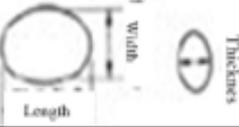
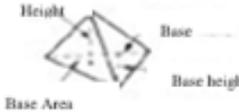
The unit mass of an object refers to the mass per unit volume of an object, the main object's unit mass, shown in Table 7-1. The column of mass (t) per 1m³ in Table 7-1 also shows the specific gravity.

Table 7—1 Unit volume mass of an object

Types of things	Mass per square meter(t)	Types of things	Mass per square meter(t)
Lead	11.4	Granite	2.5~2.8
Copper	8.9	Andesite	2.2~2.8
Steel	7.8	Basalt	2.8~3.2
Cast iron	7.2	Jie rock	2.0~2.7
Aluminum	2.7	Limestone (hard)	2.4~2.6
Concrete	2.3	Limestone (soft)	1.7~2.4
Soil	2	Marble	2.6~2.8
Gravel	1.9	Gneiss	2.5~2.7
Sand	1.8	Oak	0.9
Coal (power)	1	Pine	0.5
Coke	0.5	Cedar	0.4

Calculation of the volume of an object measures the object's dimensions and estimates the volume using this table, and multiplies the number by the specific gravity of the object. The mass of the object can be calculated (See Table 7—2)

Table 7—2 Approximate volume formula

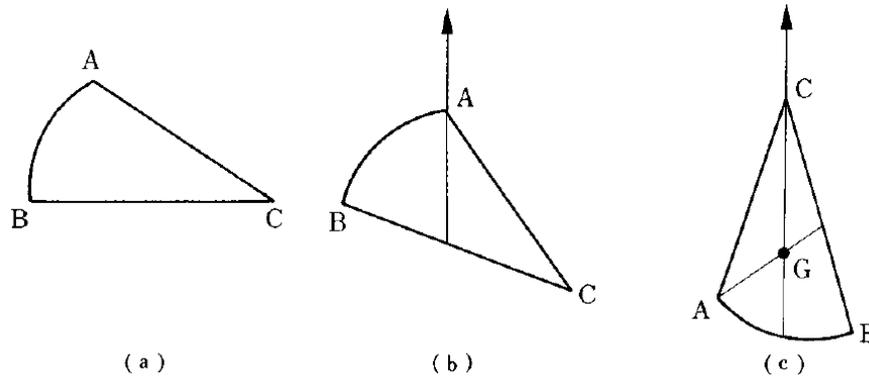
The shape of the object		Volume approximation formula
Name	Shape	
Rectangular		Vertical x horizontal x height
Cylinder		$(\text{Diameter})^2 \times \text{height} \times 0.8$
Disk		$(\text{Diameter})^2 \times \text{thickness} \times 0.8$
Ball		$(\text{Diameter})^3 \times 0.53$
Missing ball		$(\text{Height})^2 \times (\text{Diameter} \times 3 - \text{height} \times 2) \times 0.53$
Cone		$(\text{Diameter})^2 \times \text{height} \times 0.3$
Heading cone		$[(\text{Bottom base diameter})^2 + \text{bottom base diameter} \times \text{upper base diameter} + (\text{upper base diameter})^2] \times \text{height} \times 0.3$
Circle		Length x width x thickness x 0.53
Triangular pyramid		Base area x height ÷ 3 (Base area = base x base height ÷ 2)

7.2.2. Center of gravity (textbook p.117)

Gravity is acting on all the objects.

When an object is divided into small pieces, gravity acts on each of the divided parts. Therefore, it can be seen that parallel forces (gravity) are acting on the object. When these forces' resultant force is calculated, it is equal to the gravity acting on the object. This is the mass of the object.

The center of gravity is a certain point. It also does not change even if the object position or placement changes. Suppose the motion of an object (excluding the rotational force of the object itself) is treated mechanically. In that case, it can be considered that the total mass of the object is concentrated in the center of gravity.



How to find the center of gravity

7.2.3. Object stability (Suwari) (textbook p.117)

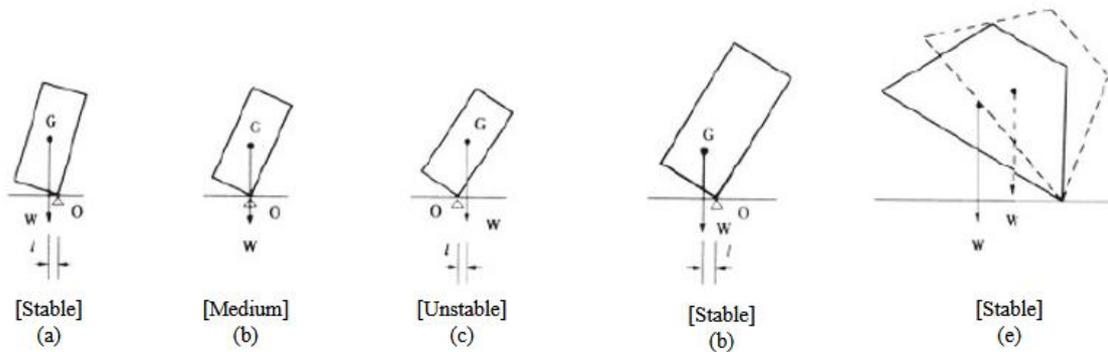
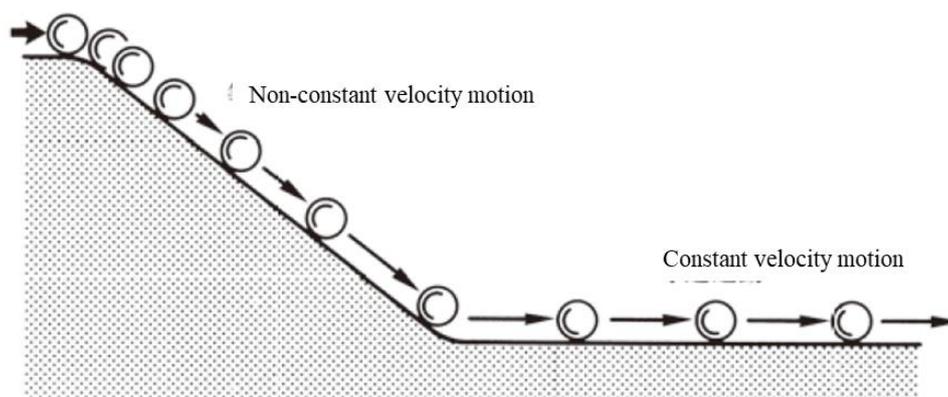


Figure 7—15 Object stability

7.3. The motion of an object (textbook p.118)

7.3.1. Speed and acceleration (textbook p.118)



The amount representing the degree of motion fast-slow object is called speed. It represents the distance the object has moved in a unit of time.

In the case of non-fast motion, when an object moves while changing its speed, the amount indicating the degree of the change is called acceleration.

7.3.2. Inertia (textbook p.119)

As a general rule, you should not start or stop suddenly. If the driver starts suddenly, the driver will be pulled backward, and if the driver stops suddenly, the driver will likely fall forward.

When it is stationary, it tries to stay stationary forever, and when it is moving, it tends to continue moving. Unless external force acts on the object. This is called as inertia.

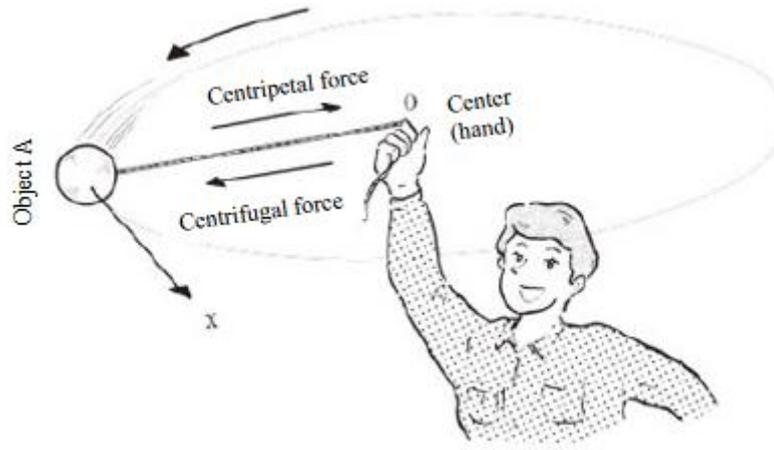
If putting it the other way around, in order to move a stationary object or change the speed or direction of motion of a moving object, an external force is required.

The greater change in speed and the heavier object leads to the required force will greatly increase.

Therefore, an inertial force acts on the dismantling machine during traveling. The inertial force increases as the speed increases, and the inertial force increases in proportion to the speed's square.

7.3.3. Centrifugal force • centripetal force (textbook p.120)

If you hold the end of the string having the weight and move it circularly, the hand will be pulled in the weight's direction. If you turn the weight fast, the hand will be pulled harder. At this time, if you release the string, the weight will fly in the tangential direction from the position when the hand is released and does not make a circular motion.



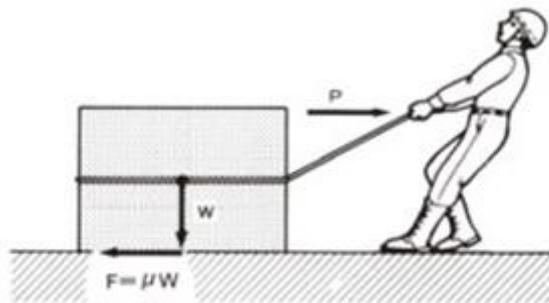
In this way, to order an object to move circularly, a certain force must act on the object (in the above example, the force that the hand pulls the weight through the string). The force which causes this object to move in a circular motion is called the centripetal force. The force that has the same force magnitude and is in the opposite direction (in the above example, the force that pulls the hand) is called centrifugal force.

For example, when going down a steep slope with a demolition machine. If the steering is suddenly turned off, centrifugal force acts on the center of gravity. The vehicle is pulled strongly outward, and the risk of falling down increases.

7.3.4. Friction (textbook p.120)

(1) Static friction and dynamic friction

When objects contact with other objects, resistance is called as a frictional force. If you place an object on the floor or board and try to move it, push or pull it. Even if you push it with force below a certain limit, it will not move. If it exceeds this, it will start to move. The frictional force below this limit is called the static frictional force, and the frictional force at the limit is called the maximum static frictional force.



Maximum static friction force $F = \mu \times \text{normal force (W)}$

The friction force is related to normal force and contact surface condition, but it is not related to the contact surface's size. Even when an object is sliding on the floor, it will stop unless a certain force is applied.

Because there is a frictional force even when moving. This is called as dynamic friction (also called as kinetic friction). It is smaller than the maximum static friction force. When moving, it takes a lot of force to start moving; for example, when sliding luggage on the floor, but once it starts moving, it can continue to move relatively easily, so you will notice this difference. This is why the brakes are hard to work when driving (especially because the inertial force is also applied).

7.4. Knowledge of electricity (textbook p.123)

7.4.1. Relationship between voltage, current, and resistance (textbook p.124)

For electricity, if the electric resistance R (ohm: Ω) in the electric circuit is equal to the greater the voltage E (volt: V), the greater the current I (ampere: A) and the greater the resistance (for example, in case of the thinner electric wire) The current is limited. This relationship can be represented by as follows.

$$\text{Electric current } I \text{ (A)} = \frac{\text{Voltage } E \text{ (V)}}{\text{Electric resistance } R \text{ (}\Omega\text{)}}$$

7.4.2. The danger of electricity (textbook p.124)

When a human body part touches the charging part and electricity flow through the human body, it is called electric shock. It causes numbness, muscle stiffness, nerve paralysis and leads to even death. This depends on the situation (wet place, sweating, energization path, energization current magnitude, energization time, etc.). In general, alternating current and direct current flow through the human body are shown in Table 7-3.

Table 7-3 Reaction unit mA (milliampere) when an electric current flows through the human body

Impact of electric shock	Alternating current (AC)		Direct current (DC)	
	Man	Woman	Man	Woman
1. A little tingling	1.1	0.7	5.2	3.5
2. Painful shock (but muscle still free)	9	6	62	41
3. Painful shock (Muscle stiffness, dyspnea)	23	15	90	60
4. Possibility of causing death instantaneously	100		500	

Note) 1 mA is 1/1000A(Ampere)

The resistance of the human body is divided into skin resistance and internal body resistance. The skin resistance is about 10,000Ω (ohm) when the skin is dry, but it drops to about 500 to 1,000Ω when sweating or when the limbs and clothes are wet. The internal body resistance is about 500Ω.

For example, if you get an electric shock at a voltage of 100V

- Limbs are wet

$$\text{Electric current} = \frac{\text{Voltage}}{\text{Electrical resistance}} = \frac{100}{1,000} = 0.1 \text{ Ampere} = 100\text{mA}$$

- Normal condition

$$\text{Electric current} = \frac{100}{10,000} = 0.01 \text{ Ampere} = 10\text{mA}$$

In the former case, the risk of electric shock death is extremely high.

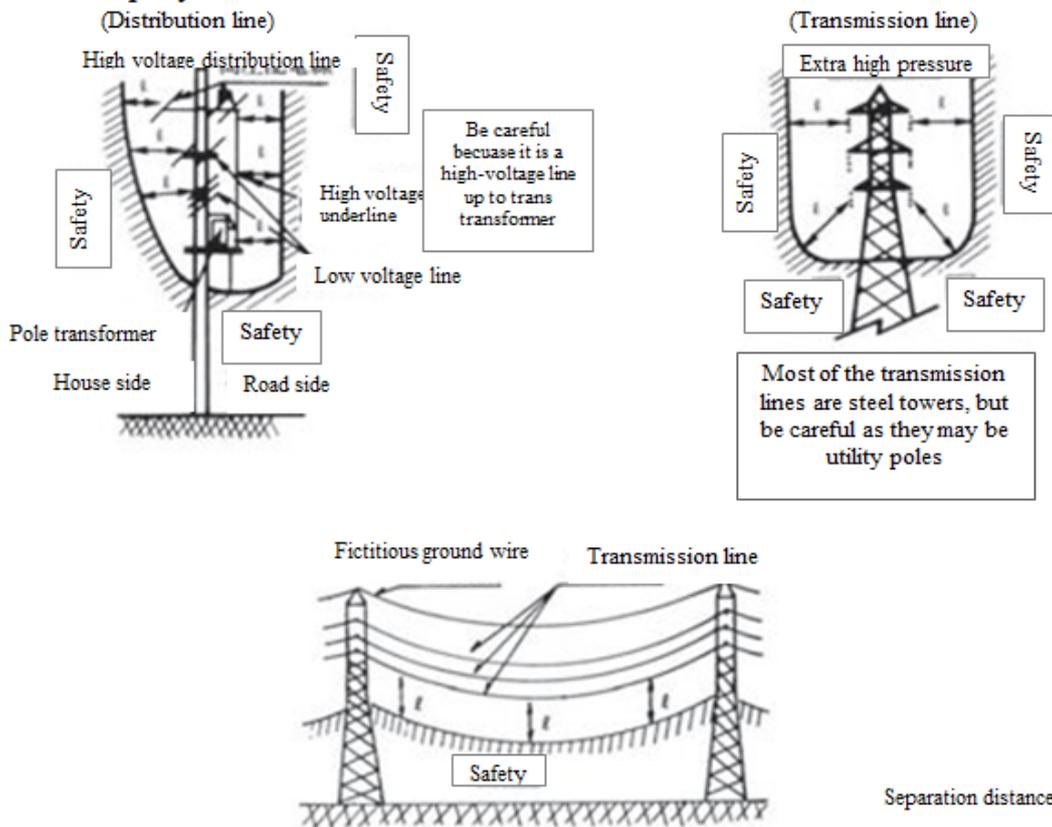
Table 7—4 Separation distance from transmission and distribution lines

Electric circuit	Transmission voltage (V)	Minimum separation distance (m)	
		Notification of director of labor standards bureau*	Electric power company target
Distribution line	Below 100 · 200	Above 1.0	Above 2.0
"	" 6,600	" 1.2	" 2.0
Transmission line	" 22,000	" 2.0	" 3.0
"	" 66,000	" 2.2	" 4.0
"	" 154,000	" 4.0	" 5.0
"	" 275,000	" 6.4	" 7.0
"	" 500,000	" 10.8	" 11.0

(NOTE) No. 759 dated December 17, 1975

** This does not apply if the insulation is protected

***[Target value of electric power company] indicates the case of TEPCO. This category and target values differ for each electric power company.



7.4.3. Battery handling (textbook p.127)

A battery is a thing that can convert electrical energy into chemical energy, store it (this is called as charging), and take it out as needed (this is called as discharging).

The points for handling the battery are as follows.

- ① Always remove dust and dirt and keep it clean. (It causes leakage (discharge).)
- ② Distilled water is always replenished between the H (High) level of L (Low) level. (Do not add dilute sulfuric acid.)
- ③ Do not add too much distilled water (It leaks, and the specific gravity changes.).
- ④ Adjust the battery fluid level for each room.
- ⑤ Stop unreasonable discharge.
- ⑥ Do not handle it roughly.
- ⑦ Tighten the terminal from time to time to avoid a loose connection
- ⑧ Be careful not to short-circuit with a spanner
- ⑨ Measure the specific gravity and charge immediately when it becomes 1.22 or less.
- ⑩ Measure the voltage with the battery tester.

Note) For refilling distilled water, since the liquid inside the battery is dilute sulfuric acid, wearing protective glasses and gloves is required. If it is splashed on your skin, rinse with plenty of water. In case of contact with eyes, wash with plenty of water and then consult an ophthalmologist.

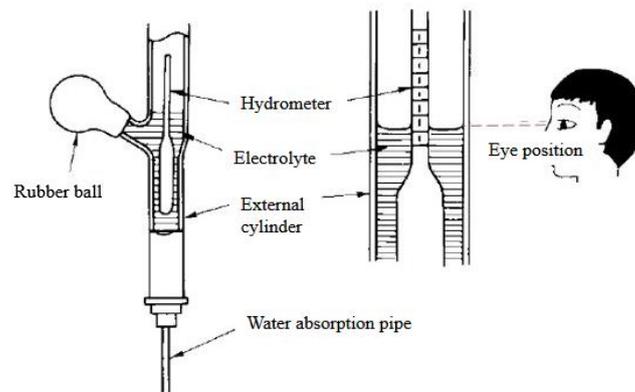


Figure 7-17 How to read the hydrometer

7.4.4. Battery charging (textbook p.128)

When the engine is running, it is charged by a rechargeable generator (alternator or dynamo). Depending on the dismantling machine's operating conditions and the voltage regulator's settings voltage, the battery's power consumption might not be sufficiently supplemented. In such a case, if it is used, the life of the battery will be shortened, so it is necessary to perform supplementary charging.

Note) Charging the battery: Hydrogen (H₂) gas and oxygen (O₂) gas are generated during charging. This performs in a well-ventilated place and strictly prohibits fire.

8. Structure type and demolition method

8.1. Structure type and structure (textbook p.129)

8.1.1. Wooden structure (W structure) (kikozou (W Zou)) (textbook p.129)

It is a structure that uses wood for the main structural members of buildings and other structures hereinafter referred to as “buildings, etc.”).

1) Characteristic

(1) Advantages

- ①It has a large specific strength (strength / specific gravity) and is possible to build a two- or three-storied building.
- ②There are many voids and high heat insulation.
- ③It is durable in dry conditions and has a lifespan of over 30 years in homes.
- ④It is generally inexpensive.

(2) Disadvantages

- ①It is flammable and vulnerable to fire.
- ②It is perishable in wet conditions.
- ③It is susceptible to insect damage such as termites (shiroari).
- ④It is easily deformed when it absorbs water.

2) Main structural types

(1) Frame structure



Figure 8-1 Example of wooden frame structure

(2) Wooden wall frame structure

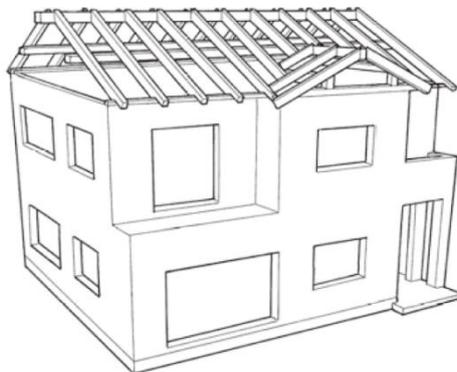


Figure 8-2 Example of wooden frame wall structure

8.1.2. Steel structure (S structure) (tekkotsukouzou (S Zou)) (Textbook p.131)

It is a structure that uses steel frames for the main structural component of buildings. Steel frames include the heavy steel frames for large buildings and the lightweight steel frames with less than 6 mm thickness for small buildings.

1) Characteristic

(1) Advantages

- ①The material is uniform and has good processability.
- ②It is strong and tough, so it can be used to build earthquake-resistant buildings, large spaces, and skyscrapers.
- ③The construction period can be shortened by processing at the factory and assembling at the site.

(2) Disadvantages

- ①Since the strength decreases significantly from about 300 to 500°C, it is vulnerable to fire.
- ②It is easily corroded by the rust in water or in places with high humidity.
- ③It greatly expands, contracts, and is easily deform due to temperature changes.

2) Main structural models

(1) Ramen frame structure (ramen kouzou)

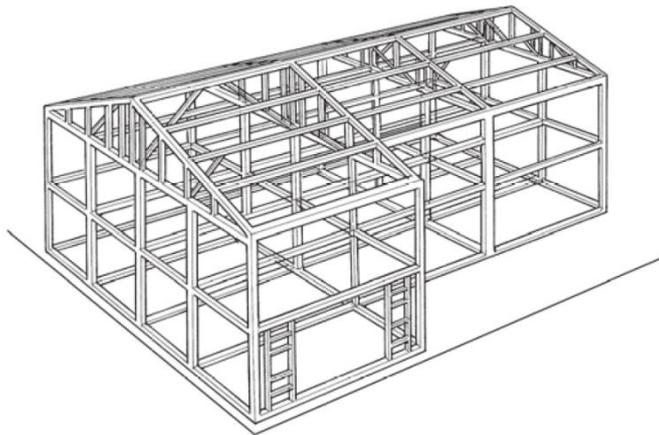


Figure 8-3 Example of steel frame ramen frame structure

(2) Truss structure

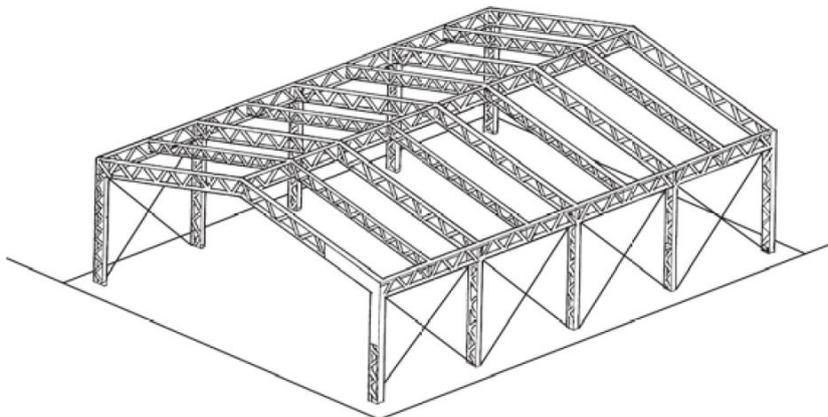


Figure 8-4 Example of steel truss structure (torasukouzou)

8.1.3. Reinforced concrete structure (RC structure) (Tekkin konkurito kozo(RC zo)) (textbook p.134)

By combining concrete with high compressive strength and low tensile strength (around 1/10 of compressive strength) and reinforcing bars having the opposite character, it is possible to construct a component having high overall strength.

1) Characteristic

(1) Advantages

- ① Due to its high strength, it is possible to build large buildings with high earthquake resistance.
- ② Since it is nonflammable, it is possible to build fireproof buildings.
- ③ It has high flexibility regarding the shape of the structure.
- ④ Since alkaline cement prevents the corrosion of the reinforcing bars, the life of buildings is long.

(2) Disadvantages

- ① If concrete shrinks and cracks, the reinforcing bar will corrode. The strength of the component decreases.
- ② Since the material mass is large (about 2.3t/m^3), the entire building and component mass are also large. Therefore, it is not suitable for the long-span component. However, It will benefit in the case of using for the dam.

2) Material

- (1) Reinforcing bar
- (2) Cement
- (3) Aggregate
- (4) Mixing material

3) Main structural types

- (1) Ramen frame structure

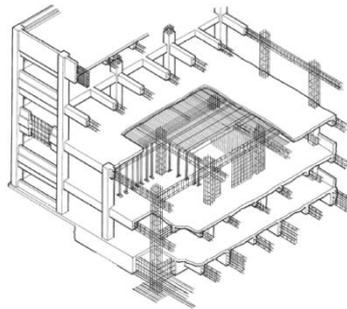


Figure 8-5 Example of reinforced concrete ramen frame structure (tekkotsu konkuritokozo)

- (2) Wall structure

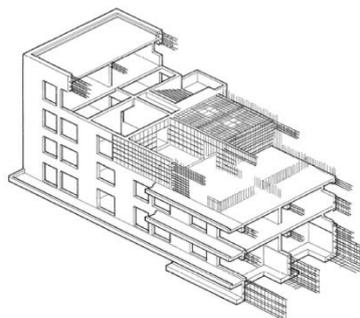


Figure 8-6 Example of reinforced concrete wall structure

8.1.4. Steel-framed reinforced concrete structure (SRC structure) (tekkotsutekkinkonkuritokouzou (SRC zou))
(textbook p.134)

It is a structure that uses steel-framed reinforced concrete (tekkotsutekkin konkurito) for the main structural members of buildings.

Reinforcing bars are built around the steel frame, and concrete is driven into it.

It is very sturdy because it has the advantages of both the steel structure (tekkinkouzou) and reinforced concrete structure (tekkinkonkuritokouzou). It is suitable for large buildings.

Recently, it is common to have a CFT (Concrete Filled Steel Tube) structure in which concrete is driven into a steel pipe.

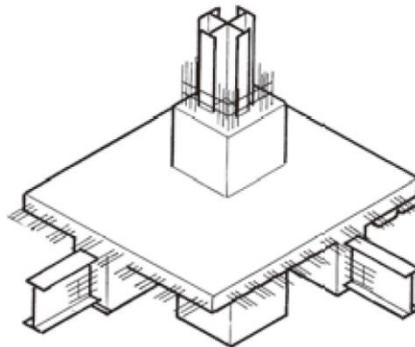


Figure 8-7 Example of steel-framed reinforced concrete rigid frame structure

8.2. Building demolition method (p.137)

8.2.1. Demolition method for wooden buildings (textbook p.137)

Demolition methods for wooden buildings include manual work methods, mechanical work methods (kikaisaagyokouhou), and manual/mechanical work combined methods.

1) Manual construction method

This is a method in which a demolition operator manually dismantles all building equipment, interior materials, roofing materials, and skeletons using hand tools such as crowbars and hammers. Before the Pacific War, it was a very common demolition method. There were many cases that dismantled parts were reused. When relocating buildings, etc., the manual construction method is used exclusively.

The manual method is the best way to properly separate materials.

The general procedure for dismantling a wooden house is shown below. (See Figure 8-9)

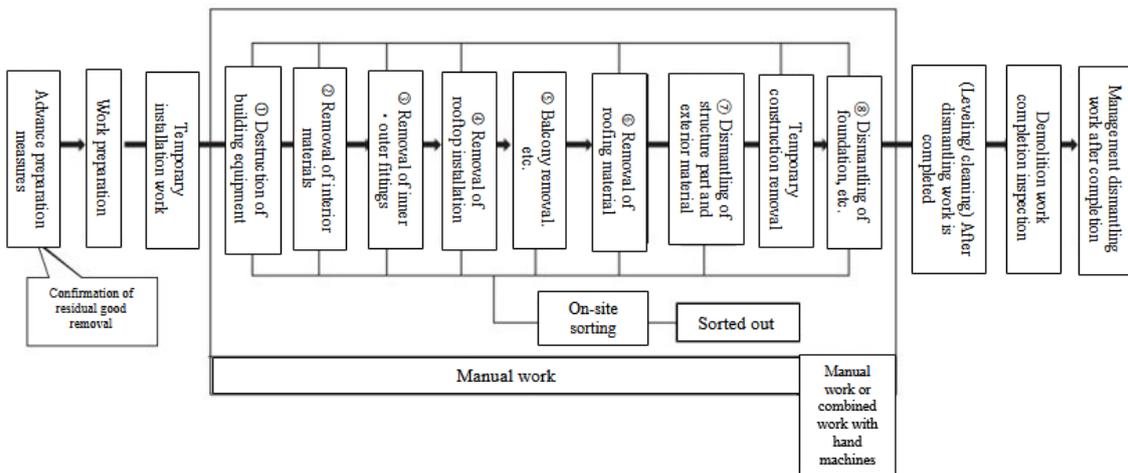


Figure 8—9 Example of manual separation and dismantling method

2) Mechanical work method

This is a construction method in which all building equipment, interior materials, roofing materials, and skeletons are dismantled mainly by mechanical force and replacing the drag shovel or bucket with a grabber.

However, construction using only the mechanical work method is difficult to recycle the generated by-products. It is prohibited by the Law Concerning the Recycling of Materials Related to Construction Work (Construction Recycling Law).

Dismantling concrete foundation with a gripping tool is not used for other purposes, so use a crushing tool.

3) Construction method for both manual and mechanical work

Normal dismantling work is carried out by using both the manual method and the mechanical method. Under the Construction Recycling Law, it is permitted to remove equipment and interior materials and roofing materials only by the manual method and to demolish the skeleton and foundation by using the mechanical work method together.

However, depending on the building's structure, there are exceptional cases that are more difficult due to the technical nature of demolition work. The mechanical work method can also be used to remove equipment and interior materials and roofing materials (See Figure 8-10).

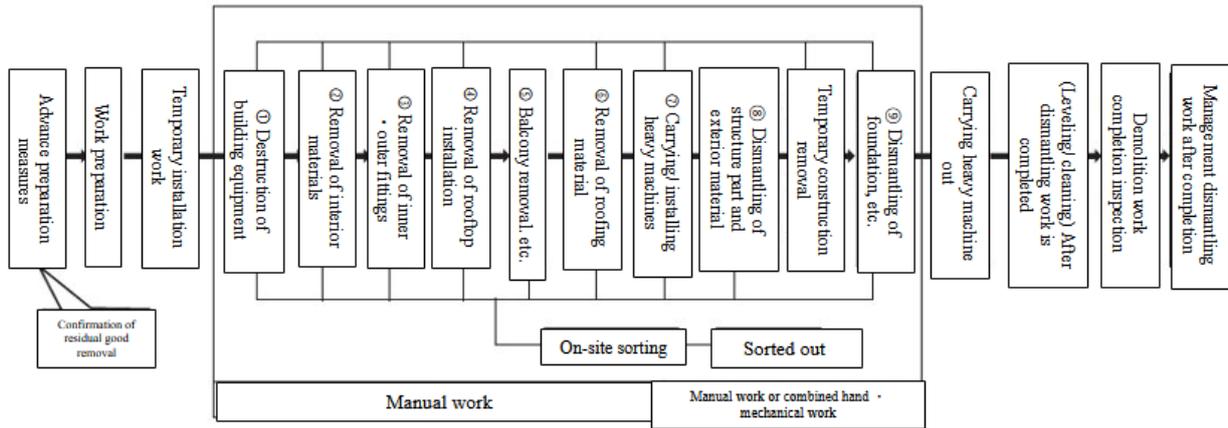


Figure 8-10 Example of separate demolition method using both manual and mechanical work

8.2.2. Demolition method for steel-framed buildings (textbook p.138)

Demolition methods for steel-framed buildings include manual work methods, mechanical work methods, and manual and mechanical work combined methods. For the dismantling work of steel-framed buildings higher than 5 m, a supervisor must be assigned and directly directed.

1) Manual construction method

This is a method in which a demolition operator manually dismantles all building equipment, interior materials, roofing materials, and skeletons using hand tools such as gas blowers, crowbars, and hammers. When reusing steel members, the manual method is mainly used.

However, even in this case, when dismantling a component with a large mass, it is necessary to temporarily hang it with a mobile crane in advance for safety reasons.

2) Mechanical work method

This is a construction method in which all building equipment, interior materials, roofing materials, and skeletons are dismantled mainly by mechanical force by replacing the bucket or bucket of the drag shovel with a steel frame cutting tool.

However, as in wooden construction, construction using only the mechanical work method is prohibited in principle by the Construction Recycling Law.

3) Manual / mechanical work combined construction method

Normal dismantling work is performed by using both manual work and mechanical work. The provisions of the Construction Recycling Law are the same as for wooden buildings.

1) Similarly, for safety reasons, when dismantling a component with a large mass. It is necessary to temporarily hang it with a mobile crane in advance.

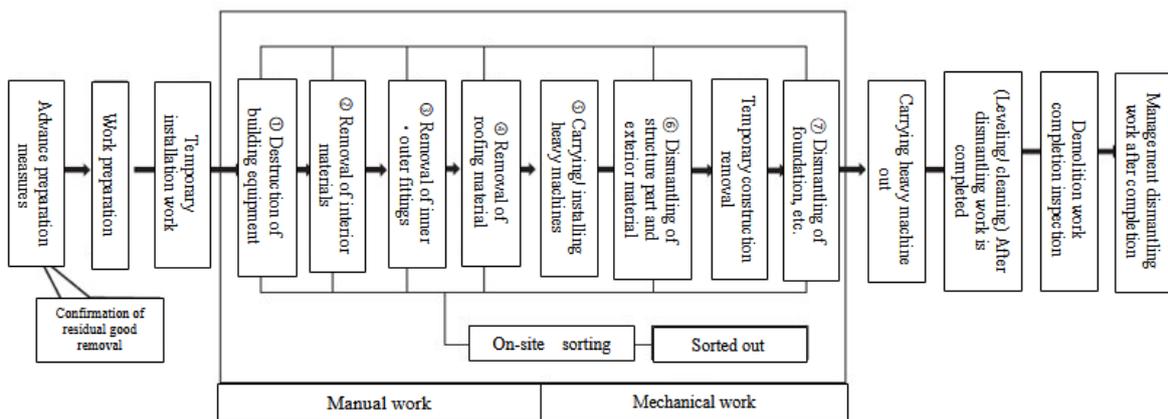


Figure 8-11 Example of separate demolition method by mechanical work

8.2.3. Demolition method of reinforced concrete building (textbook p.139)

The method of dismantling reinforced concrete buildings (tekkotsu konkurito kouzou) is shown below.

When working on reinforced concrete buildings higher than 5m, a supervisor must be assigned and given direct command.

1) Striking method

(1) Breaker method

This is a construction method in which the bucket of the drag shovel is replaced with a large breaker unit and dismantled with a hydraulic striking force only. There is also a handheld hand breaker.

Large breakers are still frequently used to dismantle mass concrete and hand breaker for small parts or partially disassembled parts. However, noise and vibration easily occur, so measures are required when working in urban areas.

The points to be aware of when using the breaker method are as follows

- ① The breaker unit depends on its specifications, such as weight. The reasonable one might be attached to the boom, arm, frame, and main body.
- ② The breaker unit is installed and removed under the direction of an experienced leader.
- ③ Enforce maintenance and inspection.
- ④ The hydraulic type has high oil pressure, so it should be careful of oil leakage from the hose.
- ⑤ The shape of the chisel should be suitable for the application.

(2) Steel ball method

This is a construction method in which an iron ball weighing about 1 ton is hung by a large crane such as a crawler crane, and this is used as a pendulum to hit the object and dismantle it. Destructive power is great. Because it generates a lot of noise and vibration, it is currently used only exceptionally.

2) Crushing method

(1) Crushing method

This is a construction method in which the bucket of a drag shovel is replaced with a hydraulic crusher and crushes and dismantles with hydraulic pressure. Recently, there is also a demolition special-purpose machine. Although it generates dust, it does not generate noise and vibration. It also has a high work efficiency, so it is the most widely used construction method at present.

The work procedure of the crusher is basically the same as that of Figure. 8-11, but ① and ② are the specific work for the crusher.

- ① In general, the beams, slabs (surabu), walls, and pillars are dismantled from the upper floor to the lower floor every span. It is divided into small pieces with a crusher for small pieces. The reinforcing bars and concrete are separated and carried out.
- ② Overall, the area around the inner span is dismantled first, and the outer wall is dismantled last. It can suppress noise during work and scattering of concrete lumps to the outside by leaving the outer wall.

There is the upstairs demolition method in which the crusher is lifted to the upper part of the building by a crane and dismantles from the rooftop. Another method is a ground dismantling method in which a large crusher is installed on the ground and dismantles all from the ground. The work procedure for dismantling upstairs is shown below.

- ① If the concrete block required for slope creation cannot be obtained even after dismantling a penthouse. The rooftop slab (surabu) will be dismantled in advance with a hand breaker, and the crusher is lifted to the floor below the rooftop.
- ② From the rooftop to the lower floors, it will be dismantled each floor.
- ③ For the dismantling work on the first floor, the central part is dismantled first, and the exterior wall is dismantled last.
- ④ After dismantling one story, dismantle the floor and beams on the lower floor, make an opening, make a slope with a concrete block, and lower the crusher downstairs.
- ⑤ Concrete blocks and scraps will be collected on the first floor by using holes (dame ana) or elevator shafts.

Although it is limited by the crane's lifting capacity and the boom length of the large crusher, it can handle up to 10-story buildings. Another construction method will be adopted for the dismantling of higher-rise or skyscrapers.

8.3. Demolition method for civil engineering works (textbook p.144)

8.3.1. Bridge demolition method (textbook p.144)

1) Demolition method of the substructure (pier)

The substructure of the bridge is usually unreinforced or reinforced concrete mass concrete. Demolition is carried out by the breaker method or the blasting (happa) method. Depending on the case, the wire saw method, cutter method, core drill method, or static expansive demolition agent method might be used together.

2) Demolition method of superstructure (bridge girder)

The superstructure of the bridge is usually reinforced concrete or steel. Demolition is carried out by the breaker method, crushing method or steel frame cutting machine method. Depending on the case, the wire saw method, cutter method, or core drill method might be used together. In special cases, blasting (happa) and dismantling might be used together.

Recently, for environmental protection, there are many constructions that, for example, cut to a certain size with a cutter or wire saw and remove using a large crane.

8.3.2. Chimney dismantling method (textbook p.144)

1) Manual construction method

2) Crushing method

3) Falling method

8.3.3. Demolition method for retaining walls, revetments, breakwaters, dam embankments (textbook p.145)

1) Breaker method

If a large breaker can be used, it is dismantled with a large breaker, but if a large breaker cannot be used, it is dismantled with a hand breaker. A wire saw, cutter or static fracturing agent might be used as the primary crushing.

2) Blasting (happa) method

8.3.4. Road pavement demolition method (textbook p.145)

1) Type of pavement

- (1) Asphalt pavement
- (2) Concrete pavement
- (3) Brick pavement

2) Pavement demolition method

(1) Asphalt pavement demolition method

The large breaker method or the hand breaker method is used to demolish the road's surface and base layer. The crusher for pavement demolition is used. This is the prototype of the crusher used for the dismantling of buildings. There is also a dedicated cutting machine for a particular cutting purpose and surface replacement.

(2) Demolition method of concrete pavement

The concrete pavement demolition method includes a large breaker method, a hand breaker method, a cutter method, and a core drill method. These construction methods will be combined and constructed according to the situation.

(3) Brick pavement demolition method

There is no established method for dismantling brick pavement, but there are large breaker methods and hand breaker methods. It can also be done manually using a pickaxe, etc.

8.3.5. Natural stone demolition method (textbook p.147)

Natural stones may appear in underground objects during demolition work. If the natural stone is large, a breaker will be used to crush it and then carry it out.

In addition, demolition construction machines excepting breakers are not used because it is not suitable for crushing natural stone.

9. Related laws and regulations

There are several laws related to worker safety and health, including Industrial Safety and Health Law. In particular, the Industrial Safety and Health Law includes provisions that must be observed to ensure the safety and health of workers and promote the formation of a comfortable work environment. The specific items associated with enforcement of the law are indicated in government, ministry ordinance, notifications, etc. The legal system for safety and health for workers is as follows.

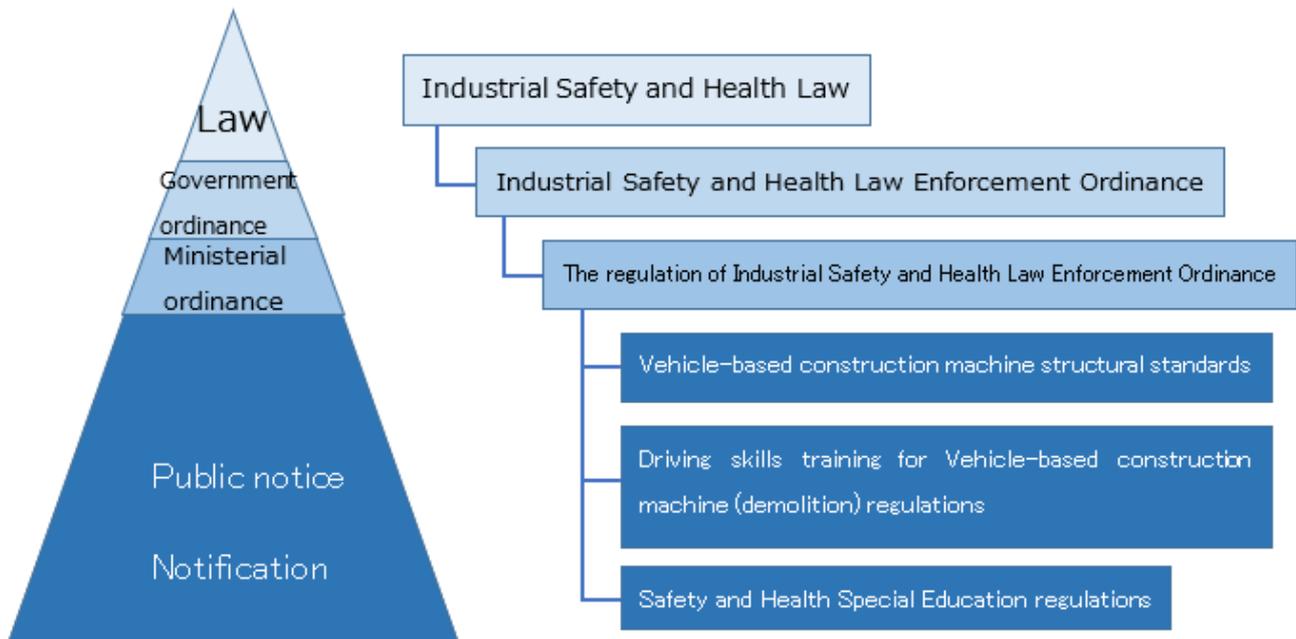


Figure 9-1 Legal framework for driving skills of vehicle-type construction machinery (for demolition)

(Reference) Ministry of Health, Labour and Welfare, Risk assessment manual for the building maintenance industry

9.1. Industrial Safety and Health Law and Order for Enforcement of the Industrial Safety and Health Law (extract)
(textbook p.149))

Chapter 1 General rules

Article 3 <Responsibilities of employers, etc.>

Employers need not only simply preserve minimum standards for the prevention of occupational accidents stipulated by this law but ensure the safety and health of workers in the workplace by creating comfortable working environments and improving working conditions. Also, employers need to cooperate with the policy preventing occupational accidents enforcing by the government.

2 The person who designs machines and other equipment and manufactures or imports and the person who manufactures raw material or imports or builds or designs a building, regarding designing, manufacturing, importing or constructing these items, make efforts to prevent occupational accidents caused by the use of these materials.

3 The person who undertakes works such as contractors for construction needs to care not to impair conditions for safety and sanitary work in construction method and construction period, etc.

Article 4 workers make efforts to follow the necessity for preventing occupational accident and cooperate with measures to prevent occupational accidents implemented by employers and other related persons

Chapter 5 Regulations on machines, etc. and deleterious material

Article 45 <Periodical self-inspection>

According to the Ordinance of the Ministry of Health, Labor and Welfare, employers regularly need to check self-inspection of boilers and other machines specified by the government ordinance and compiles the result.

2 When employers conduct the self-inspection, which is specified government ordinance about the preceding paragraph of machines, etc. by the ordinance of the ministry of Health, Labor and Welfare, it is needed to enforce by workers who use them and have the qualifications specified by the ordinance of the ministry of Health, Labor and Welfare or who are received registration specified in article 54-3 paragraph 1 and conduct a specific voluntary inspection of machines requested by others.

3 The minister of Health, Labor, and Welfare publish the self-inspection policy, which is necessary for the appropriate and effective implementation according to regulation paragraph 1.

4 Abbreviation

Table 5-1 Related law and regulations

Inspection classification	Article	Implementer / Qualification	Storage period of inspection check sheet
Operation before/after	Safety rules Article 170,171	Driver	During machine is in operation
Periodical self- inspection (once/month)	Safety rules Article 168,169,171	Person who is selected by the safety manager	Inspection check sheet 3 years
Specified self- inspection (once/year))	Safety rules Article 167,169, 169(2),171	Inspector	Inspection check sheet 3 years (posted inspected mark)

※ Although not required by law, it is desirable to keep the inspection reports for as long as the machine is in operation.

Chapter 6 Measures for workers' employment

Article 61 <Working restrictions>

In crane and other operations specified government ordinance, employers must not let the person engage in the relevant operations without obtained a license for them by prefectural labor director, completed skill-training related them by the person who is registered by it and having certification specified by the ordinance of the ministry of Health, Labor and Welfare.

2 No one excepting person who can engage in the relevant operations according to the regulation preceding paragraph can conduct this operation.

3 Person who can engage in the relevant operations according to the regulation paragraph 1 need to carry the license or certification for operations.

4 Abbreviation.

Qualifications required for machine operators

Machine name		Machine capacity		Type of qualifications		
				License	Technical training	Special training
Crane	Crane Floor-operated crane (Moves with the load)	Lifting Capacity	5 tons or more	<input type="radio"/>		
		Lifting Capacity	Less than 5 tons 5 tons or more Less than 5 tons		<input type="radio"/>	<input type="radio"/>
Mobile crane		Lifting Capacity	5 tons or more			
			1 ton or more Less than 5 tons		<input type="radio"/>	
			Less than 1 ton			<input type="radio"/>
Vehicle type construction equipment	For land preparation, transportation, loading and excavation	Machine body mass	3 tons or more Less than 3 tons		<input type="radio"/>	<input type="radio"/>
			Compaction (roller) For demolition	Machine body mass	No limits 1 ton or more Less than 1 ton	
Shovel loader, fork loader		Maximum load	1 ton or more Less than 1 ton		<input type="radio"/>	<input type="radio"/>
			Transporting vehicle on rough terrain	Maximum loading capacity	1 ton or more Less than 1 ton	

Qualifications required for operators

Operation Name	Operation contents	Types of Qualifications		
		License	Skill Training	Special education
Slinging work	Lifting Capacity more than 1 ton less than 1 ton		<input type="radio"/>	<input type="radio"/>
Stone latitude handling operation	Operation such as demolition of buildings where stone latitude is used		<input type="radio"/> Chief operation	<input type="radio"/>

【 Government ordinance 】

Article 20 <Operation related to working restriction>

The business specified by the government ordinance of article 61, paragraph 1, is below.

1~11 Abbreviation

12 The operation of machines with a 3-tons weight or more which can drive self-propelled (except driving on the road) in unspecific places and use power in appendix list 1,2,3, and 6.

13 The rest is abbreviated.

(Scope and duration of training courses for persons engaged in restricted employment specified by the Minister of Health, Labour and Welfare pursuant to the provisions of Article 83, paragraph 1, item 3 of the Ministerial Ordinance on Registration and Designation pertaining to the Industrial Safety and Health Act and orders based thereon)
◆ Ministry of Health, Labour and Welfare Notification No. 144 (March 30, 2009) ◆

Article 1 to Article 2 Omitted
 (Training Course for Workers Engaged in Operation of Vehicle-Based Construction Equipment)
Article 3 A training course set forth in Article 99-3, paragraph (1) of the Act for those who are able to engage in the work set forth in Article 20, item (xii) of the Order shall be conducted for the training subjects listed in the upper column of the following table for the durations specified in the lower column of the same table for the ranges respectively listed in the middle column of the same table.

Lecture Subjects	Scope	Duration
Structure of work-restricted machinery, etc.	Structure of equipment related to traveling and working of vehicle-based construction machinery	1 hour
(2) Functions of safety devices, etc. related to work-restricted machinery, etc.	Functions of safety devices and brakes of vehicle-based construction machinery	1 hour
Maintenance and management of work-restricted machinery, etc.	Inspection and maintenance of vehicle-based construction equipment	1 hour
Methods of work related to machines, etc. work-restricted machinery, etc.	Safety measures according to the method of work related to vehicle-based construction equipment	1.5 hours
Safety and health related laws and regulations	Relevant provisions in laws, ordinances, and industrial safety and health regulations	1.5 hours
Examples of occupational accidents and their prevention measures	Research on occupational accidents	2 hours

Article 4 Omitted

9.2. Industrial Safety and Health Law Regulations (extract) (textbook p.160)

Part 1 General Rules

Chapter 7 licenses, etc

Section 3 skill-training

Article 82 <Reissuance of certification of skill-training completion, etc.>

When the person issued a certification of skill-training completion and work-related or will work, lost or damages the certification, excepting regulation 3, the person needs to submit an application for reissuing certification of skill-training completion (Form article 18) to the institution that you received that certification and reissue it.

2 When the person, regulated preceding paragraph, change the name, excepting regulation 3, the person needs to submit application for rewriting certification of skill-training completion (Form article 18) to the institution you received that certification rewrite it.

3 The rest is abbreviated.

Part 2 Safety Standards

Chapter 2 Constriction machines, etc

Section 1 Vehicle-based construction machines

Subsection 1-2 Structure

Article 152 <Establishing headlights>

Employers need to equip the headlights with vehicle type construction machines. However, it is not applied that vehicle-based construction machines are used to maintain illuminance for safe-operation.

Article 153 <Head guard>

When employers operate vehicle-type construction machine *1 (only bulldozers, tractor excavators, stackers, power excavators, drag excavators, and Demolition machines) in the place where there are risks for worker falling rocks, etc., solid head guard *2 need to be equipped on vehicle-based construction machines.

Note 1) The phrase “the place wherefalling rocks” means light excavation work, quarrying excavation work and constructing road work using machines, and the place where rocks maybe fallen caused by operating machines.

Note 2) Regarding head guard, the structural standard is indicated by No 559 Sep 26,1975.

Subsection 2 Prevention of dangers related to the use of vehicle type construction machines.

Article 154 <Survey and Record>

Employers need to investigate the topography, geological condition, etc., of places related to operating and record the result in advance when starting operation using vehicle-based construction machine to prevent workers' danger due to fallen its machines and demolished ground, etc.

Article 155 <Operation plans>

When workers operate vehicle-based condition machines, employers need to establish an operation plan adapting the investigation preceding article in advance and operate following that plan.

2 Operation plans in the preceding paragraph need to indicate the following items.

1 Types and capabilities of vehicle-type construction machine

2 Operation route of vehicle-type construction machine

3 Operation method for vehicle-type construction machine

3 Employers need to publish to the relevant worker about the preceding paragraph items 2 and 3 when they have established the operation plan.

Article 156 <Speed limit>

When employers operate using vehicle-type construction machine (excepting maximum speed is less than 10km), in advance, the employers need to operate specified appropriate speed limit for it according to the topography, geological condition, etc. *, of places related to operating.

2 The driver of the vehicle-type construction machine preceding paragraph must not drive it over the speed limit in the same paragraph.

Note: "etc." in "topography, geological conditions, etc." includes cases where other machinery and equipment are installed.

Article 157 <Prevention of falling, etc.>

When employers operate using vehicle type construction machines, employers need to take necessary measures and maintain the required width to prevent workers' danger due to fall or vehicle-based construction machines fallen, the collapse of shoulders for operation route and uneven settlement of ground.

2 When employers operate using vehicle-type construction machine on shoulders, slopes, etc., if there is a risk of danger to the worker due to the fall or vehicle-type construction machine is fallen, the business operator needs to assign a guide and let him/her guide vehicle-type construction machine.

3 Drivers of vehicle-type construction machine preceding paragraph need to follow the inductor's (yudosha) guidance in the same paragraph.

Note 1) "Etc" in "necessary measures and maintain the required width" includes establish guardrails and setting signs.

Note 2) In establishing guardrails and setting signs not to falling, assigning an inductor in paragraph 2 is not needed.

Article 157-2

At the place where there is a risk for driver falling or vehicle-type construction machine at shoulders, slopes, etc., rollover, employers must ensure the driver use seat belts and machines with fall protection structure.

Article 158 <Contact prevention>

When employers operate using vehicle type construction machines, workers must not be allowed to enter the place where there is a risk of danger contacting that machine's driving.

However, it is not applied if an inductor is assigned and guides the vehicle-type construction machine.

2 The driver of the vehicle-type construction machine preceding paragraph needs to follow the guidance given by the inductor of the same paragraph.

Note) "the place where there is a risk of danger" includes places within operating range of equipment such as arms and booms as well as traveling range of machines.

Article 159 <Signals>

When employers assign a guide for driving vehicle type construction machines, they need to decide certain signals and make the guide use them.

2 Drivers of vehicle-type construction machine preceding paragraph need to follow the signal of the same paragraph.

Article 160 <Measures in case of being away from driving position>

When the operator of the vehicle-type construction machine leaves the operation position, the operator shall have the operator take the following measures

1 Lower the work equipment such as buckets and jiggers*1 to the ground.

2 Stop the prime mover and apply the traveling brake, or take other measures*2 to prevent the vehicle-type construction machine from running away.

2 The preceding paragraph's operator shall take the measures listed in each item of the same paragraph when leaving the operating position of the vehicle-type construction machine.

Note 1: "Etc." in "bucket, zipper, etc." includes shovels, soil removal boards, etc.

Note 2: "etc." in "applying the traveling brake, etc." includes stopping with a wedge, stopper, etc.

Article 161 < Transportation of Vehicle-type construction machine >

When employers operate loading and unloading freight vehicles, etc. Due to transferring vehicle-type construction machine need to use boards, embankments (morido), they need to park it as bellow due to prevent dangers from falling or tipping over.

1 Operate loading and unloading on flat and firm surfaces.

2 When the road board is in use, make sure the road board has enough*2 lengths, width, and strength and fits appropriate gradient*3.

3 when you use embankments (morido) and temporary stands, ensure enough width and strength*4 and appropriate slop.

Note 1) “Etc” in “freight vehicles, etc.” is including trailers.

Note 2) “Enough” in “enough length” is determined according to the weight and size of vehicle type construction machines for loading and unloading.

Note 3) “Appropriate gradient” is within a safe range in consideration of machines such as the climbing ability.

Note 4) “Strength of embankment (morido)” is ensured by striking logs in the embankment (morido) and make it enough harden.

Article 162 <Restrictions on ride>

Employers shall not allow workers to ride on any part of the vehicle other than the passenger seats※ when working with vehicle-type construction machine.

Note: "Passenger seats" refers to the driver's seat, front passenger seat, and other seats for passengers.

Article 163 <Restriction for use>

In order to prevent danger to workers due to overturning or destruction of working equipment such as booms and arms, operators shall observe the *stability, maximum working load, etc., specified in the structure of the relevant construction equipment when they work with the construction equipment.

Note: "Defined in terms of its structure" means as indicated in the structural standards for vehicle-type construction machine.

Article 164 < Restrictions on use other than for the original purpose >

Employers shall not use vehicle-type construction machine for any purpose other than the intended use of said vehicle-type construction machine, such as lifting loads with a power shovel or lifting workers with a clamshell.

2 The provisions of the preceding paragraph shall not apply in any of the following cases

1 When the work of lifting cargo*2 is performed, and all of the following apply.

(a) When it is unavoidable due to the nature of the work or when necessary for the safe execution of the work*3.

(b) When using arms, buckets, or other work equipment with hooks, shackles, or other metal fittings or other devices for lifting that fall under any of the following categories*4.

(1) Has sufficient strength*5 for the load to be applied.

(2) There is no risk of the load being lifted from the equipment falling due to the use of a detachable device.

(3) There is no risk of the equipment being detached from the work equipment*6.

2 When performing work other than lifting loads, and when there is no risk of danger to workers.

Note 1: The "etc." in "lifting and lowering workers by clamshell" includes the use of booms, arms, etc., as an alternative to ramps.

Note 2: "Work of lifting cargo" includes turning off the boom while holding the cargo and traveling while holding the cargo.

Note 3: "When it is unavoidable due to the nature of the work or when it is necessary for the safe execution of the work" refers to the case where lifting of sheet piles, fume pipes, etc. for soil stabilization is temporarily carried out to reduce the danger of soil collapse as part of excavation work using vehicle-type construction machine, and the worksite is narrow, and if a mobile crane is brought in to carry out the work, the worksite will be more complicated, and the danger will increase.

Note 4: "When a lifting device is attached to the work equipment and used" means that hooks, shackles, wire ropes, lifting chains, etc. are attached to the work equipment so that they cannot be easily removed, and the work equipment is used to lift the load. It does not include the case where a wire rope is attached to the bucket jaws to lift a load or where a wire rope is directly attached to the boom or arm to lift a load.

Note 5: The strength of the lifting equipment shall be that the safety factor is five or more (the value obtained by dividing the value of the cutting load of the lifting equipment by the value of the load in Paragraph 3, Item 4).

Note 6: "There is no risk of the equipment being detached from the work equipment" refers to hooks, etc., that are welded in such a way that there is sufficient penetration, throat thickness, etc., and that the hooks, etc., are welded around the entire circumference of the mounting area.

(Note) The work must be performed by a person who is certified in mobile crane and slinging.

Article 165 <Repairs, etc.>

When an operator carries out repair work or attachment or removal work of vehicle-type construction machine, the operator shall appoint a person to direct the work and have that person take the following measures

1 To determine the work procedures and direct the work.

2 To monitor the use of safety poles, safety blocks, etc., as specified in paragraph 1 of the following article, and platforms as specified in paragraph 1 of Article 166-2.

Article 166 < Prevention of danger due to the lowering of booms, etc. >

The employer shall, when raising the boom, arm, etc. of a vehicle-type construction machine and performing the repair, inspection, etc. under the boom, arm, etc., have workers engaged in the work use safety poles, safety blocks, etc. to prevent danger to workers due to the unexpected lowering of the boom, arm, etc.

2 Workers engaged in the preceding paragraph's work shall use the safety poles, safety blocks, etc.* of the same paragraph.

Note: The "etc." in "safety blocks, etc." includes platforms, etc.

Article 166-2 <Prevention of Danger due to Collapse of Attachment>

When a business installs or removes an attachment of a vehicle-type construction machine, the business shall have workers engaged in the work use a platform in order to prevent danger to workers due to the collapse of the attachment.

2 Workers engaged in the work of the preceding paragraph shall use the platforms of the same paragraph.

Article 166-3 <Restriction on attachments>

Operators shall not install attachments that exceed the weight specified for the vehicle-type construction machine.

Article 166-4 < Attachment weight indication, etc. >

When an attachment of a vehicle construction machine vehicle-type construction machine has been replaced, the business operator shall place the weight of the attachment (including the capacity or maximum loading weight of the bucket, zipper, etc., when the bucket, zipper, etc., has been installed. The same shall apply hereinafter in this article), or the said vehicle-type construction machine shall be equipped with a document that enables the operator to easily confirm the weight of the attachment.

Chapter 8-5 Prevention of danger in demolition works, etc. of concrete structures

Article 517-15 < Demolition, etc. of Concrete Structures >

The employer shall take the following measures when performing the work specified in Article 6, Item 15-5 of the Order.

- 1 To prohibit workers other than the workers concerned from entering the area where the work is to be performed.
2. To suspend the work when it is expected to be dangerous to carry out the work due to bad weather conditions such as strong winds, heavy rain, or heavy snow.
- 3 When lifting or lowering equipment, tools, etc., have workers use a suspension line, suspension bag, etc.

Article 517-16 <Signals for work such as pulling down >

The employer shall, when carrying out the work outlined in Article 6, Item 15-5 of the Order and when carrying out work such as pulling down exterior walls, pillars, etc., establish certain signals for pulling down and make them known to the workers concerned.

- 2 The employer shall, in the case where carrying out a down pulling operation outlined in the preceding paragraph, when there is a risk of danger to workers other than those engaged in the said pulling down operation (hereinafter referred to as "other workers" in this Article), have the said worker give the signals and not start the said pulling down operations unless otherwise having confirmed that the other workers have evacuated the area.
- 3 When there is a risk of causing the danger mentioned in the preceding paragraph, workers engaged in the work of pulling down, etc. in paragraph 1 shall not engage in the work of pulling down, etc. unless they have given a signal in advance and confirmed that other workers have evacuated the area.

Article 517-17 < Appointment of work leaders for demolition of concrete structures >

The employer shall, concerning the work outlined in Article 6, item 15-5 of the Order, appoint a chief engineer for the demolition of concrete structures from among those who have completed a training course for chief engineers for the demolition of concrete structures.

Article 517-18 < Duties of the chief of operations for demolition of concrete structures >

The employer shall have a chief engineer of work for demolition of concrete structures perform the following.

- 1 To decide the method of work and the assignment of workers and directly direct the work.
- 2 To inspect the function of equipment, tools, safety belts, etc., and safety helmets.
- 3 To monitor the use of safety belts, etc., and safety helmets.

Article 517-19 < Wearing of safety helmet >

When performing the work set forth in Article 6, Item 15-5 of the Order, the employer has workers engaged in the work wear safety helmets to prevent danger to workers from flying or falling objects.

- 2 Workers engaged in the preceding paragraph's work shall wear the safety helmet of the same paragraph.

Part 4 Special regulations

Chapter 2 Special regulations concerning lenders of machinery, etc.

Article 666 < Measures to be Taken by Lenders of Machinery, etc. >

The person prescribed in the preceding article (hereinafter referred to as the "Lender of Machinery, etc.") shall take the following measures when leasing said machinery, etc., to other business operators.

1 To inspect the relevant machinery, etc., in advance*1 and, if any abnormality is found, repair or perform other necessary maintenance.

2 To deliver the document stating the following matters to the employer who receives the loan of said machinery, etc.

(a) The capacity of the said machine, etc. *2

(b) Characteristics of said machine, etc. and other matters to be noted in its use*3

2 The provisions of the preceding paragraph shall not apply to the case that the selection of the model of machine, etc. to be lent at the time of purchase, and its maintenance after lending, and other operations that should be performed originally by the owner of said machine, etc. are performed by the business operator who receives the loan of said machine, etc. (including the equipment lending business conducted by the prefectural equipment lending institution prescribed in Article 2, paragraph 6 of the Act on Subsidies for the Introduction of Equipment to Small-Scale Enterprises (Act No. 115 of 1956)).

Note 1: "In advance" does not necessarily mean that all of the equipment should be inspected each time it is leased, but it is acceptable to limit the inspection to necessary parts depending on the conditions of use.

Note 2: "Capacity of the relevant machine, etc." means, in the case of vehicle-type construction machine, the capacity especially required for use, such as stability, bucket capacity, and other major items.

Note 3: "Other matters to be noted in its use" refers to matters that should be noted in the use of the relevant machine, such as the fuel used and the method of adjustment.

Note 4: The purpose of paragraph 2 is to exclude the application of this Article to a lease that is made as a financial instrument in the form of a lease.

9.3. Vehicle-type construction machine structural standards (extract) (textbook p.177)

Article 1 <Strength, etc.>

Article 2 <Stability>

Article 3 <Stability of piling and piling extracting machine>

Article 4 (rear stability of the excavation machine(except crawler type) and demolition machine (except crawler type))

Article 5 <Brakes for driving, etc.>

Article 6 <Brakes for work equipment>

Article 7 <Operating parts of running gear, etc.>

Article 8 (The function of the operation part, operating method, and items necessary for operation)

Article 9 <Visibility required for driving, etc.>

Article 10 <Elevating equipment>

Article 11 <Hazard control equipment for such as arm elevating>

Article 12 <Direction indicator>

Article 13 <Alarm device>

Article 13-2 <Automatic stop devices when the working range is exceeded>

Article 14 <Safety valve, etc.>

Article 15 <Display>

Article 16 < Vehicle-type construction machine with special structure>

Article 17 <Exclusion of application>

10. Disaster cases

Chart 10-1 shows the transition of casualties disaster taking more than 4 days off in the construction industry.

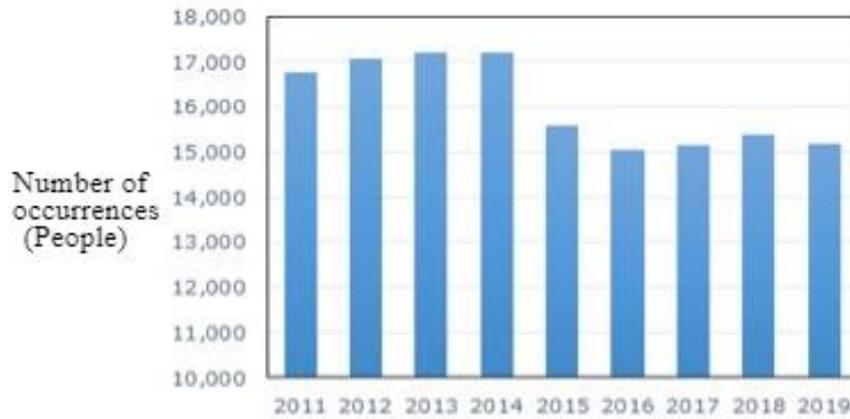


Chart 10-1 The transition of casualties disaster taking more than 4 days off in the construction industry.
(Excepting those directly caused by the Great East Japan earthquake.)

In addition, in the case of compiling by cause of disasters extracted from casualties disaster of taking 4 days off in 2017, approximately 56% is for leveling, transportation, stowage, and excavation, and approximately 15% is for demolition in the cause of construction machines, etc.

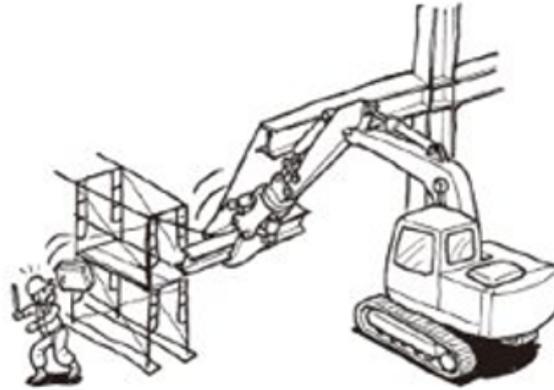
(Reference) Ministry of Health, Labor and Welfare Occupational accidents situation workplace safety site:
Analysis of factors causing occupational accidents. (construction industry in 2009)

Case 1. Fallen floatstones during crushing work.

Fallen floatstones during crushing work.					
					
Work type	Road construction business	Age	59	Years of experience	35
Accident type	Clash	Injury and illness name	Fracture (Casualties disaster)	After admission	day
Cause	Demolition machines	Occupation	Driver of construction machine		
Situation of disaster occurrence	During disaster rehabilitation work on the road, the driver's seat of the breaker is slipped pumice down directly.				
Cause	<ul style="list-style-type: none"> · Not to be conformed rock condition and operated by a guard. · Not having knowledge of ground materials, etc for breaker operator. 				
Countermeasure	<ul style="list-style-type: none"> · To educate breaker operators based on disaster cases such as slipping, etc. · To use vehicle-based construction machines equipped with head guards for work which has risk for slipping rock, etc off. · To being monitored operating information by a guard. 				

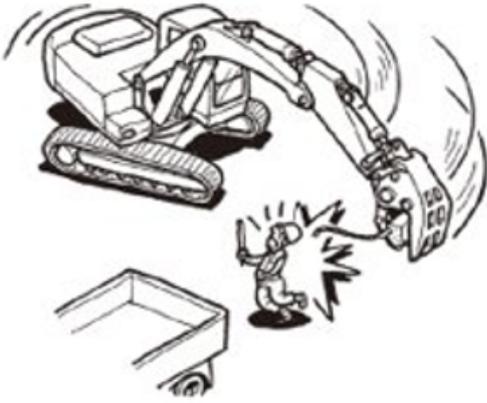
Case 2 Crash into falling objects during demolition work.

Crash into falling objects during demolition work.



Work type	Other construction business	Age	65	Years of experience	21
Accident type	Clash, Collapse	Injury and illness name	Fracture	After admission	day
Cause	Demolition machines	Occupation	Foremen		
Situation of disaster occurrence	During demolishing the attic part of steel building, when worker cut girders with steel cutting tools and put them down, he/she pulled temporary electric wire at the top of girders together then distribution board fell on workers operating nearby.				
Cause	<ul style="list-style-type: none"> · Not being planed appropriate operate plan based on the condition of demolished object. · Not being prohibited from entering the inside of demolishing work area. · Not being wire removed without checking the location before demolition. 				
Countermeasure	<ul style="list-style-type: none"> · To investigate the demolished object in advance and decide the appropriate operate plan base on the situation and work following it. · To prohibit entering places where there is risks for danger of workers flying or falling cut materials. · To educate operators using procedures for steeling cutting. 				

Case 3. Hit reinforcing bar entering within operating radius.

Hit reinforcing bar entering within operating radius.					
					
Work type	Security	Age	69	Years of experience	3
Accident type	Clash	Injury and illness name	Fracture	After admission	day
Cause	Demolition machines	Occupation	Security guard		
Situation of disaster occurrence	When guide for vehicle was guiding a truck for unloading at demolition operation area, the arm of the construction machine crushing concrete turned and reinforcing bar which pinched between small crushers is hit the guide.				
Cause	<ul style="list-style-type: none"> • To enter guide into operating radius of vehicle-based construction machine. • Not having knowledge for truck guides about safety operation regarding demolition operation such as movable range of vehicle-based construction machines. • Not operator for concrete crusher machines confirmed anyone entering inside of operating radius. 				
Countermeasure	<ul style="list-style-type: none"> • To prohibit entering the area where there is a possibility of hit with operating concrete crusher machines. • To assigned the guide for the construction machines and guide that machines with predecided signal if it is unavoidable to enter the operate range of the machines. • To educate guides and operators for concrete crusher machines safety such as the range of movement of machines and disaster cases. 				

Case 4. Break a right hand pinched between demolition attachment and belt.

Break a right hand pinched between dismantling attachment and belt.					
					
Work type	Other public works business	Age	36	Years of experience	1
Accident type	Pinch and getting caught in	Injury and illness name	Fracture (Casualties disaster)	After admission	day
Cause	Other construction machines	Occupation	Earthworks		
Situation of disaster occurrence	During demoloying operation of 2 floors wooden house (avaible if it is "under demoliting constrution"), when transferring flexible container bag containing waste material by hanging on the gripping arm, worker pinched his/her hand between grip arm and band of flexible container back and gave drag shovel signal to move.				
Cause	<ul style="list-style-type: none"> • Not making plans using constrution machine and conferring whether lifting operation ecisting. • To try to lift the flexible container bag with a grip. 				
Countermeasure	<ul style="list-style-type: none"> • To decide operating plan using vehicle-based construction machines and work. • To prohibit transfer lifting objects with grip. • To use cranes (with crane function) due to operating lifting objects. • To prohibit workers to enter in the operating radiud of construction machines. 				

Case 5. Pinch foot while replacing the attachment.

Pinch foot during replacing the attachment.					
					
Work type	Other construction business	Age	41	Years of experience	3
Accident type	Pinch and getting caught in	Injury and illness name	Fracture	After admission	day
Cause	Demolition machines	Occupation	Driver of dump truck, etc.		
Situation of disaster occurrence	In the demolition place, to replace buckets from gripper of vehicle-based construction machines, the worker pulled out the pin which fixing arms and grip then grip fall down and this leg was pinched.				
Cause	<ul style="list-style-type: none"> · Not taking measures for falling prevention of replacing attachments. · Not fully understand the procedure for replacing attachment operation. · Not having safety and health knowledge in replacing attachment operation. 				
Countermeasure	<ul style="list-style-type: none"> · To prevent falling attachments using stands for replacing when it is attaching or detaching them. · To determine the procedure in advance for replacing attachments and make workers thorough. · To educate safety and health for replacing attachments to workers. 				

Case 6. Fall losing balance when turning.

Fall losing balance when turning.					
					
Work type	Other construction business	Age	38	Years of experience	16
Accident type	Fallen	Injury and illness name	Bruise	After admission	day
Cause	Demolition machines	Occupation	Operator of construction machine		
Situation of disaster occurrence	During demolition operation of building by setting cutting machines for steel frame on the crushed block, when operator, worried about the stop location of unloading truck, tried to check turning upper body, its machine lost balance and fall from blocks.				
Cause	<ul style="list-style-type: none"> · To park machine in unflat place and turning upper body in unstable situation. · Not having knowledge of the stability of machines for operator. 				
Countermeasure	<ul style="list-style-type: none"> · To operate parking vehicle-based construction machine in the flat ground having enough strength for operation. · To educate operators in advance about the dangers in unflat place and usage of machines. · To equip with a stability detector on machines, if vehicle stability enters in crisis zone, it makes warning sound to the operator. 				

Exam questions

Chapter 1. Basic Knowledge about vehicle-type construction machinery

■ Question No. 1 (Types and applications (characteristics) of demolition machines, etc.)

Select the most incorrect answer from the following four explanations regarding the types and uses (characteristics) of demolition machines.

- (1) A breaker is a machine equipped with a breaker unit (impact breaker) operated by hydraulic or pneumatic pressure as an attachment.
- (2) A steel frame cutting machine is a machine equipped with a scissors-like attachment for cutting steel frames, etc. (including nonferrous metal structures).
- (3) A concrete crushing machines is a machine equipped with a scissor-like attachment for crushing concrete structures.
- (4) A demolition gripper is a machine equipped with a fork-shaped gripper tool as an attachment to demolish concrete structures or grab and lift demolished structures.

■ Question No. 2 (Terms related to vehicle type construction machines)

Choose one of the following four explanations of terms related to vehicle type construction machines that is correct.

- (1) Machine weight (or mass) is the dry mass (mass without fuel, oil, water, etc.) of the vehicle type construction machine excluding the work devices, that is, the mass of the machine itself.
- (2) Machine body weight (or mass) is the wet mass (mass containing fuel, oil, water, etc.) of the vehicle construction equipment with the necessary work devices attached and with no load on the bucket, etc. (no load state).
- (3) Machine body weight (or mass) is the weight (or mass), of the machine, the maximum loading weight (or mass), and 70 kg multiplied by the seating capacity.
- (4) Gross vehicle weight (or mass) is the sum of the machine weight (or mass), the maximum loading weight (or mass), and 55 kg multiplied by the seating capacity.

Chapter 2. Prime mover and hydraulic system of vehicle type construction machines

■ Question No. 3 (Prime mover)

Choose one of the following four explanations of the prime mover that is correct.

- (1) A prime mover is a device that converts mechanical work into various forms of energy.
- (2) Typical prime movers used in machinery include internal combustion engines such as diesel and gasoline engines, as well as motors and other electric motors.
- (3) In general, gasoline engines are mainly used as prime movers for vehicle type construction machines.
- (4) Mixing multiple fuels (diesel fuel (keiyu) and gasoline) improves fuel efficiency.

■ Question No. 4 (Fuel and engine oil)

Choose one of the following four explanations about fuel and engine oil that is most incorrect.

- (1) Engine oil has the function of lubricating.
- (2) Engine oil has the function of cooling.
- (3) Engine oil has the function of sealing.
- (4) There is no need to use engine oil of the standard specified in the instruction manual of the construction machine.

■ Question No. 5 (Hydraulic system)

Choose one of the following four explanations about hydraulic systems that is correct.

- (1) The pump is not a precision machine, so it will not be subject to wear and tear caused by dust, sand, etc.
- (2) Be careful because if the filter gets clogged, the pressure will not rise.
- (3) Filters mix dirt with the hydraulic oil in the hydraulic circuit.
- (4) When the filter gets clogged, the pressure will get regulated properly.

Chapter 3. Structure related to the running of demolition machines.

■ Question No. 6 (Undercarriage system)

Choose one of the following four explanations of the undercarriage system that is correct.

- (1) If the air pressure is too low, the tire collapses and generates a lot of heat due to distortion, resulting in peeling.
- (2) When the air pressure is too low, the ground contact area between the tire and the ground increases, making it more effective for braking.
- (3) If the air pressure is too high, both ends of the tire will touch the ground and this part of the tire will wear quickly.
- (4) The higher the air pressure, the harder the tire and the tougher the tire.

■ Question No. 7 (Safety devices for demolition machinery)

Choose one correct answer from the following four explanations about safety devices, etc. for demolition machinery.

- (1) The machine is equipped with a vibration device that warns concerned workers by vibration to ensure safety during driving and work operations.
- (2) Various safety lock levers are installed to prevent the base machine and attachments from moving unexpectedly when the machine is being inspected or serviced, or when work is stopped.
- (3) A monitoring system is a system that allows the operator to quickly check the condition of the machine during operation to ensure safe operation and alerts the operator by constantly lighting a lamp and sounding a buzzer.
- (4) When working with specified demolition machine, operators may continue to work even when there is a risk of the base machine tipping over or falling on the shoulder of the road, on an inclined ground, or in other unstable conditions.

Chapter 4. Handling of equipment regarding operation with demolition attachments, etc.

■ Question No. 8 (Selection and installation of breakers)

Choose one of the following four explanations about the selection and installation of breaker that is correct.

- (1) The size of the breaker unit has no relation to the material to be crushed.
- (2) The required oil volume, hydraulic pressure, and weight of the breaker unit have no relation to the base machine.
- (3) The hydraulic circuit of the base machine is irrelevant to the selection of the breaker.
- (4) The breaker unit is attached to the arm of the base machine with a pin, and the hydraulic circuit for the breaker on the arm is connected to the breaker unit with a hydraulic hose.

■ Question No. 9 (Characteristics of breaker)

Choose one of the following four explanations of the characteristics of a breaker that is correct.

- (1) A breaker uses a piston that impacts the chisel and concentrates the impact force on the tip of the chisel to crush the object.
- (2) Breaker must not be used for bedrock crushing, concrete crushing, or the stripping cement paste.
- (3) Breaker do not utilize the hydraulic pressure of the base machine.
- (4) Breaker have poor mobility and are not suitable for detailed work.

■ Question No. 10 (Types of breaker)

Choose one of the following four explanations about the types of breaker that are correct.

- (1) In the repulsive hydraulic regeneration type operation method, the high-pressure hydraulic pressure acting on the lower pressure-receiving surface of the piston raises the piston and compresses the nitrogen gas sealed in the upper part of the piston.
- (2) In the direct-acting hydraulic type method, high pressure oil pressure is always applied to the lower pressure receiving surface of the piston. The only way that piston is activated is by the switching of the upper pressure receiving surface of the piston between low and high pressure.
- (3) The only way that the hydraulic direct-acting type operates is by constantly applying high hydraulic pressure to the upper pressure receiving surface of the piston and switching the lower pressure receiving surface of the piston between high-pressure and low-pressure to operate the piston.
- (4) In some models of direct-acting hydraulic system type pistons, the upper part of the piston is filled with propane gas, and the blow is made by hydraulic pressure and the expansion of compressed nitrogen gas.

■ Question No. 11 (Operation of breaker, etc.)

Choose one of the following four explanations about breaker operation, etc. that is correct.

- (1) The only basic operation of the breaker is to raise and lower the boom.
- (2) Except for the striking action of the breaker unit, the operation is the same as that of a hydraulic shovel.
- (3) As for hydraulic shovels, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has restricted the spread of machines with uniform operation methods.
- (4) The basic operation of breaker does not include the striking action of the breaker unit.

■ Question No. 12 (General working method of breaker)

Choose one of the following four explanations about the general working method of a breaker that is correct.

- (1) The breaker can perform the work of demolition of structures and crushing of rocks.
- (2) The breaker unit may be used even if it is not adapted to the capacity of the base machine.
- (3) When working with a breaker, it is not necessary to inject grease at the grease injection points of the breaker.
- (4) When working with a breaker, place the chisel parallel to the surface to be crushed, apply pressure, and finish the blow.

■ Question No. 13 (Precautions after finishing work)

Choose one of the following four explanations about caution after finishing the work that is correct.

- (1) Park the base machine with the breaker unit installed on a wet, inclined surface.
- (2) Do not wipe off any mud, etc. that may have adhered to the breaker unit.
- (3) When removing the breaker unit from the arm, do so with the temperature of the hydraulic oil as high as possible.
- (4) When attaching and detaching hydraulic hoses, take extra care to prevent foreign matter from entering the hydraulic oil.

■ Question No. 14 (Precautions after finishing work)

Choose one of the following four explanations of the caution after finishing work that is correct.

- (1) Store the removed breaker unit outdoors.
- (2) Clean off any mud or water that may have adhered to the base machine.
- (3) Do not clean the area around or inside the driver's seat, including the Undercarriage and lifting equipment, until before the next operation.
- (4) Never clean the hydraulic cylinder rod surface.

■ Question No. 15 (Characteristics of steel frame cutting machines)

Choose one of the following four explanations about the characteristics of steel frame cutting machines that is correct.

- (1) Gas cutting machines are dangerous and must not be used.
- (2) The use of steel frame cutting machines has increased the risk of crashes and falls.
- (3) Conventional gas fusing machines had the danger of crash and fall and the danger of causing gas flame for the cutting workers that performed gas welding work in high places.
- (4) Conventional gas fusing machines can be reused by using steel frame cutting machines.

■ Question No. 16 (Name and function of each part of the steel frame cutting tool)

Select the most incorrect explanation out of the following four about the name and function of each part of the steel frame cutting tool.

- (1) A steel cutting tool consists of a cutting arm.
- (2) A steel cutting tool consists of a cutter.
- (3) A steel cutting tool consists of an opening and closing cylinder.
- (4) A steel cutting tool consists of a central frame.

■ Question No. 17 (Types of steel frame cutting tools)

Choose one of the following four explanations about the types of steel frame cutting tools that is correct.

- (1) Cutting tools are suitable for cutting steel constructions and buildings that do not move when pressed, because the tip opening width can be increased.
- (2) Cutting tools are not suitable for cutting steel structures and buildings because the tip opening width cannot be increased.
- (3) The non-slippery shape with a “v-shaped” tip is a cutting tool that reduces the tip opening width, but requires the cutter to be pressed down.
- (4) The non-slippery shape of the "v-shaped" tip is not suitable for cutting steel scrap.

■ Question No. 18 (Selection and Installation of a steel frame cutting machines)

Choose one of the following four explanations for the selection and installation of a steel frame cutting machine that is correct.

- (1) It is not necessary to select the shape of the steel frame cutting tool according to the application and the size of the steel frame cutting tool according to the object to be cut.
- (2) It is not necessary to select a base machine adapted to the hydraulic pressure and weight of the steel frame cutting tool according to the balance between the required oil volume and weight (or mass) of the machine body.
- (3) Do not take out the hydraulic source for the steel frame cutting tool from the hydraulic circuit of the base machine, and do not install the hydraulic circuit for the steel frame cutting tool through the hydraulic pump, boom, and arm.
- (4) Attach the steel frame cutting tool to the arm of the base machine with a pin and connect the steel frame cutting tool to the hydraulic circuit for the steel frame cutting tool on the arm with an oil hose.

■ Question No. 19 (General work method for steel frame cutting machines)

Choose one of the following four explanations about the general work method for steel frame cutting machines that is correct.

- (1) Warm up the hydraulic oil in the base machine and operate it once the oil temperature has risen slightly.
- (2) There is no need to follow the manufacturer's instruction manual for the proper range of oil temperature.
- (3) When you start using a new steel frame cutting tool, increase the engine rotation speed.
- (4) At the beginning of using a new steel frame cutting tool, reduce the cylinder opening and closing speed and perform running-in operation for about one minute.

■ Question No. 20 (Precautions after finishing work)

Choose one of the following four explanations about precautions after finishing work that is correct.

- (1) A base machine equipped with a steel frame cutting tool shall be parked on a hard, dry, and flat surface.
- (2) Do not wipe off mud or other dirt from the steel frame cutting tool.
- (3) When removing the steel frame cutting tool from the arm section, do so while the temperature of the hydraulic oil is as high as possible.
- (4) When attaching and detaching hydraulic hoses, it is acceptable that foreign matter enters the hydraulic oil.

■ Question No. 21 (Precautions after finishing work)

Choose one of the following four explanations about precautions after finishing work that is correct.

- (1) Store the removed steel frame cutting tool outdoors.
- (2) Remove mud and water adhered to the base machine.
- (3) Perform lubrication, etc. before the next operation.
- (4) Do not clean the hydraulic cylinder rod surface.

■ Question No. 22 (Characteristics of concrete crusher machines)

Choose one of the following four explanations about the characteristics of the demolition method using concrete crusher machines for concrete buildings that is correct.

- (1) They have a higher noise level compared to breaker.
- (2) They have a higher vibration level compared to breaker.
- (3) There is no advantage or disadvantage over breaker.
- (4) Compared with breaker, they generate less scattered fragments.

■ Question No. 23 (Name and function of each part of a concrete crusher)

Select the most incorrect of the following four explanations about the name and function of each part of a concrete crusher.

- (1) A concrete crusher (rough crusher) consists of a crusher arm.
- (2) A concrete crusher (rough crusher) consists of a cutter.
- (3) A concrete crusher (rough crusher) consists of a central frame.
- (4) A concrete crusher (rough crusher) consists of a swing bearing.

■ Question No. 24 (Types of concrete crushers)

Choose the one of the following four explanations of the types of concrete crushers that are correct.

- (1) Concrete crushers (rough crushers) are used to crush and cut concrete structures and buildings into concrete blocks large enough to be processed into small pieces.
- (2) Concrete crushers (rough crushers) do not have a slewing device.
- (3) Concrete crushers (fine crushers) should be used before rough crushers.
- (4) Concrete crushers (small breaker) cannot separate concrete from reinforcing steel.

■ Question No. 25 (Selection and installation of concrete crushers)

Choose one of the following four explanations for the selection and installation of concrete crushers that is correct.

- (1) Select the shape of the concrete crusher according to the application and the size of the crusher in accordance with the object to be crushed.
- (2) A fine crusher cuts concrete structures and buildings to a size that can be processed by the rough crusher.
- (3) A rough crusher separates reinforced concrete blocks cut out by a fine crusher into small pieces and separates them into reinforcing bars and concrete pieces.
- (4) The balance between the required amount of oil and the weight of the concrete crusher is irrelevant to the selection of the base machine.

■ Question No. 26 (General work method for concrete crushers)

Choose one of the following four explanations about the general work method for concrete crushers that is correct.

- (1) When working with a concrete crusher machine, it is not necessary to inject grease at the grease injection points of the crusher.
- (2) Work with caution in unstable areas where the base machine may fall over, such as on soft ground or concrete blocks.
- (3) Working longitudinally with respect to the crawlers (crawler straps) is more unstable than working laterally, and there is a higher risk of the machine lifting off the ground or falling over.
- (4) Do not pry (kojiru) during crushing work, as it may cause deformation of the crusher arm, breakage, burning or breaking of the pins, and breakage and damage to the base machine.

■ Question No. 27 (Precautions after finishing work)

Choose one of the following four explanations about precautions after finishing work that is correct.

- (1) To protect the opening and closing cylinder rods, place the concrete crusher on the ground in a stable position with the cutting arm extended.
- (2) It is not necessary to wipe off mud or other dirt from the concrete crusher.
- (3) When removing the concrete crusher from the arm of the machine, do so while the temperature of the hydraulic oil is as high as possible.
- (4) Do not allow foreign matter to enter the hydraulic oil when attaching or detaching hydraulic hoses.

■ Question No. 28 (Precautions after finishing work)

Choose one of the following four explanations about precautions after finishing work that is correct.

- (1) It is not necessary to cover the removed concrete crusher tool with a rainwater sheet even if it is stored outdoors.
- (2) Remove mud and water from the base machine.
- (3) Perform lubrication, etc. of the base machine before the next operation.
- (4) Water droplets and mud on the hydraulic cylinder rod surface must be left that way.

■ Question No. 29 (Characteristics of a gripper machine)

Choose one of the following four descriptions about the characteristics of a gripper machine that is correct.

- (1) Do not use a gripper machine for demolition of wooden houses or debris disposal work.
- (2) When dismantling an object, it causes a lot of noise and scattering of dismantled materials.
- (3) In debris disposal, the use of buckets is efficient for sorting and processing mixed materials of various masses, materials, and shapes.
- (4) It can easily grasp, classify, and load lightweight materials such as wood, long columns and steel frames, and soft materials such as fabrics.

■ Question No. 30 (Name and function of each part of the gripper tool)

Choose the most incorrect one of the following four explanations about the name and function of each part of the gripper tool.

- (1) A gripper tool consists of a grabbing arm, etc.
- (2) A gripper tool consists of a gripper link, etc.
- (3) A gripper tool consists of a central frame, etc.
- (4) A gripper tool consists of an upper frame, etc.

■ Question No. 31 (Selection and installation of gripper tools)

Choose one of the following four explanations for the selection and installation of gripper tools that is correct.

- (1) The internal cylinder-actuated gripper tool with a slewing device allows free adjustment of the gripping angle and delicate positioning by pivoting with the internal cylinder and hydraulic swivel.
- (2) The gripping angle cannot be adjusted by pivoting with the internal cylinder.
- (3) The external cylinder-operated type automatically adjusts the gripping angle.
- (4) There is no need for reinforcement in the combination of gripping tool and base machine.

■ Question No. 32 (Selection and installation of gripper tools)

Choose one of the following four explanations for the selection and installation of gripper tools that is correct.

- (1) The shape of the gripper tool according to the application is irrelevant to the size of the gripper according to the object to be grasped.
- (2) It is not necessary to select a hydraulic shovel suitable for hydraulic pressure and gripping capacity, depending on the balance between the required oil volume of the gripper tool and the gripping weight of the main body.
- (3) The hydraulic source for the gripper tool should be taken from the hydraulic circuit of the base machine, and the hydraulic circuit for the gripper should be installed through the hydraulic pump, boom and arm.
- (4) Depending on the base machine, it may not be necessary to install additional hydraulic valves or relief valves.

■ Question No. 33 (General work method for gripper machines)

Choose one of the following four explanations about the general work method for gripper machines that is correct.

- (1) When working with the gripper machine, it is not necessary to inject grease at the grease injection points of the gripping tool.
- (2) Work carefully in unstable areas where the base machine may tip over, such as on soft ground or concrete blocks.
- (3) Longitudinal work in relation to the crawlers (crawler straps) is more unstable than lateral work, and there is a higher risk of the machine lifting off the ground or falling over.
- (4) Do not pry (kojiru) during gripping work, as it may cause deformation or breakage of the gripper machine arm, burning of the pins, or damage to the base machine.

■ Question No. 34 (Precautions after work)

Select the correct answer out of the following four explanations regarding the precautions after the work.

- (1) The base machine with the gripper is parked on a hard, dry and slope.
- (2) Do not wipe off mud and so on adhering to the gripper.
- (3) Removing gripper from the arm of the base machine should be done while the temperature of the hydraulic oil is as high as possible.
- (4) Attaching or detaching the hydraulic hose should be careful not to let foreign materials into the hydraulic oil.

■ Question No. 35 (Removal of attachment)

Select the correct answer of the following four instructions about the attachment removal.

- (1) The work of attaching and detaching the attachment does not require the direction of the supervisor directly.
- (2) Attaching and detaching the attachment will be performed according to the procedure specified in the instruction manual of the dismantling machine.
- (3) It is not necessary to use safety columns, safety blocks, etc. so that the arms, booms, etc., do not descend.
- (4) Do not use a stand to prevent the attachment from collapsing.

■ Question No.36(Loading and unloading)

Select the correct answer of the following four explanations for loading and unloading.

- (1) Loading and transporting demolition construction machinery on a trailer or truck do not need to use a vehicle for transporting construction machinery.
- (2) Loading and unloading of construction machinery for dismantling to transport, it is not necessary to carry out under the direction of a designated supervisor.
- (3) As a general rule, the place for loading and unloading should be undulating and soft ground.
- (4) The climbing equipment (road board) applied to the loading platform of transportation vehicles uses the climbing equipment with claws to prevent the climbing equipment from coming off the loading platform due to the rotation of the crawler or tires.

■ Question No.37(Self-propelled transfer)

Select the correct answer of the following four explanations regarding self-propelled transfer.

- (1) When driving on a soft road, it is not necessary to be aware of the collapse of the road shoulder.
- (2) When passing through unmanned railroad crossings or narrow areas, it is not necessary to check on the safety.
- (3) When demolition construction machinery passes under railroad overhead lines, electric wires, bridge girders, etc. It is not necessary to check whether the separation distance is a sufficient that the tip of the boom does not touch.
- (4) If it is unavoidable to self-propelled transfer the demolition construction machine, it must comply with relevant laws and regulations such as the Road Traffic Law, Road Transport Vehicle Law, and Vehicle Restriction Ordinance.

Chapter 5. Inspection and maintenance of construction machinery for demolition

■ Question No.38(General precautions for inspection and maintenance)

Select the correct answer of the following four explanations regarding general precautions for inspection and maintenance.

- (1) Before performing on-site inspection and maintenance, the demolition construction machine will be stopped in a rugged place.
- (2) Always apply brakes, safety lock, and each operating device of the demolition construction machine.
- (3) Repair of demolition construction machinery is not necessary to perform under the direction of the supervisor.
- (4) There is no need to prohibit anyone excepting involved participants from entering the work area for inspection and maintenance.

■ Question No.39(Before starting the engine)

Select the correct answer of the following four explanations about before starting the engine.

- (1) Walk around the base machine and inspect whether there are no water or oil leaks on the ground and no leaks from the pipes.
- (2) Open the radiator cap and check whether the water is empty or not.
- (3) Refuel before the end of the work and drain the fuel tank after the work.
- (4) Tire pressure will be measured when the tires are hot after work.

■ Question No.40(After starting the engine)

Select the correct answer of the following four explanations about after starting the engine.

- (1) After starting the engine, let it idle sufficiently and inspect the operation of each instrument and the monitoring system condition.
- (2) If there is no water or oil leak when the engine is stopped, it will not leak when the engine is started.
- (3) When changing the rotation speed with low idling, high idling, full stall, at that time, it is not necessary to check whether there are no abnormalities in the exhaust color, engine noise, exhaust odor and vibration.
- (4) There is no need to check on attachment, arms, booms, etc., if it can move smoothly.

■ Question No.41(After work is completed)

Select the correct answer of the following four explanations about after work.

- (1) If there is mud or oil on the board, pedals, levers, etc. It will be slippery, so wipe it off well.
- (2) Refuel without stopping the engine.
- (3) The parking place where is a flat place might be a risk of falling rocks, flooding, landslides, etc.
- (4) In case of outdoors, there is no need to cover the machine with a sheet.

Chapter 6. Matters related to the demolition work.

■ Question No.42(Precautions for safe driving)

Select the correct answer of the following four explanations regarding the safe driving.

- (1) The driver does not need to wear a protective hat or safety equipment.
- (2) The driver does not need to fasten his seat belt.
- (3) The driver carries a copy of the certificate when driving.
- (4) Always carry out a pre-work inspection and confirm whether there are no abnormalities.

■ Question No.43(Signals and guidance)

Select the correct answer of the following four explanations regarding signals and guidance.

- (1) When operating the dismantling machine, in principle, it does not have to be performed by the signal or guidance from a signaler or guide.
- (2) Before the work, the driver does not to sufficiently discuss with the signaler or guide about the other construction machine position, the participant position, the dangerous place, and the signal method.
- (3) There is not a specific person assigned by the person in charge as the signaler or guide, it is not necessary to drive with the signal or guidance of that person.
- (4) The guide should wear clothes and perform at positions that can be easily seen and confirmed by the driver or the operator.

Chapter 7. Knowledge of mechanics and electricity

■ Question No.44(Moment of force)

Select the correct answer of the following four explanations regarding the moment of force.

- (1) When breaking a rock in a tunnel with a breaker, there is a moment that works to overturn the breaker.
- (2) When grasping an object such as concrete debris (gara), there is a moment that acts to overturn the machine.
- (3) When grabbing an object that is close to the machine, the moment that acts to overturn the machine increases, increasing the risk of the machine falling.
- (4) Depending on the angle of the boom, the specific dismantling machine becomes less stable and might tip over.

■ Question No.45(Center of gravity)

Select the correct answer of the following four explanations regarding the center of gravity.

- (1) When an object is divided into small pieces, gravity does not act on each of the divided parts.
- (2) It can be seen that many parallel forces (gravity) are acting on the object. When the resultant force of these forces is calculated, it is equal to the gravity acting on the object. It is the mass of the object.
- (3) The center of gravity is a fluctuating point for a certain object, and the center of gravity also changes when the position or placement of the object changes.
- (4) When the motion of an object (excluding the rotational force of the object itself) is treated mechanically, it cannot be considered that the total mass of the object is concentrated in the center of gravity.

■ Question No.46(Inertia)

Select the correct answer of the following four instructions regarding the inertia.

- (1) As a rule, the driver might start suddenly or stop suddenly, but If the driver starts suddenly, the driver will be pulled forward, and if the driver stops suddenly, the driver will likely fall backward.
- (2) Unless an external force acts on the object. When moving, there is the property that trying to continue moving. It is called as rigidity.
- (3) To change the direction of movement direction and the moving object speed, external force is required, the greater change in speed, and the heavier object, the force required will increase.
- (4) Inertial force acts on the dismantling machine during running, and the inertial force increases as the speed increases, and the inertial force increases in proportion to the cube of the speed.

■ Question No.47(Centrifugal force and centripetal force)

Select the correct answer of the following four instructions for centrifugal force and centripetal force

- (1) If you hold the end of the string having the weight and move it circularly, the hand will be pulled in the direction opposite to the direction of the weight.
- (2) As you turn the weight faster, you will feel your hand pulled weaker.
- (3) The force that makes an object move circularly is called as the centrifugal force, and the force that has the same force magnitude and is in the opposite direction is called as the centripetal force.
- (4) When descending a slope with a dismantling machine, if the steering is suddenly turned off, centrifugal force acts on the center of gravity, this will cause the machine to be pulled strongly outward, and increase in the risk of falling.

■ Question No.48(Friction)

Select the most inappropriate sentence among the following four instructions regarding friction.

- (1) When objects contact with other object, the resistance is called as frictional force.
- (2) If you place the object on the floor or board and try to move it by pushing or pulling it, it doesn't move even if you push it with a force below a certain limit. If you push it with a force exceeding a certain limit, it will start to move.
- (3) The frictional force is related to the normal force and the contact surface, but it is not related to the size of the contact surface.
- (4) When driving, the brakes are easier to apply than when vehicle is stopping.

■ Question No.49(Battery handling)

Select the correct answer of the following four instructions for battery handling.

- (1) There's no need to always keep it clean and dusty
- (2) Distilled water might be added too much.
- (3) Stop unreasonable discharge
- (4) It can be handled roughly.

■ Question No.50(Battery handling)

Select the correct answer of the following four instructions for battery handling.

- (1) There is no need to retighten the terminal from time to time to avoid lose connection.
- (2) Be careful not to short-circuit with a spanner, etc.
- (3) Measure the specific gravity and charge immediately when it reaches 1.22 or higher.
- (4) There is no need to measure the voltage with a battery tester.

Chapter 8. Structure type and demolition method

■ Question No.51(Reinforced concrete structure (tekkinkonkuritokouzou) (RC structure (RC zou))

Select the correct answer of the following four instructions regarding the Reinforced concrete structure (tekkinkonkuritokouzou) (RC structure (RC zou))

- (1) Since it is nonflammable, it is not possible to build fireproof buildings.
- (2) The degree of freedom regarding the shape of the structure is low.
- (3) As the alkalinity of cement does not prevent rusting of reinforcing bars, the life of buildings is short.
- (4) When concrete shrinks and cracks, reinforcing bars corrode and the strength of the components decreases.

■ Question No.52(Demolition method for wooden buildings, etc.)

Select the correct answer of the following four instructions regarding the demolition method for wooden buildings, etc.

- (1) The manual method is not suitable for the material separation work.
- (2) Construction using only the mechanical work method makes it difficult to recycle the generated by-products, but in principle it is not prohibited by the Law Concerning the Recycling of Materials Related to Construction Work (Construction Recycling Law).
- (3) Normal dismantling work is performed by either the manual method or the mechanical method.
- (4) Dismantling foundation concrete with a gripping tool is not used for other purposes, so it uses a crushing tool.

■ Question No.53(Road pavement demolition method)

Select the most inappropriate sentence among the following four explanations regarding the road pavement demolition method.

- (1) A large breaker method or a hand breaker method is used to demolish the surface and the base layer of the road.
- (2) Do not use crushers for pavement demolition.
- (3) The concrete pavement demolition method includes a large breaker method, a hand breaker method, a cutter method, and a core drill method.
- (4) There is no established method for dismantling brick pavement, but there are large breaker methods and hand breaker methods.

Chapter 9. Related laws and regulations

■ Question No.54(Regular self-inspection)

Select the correct answer of the following four explanations about the regular self-inspection.

- (1) The business operator regularly conducts self-inspection of vehicle-based construction machinery in accordance with the Ordinance of the Ministry of Health, Labor and Welfare, and records the results.
- (2) The business operator regularly conducts self-inspection of vehicle-type construction machinery in accordance with the Ordinance of the Ministry of Education, Culture, Sports, Science and Technology, and records the results.
- (3) The business operator does not need to regularly carry out self-inspection of vehicle-type construction machinery and record the results, as provided for by the Ordinance of the Ministry of Health, Labor and Welfare.
- (4) The Minister of Health, Labor and Welfare will not publish the self-inspection guidelines necessary for the proper and effective implementation of self-inspection.

■ Question No.55(Reissuance of skill training completion certificate, etc.)

Select the correct answer of the following four explanations regarding the reissuance of skill training completion certificate, etc.

- (1) Skill training certificate cannot be reissued.
- (2) If the skill training certificate is lost or damaged, it can be reissued by submitting the application for reissuance of the skill training certificate to the registered training institution that received the skill training certificate.
- (3) If the skill training certificate is lost or damaged, it can be reissued by submitting the application for reissuance of the skill training certificate to the Ministry of Health, Labor and Welfare.
- (4) When the name is changed, the skill training certificate cannot be rewritten.

■ Question No.56(Installation of headlights)

Select the correct answer of the following four explanations for installation of headlights.

- (1) Vehicle-type construction equipment does not need to be equipped with headlights.
- (2) Headlights must also be provided for vehicle-type construction equipment used in locations where the required illuminance for safe work is maintained.
- (3) It is not necessary to equip headlights for vehicle type construction machines used in places where the illuminance required for safe work is not maintained.
- (4) Headlights do not have to be provided for vehicle-type construction machinery used in places where the illuminance required for safe work is maintained.

■ Question No.57(Speed limit)

Select the correct answer of the following four explanations regarding the speed limit.

- (1) When working with Vehicle-type construction machine (excluding those with a maximum speed of 10 kilometers per hour or less), it is necessary to set a speed limit in advance.
- (2) When working with Vehicle-type construction machine (excluding those with a maximum speed of 10 km per hour or less), it is not necessary to set a speed limit in advance.
- (3) The driver of the Vehicle-type construction machine can drive the Vehicle-type construction machine beyond the speed limit in a wide area.
- (4) When working with Vehicle-type construction machine (excluding those with a maximum speed of 30 km per hour or less), it is necessary to set a speed limit in advance.

■ Question No.58(Prevention of falls, etc.)

Select the correct answer of the following four explanations regarding the prevention of falls, etc.

- (1) When working with Vehicle-type construction machine, there is no need to take necessary measures to prevent the risk of workers due to the Vehicle-type construction machine falling or tipping over
- (2) When working with a Vehicle-type construction machine on a shoulder, slope, etc., it is not necessary to assign a guide even when there is a risk that the worker may be in danger due to the Vehicle-type construction machine falling or tipping over
- (3) The driver of a Vehicle-type construction machine must follow the guidance provided by the guide.
- (4) The driver of a Vehicle-type construction machine does not have to follow the guidance given by the guide.

■ Question No.59(Transfer of Vehicle-type construction machine)

Select the correct answer of the following four explanations regarding the transfer of Vehicle-type construction machine.

- (1) If loading and unloading a motor-lorry to transfer Vehicle-type construction machine, uses road boards, embankments (morido), etc., the loading and unloading must be done in a flat and solid place.
- (2) When loading and unloading Vehicle-type construction machine to a motor-lorry uses road boards, embankments (morido), etc., it is not necessary to carry out loading and unloading in a flat and solid place.
- (3) When using a board, it is not necessary to use a road board with sufficient length, width and strength.
- (4) When using embankment (morido), temporary stand, etc. It is not necessary to ensure sufficient width and strength as well a moderate slope.

■ Question No.60(Measures the lender must take, such as machinery)

Select the correct answer of the following four explanations regarding measures the lender has to take, such as machinery.

- (1) When lending to another business operator, the machine lender does not need to inspect the machine, etc., in advance.
- (2) When lending to another business operator, the machine lender must inspect the machine, etc., in advance. If any abnormality is found, it is necessary to carry out repairs and other necessary maintenance.
- (3) When lending to another business operator, the machine lender does not need to deliver a document stating the capabilities of the machine, etc., to the business operator receiving the loan.
- (4) When lending to another business operator, the machine lender does not need to deliver a document that describes the machine characteristics and other precautions for using it to the business operator receiving the loan.

Correct answer

Chapter 1. Basic Knowledge about vehicle-type construction machinery

- Question No. 1 (Types and applications (characteristics) of demolition machines, etc.) : (4)
- Question No. 2 (Terms related to vehicle type construction machines) : (4)

Chapter 2. Prime mover and hydraulic system of vehicle type construction machines

- Question No. 3 (Prime mover) : (2)
- Question No. 4 (Fuel and engine oil) : (4)
- Question No. 5 (Hydraulic system) : (2)

Chapter 3. Structure related to the running of demolition machines.

- Question No. 6 (Undercarriage system) : (1)
- Question No. 7 (Safety devices for demolition machinery) : (2)

Chapter 4. Handling of equipment regarding operation with demolition attachments, etc.

■ Question No. 8 (Selection and installation of breakers)	(4)
■ Question No. 9 (Characteristics of breaker)	(1)
■ Question No. 10 (Types of breaker)	(1)
■ Question No. 11 (Operation of breaker, etc.)	(2)
■ Question No. 12 (General working method of breaker)	(1)
■ Question No. 13 (Precautions after finishing work)	(4)
■ Question No. 14 (Precautions after finishing work)	(2)
■ Question No. 15 (Characteristics of steel frame cutting machines)	(3)
■ Question No. 16 (Name and function of each part of the steel frame cutting tool)	(4)
■ Question No. 17 (Types of steel frame cutting tools)	(1)
■ Question No. 18 (Selection and Installation of a steel frame cutting machines)	(4)
■ Question No. 19 (General work method for steel frame cutting machines)	(1)
■ Question No. 20 (Precautions after finishing work)	(1)
■ Question No. 21 (Precautions after finishing work))	(2)
■ Question No. 22 (Characteristics of concrete crusher machines)	(4)
■ Question No. 23 (Name and function of each part of a concrete crusher)	(3)
■ Question No. 24 (Types of concrete crushers)	(1)
■ Question No. 25 (Selection and installation of concrete crushers)	(1)
■ Question No. 26 (General work method for concrete crushers)	(4)
■ Question No. 27 (Precautions after finishing work)	(1)
■ Question No. 28 (Precautions after finishing work)	(2)
■ Question No. 29 (Characteristics of a gripper machine)	(4)
■ Question No. 30 (Name and function of each part of the gripper tool)	(3)
■ Question No. 31 (Selection and installation of gripper tools)	(1)
■ Question No. 32 (Selection and installation of gripper tools)	(3)
■ Question No. 33 (General work method for gripper machines)	(4)
■ Question No. 34 (Precautions after work)	(4)
■ Question No. 35 (Removal of attachment)	(2)
■ Question No. 36 (Loading and unloading)	(4)
■ Question No. 37 (Self-propelled transfer)	(4)

Chapter 5. Inspection and maintenance of construction machinery for demolition

- Question No.38 (General precautions for inspection and maintenance) : (2)
- Question No.39 (Before starting the engine) : (1)
- Question No.40 (After starting the engine) : (1)
- Question No.41 (After work is completed) : (1)

Chapter 6. Matters related to the demolition work.

- Question No.42 (Precautions for safe driving) : (4)
- Question No.43 (Signals and guidance) : (4)

Chapter 7. Knowledge of mechanics and electricity

- Question No.44 (Moment of force) : (3)
- Question No.45 (Center of gravity) : (2)
- Question No.46 (Inertia) : (3)
- Question No.47 (Centrifugal force and centripetal force) : (4)
- Question No.48 (Friction) : (4)
- Question No.49 (Battery handling) : (3)
- Question No.50 (Battery handling) : (2)

Chapter 8. Structure type and demolition method

- Question No.51 (Reinforced concrete structure (tekkinkonkuritokouzou) (RC structure (RC zou)) : (4)
- Question No.52 (Demolition method for wooden buildings, etc.) : (4)
- Question No.53 (Road pavement demolition method) : (2)

Chapter 9. Related laws and regulations

- Question No.54 (Regular self-inspection) : (1)
- Question No.55 (Reissuance of skill training completion certificate, etc.) : (2)
- Question No.56 (Installation of headlights) : (4)
- Question No.57 (Speed limit) : (1)
- Question No.58 (Prevention of falls, etc.) : (3)
- Question No.59 (Transfer of Vehicle-type construction machine) : (1)
- Question No.60 (Measures the lender must take, such as machinery) : (2)