外国人労働者に対する安全衛生教育教材作成事業（建設業）

“Tunnel propulsion and Construction Machinery and Earthwork” The important points for Safety and health

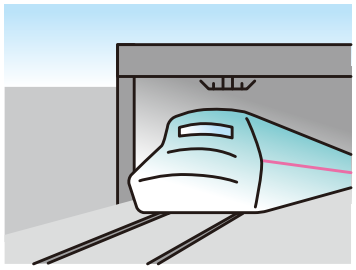
Safety of a tunnel propulsion work (Tunneling work)

The tunnel propulsion work is to build tunnels and shafts required for tunnel construction.

(1) Tunnel types and construction methods

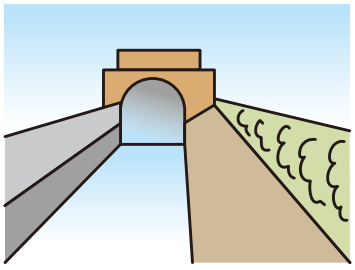
1. Tunnel type

Tunnels are used for railways, roads, waterways, and other infrastructures. There are various sizes of tunnels, from large ones that trains and cars to pass through to small pipes that electric wires to pass through.

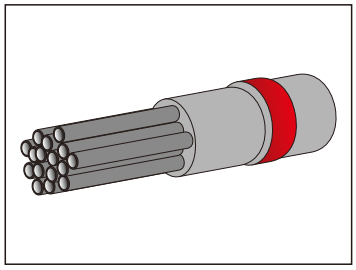


Railway tunnel

Road tunnel



Aqueduct tunnel

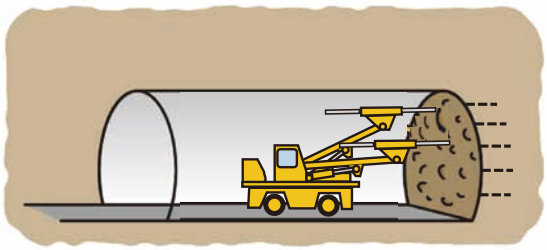


Conduit tube

2. Construction methods of tunnel

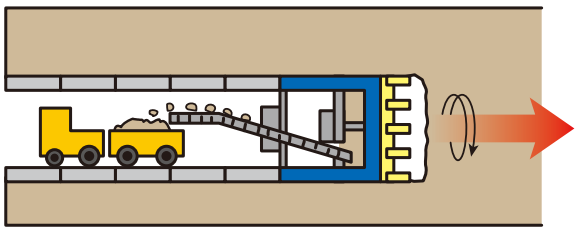
Mountain tunneling method

After excavating with blasting or a machinery, installing supports on the excavated surface, wind up concrete to build a tunnel.



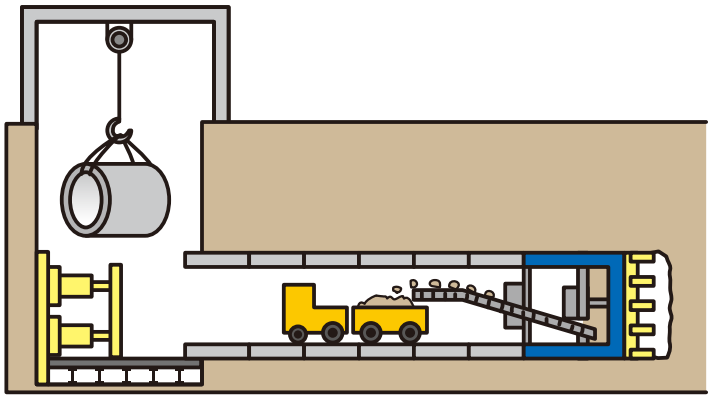
Shield method

Excavation is performed with a dedicated excavator, and a segment assembly tunnel is built at the rear of an excavator. Depending on the conditions, the concrete is wound inside the segment.



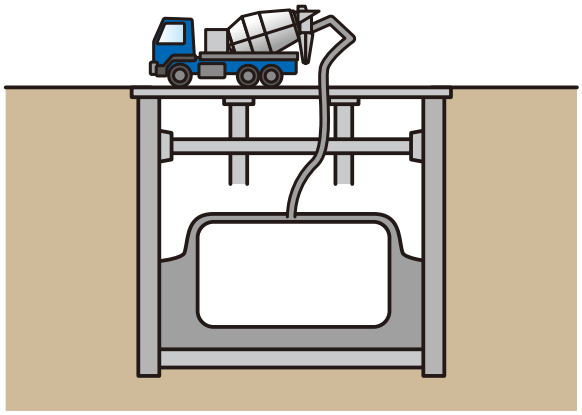
Method of propulsion

For the tunnel, pipes pre-fabricated at the factory are used. While excavating with an excavator, the pipe connected to the excavator is pushed into the ground with jacks installed in the vertical shaft.



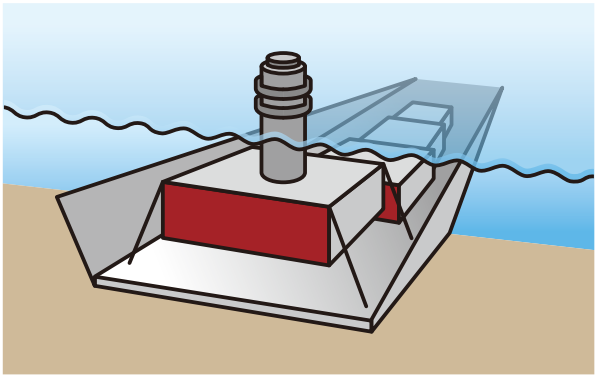
Open-cut method

Excavating from the ground while reinforcing with earth retaining supports. Build a tunnel in the excavated space. After the tunnel is built, the portion other than the tunnel are backfilled.



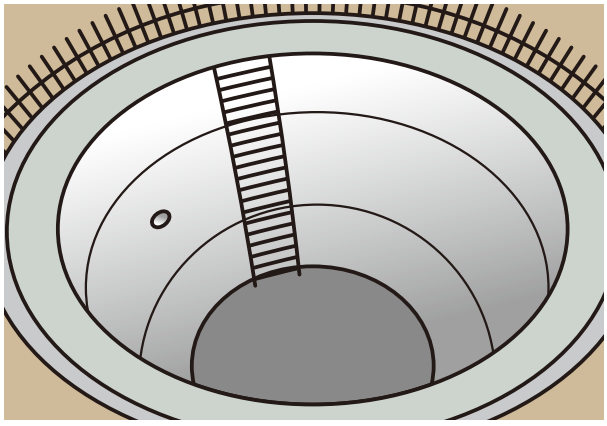
Immersed tunneling method

Carry the tunnels pre-fabricated in advance by ship, and sink them to the bottom of the sea or river and join them together.



3. Tunnel accessories

A vertical shaft is built as a liaison between the tunnel base and the ground part during construction. After the construction, it is used for various purposes such a basement and a ventilation tower.



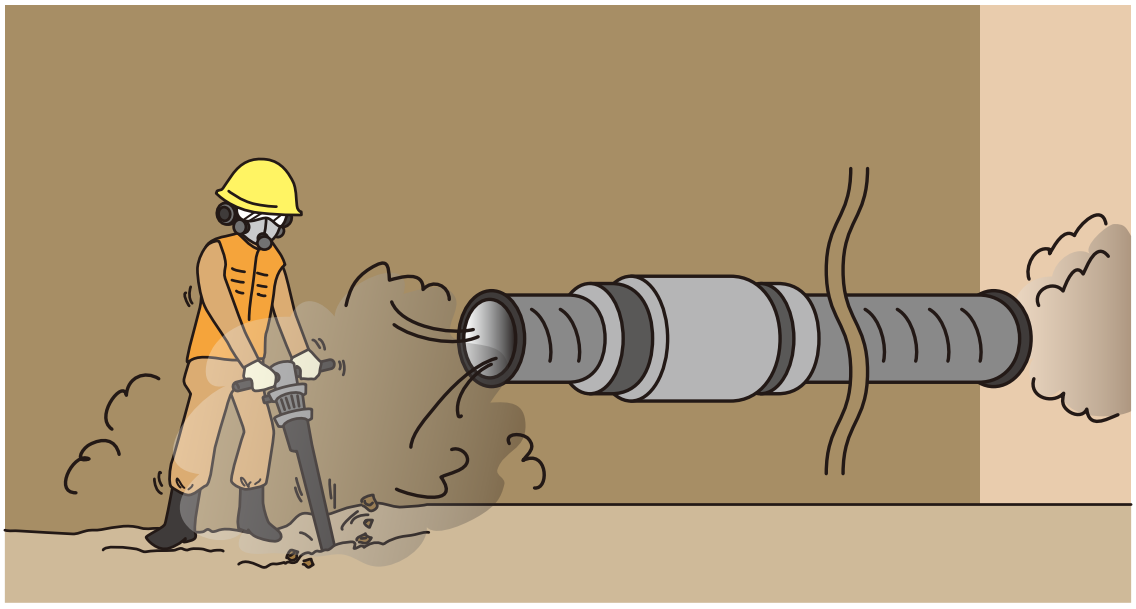
(2) Safety in dust works

1. Dust is produced under following occasions:

- Drilling of rock or concrete
- Inside the underground mining after blasting
- Loading of crushed earth and sand
- Shotcrete work
- Dust by passing cars and cleaning of dust that accumulated in an underground mining

2. Measures to eliminate dust

Ventilation is carried out using a dust collector. In order to prevent divergence, water spray and restricting running speed of vehicles are applied.

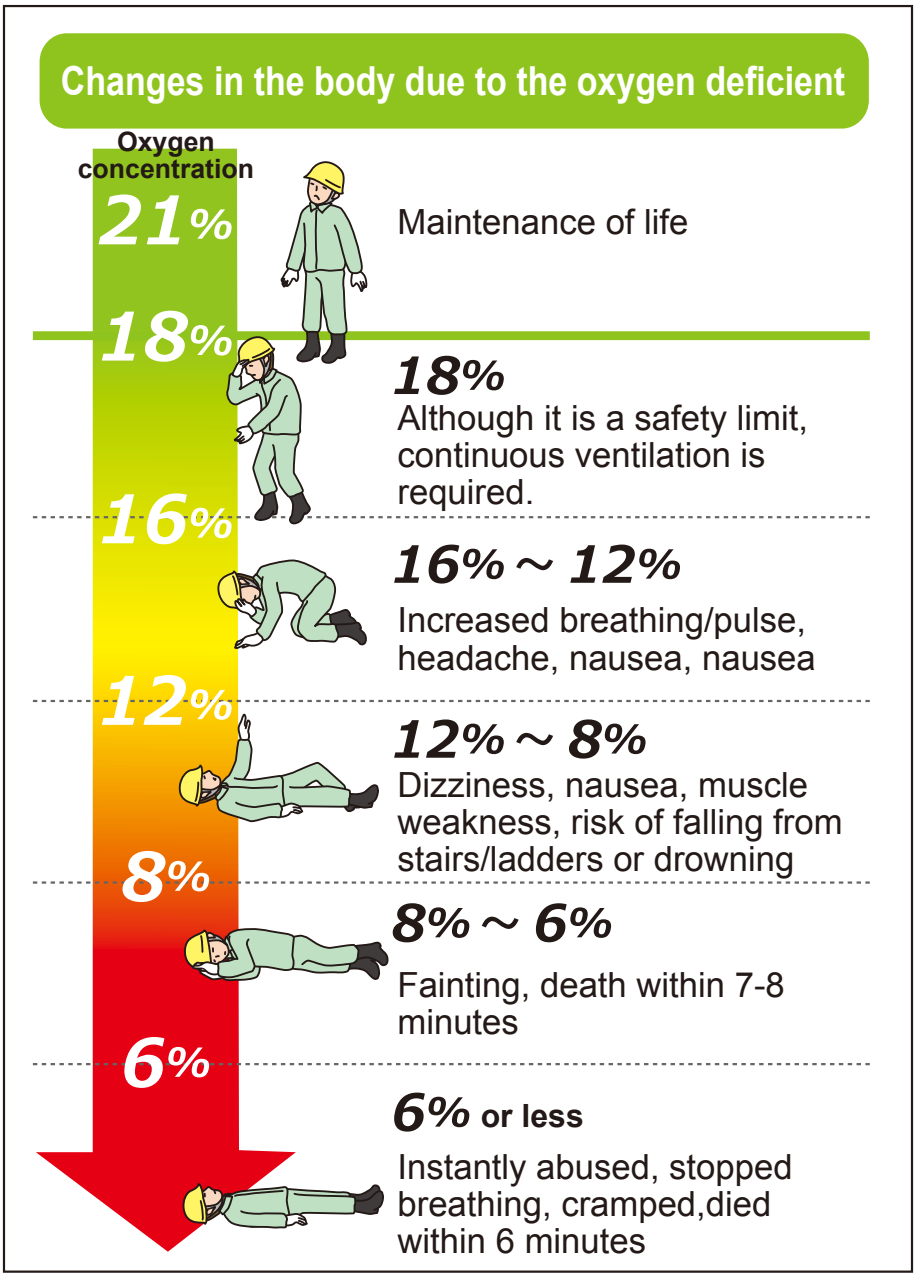


3. Respiratory protective equipment

A dust mask must be worn when working in the dust atmosphere.
In particular, it is used for underground excavation works such as excavations by using power, works at places where loading and unloading are carried out, and works where concrete is sprayed.

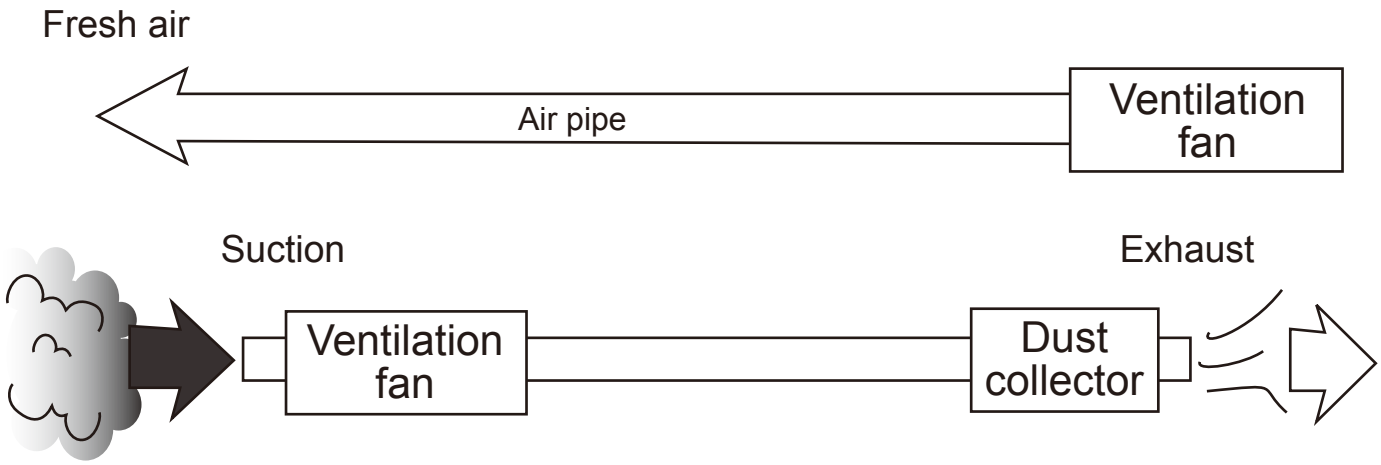
(3) Measures for lack of oxygen/toxic gas

IIn a tunnel construction site, caution is required for oxygen deficient and generation of toxic gas. Carbon monoxide and carbon dioxide are colorless and odorless. In the unlikely event that you go to rescue a colleague without protective equipment, a secondary damage may occur. Also, flammable gas can explode.



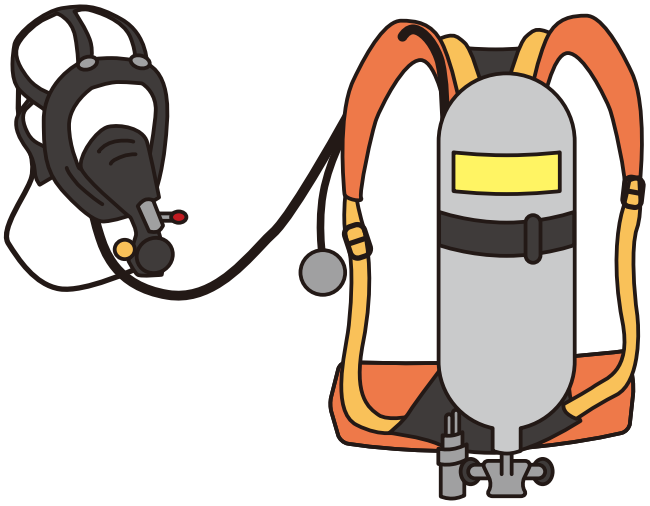
1. Measures for lack of oxygen/toxic gas

In a construction site, ventilation is carried out by sucking contaminated air such as toxic gas generated and sending fresh air.



2. Aerial respiration device

An aerial respiration device is a respiratory protective equipment that compresses air in the atmosphere and fills in an air tank. Let’s learn how to use an aerial respiration device in case of evacuation or rescue.



(4) Safety in noise and vibration work

When using hand-held vibration tools, safety measures for vibration and noise are required.

1. For the following situations

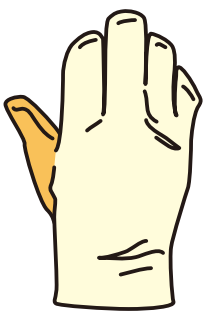
Works using vibration tools include crushing rock or concrete, or excavating the ground manually with vibration tools.

2. Work hours

Work hours with a vibration tool is generally two hours a day.

3. Wearing of the protective equipment

To reduce the risk of noise exposure, use soundproofing equipment such as earmuffs and earplugs. Use anti-vibration gloves to reduce the risk of vibration exposure. Ear muffs and gloves are consumables and should be replaced regularly.



(5) Operation at the cutting edge

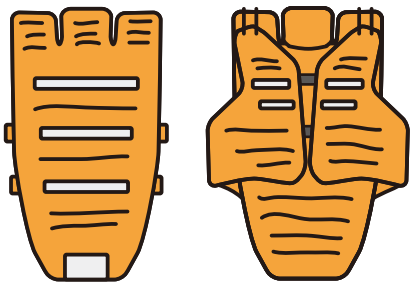
Since the ground is exposed at the tunnel heading face of a mountain tunnel construction (face), there is a risk of falling rock (spalling).

1. The watcher in charge of monitoring the excavated tunnel heading face to predict the fall of rocks.

Take action to evacuate from the tunnel heading face immediately if there is a risk of being damaged by the fall of rocks.

2. Wearing of protective equipment

The workers at the tunnel heading face wear protective caps, protective equipment (back protector, etc.), safety shoes (boots), and the respiratory protective equipment with an electric fan if necessary.



Back protector
[Example of the protective tool for the tunnel heading face]

(6) Evacuation and the fire fighting drill

- The work inside the tunnel is a work in a deep and narrow space (in the hole). For this reason, safety considerations are very important because it is far from an evacuation site and the exit from the tunnel pit, and it takes time for a rescue operation in the event of an accident.
- It is important to know the evacuation method, the evacuation areas, use of evacuation tools, and the fire extinguishing method in the preparation for rock falling, flood, gas explosion, and fire.