Conduit Inner Surface Inspection and Repairing Works

Sewer Pipeline Inner Surface Inspection

1. House Connection Inspection
2. Main Pipe Inspection

(1) Visual Inspection

(Pipe with a Diameter of 800mm or larger)

(2) Remote Video Camera Inspection

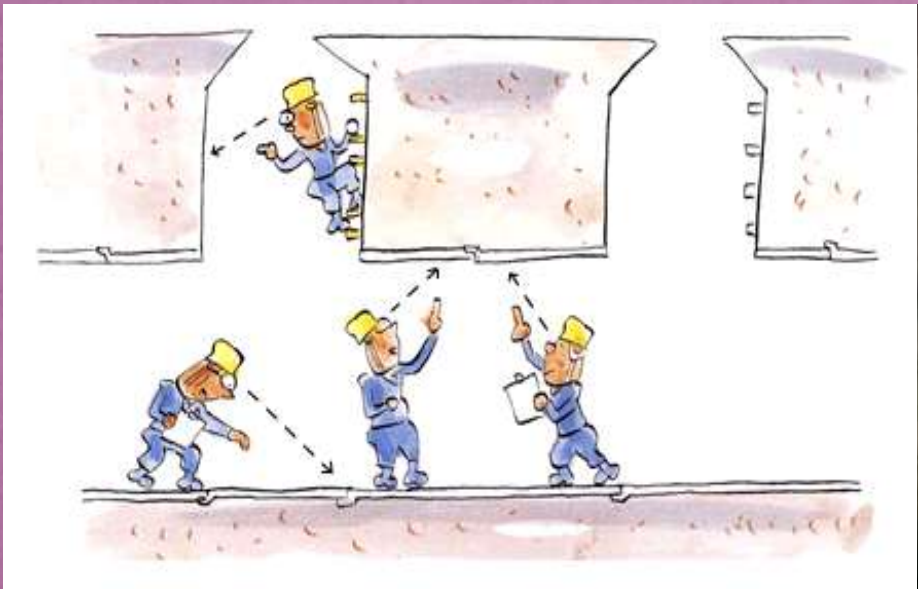
(Pipe with a Diameter of smaller than 800mm)

House Connection Inspection
(with potable video camera)

Inspection of pipe with a diameter of 150mm-200mm through video camera inserted from house inlet to see any damage and deterioration of pipe.

Main Pipe Inspection
(Visual Inspection)

Inspection of main pipe with a diameter of 800mm or larger by human eyes to see any defect in manhole wall joint, damage on pipe, disconnection of pipes, piling of sludge, etc.



Source: Kansei Kogyo Website

Main Pipe Inspection
(Visual Inspection)

【Safety measures】

(1) Measurement of gas concentration

- Oxygen (more than 18%)
- Hydrogen sulfide (less than 10ppm)
- No flammable gas, no carbon monoxide

Gas detector

Main Pipe Inspection
(Visual Inspection)

【Safety measures】
(2) Forced ventilation by air blower

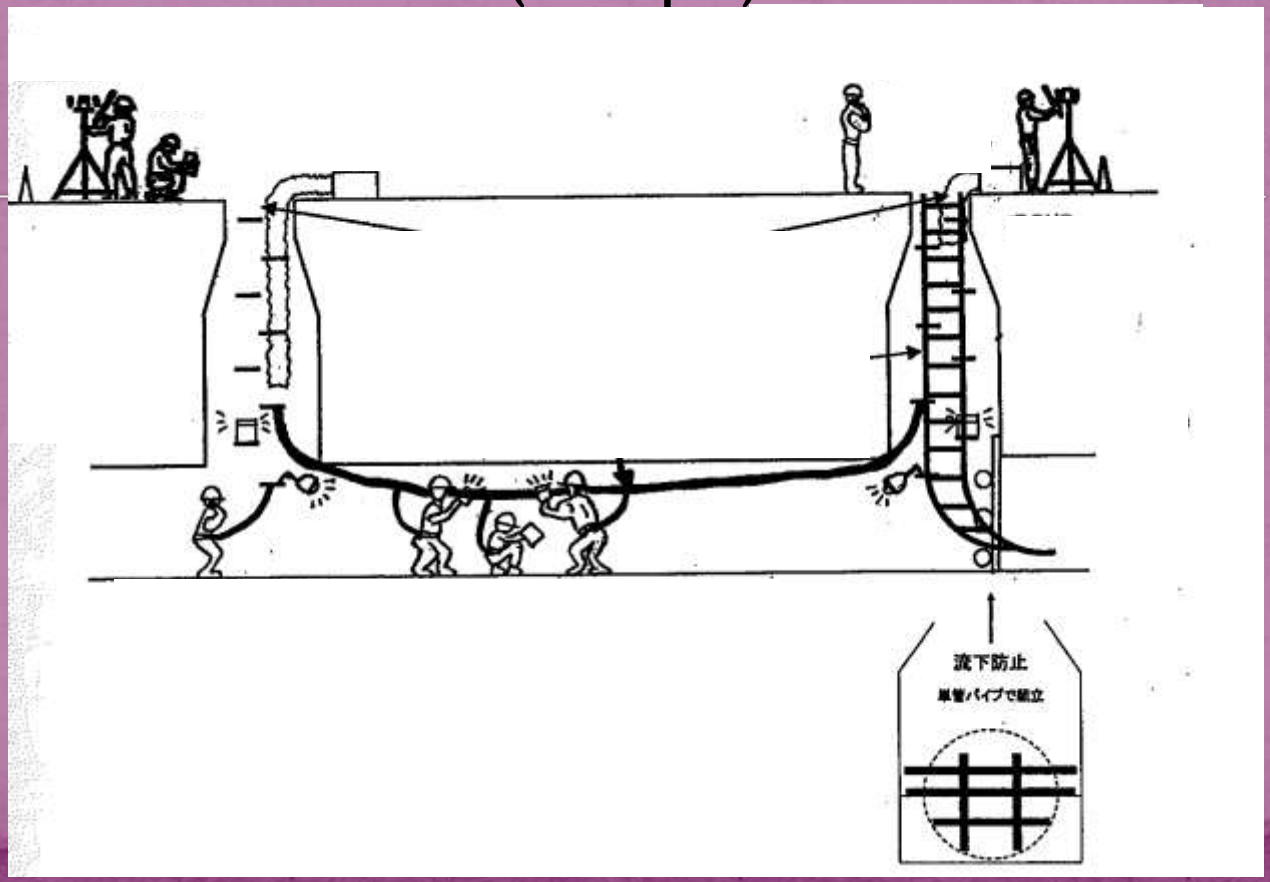
Main Pipe Inspection

(Visual Inspection)

Visual inspection of pipe with a diameter of 800mm or larger

【Safety measures】

(3) Prevention of human loss (example)

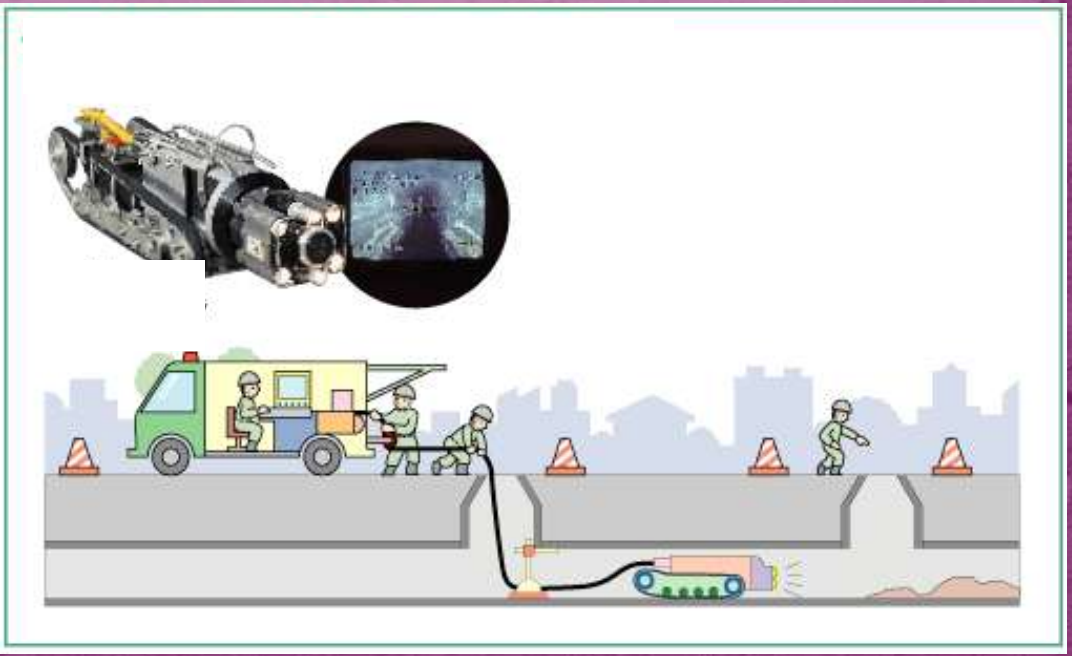


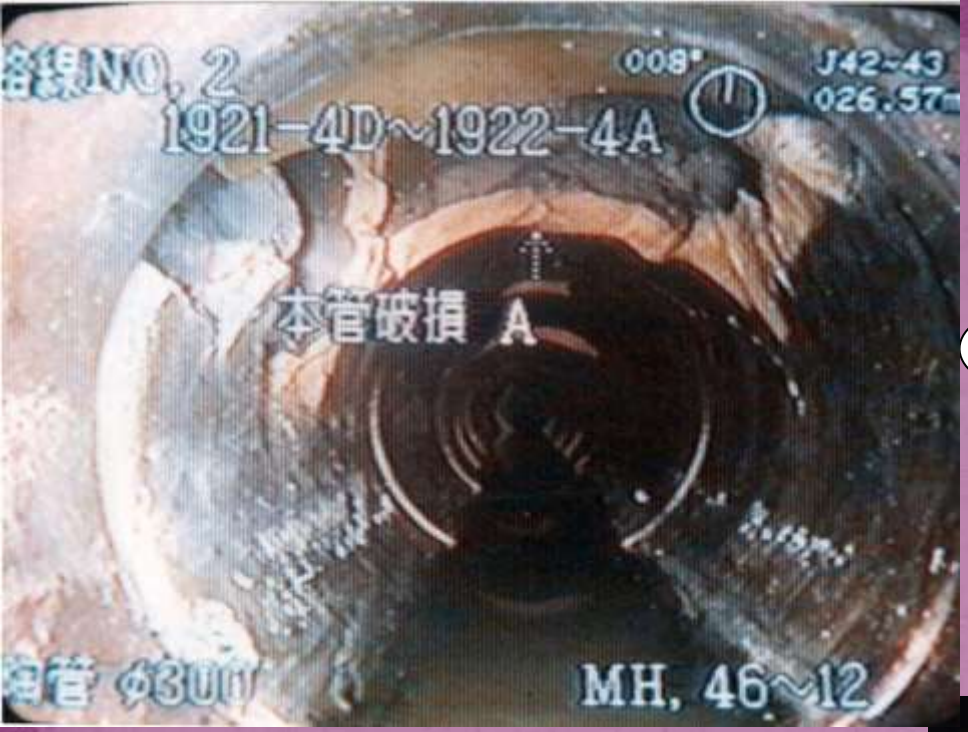
Main Pipe Inspection
(Video Camera Inspection)

Inspection through video camera inserted and moved from upper to down stream at a steady pace to see any damage or deterioration of pipe.

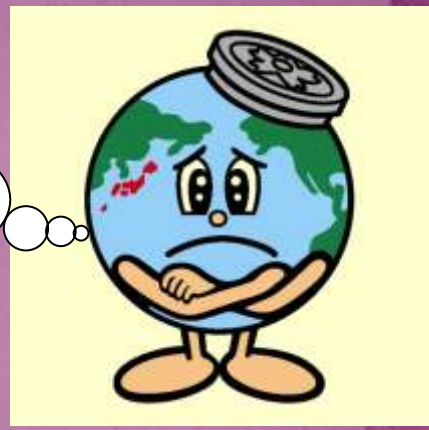
(1) Self-propelled type (as shown below)
(2) Traction type (pulled by winch)

Self-propelled type is popular, but traction type is also used to overcome mortar-like obstacles.

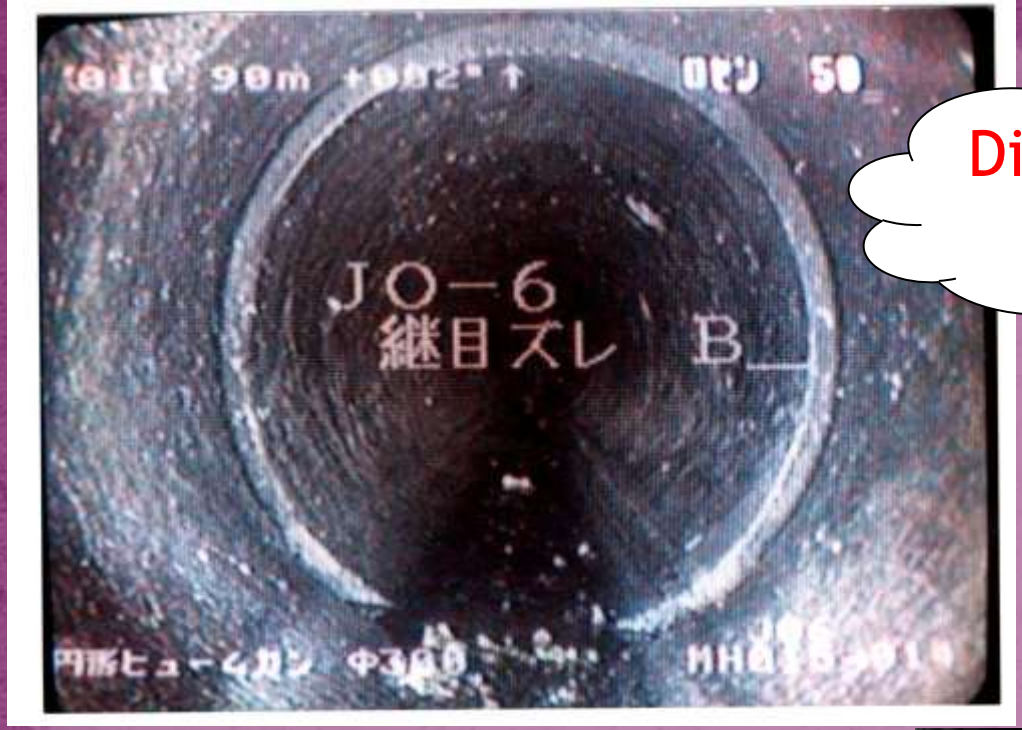




Broken pipe

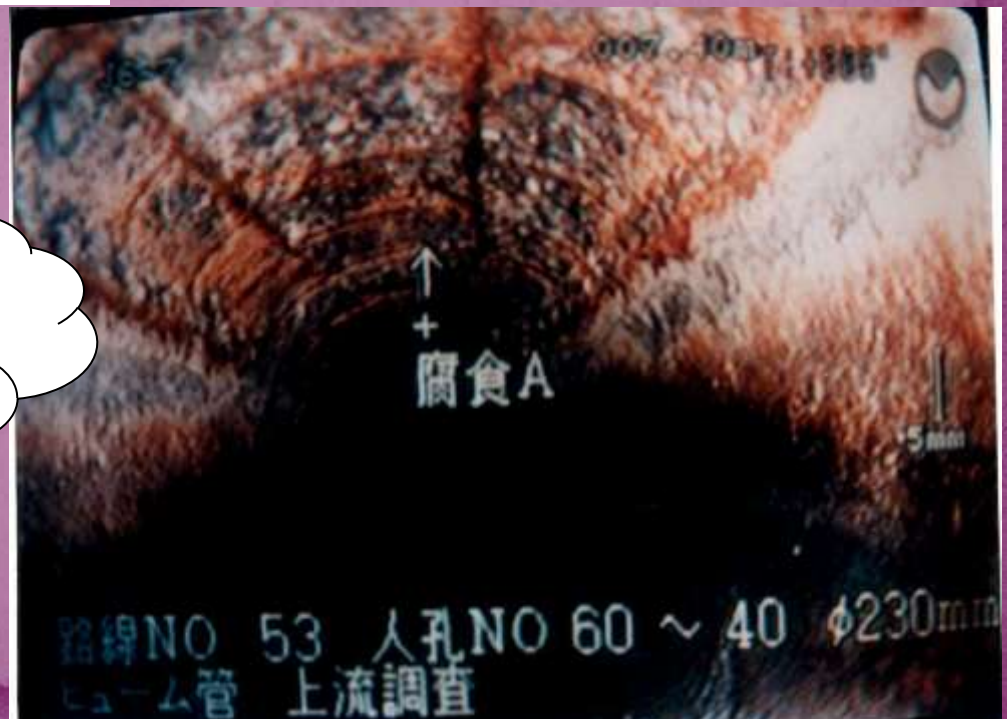


Cracked pipe



Disconnected Pipe

Corroded Pipe



Inspection through Video Camera by the Bureau of Sewerage, TMG

1. Omnidirectional Video Camera System
2. Conduit Inner Surface Image Unrolling System
3. Conduit Inspection and Diagnosis Supporting System

Inspection through Video Camera by the Bureau of Sewerage, TMG

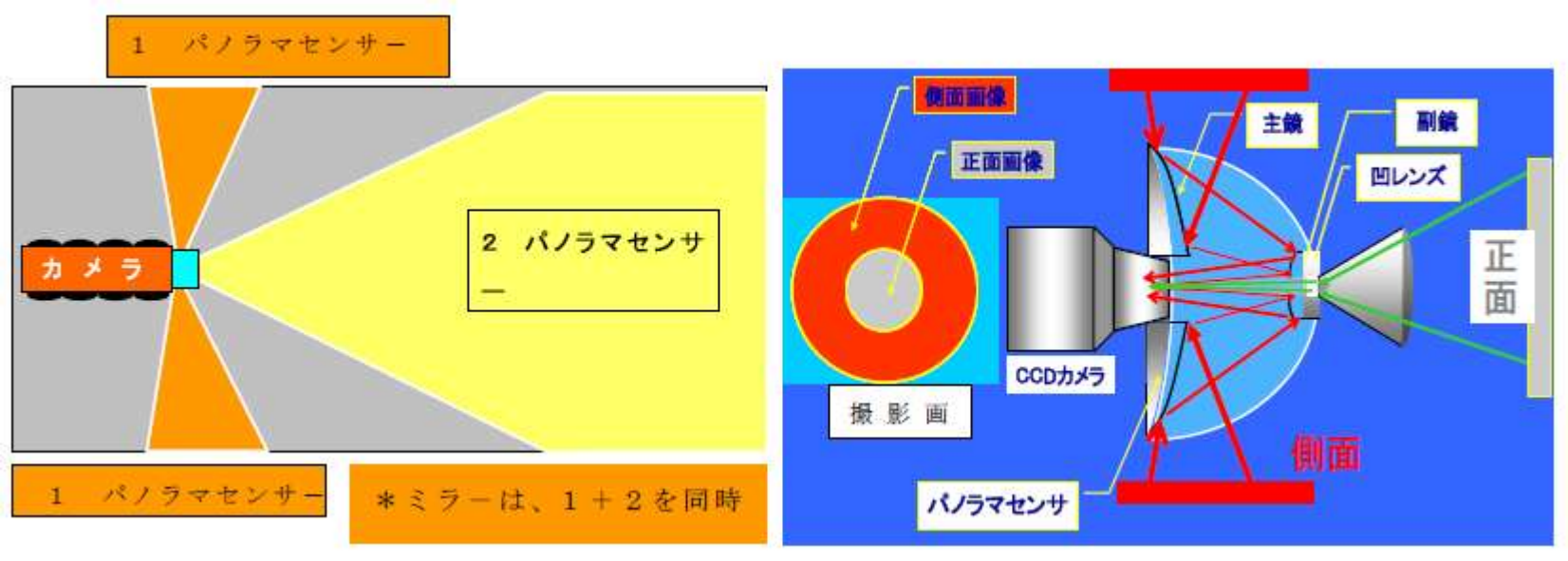
Inspection by omnidirectional video camera was partially introduced through public tender in FY2009 and has been fully practiced since FY2010 to achieve efficient operation and maintenance of conduit systems.

Omnidirectional video camera

Inspection through Video Camera by the Bureau of Sewerage, TMG

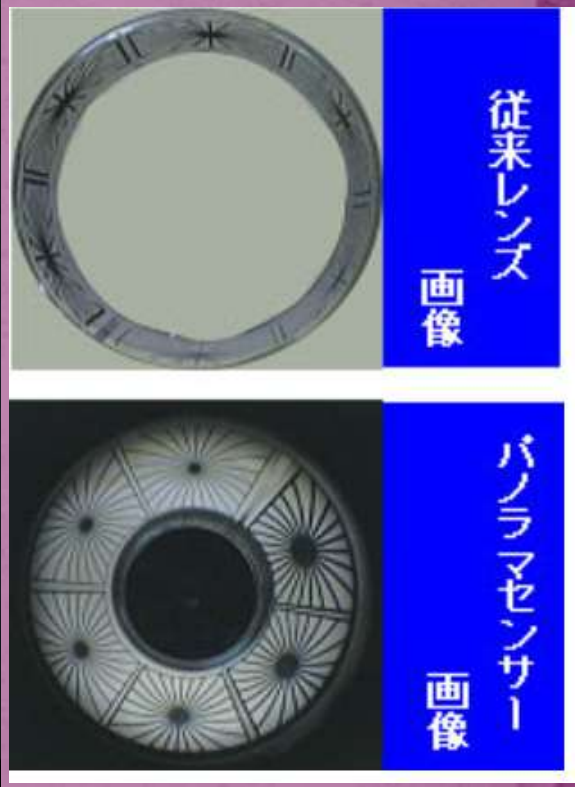
(1) Omnidirectional video camera with panoramic sensor

(2) Monitoring side view while moving forward, significantly decreasing the time required for video shooting



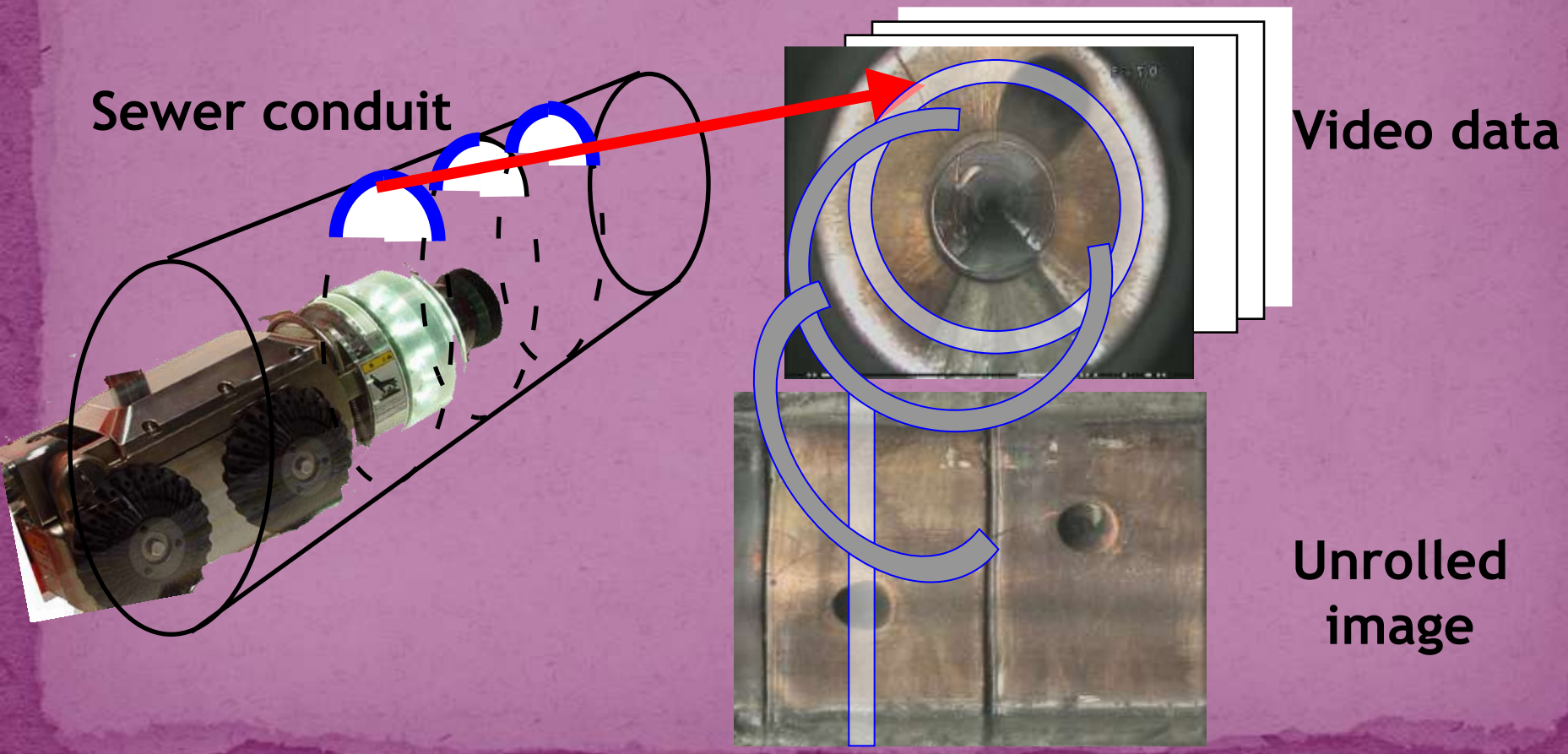
View　　Schematic

Video picture (still image)



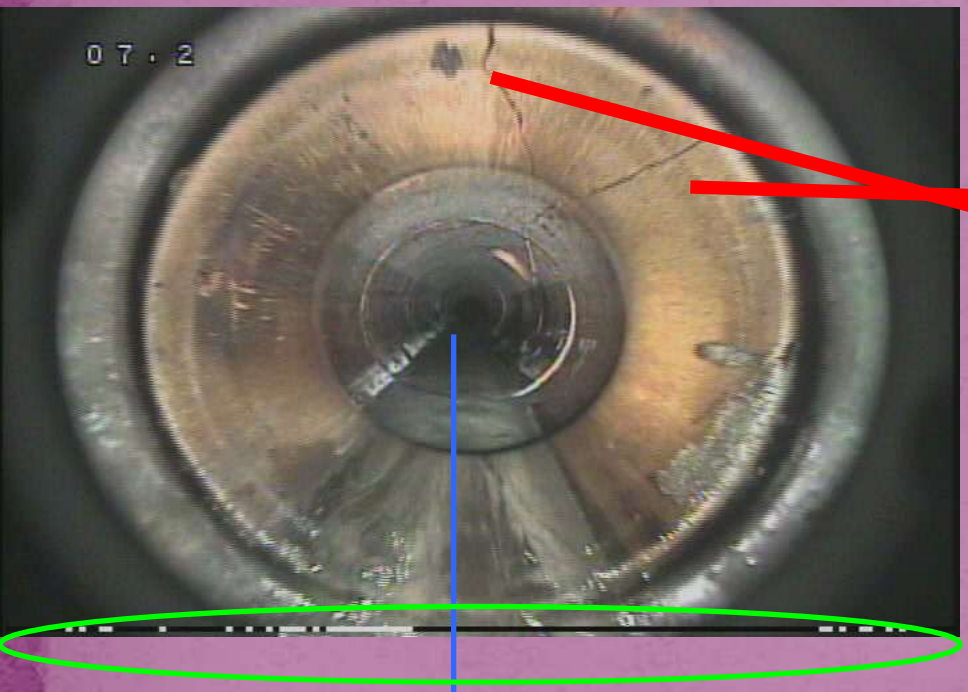
Unrolled Image of Conduit Inner Surface

Side wall data is processed by coordinate transformation to reproduce its unrolled image.



Unrolled image

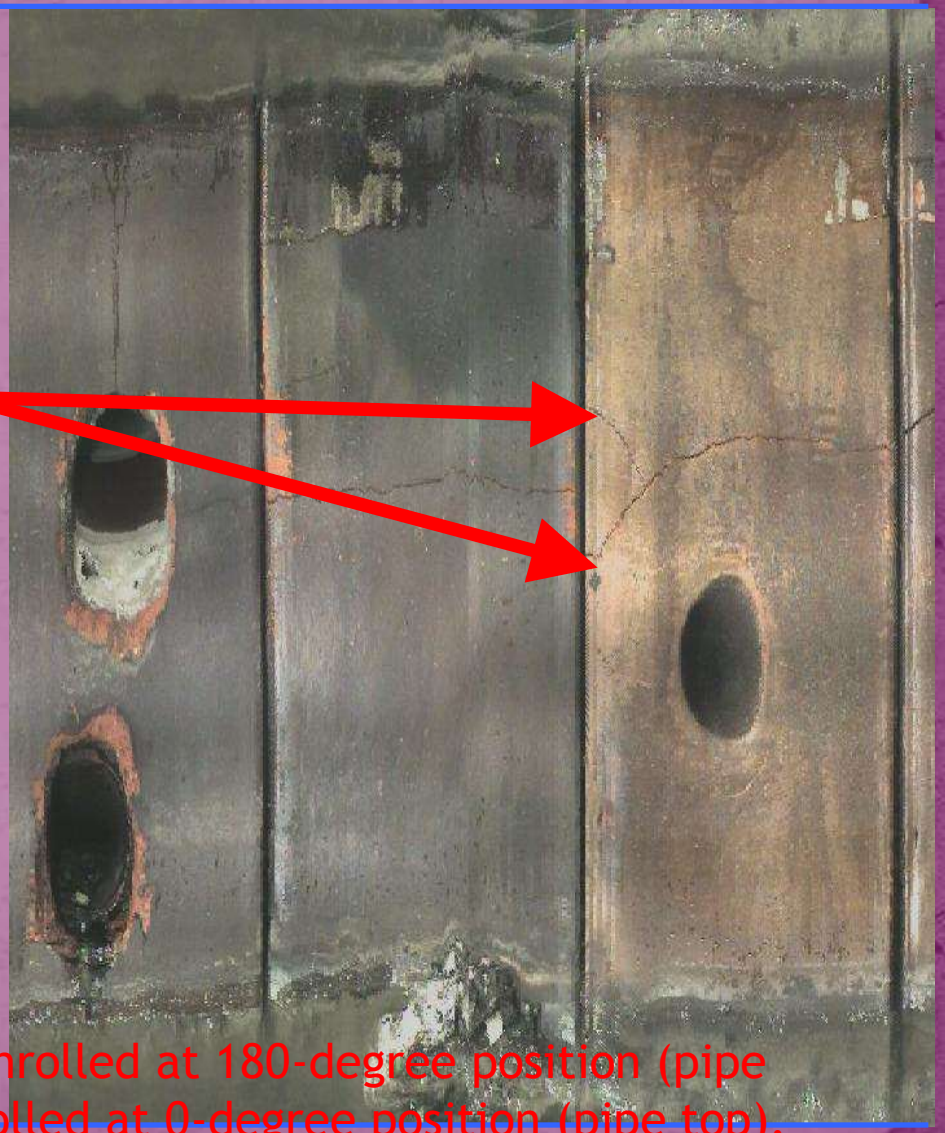
Pipe bottom→A



B A B

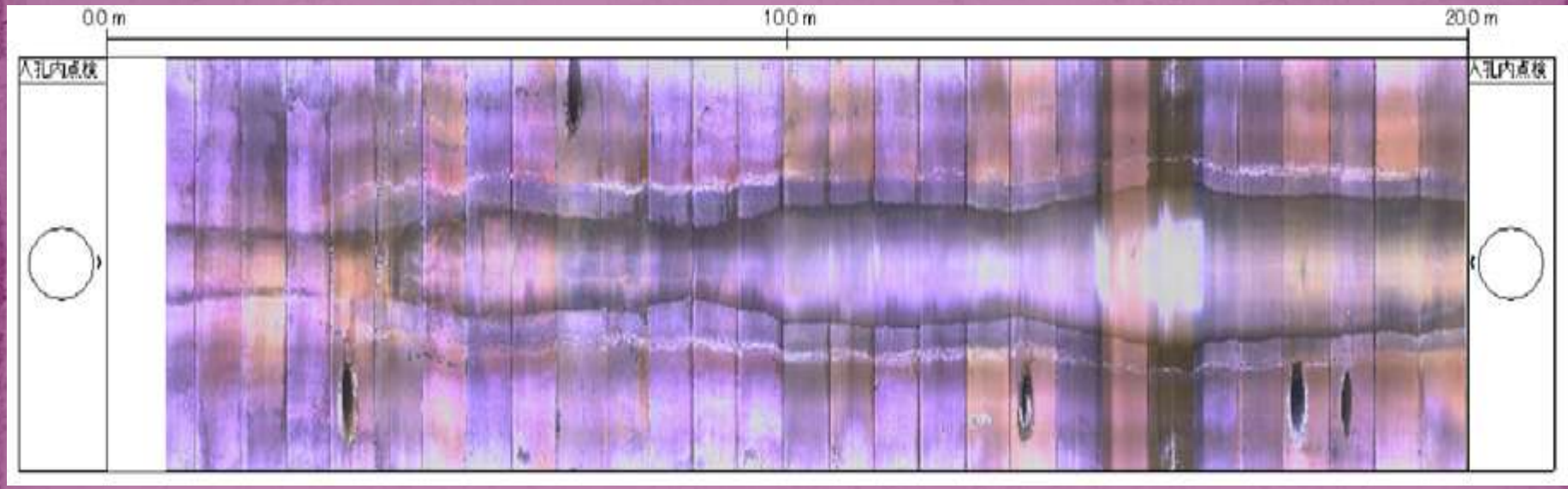
Original image

Unrolled image



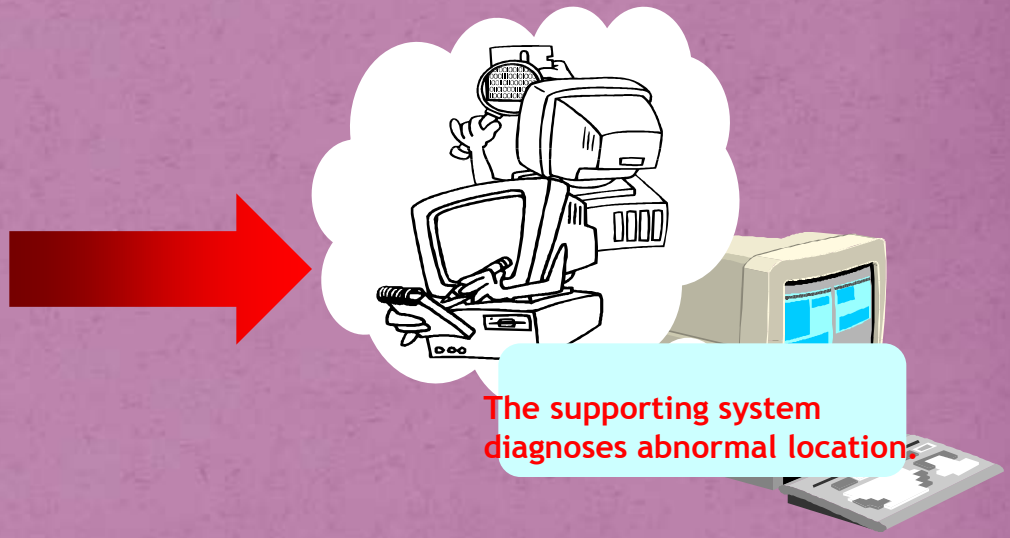
* Picture shown above is an image unrolled at 180-degree position (pipe bottom). By default, an image is unrolled at 0-degree position (pipe top).

Conduit Inner Surface Image Unrolling System
Unrolled images



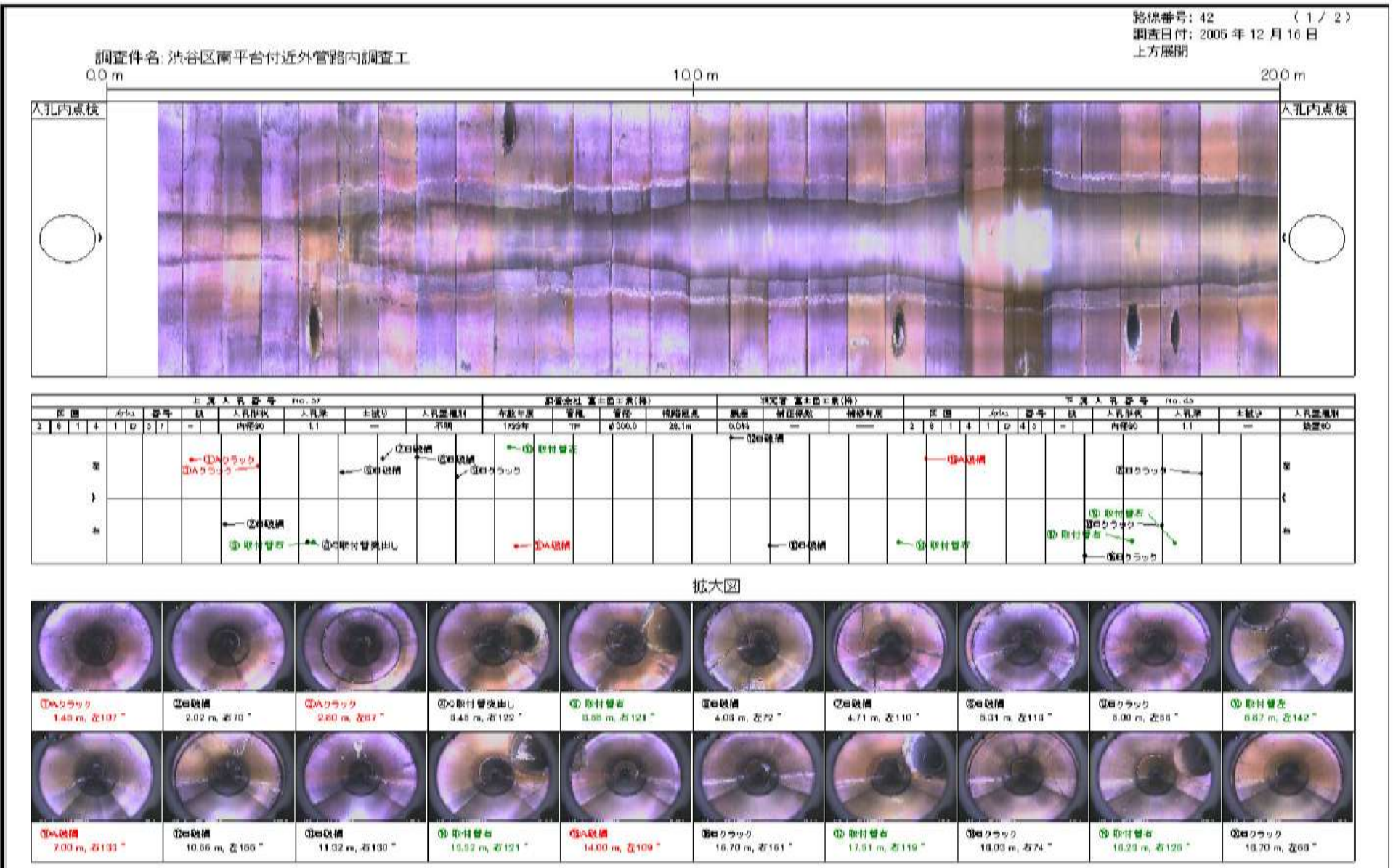
Conduit Inspection and Diagnosis Supporting System (Diagnosis)

The system enables remote PC diagnosis of conduit inner surface, the job that have been done by on-site operator so far.



*** Semi-automatic diagnosis; The diagnosis needs to be confirmed by human inspector.**

Unrolled Image Record File (Diagnosis results)



Repair and Improvement Works

Sewer Works at Tokyo

1. Repair Works
   - Repair a part of damaged sewer pipe.
   - Minimum repair to maintain its function.
   - No service life is extended.

2. Improvement Works
   - Renew or replace a whole sewer pipe system.
   - Service life is extended.

Sewer Works at Tokyo

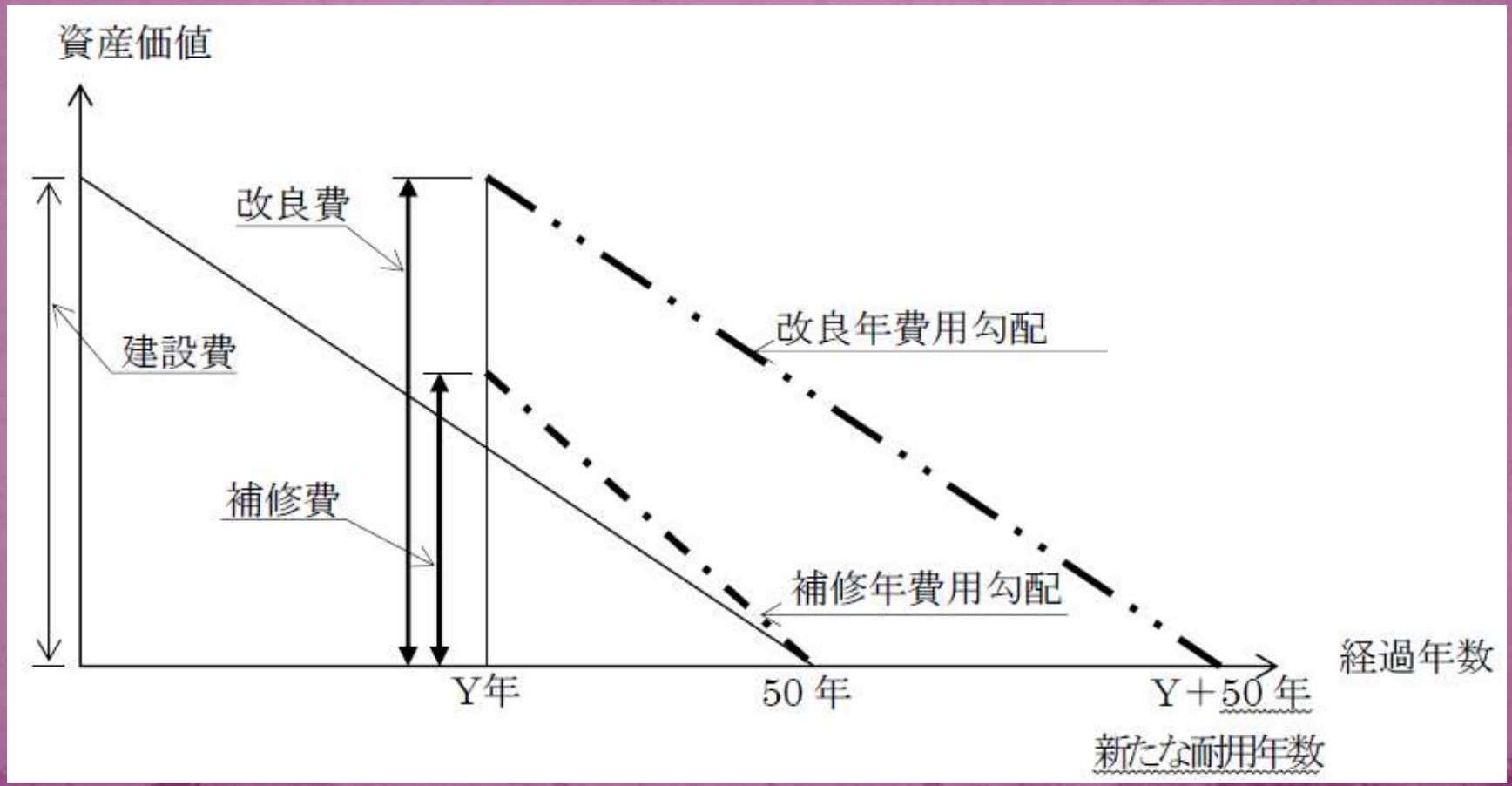
How to judge repair or improvement works (economical comparison).

Improvement work is planned when the following inequality is established.

$$\frac{\text{改良工事に要する費用}}{\text{新たな耐用年数}} \leqq \frac{\text{補修工事に要する費用}}{\text{残存耐用年数}}$$

Sewer Works at Tokyo

Comparison of cost and service life between repair and improvement works on the pipes needed remedy after Y years.



Work Summary (Improvement)

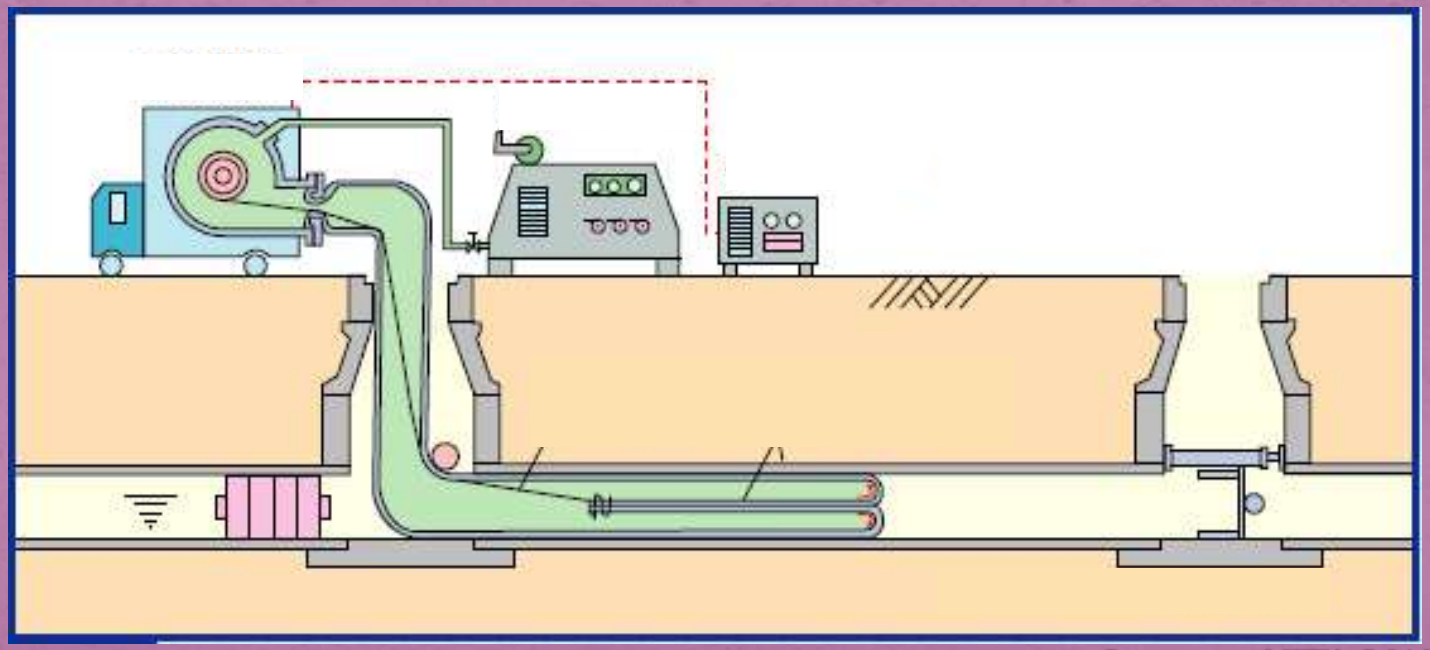
1. Open-cut Excavation
   Dig out and replace old sewer pipes.

2. Pipe Rehabilitation
   Install a new pipe in an existing pipe or reinforce the existing pipe with protective measures.
   (1) Cured-in-place pipe inversion method
   (2) Lining pipe: pull and press
   (3) Slipling method
   (4) Spiral liner method

Pipe Rehabilitation

(1) Cured-in-place pipe inversion method

Inversely insert fibrous repairing material impregnated with hardening resin into an existing manhole. Inflate the material or expand it with water to press onto the inner surface of the existing pipe until the resin hardens.

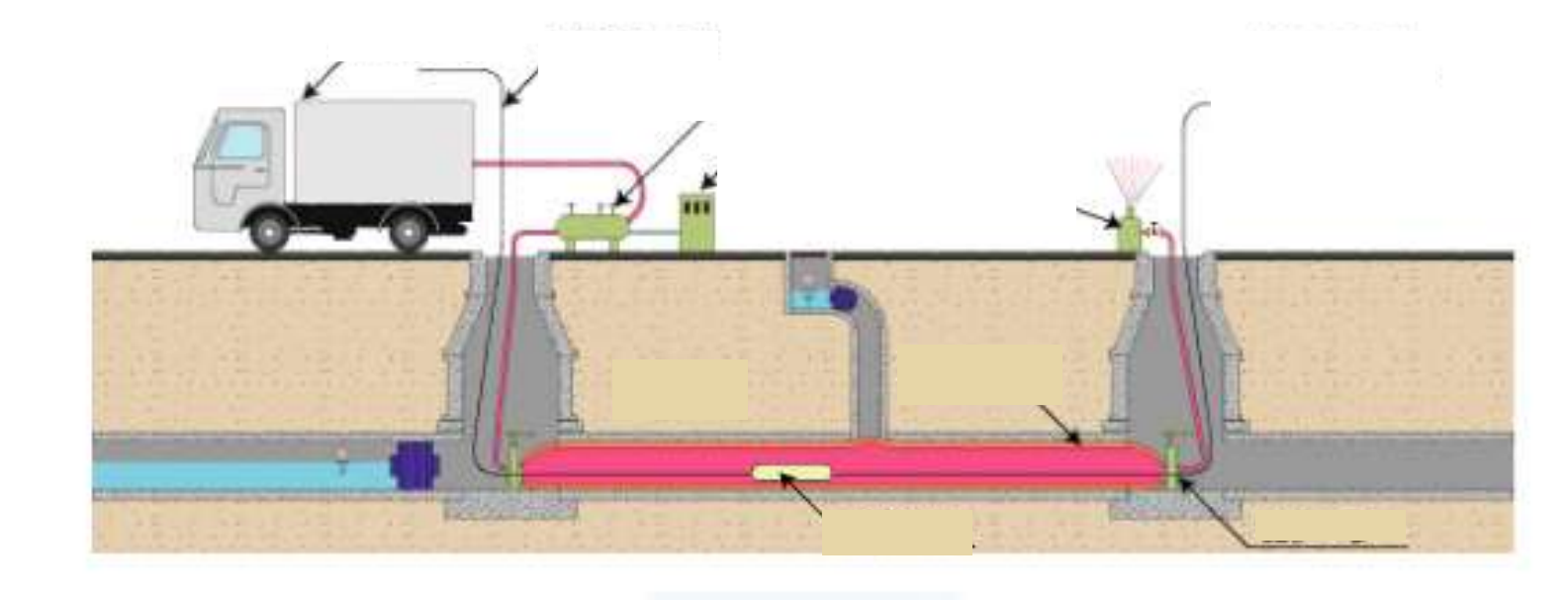


Source: KITAC Website

Pipe Rehabilitation

(2) Lining pipe: pull and press

Insert and pull fibrous lining material impregnated with hardening resin into an existing pipe. Inflate the lining material to press onto the inner surface of the existing pipe until the resin hardens.



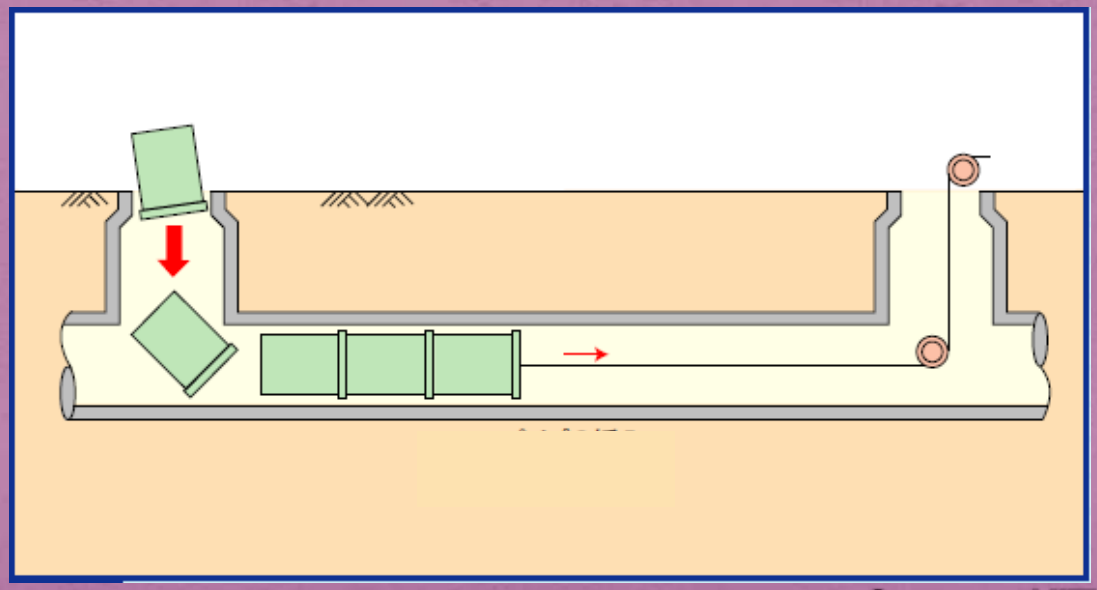
Source: PULTEM Website

Pipe Rehabilitation

(3) Slipling method

Insert and pull a series of prefabricated pipe modules smaller than the existing pipe in diameter. The gap between new and old pipes is filled to unite them as a new duplex pipe. The inner pipe modules prefabricated in factory assure reliable construction.

(Example)
FRP pipe
modules

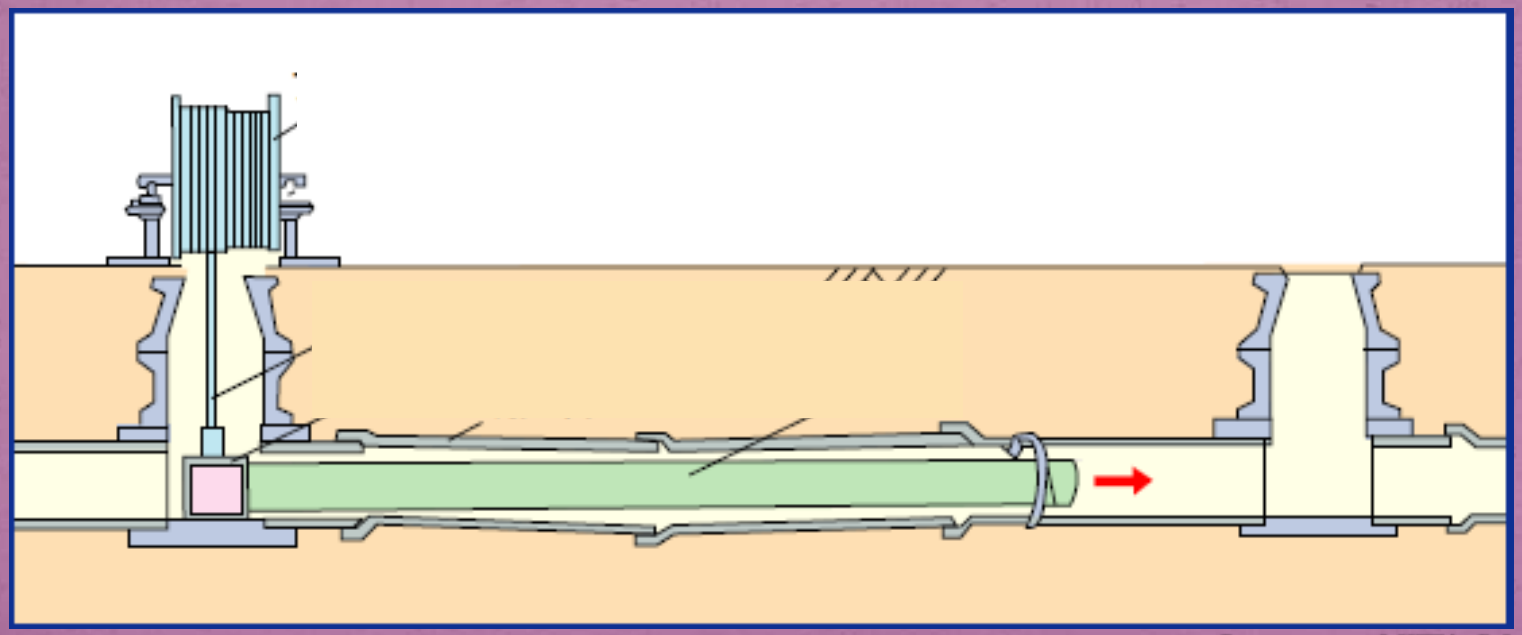


Source: KITAC Website

Pipe Rehabilitation

(4) Spiral liner method

Create a new inner pipe inside an existing pipe, by inserting hard vinyl chloride material in a spiral manner. The gap between new and old pipes is filled by back-filling material to unite them as a new duplex pipe.

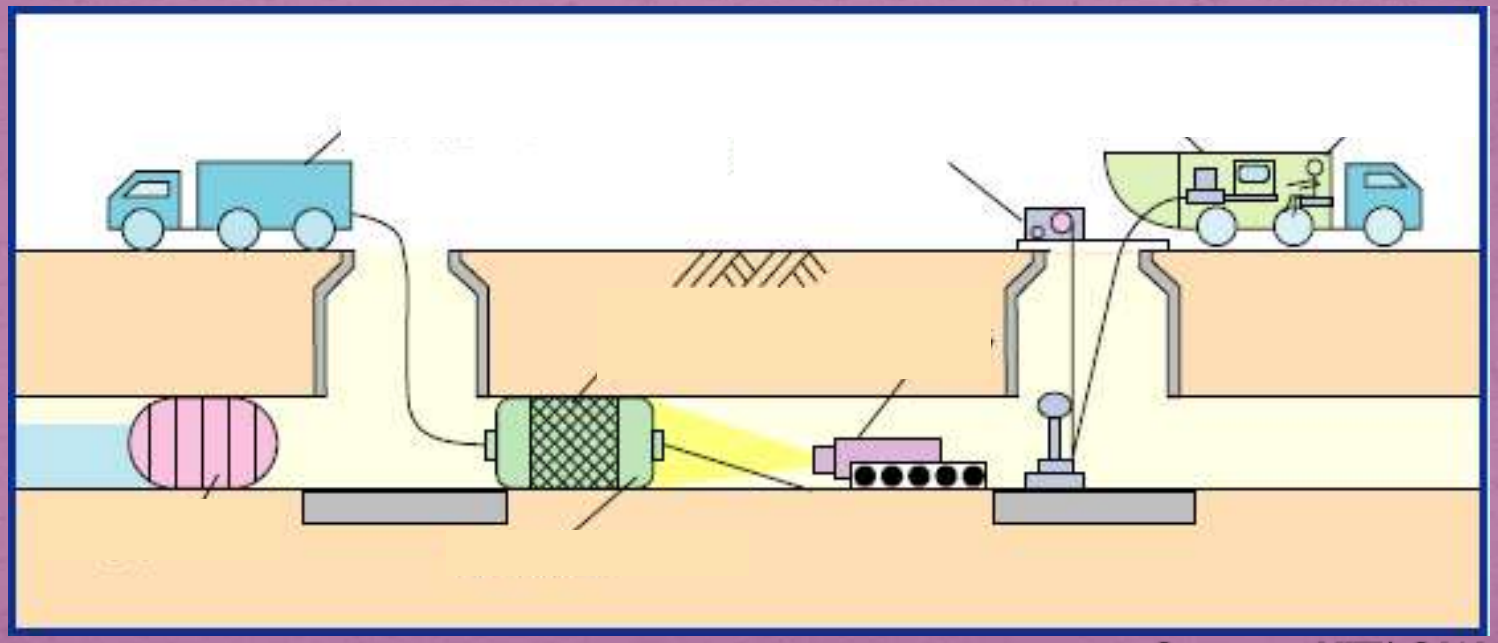


Source: KITAC Website

Pipe Rehabilitation (Partial Repair)

Partial repair

Apply fibrous repairing material impregnated with hardening resin onto the surface of repairing section. The resin hardens by heat, light, or time.



Source: KITAC Website