



TRENCHLESS ASIA 2026

THAILAND

PVC PIPE JACKING SYSTEM

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www.trenchlessasia.com

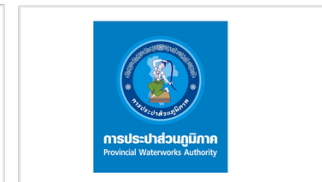
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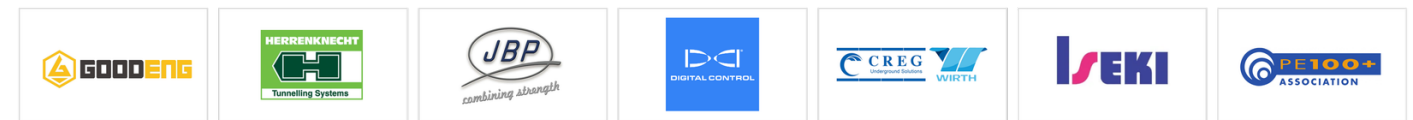
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PVC Pipe Jacking System

Unique Pipe Jacking method using PVC pipe for small diameter sewage pipe to Reduce cost, Improve accuracy & quality and Prolong service life



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Trenchless Asia 2026
Presented by Hiroshi Sazanami

1. Introduction and background

ISEKI has been developing unique machines and leading TBM industries up to now

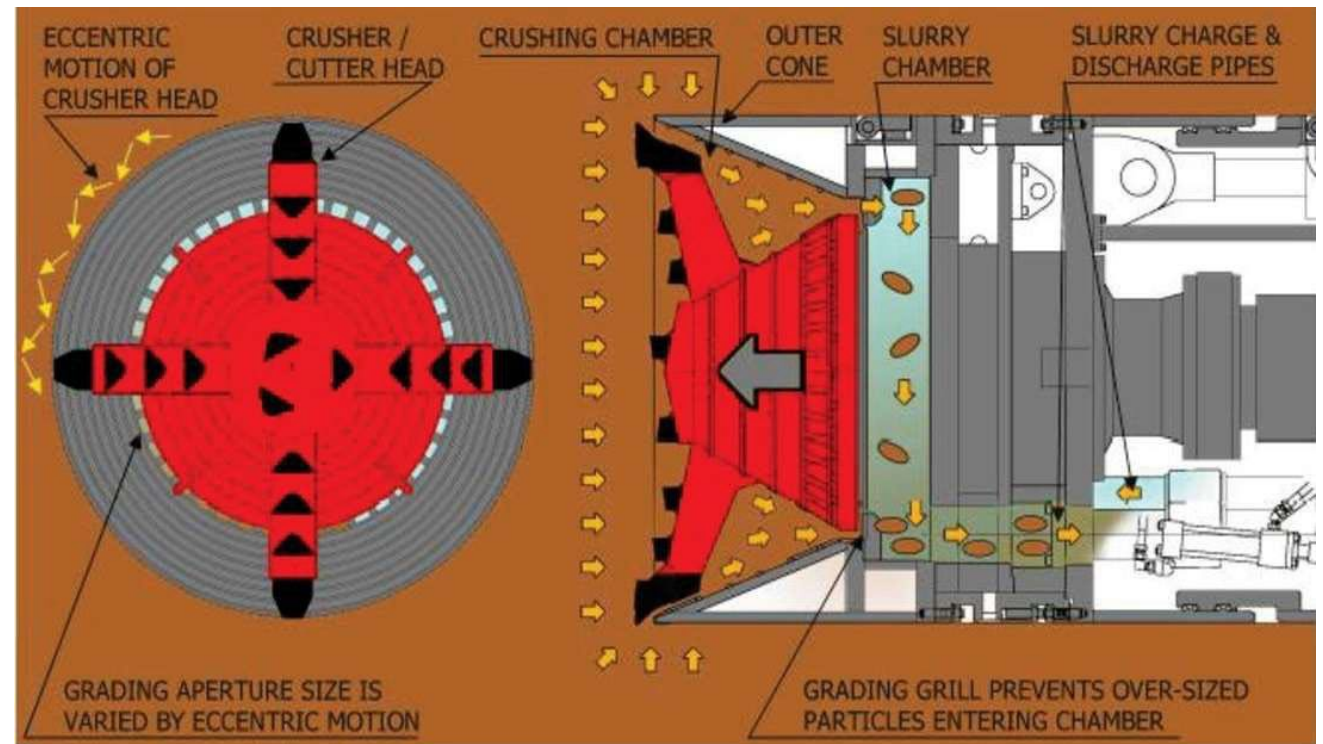
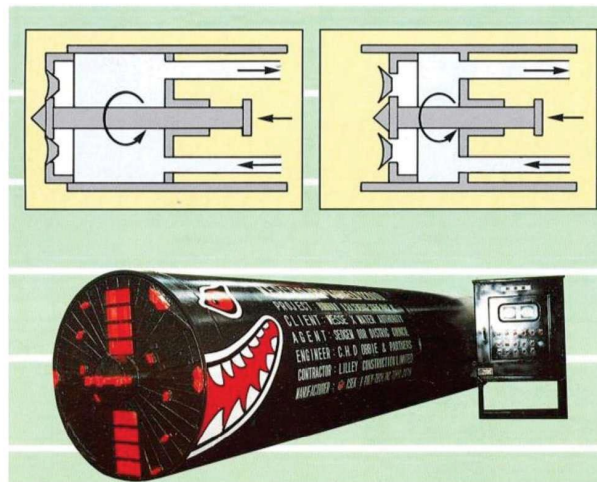
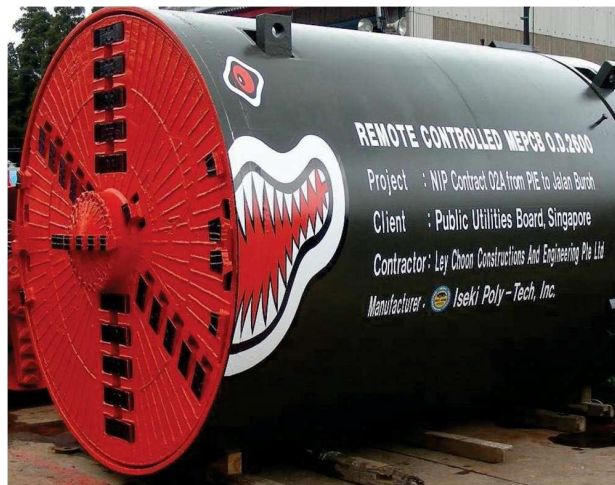
ISEKI HISTORY

1971 Company was established in Japan

1972 First slurry shield equipped with MEP system to cope with highly unstable and sensitive ground with high GWL was developed.

1984 UNCLEMOLE (TCC) equipped with a unique eccentric rotation cone crusher was launched.

1994 UNCLEMOLE SUPER (TCS) series was launched, widening compatible ground conditions to include hard rock with UCS of ≤ 200 MPa and boulders with $>30\%$ of the machine diameter.



1. Introduction and background

Thanks to the unique feature of Unclemole, ISEKI has delivered more than 2,500 unit of

ISEKI DELIVERY RECORD



2. Easy to maintain and manage.

Very flexible and possible to withstand earthquakes and land subsidence.
Also shock resistant and will not break during normal transportation or construction.

3. Excellent chemical resistance and durability.

It changes very little over time and is not affected by acids or alkalis.

4. Good hydraulic properties and excellent watertightness. (Lower roughness coefficient)

Inner surface is extremely smooth and has low friction resistance.
There is little scale generation or adhesion of dirt, allowing water to pass through efficiently.
The pipe diameter can be reduced and the pipe slope can be minimized.

5. Easy to handle and reliable construction.

Due to its light weight, easier to transport and handle at the construction site and reduce cost.

1. Economical and long-life

Japan PVC Pipe and Fittings Association conducted test to prove PVC pipe durability

(1) Internal pressure creep test

Estimated burst water pressure after 100 years has a safety factor of more than 2.5 times the normal water pressure.

(2) Hydraulic pressure testing of excavated pipes

PVC pipes that had been in use for 14 to 43 years were excavated and compared with unused pipes. As a result, there was no difference in either pressure resistance or durability.

(3) Tensile Strength

Tensile strength tests were conducted on PVC pipes that had been in use for several years to 52 years, and all pipes met the standard values for new pipes.

2. Feature of PVC pipe (Polyvinyl chloride pipe)

PVC pipe usage in Japan (2012)

ID less than 300mm

| | PVC Pipe | Others | Total |
|---------------|----------|--------|---------|
| Distance (km) | 2,947.0 | 245.5 | 3,192.5 |
| Ratio (%) | 93 % | 7 % | 100 |

ID 300mm – 450mm

| | PVC Pipe | Others | Total |
|---------------|----------|--------|-------|
| Distance (km) | 44.1 | 58.4 | 102.5 |
| Ratio (%) | 43 % | 57 % | 100 |

ID 500mm – 600mm

| | PVC Pipe | Others | Total |
|---------------|----------|--------|-------|
| Distance (km) | 9.5 | 62.6 | 72.1 |
| Ratio (%) | 13 % | 87 % | 100 |

Due to the features of PVC pipe, PVC pipe is most common materials especially maller diameter pipe.

3. PVC pipe jacking system

Jacking machine: Unclemole V (TCV) Series ID200-500mm

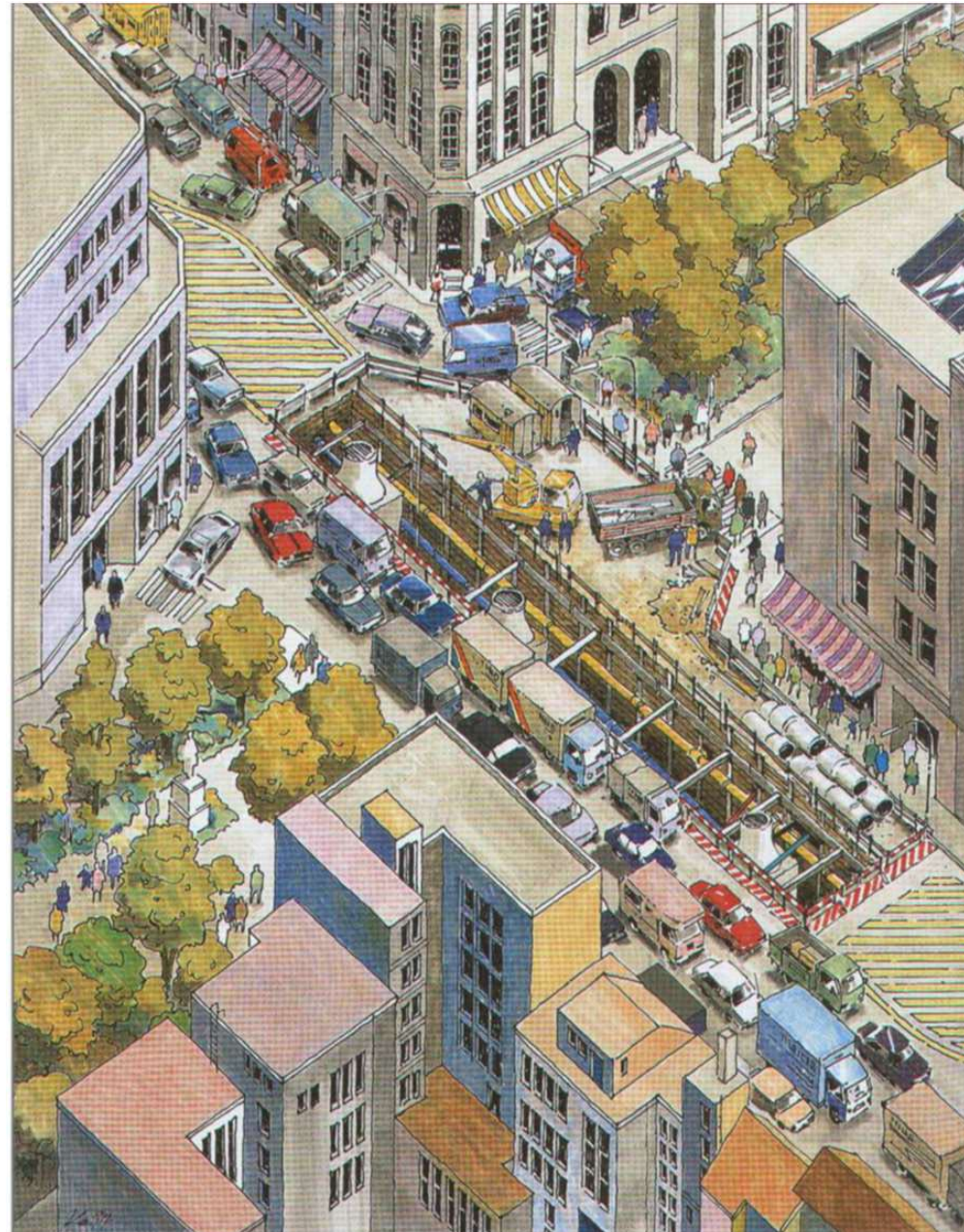


SUS Collar PVC pipe
(Stainless Steel Collar)
Applicable ID 200mm to 500mm

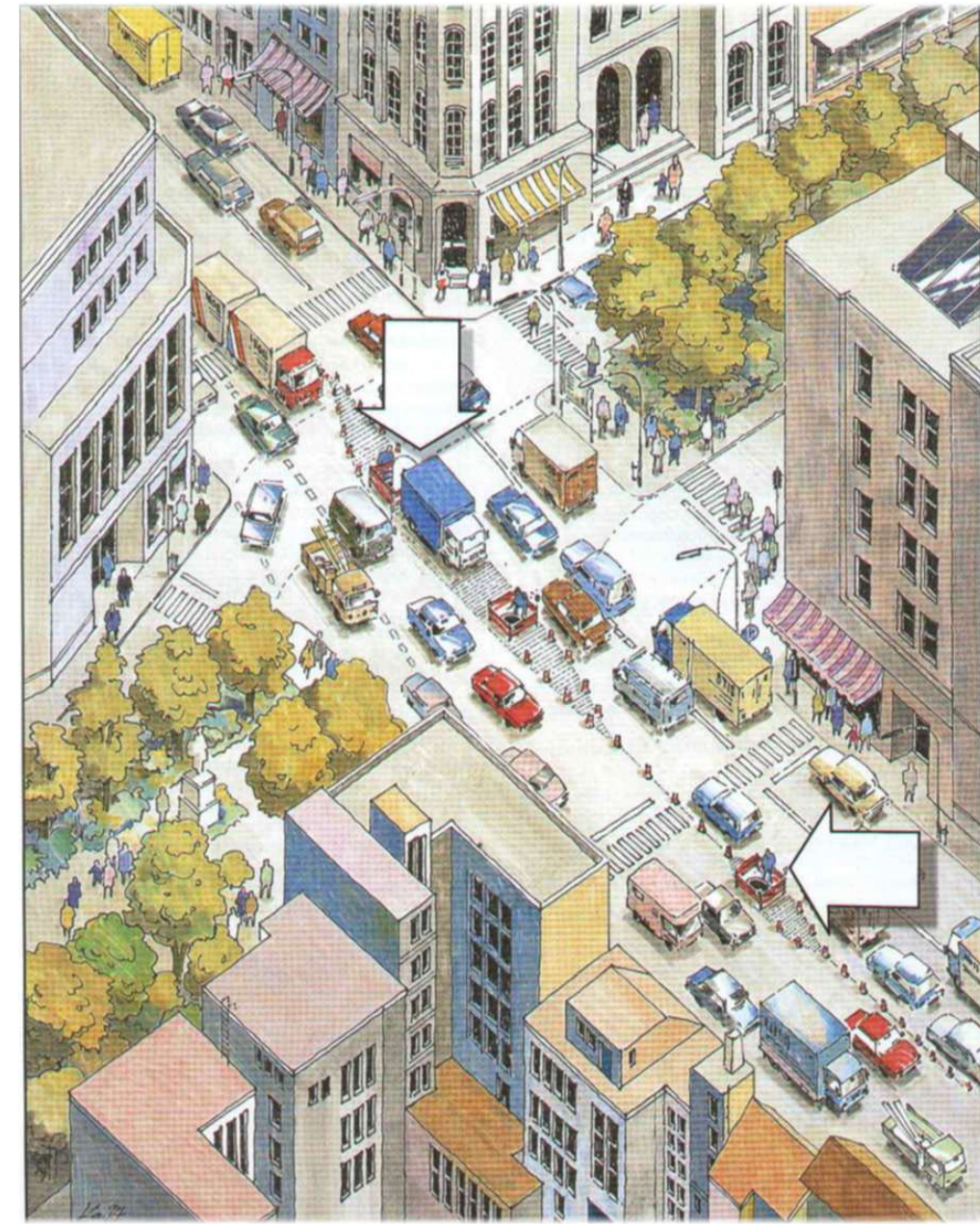


Feature of Pipe Jacking System

Minimize disturbing the surface traffic, infrastructures and life of residence.



Open Cut Method



Pipe Jacking Method

Feature of Pipe Jacking System

1. Vertical load on the pipe

Open cut method, direct earth pressure which from the area and depth of open cut, compacting force when backfilling are applied vertically on the pipe .

Pipe jacking method, the earth pressure of loosened ground is the maximum vertical load on the pipe.

Pipe jacking's vertical load on the pipe is possibly smaller than Open cut method.

2. Effect of groundwater pressure on the pipe

Open cut method, the backfilled ground has a lower soil bearing power than the existing ground under the pipe. This may cause floating of the pipe due to ground water pressure from below.

Pipe jacking method, the original soil composition does not change and is less affected of the ground water pressure than the open cut method.

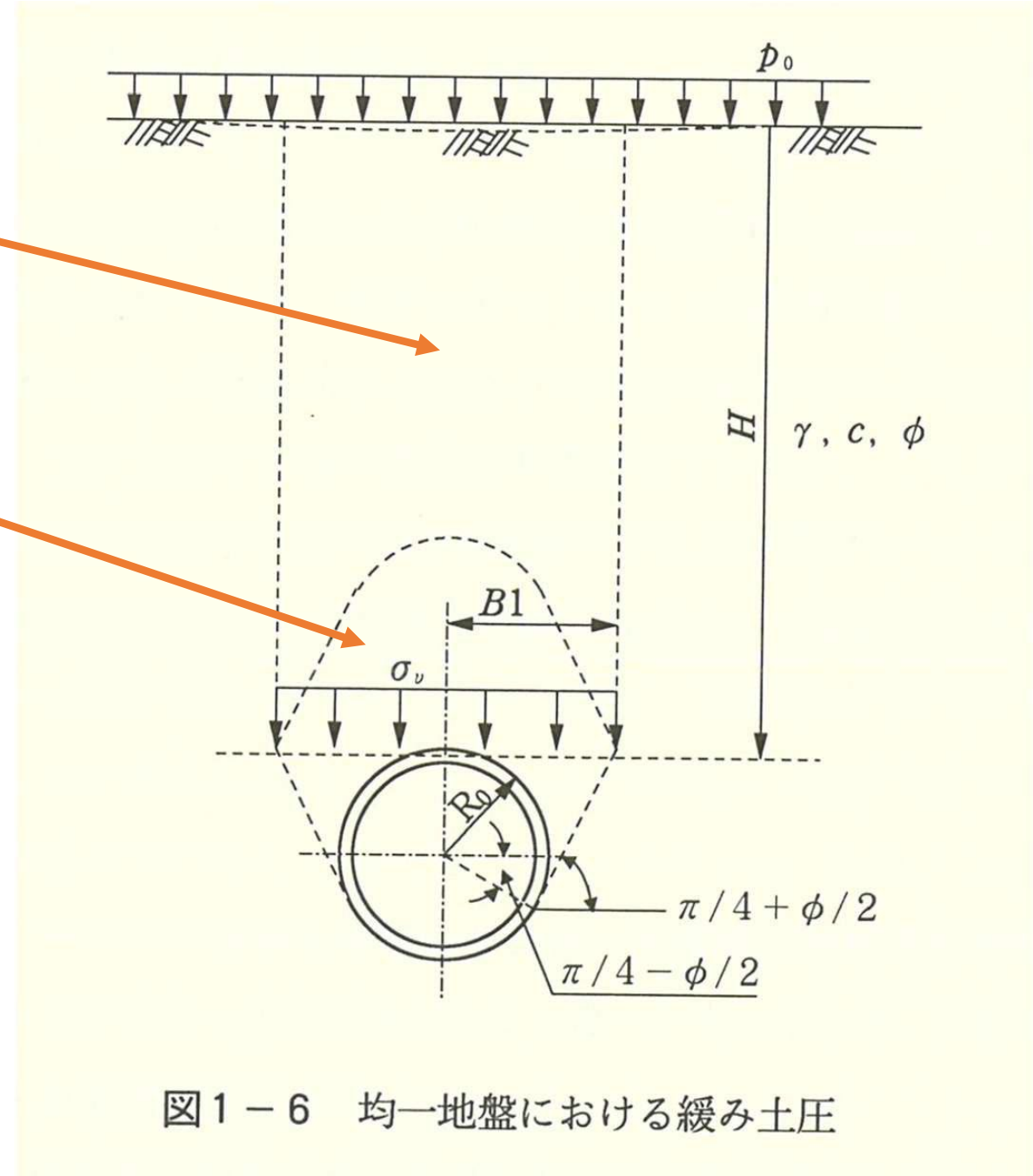
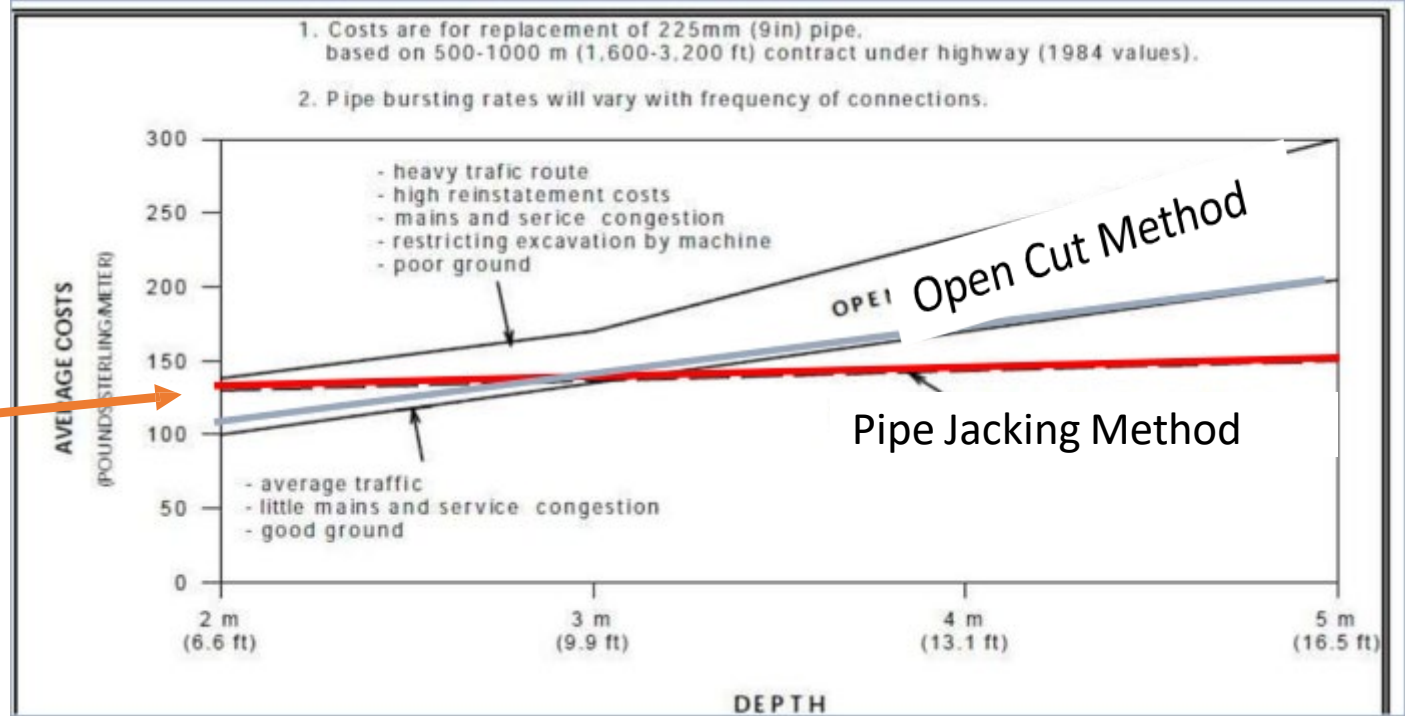


図1-6 均一地盤における緩み土圧

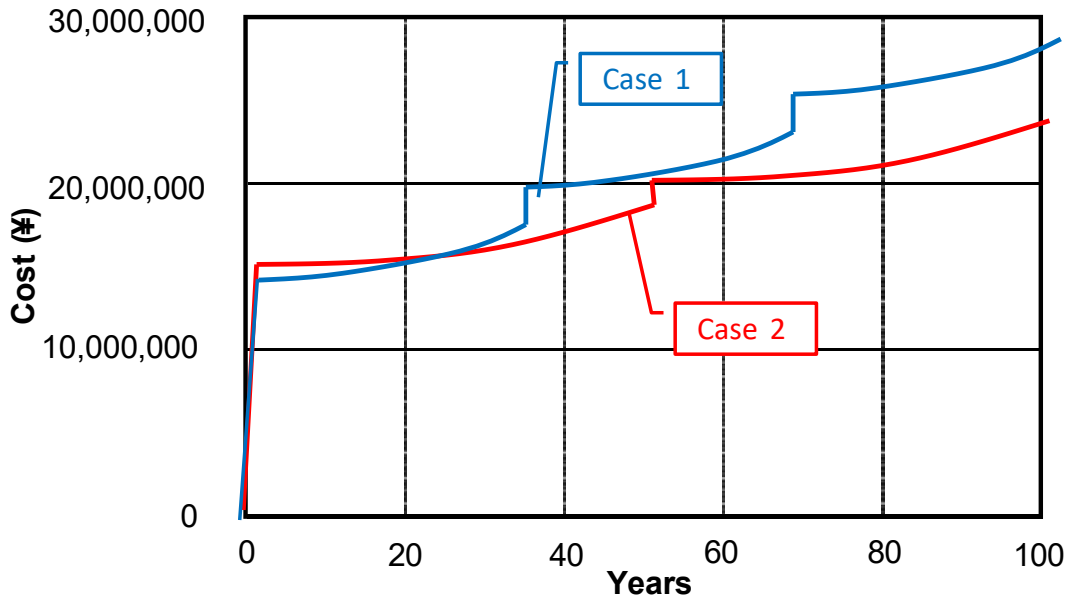
Economic efficiency

1. Initial Cost

In general, compare Pipe jacking method initial cost with Open cut method, it depends on the depth of the pipe and if the depth is more than 3.0m Pipe jacking method is cheaper than the opencut method.



Life Cycle Cost Estimation

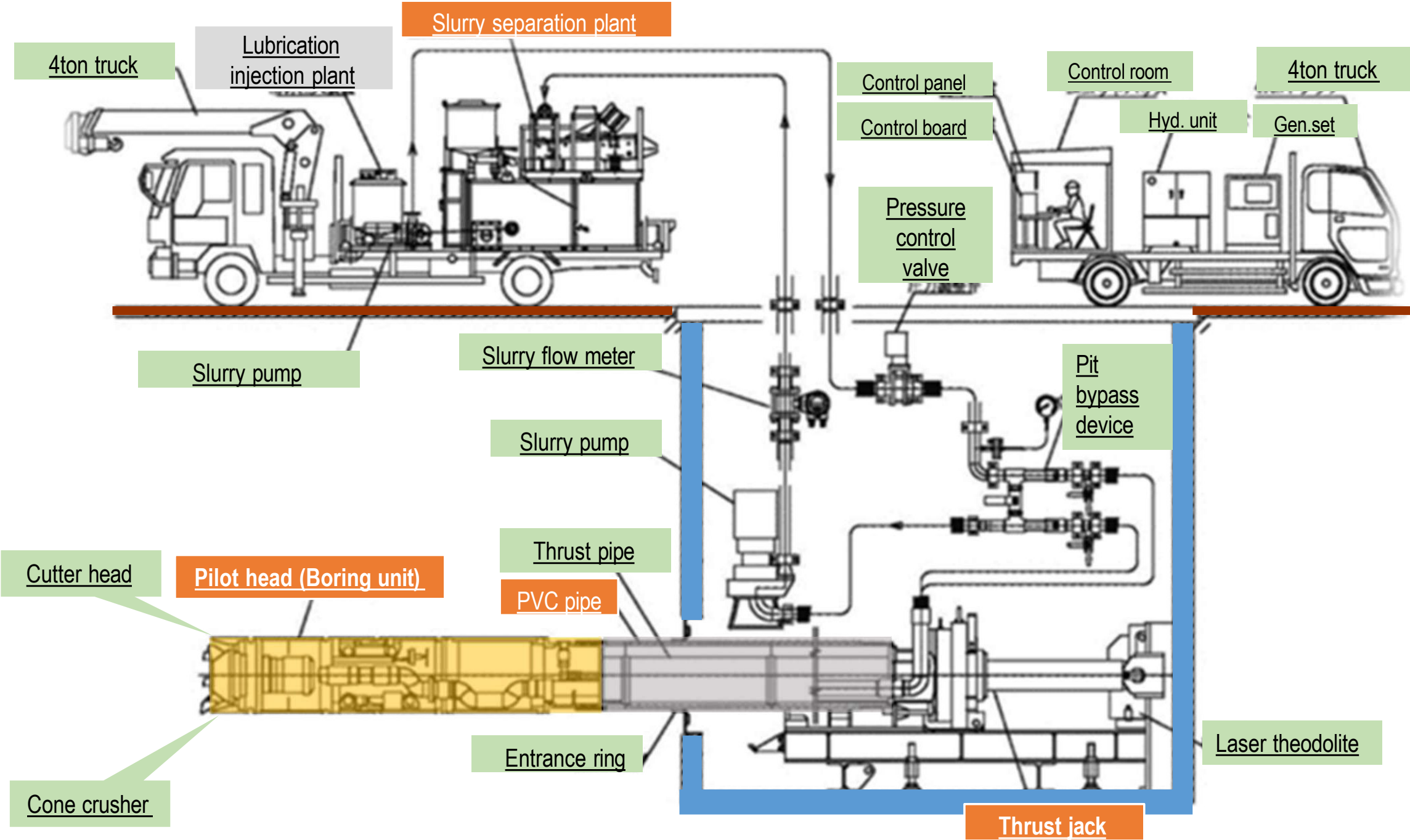


2. Life cycle cost estimation (¥/m)

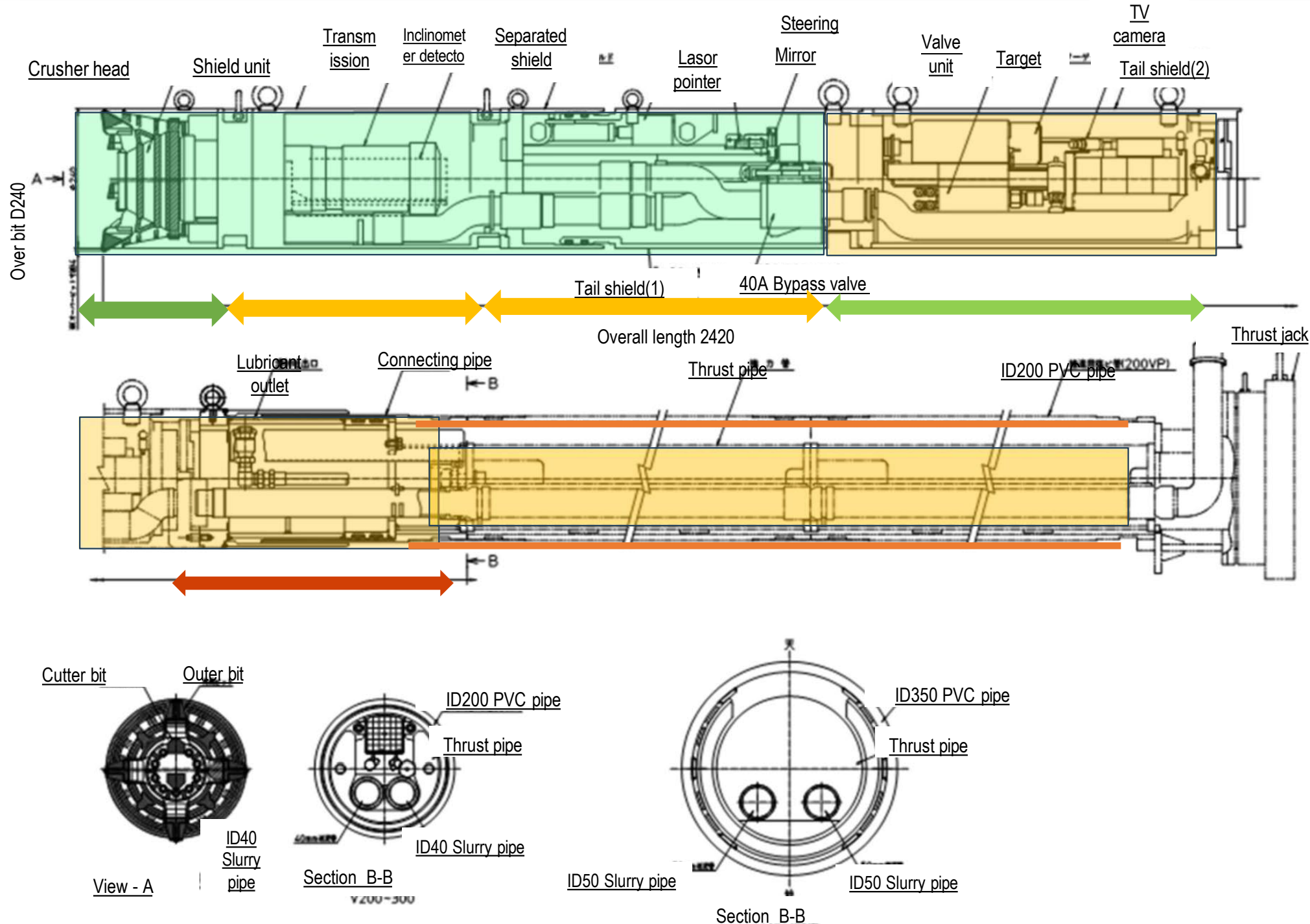
Case 1: RCP or VCP pipe which maintain every 35 just before designed life.
Case 2: PVC pipe which number of maintenance is reduced to every 50 years.

PVC pipe estimated 100 years life cycle cost is cheaper than RCP or VCP pipe around 16%.

3. PVC pipe jacking system



3. PVC pipe jacking system



TBM consists Shield unit and Tail Shield

These can be divided when starting.

Shield unit can be divided into 3 segments

Tail shield can be divided into 2 segments.

TBM can be divided into 5 segments for Retrieval.

Minimize start and arriving shaft diameter

4. Feature of PVC pipe jacking

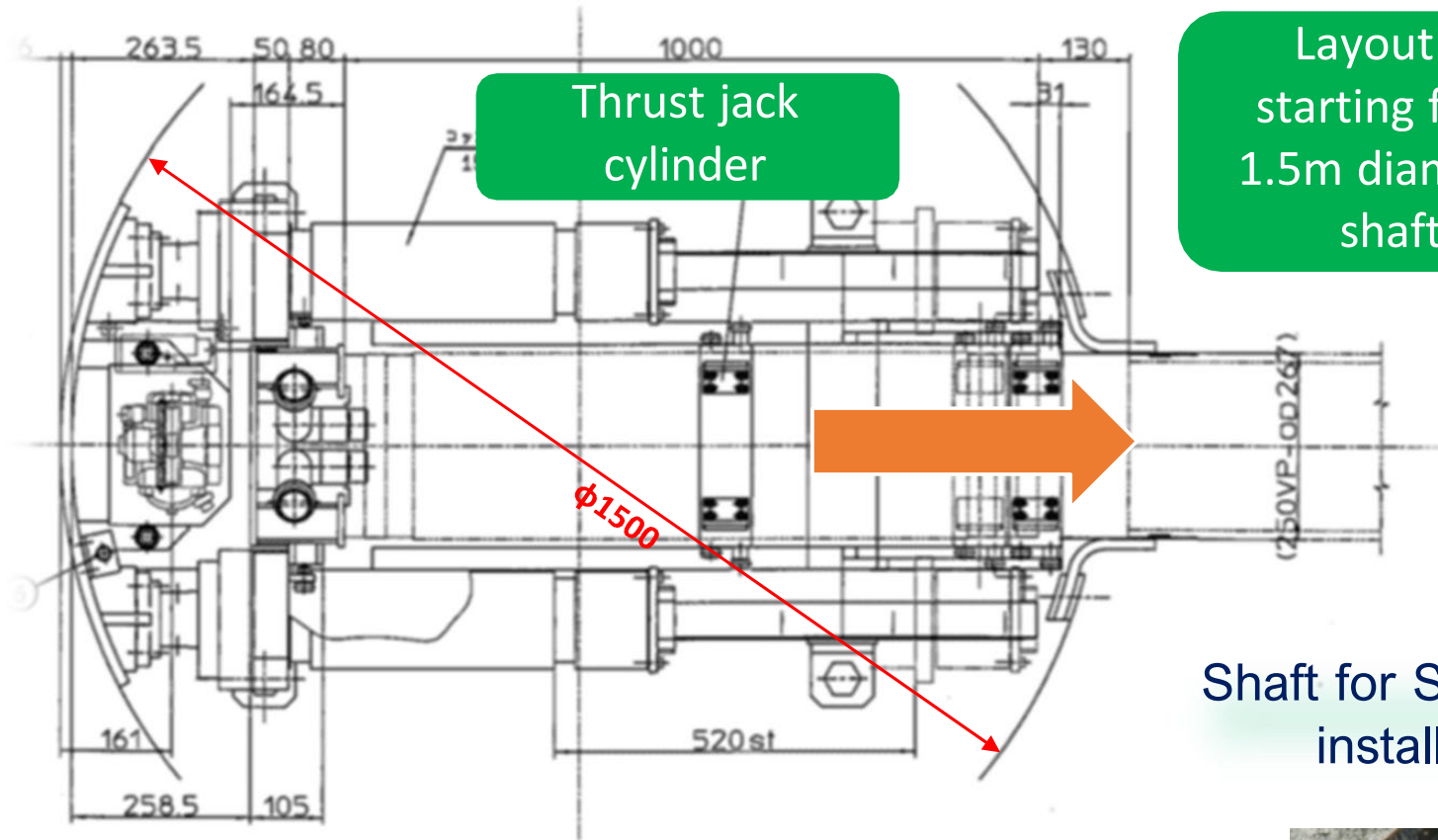


Table 1: Minimum dimension of the separable launching shaft

| Nominal Diameter (mm) | Minimum ID (m) |
|-----------------------|----------------|
| 200/250 | 1.4 |
| 300 | 1.5 |
| 350/400 | 1.5 |
| 450 | 1.7 |

Launch from a small shaft

Shaft for Separable launching and installation of thrust jack



Pilot head can be separated into 5 segments

Table 2: Minimum internal dimensions of existing manholes for separable retrieve

| Nominal Diameter (mm) | Minimum ID (m) | Clearance under Pilot Head (m) | Number of segment |
|-----------------------|----------------|--------------------------------|-------------------|
| 200/250 | 0.9 | 0.3 and above | 5 |
| 300-400 | 1.2 | | |
| 450 | 1.5 | | 4 |



Retrieval shaft is smaller than starting shaft (Min 1.4m)

Table 3: Guideline jacking distance for each nominal diameter (depending on soil conditions)

| Nominal Diameter (mm) | Jacking distance guideline (m) |
|-----------------------|--------------------------------|
| 200 | ~80 |
| 250 | ~80 |
| 300 | ~100 |
| 350 | ~100 |
| 400 | ~120 |
| 450 | ~120 |
| 500 | ~120 |

It is possible to minimize shaft diameter both starting and retrieval even can utilize existing manhole. It can reduce Construction cost.

Due to unique function of cone crusher, possible to handle wide range of soil

A-I soil type: Sandy soil, cohesive soil ($N \text{ value} \leq 30$)

A-II soil type: Gravel content is about 20%, maximum gravel diameter is less than 20mm

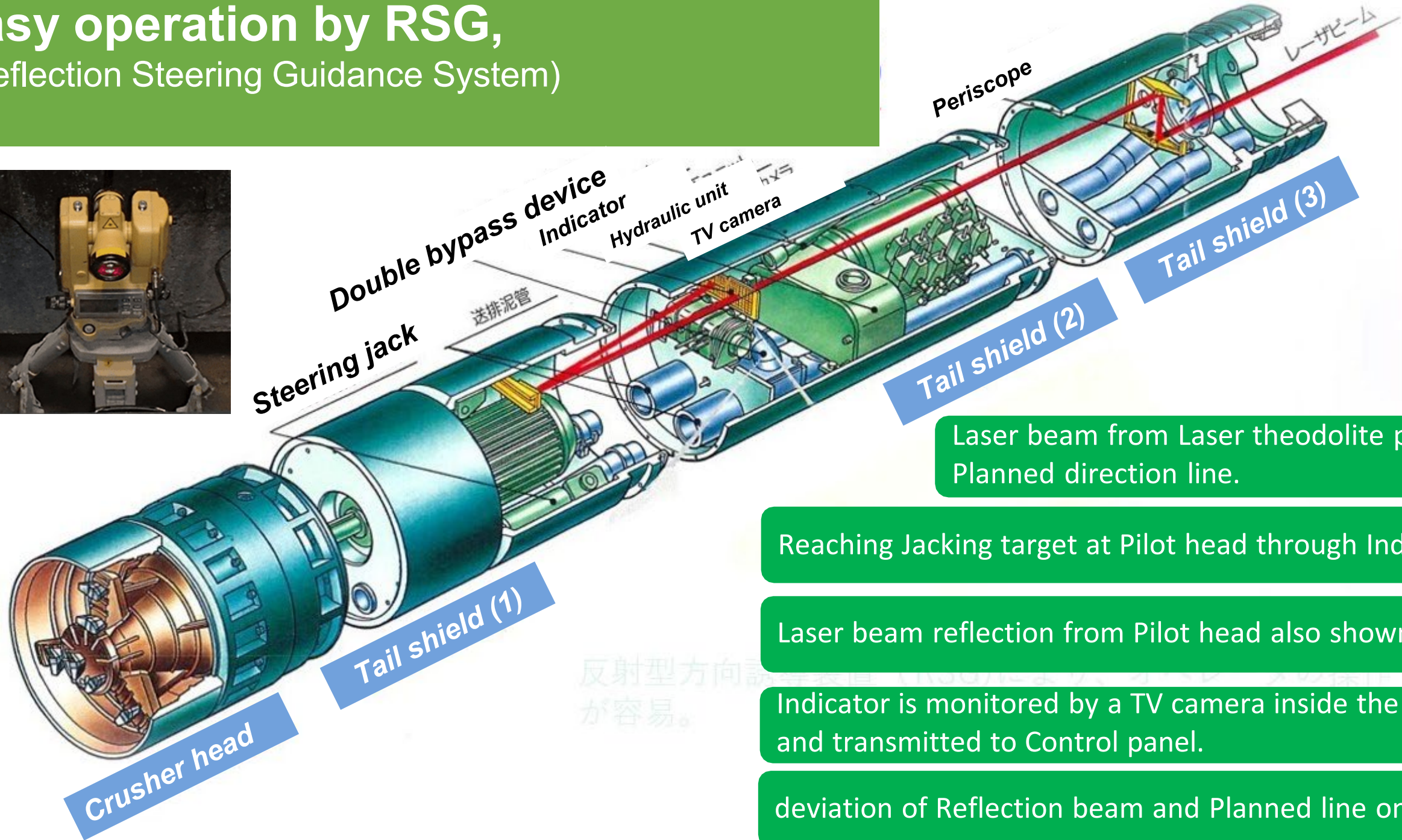
B gravelly soil: Gravel content is about 30%, maximum gravel diameter and maximum allowable number of gravels per meter are shown in Table 4.

Table 4: Maximum gravel diameter and maximum allowable number of gravels per meter

| | | | | | | | |
|--|-----|-----|-----|-----|-----|-----|-----|
| Nominal diameter (mm) | 200 | 250 | 300 | 350 | 400 | 450 | 500 |
| Maximum gravel diameter (mm) | 65 | 80 | 100 | 110 | 130 | 145 | 180 |
| Maximum allowable number of garavel (pieces/m) | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

D Hard soil: Mudstone, consolidated soil, soft rock (up to 4MN/m^2)

Easy operation by RSG, (Reflection Steering Guidance System)



Laser beam from Laser theodolite pointing Planned direction line.

Reaching Jacking target at Pilot head through Indicator

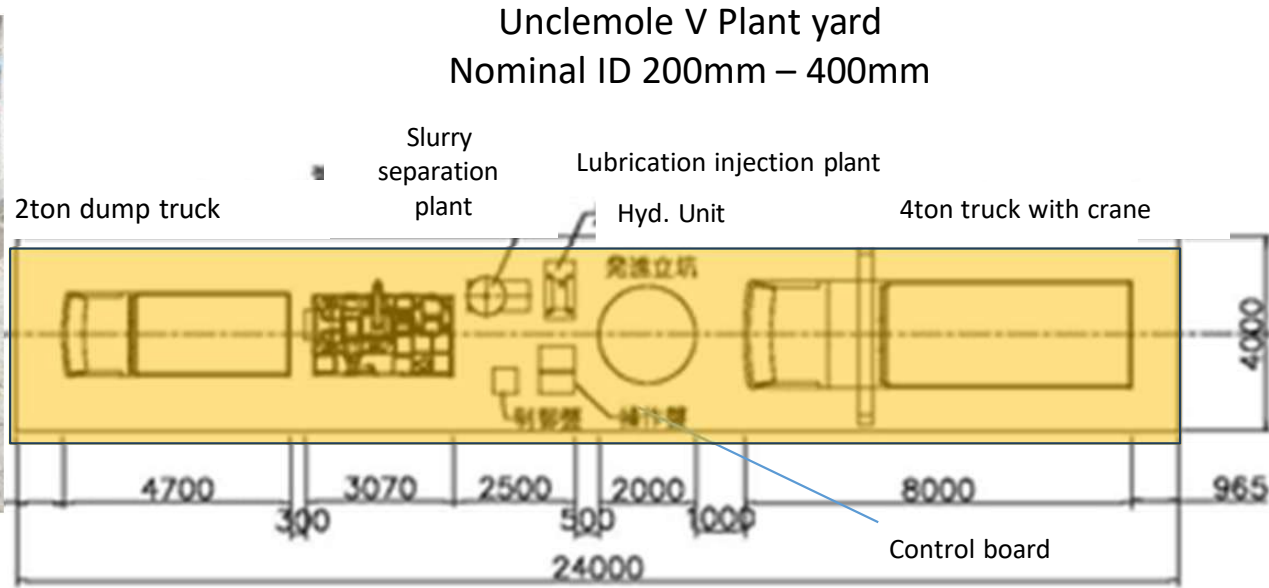
Laser beam reflection from Pilot head also shown on Indicator

Indicator is monitored by a TV camera inside the pilot head and transmitted to Control panel.

deviation of Reflection beam and Planned line on TV monitor.

反射型方向誘導装置(RSG)によるパイプジャッキングが容易。

Small Construction site are is required

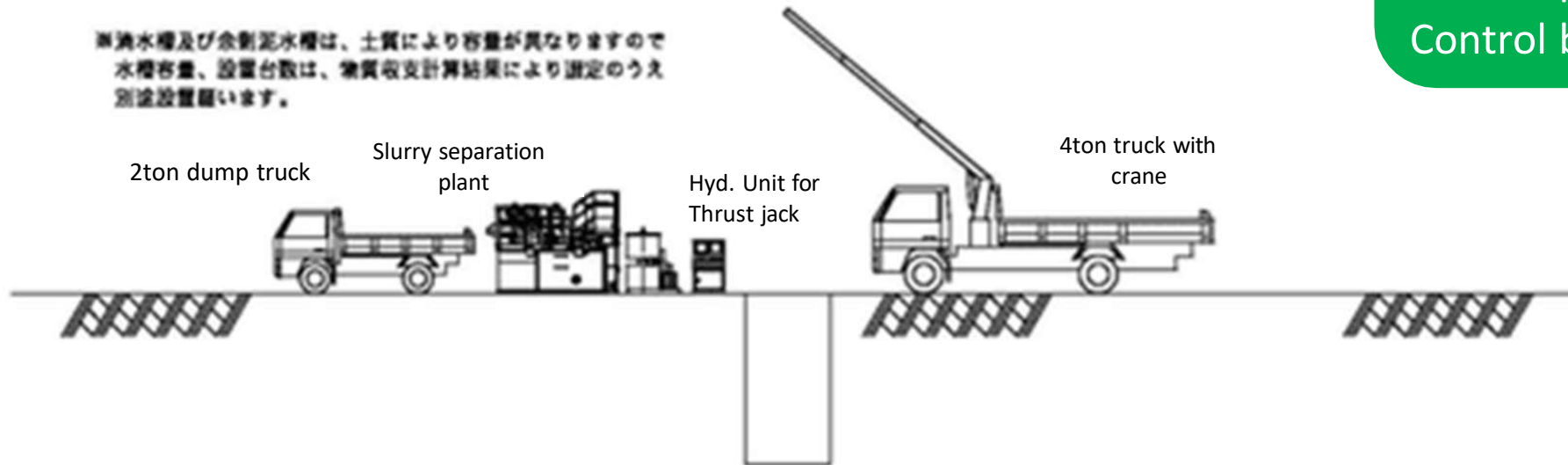


On-site plant equipment location

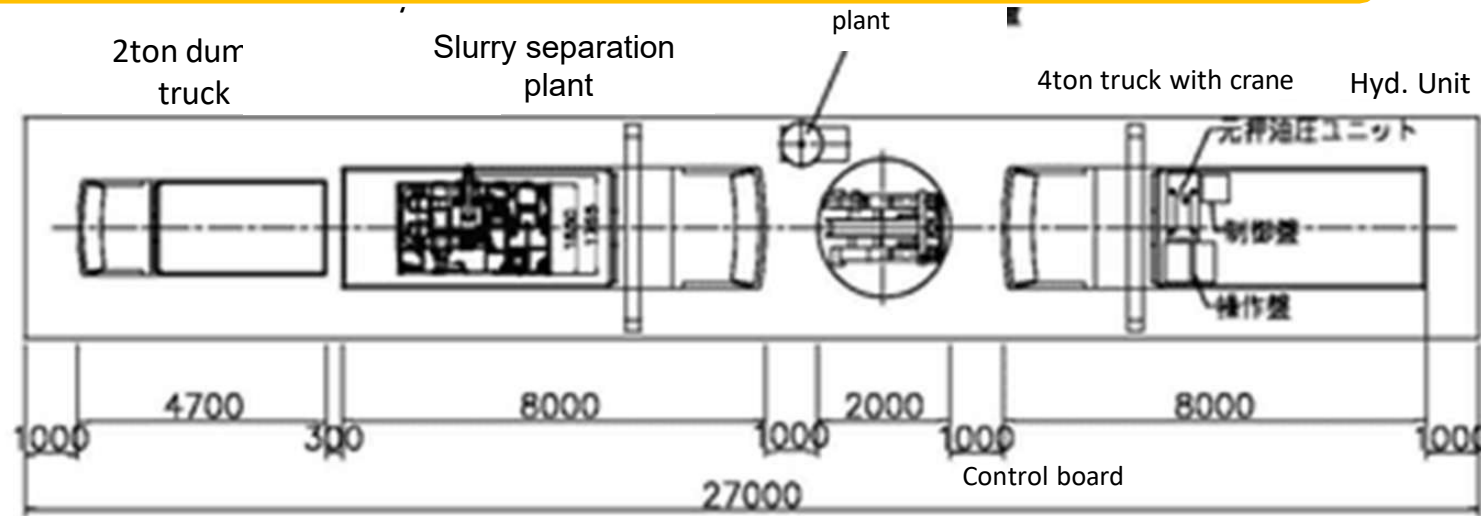
24 m x 4m width road

4t truck with crane
2t dump truck
Slurry separation plant
Hydraulic power unit
Control panel
Control board

※ 潤滑水槽及び余剰泥水槽は、土質により容量が異なりますので
水槽容量、設置台数は、物質収支計算結果により設定のうえ
別途設置願います。

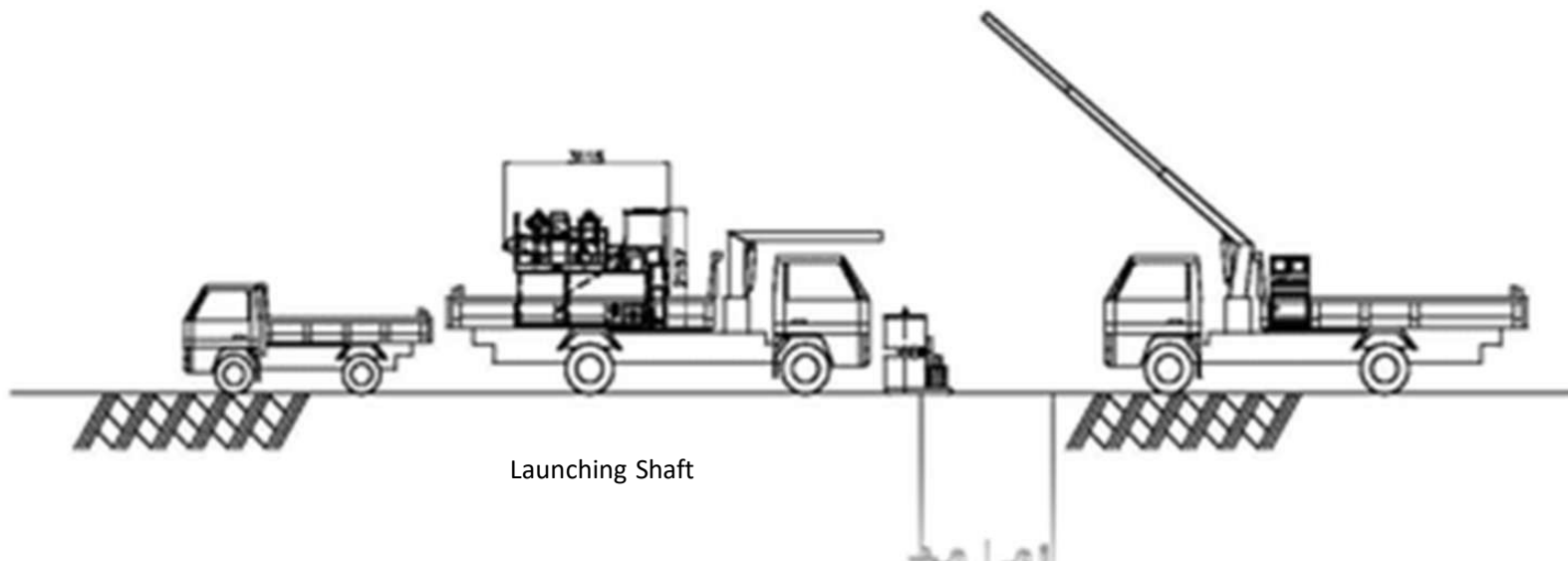


Small Construction site are is required



On-vehicle plant equipment location

- 4t truck with crane x 2
- 2t dump truck
- Slurry separation plant
- Hydraulic power unit
- Control panel
- Control board



It can be operated in small area and minimize impact on traffic and residential life.



4. Feature of PVC pipe jacking (Jacking speed)

| Nominal Diameter | ID 200 – ID 300 | | | | ID 350 & ID 400 | | | |
|-------------------------------------|-----------------|-------------|------------|------------|-----------------|-------------|------------|------------|
| Type of Soil | A | B | C | D | A | B | C | D |
| Replacing pipe time per cycle (min) | 40 | | | | | | | |
| Preparation time per cycle (min) | 10 | | | | | | | |
| Jacking speed (cm/min) | 15 | 4.5 | 1.95 | 3.75 | 14.7 | 4.2 | 1.8 | 3.6 |
| Jacking time per single pipe (sec) | 13 | 44 | 103 | 53 | 17 | 58 | 105 | 68 |
| Total Cycle time (sec) | 63 | 94 | 153 | 103 | 67 | 108 | 185 | 118 |
| Number of cycle per day | 7.62 | 5.11 | 3.14 | 4.66 | 7.16 | 4.44 | 2.59 | 4.07 |
| Jacking distance (m/day) | 15.2 | 10.2 | 6.3 | 9.3 | 17.4 | 10.8 | 6.3 | 9.9 |

| | | |
|----------|-----------------------------------|--|
| A | Normal Soil | Gravel contents less than 30%. Sand or Clay (N Value less than 30) or Maximum gravel diameter less than 20mm |
| B | Gravel Soil | Gravel contents less than 30% and Maximum gravel diameter less than 50mm |
| C | Soil contains cobble stone | Gravel contents less than 60%, Hydraulic Conductivity up to 1×10^{-2} |
| D | Hard soil | Mud stone, Cemented soil (Uniaxial Compression up to 5MN/m ²) |

Why PVC pipe is suitable for smaller diameter sewer pipe

- PVC pipe durability is same as RCP and VCP.
- PVC pipe chemical resistance is better than RCP and VCP.
- PVC pipe life cycle cost is cheaper than RCP and VCP.
- By installing with Pipe jacking, PVC pipe get no effect from the surface such as vibration of the t compacting force.

Benefit of using Iseki Unclemole TCV series

- TCV is possible to launch and retrieve from small shaft
- TCV is possible to dig with variety of soil conditions
- TCV is possible to operate easily and accurately.
- TCV is possible to construct in compact site.

**PVC pipe jacking method can be used to improve Asian sewerage system with
lower cost, lower impact and higher quality
ISEKI willing to support to implement !**

END



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