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Microtunneling Projects for Power-Transmission Pipes – Steep Slopes and Casing Technology

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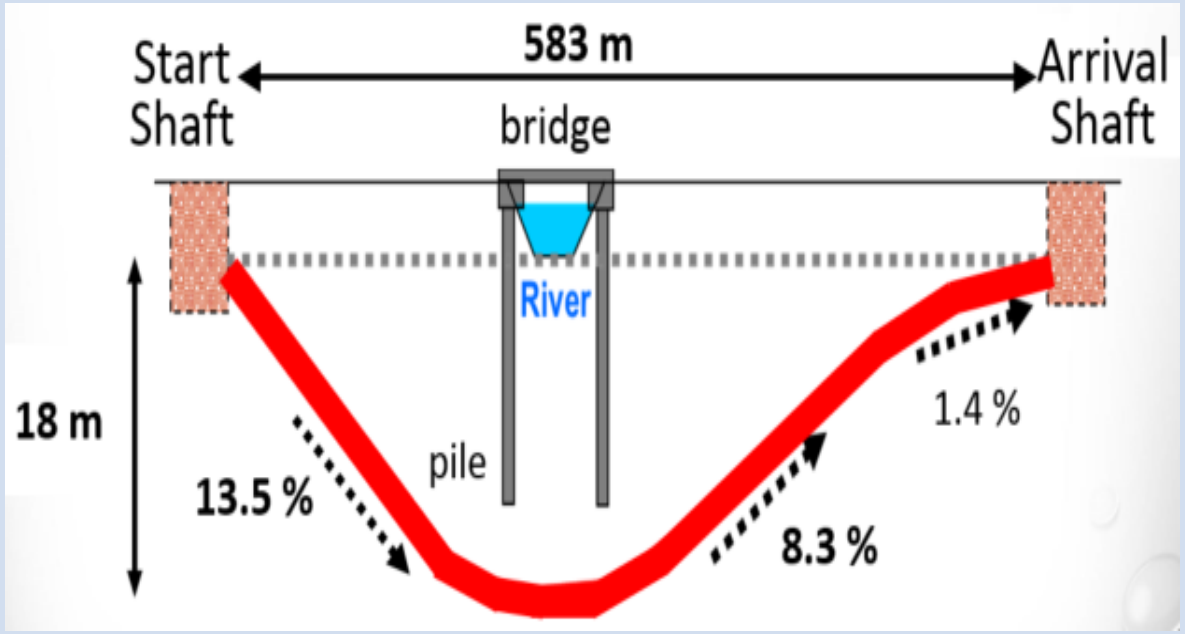
1．Introduction

The alignment design for power transmitting pipes does not need to consider gravity slopes which are typical to sewer designs. Therefore, steep gradient lines can be incorporated.

【Project A example 1】



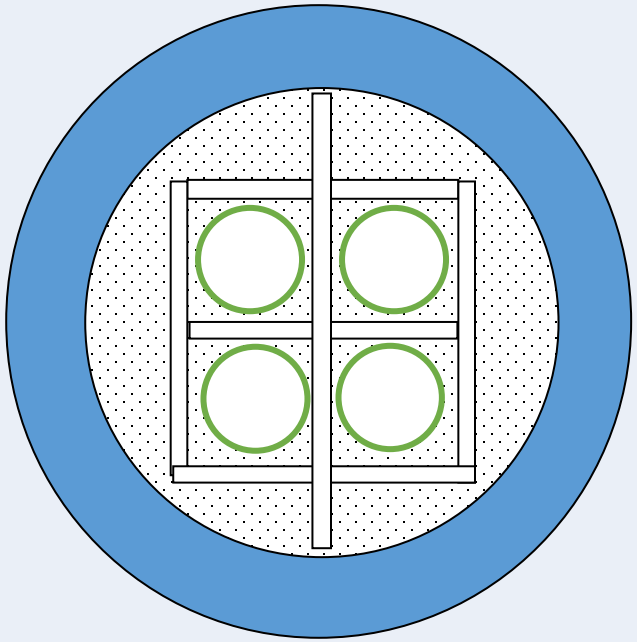
【Project B example 2 】

This paper presents actual two examples of the measures that were taken to overcome three challenges.

2．Purpose and challenges

There are three challenges in applying steep slopes.

【Challenge 1】	【Challenge 2】	【Challenge 3】
Preventing the clogging of slurry-discharge pipes	Ensuring work safety	Adopting internal parallel piping



3. Features of steep slope

A steep gradient in the vertical alignment can make both the start shaft and the arrival shaft shallow and shorten the tunneling distance, thereby reducing the construction cost.

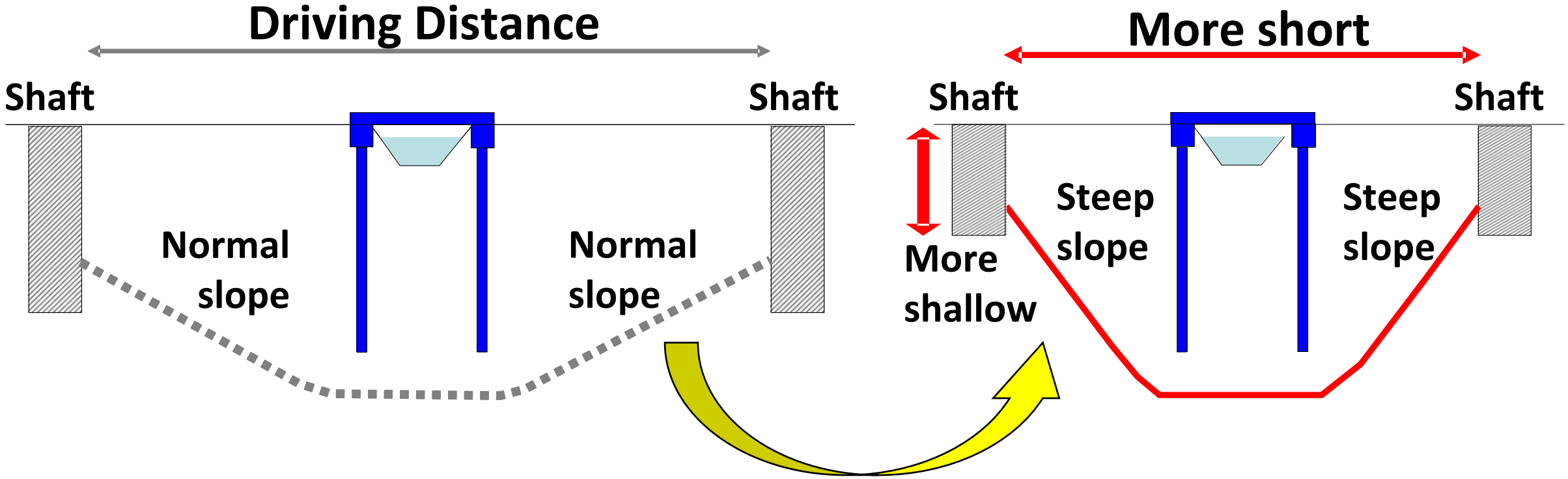


Figure 1. Comparison of the depths of shafts and the driving distances for micro-tunneling performed with different gradients

4-1. Project A

A steep alignment was adopted in mud-slurry micro-tunneling to install 900 mm pipes over a driving distance of roughly 583 m across a river while circumventing bridge foundation piles.

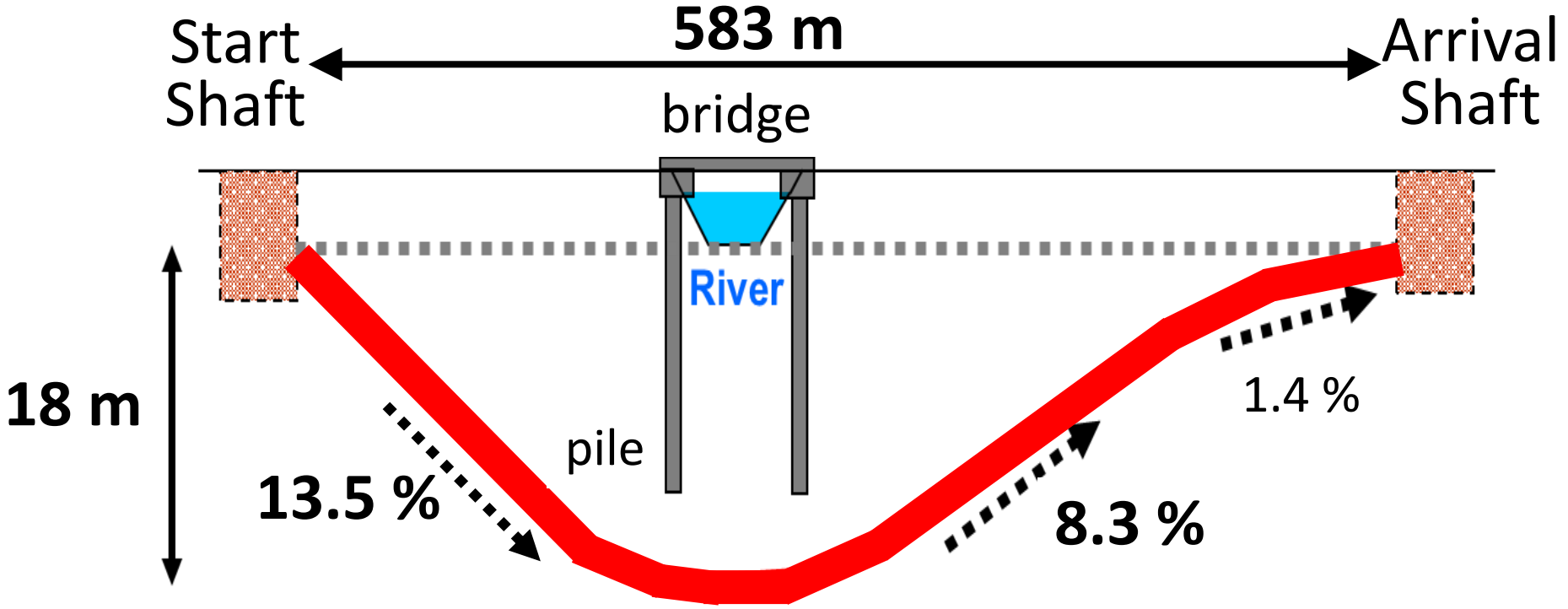


Figure 2. Project A with steep slopes for crossing a river

4-2. Project B

Figure 3 shows the vertical alignment of mud-slurry micro-tunneling carried out with 800 mm pipes in Project B to cross an expressway over a driving distance of roughly 574 m.

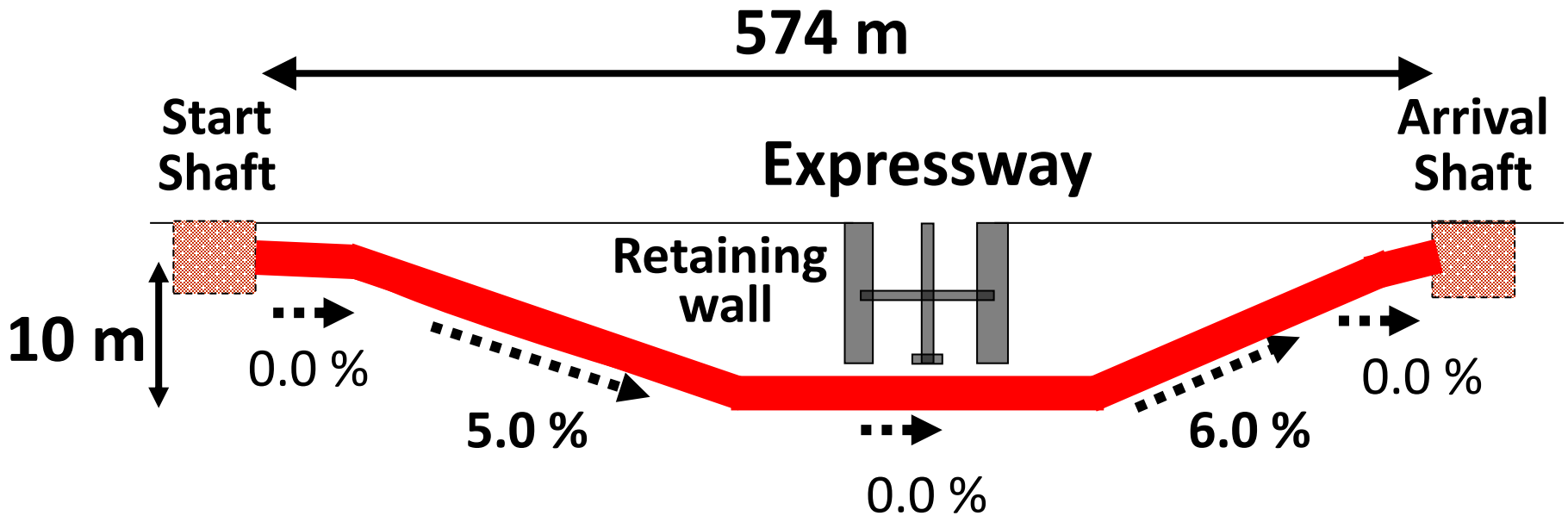
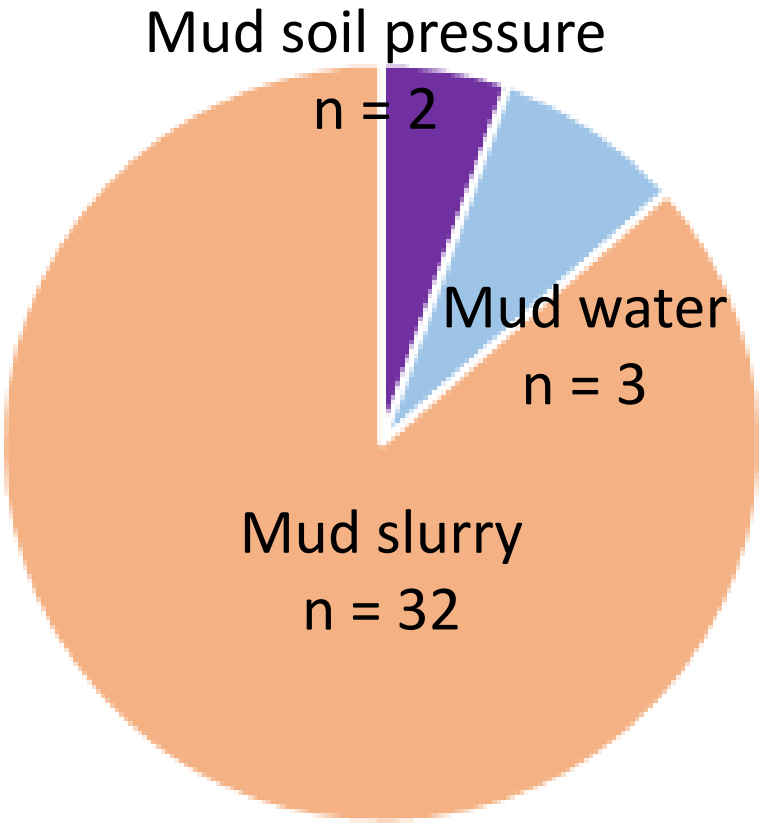


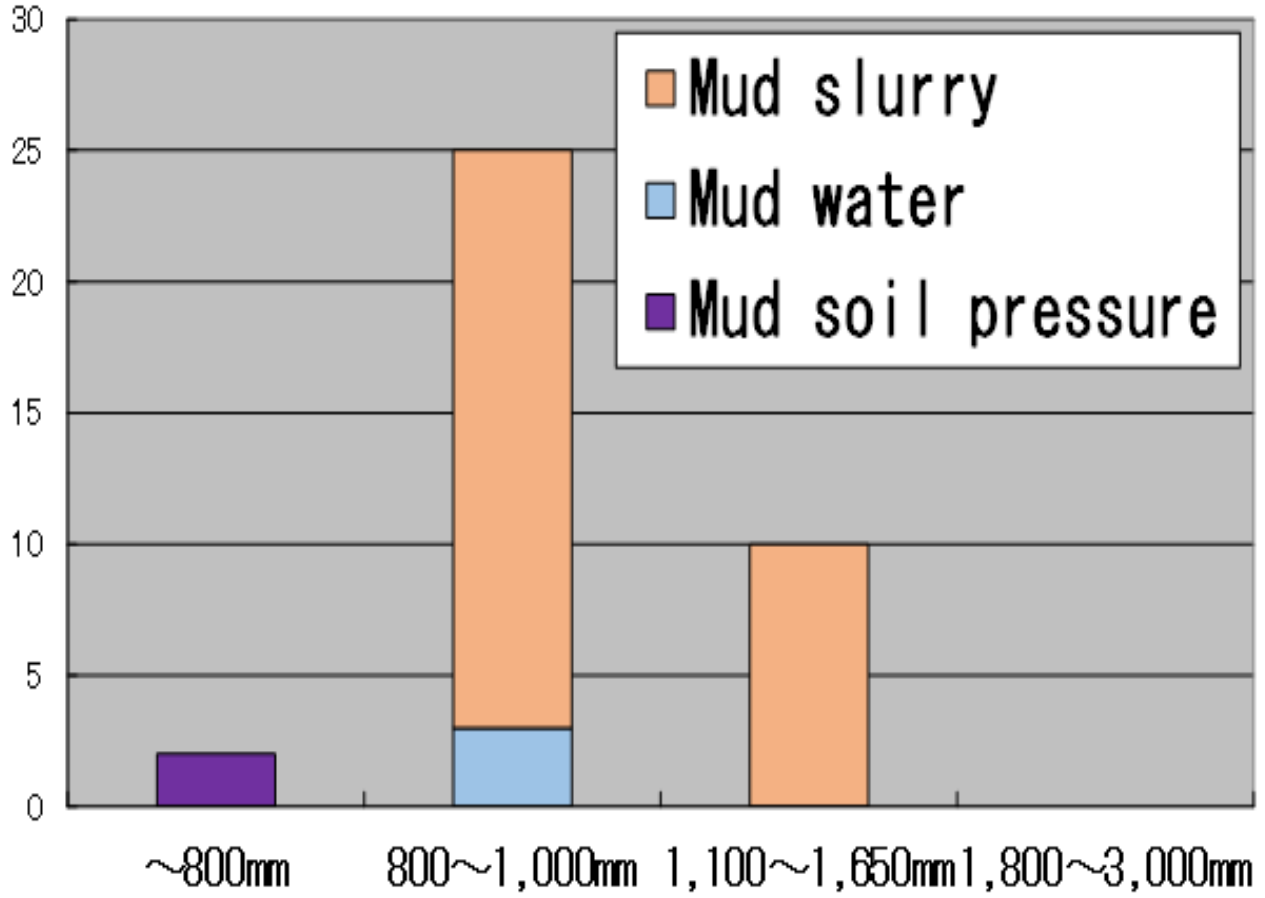
Figure 3. Project B with steep slopes for crossing an expressway

5．Steep slope results

In recent 10 years, there are many mud-slurry micro-tunneling work on steep slopes

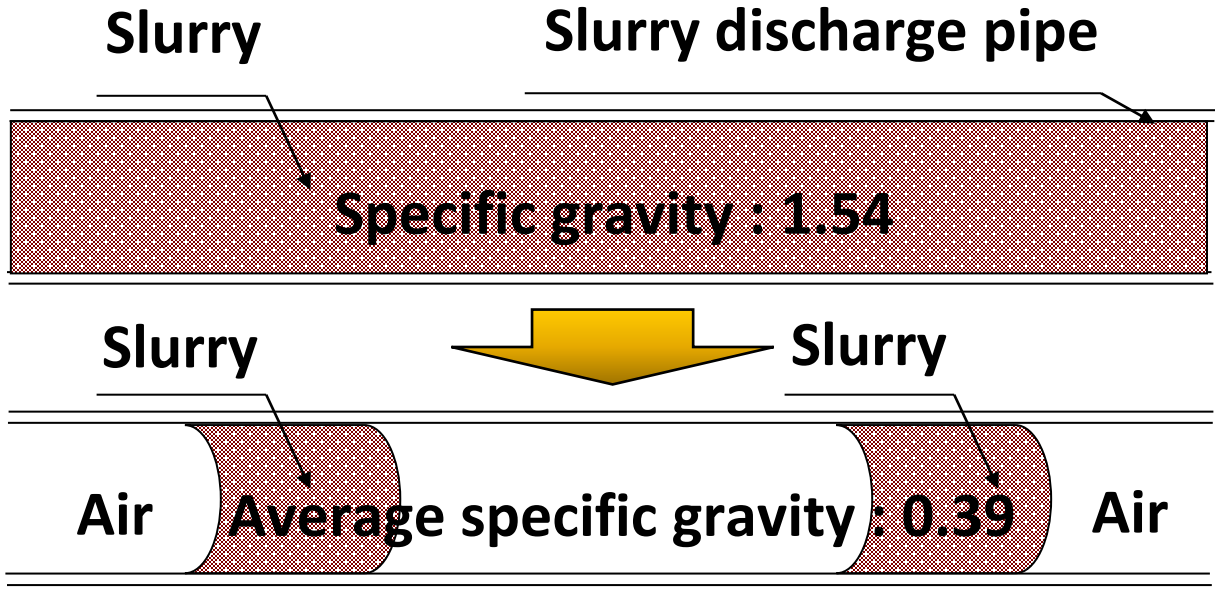


2008 - 2018



6-1. Challenge 1 (Project A)

Slurry discharge pipes may experience blockage when they are laid on a steep gradient.



8.2 m / 1.54 = 5.3 m

8.2 m / 0.39 = 21.0 m

80 kPa pump is applicable!

Figure 4. Illustration of the interior of a discharge pipe and the apparent specific gravity of slurry

6-2. Challenge 1 (Project A)

Blockage of slurry discharge pipes occurred when the excavating machine reached the two spots indicated

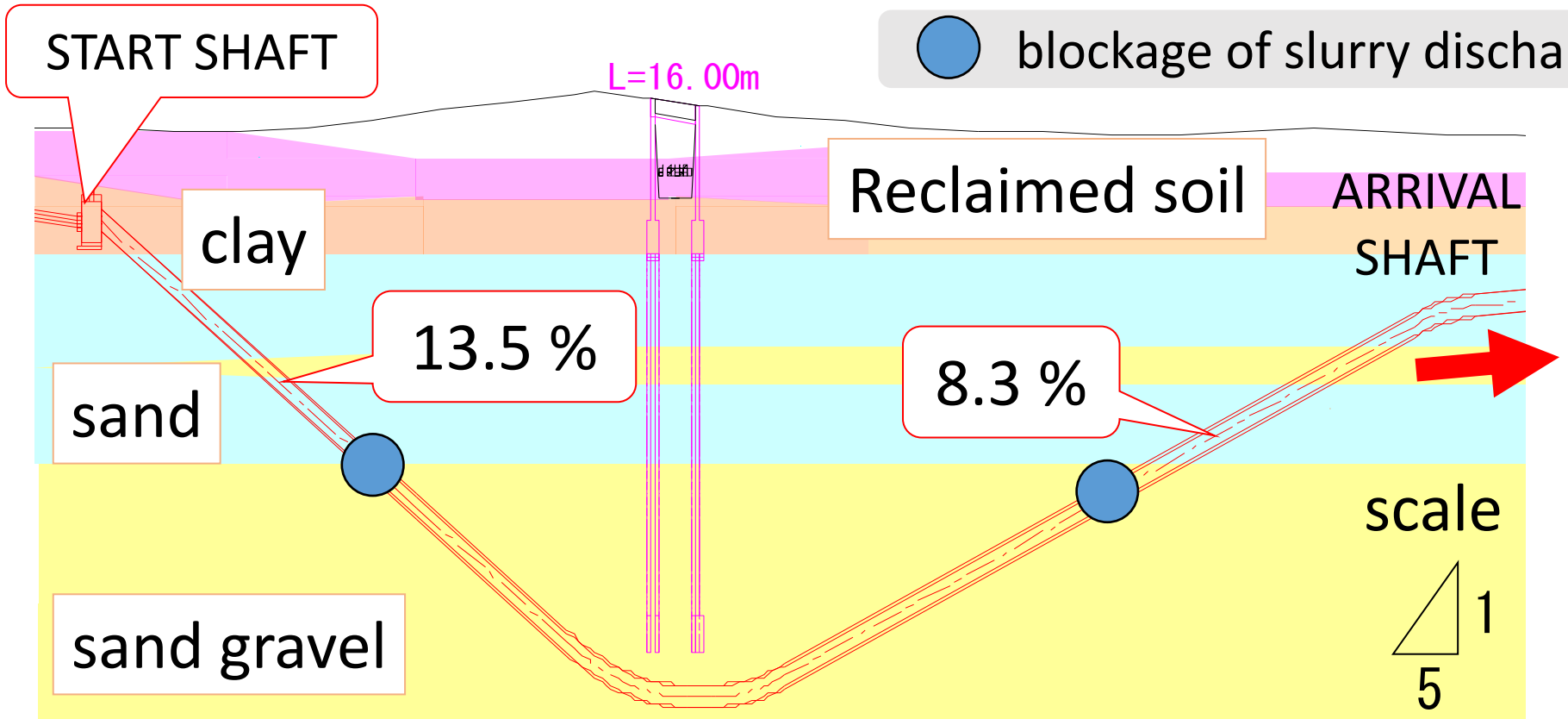


Figure 5. Blockage of slurry discharge pipes

6-3. Challenge 1 (Project A)

The mechanism of the blockage can be explained in steps 1 through 3 below

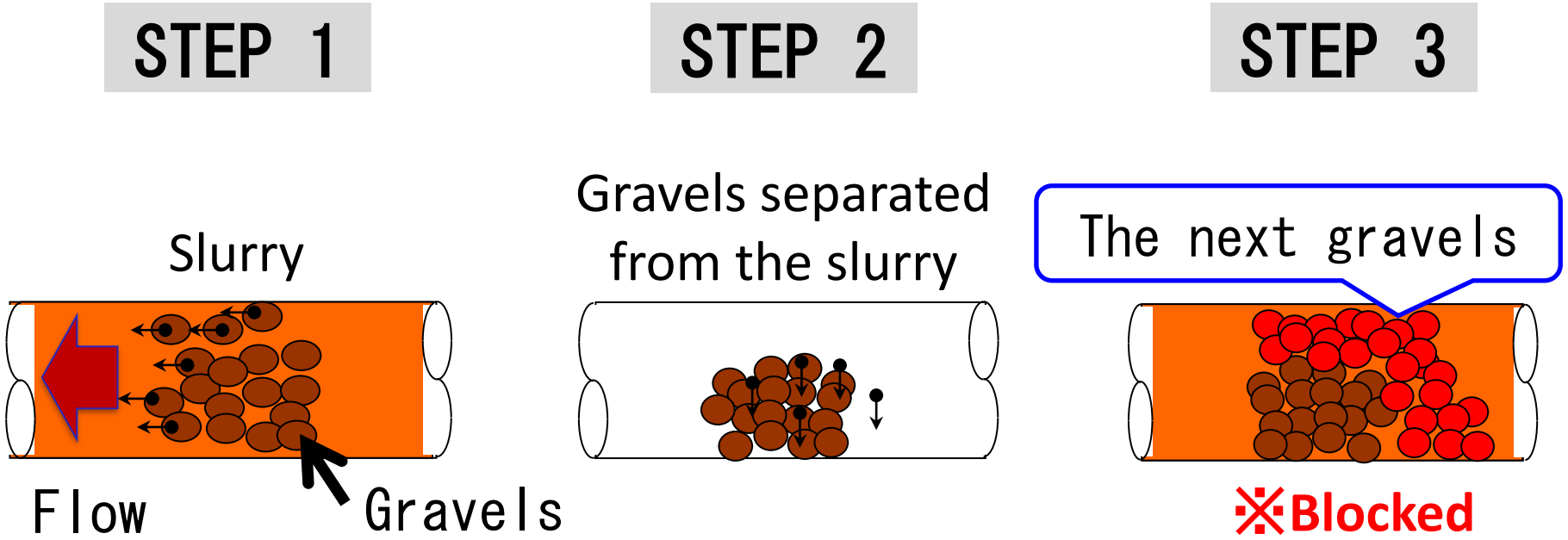


Figure 6. How a slurry discharge gets blocked

6-4. Challenge 1 (Project A)

Figure 7 illustrates measures to prevent the blockage of slurry discharge pipes.

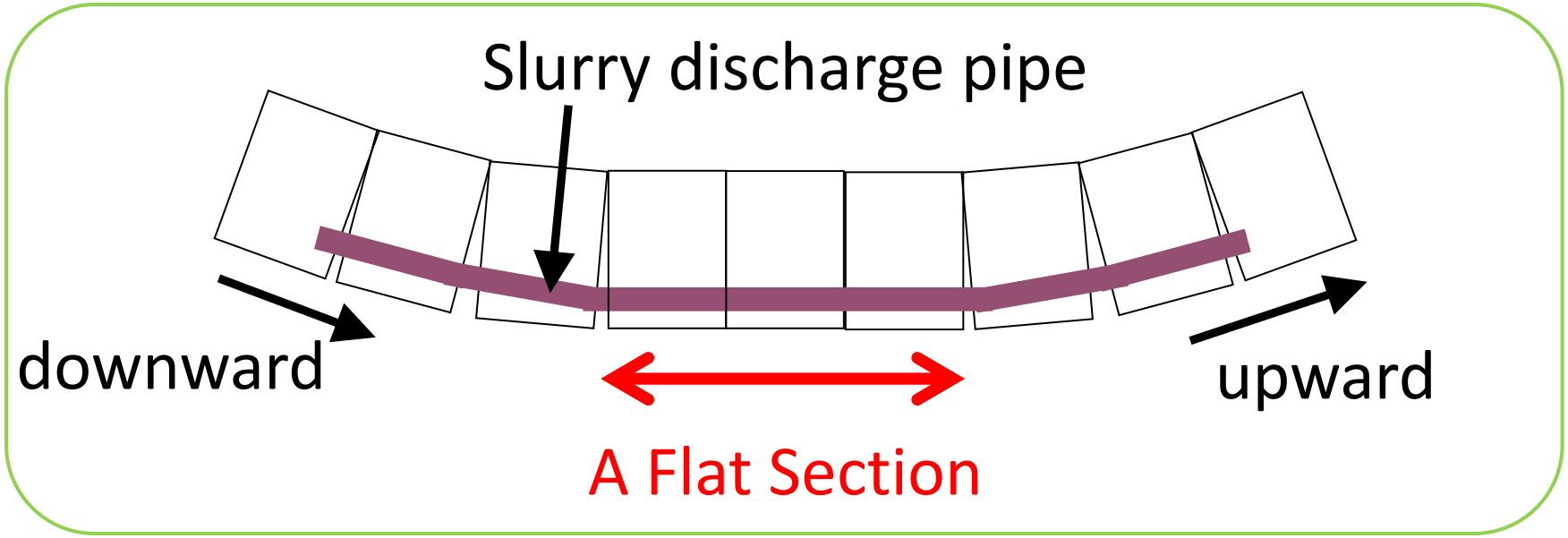


Figure 7. Measures to prevent the blockage of slurry discharge pipes

6-5. Challenge 2 (Project A)

In Project A, various measures were taken to ensure safety during micro-tunneling with a steep gradient and a great height difference.

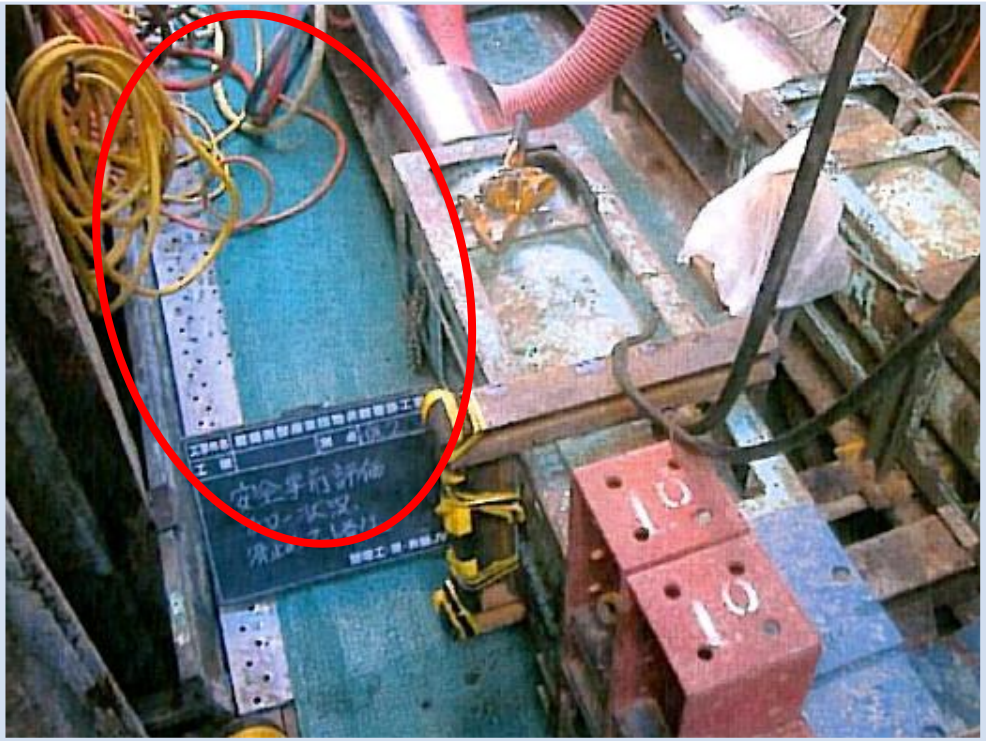
① Anti-slip measures 1	② Anti-slip measures 2
	

Figure 8. Safety measures taken at the start shaft

6-6. Challenge 2 (Project A)

During the project, a tiny motorized car was used in the micro-tunnel so that workers can travel up and down the steep slopes safely and efficiently.

Figure 9. A tiny motorized car

6-7. Challenge 3 (Project B)

Figure 10 shows the installation design of the trolleys and the four pipes inside the host pipe.

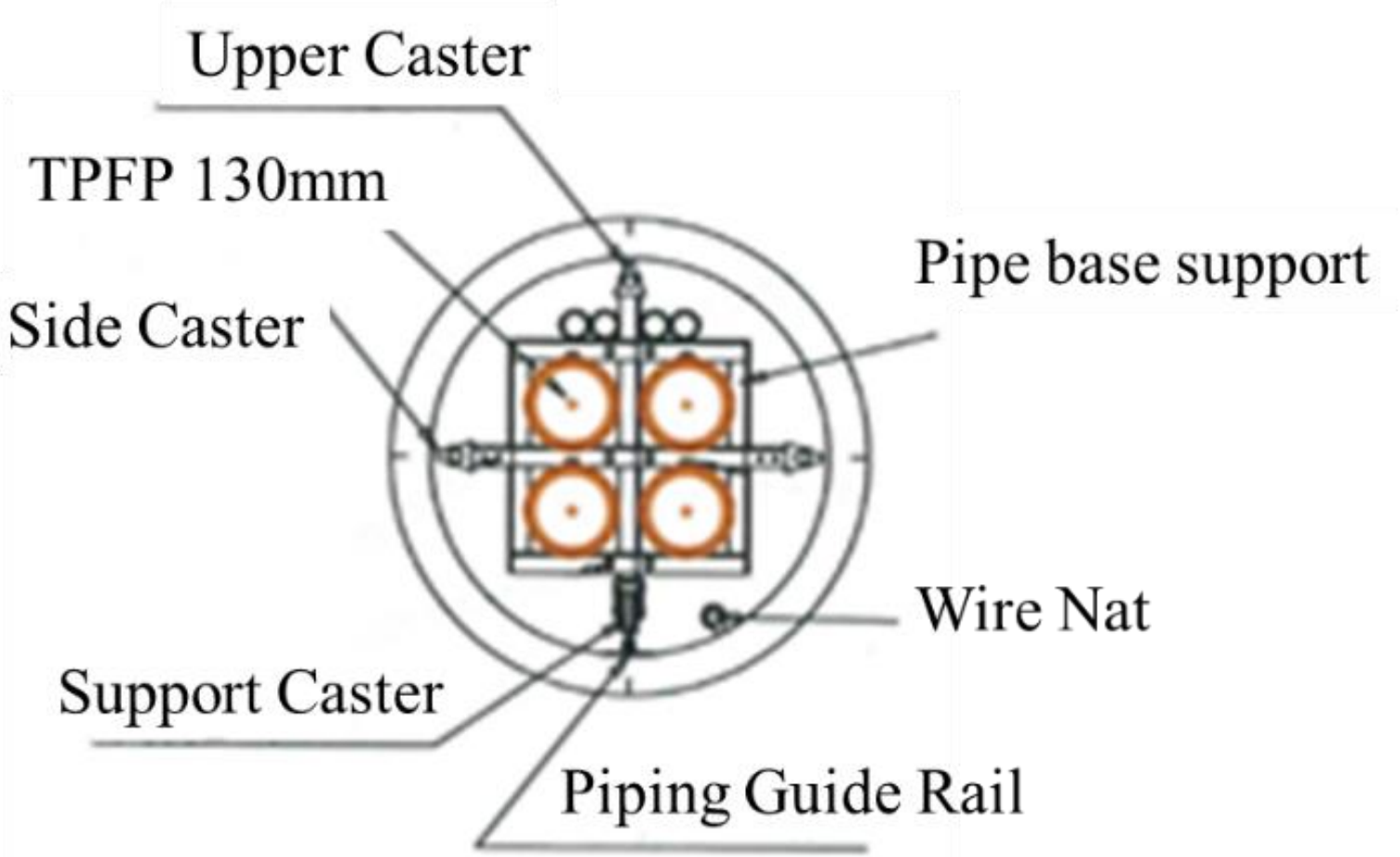


Figure 10 Installation design for four pipes and trolleys inside the host pipe

6-8. Challenge 3 (Project B)

Two types of trolleys were used: a leading trolley and trolleys for carrying pipes.

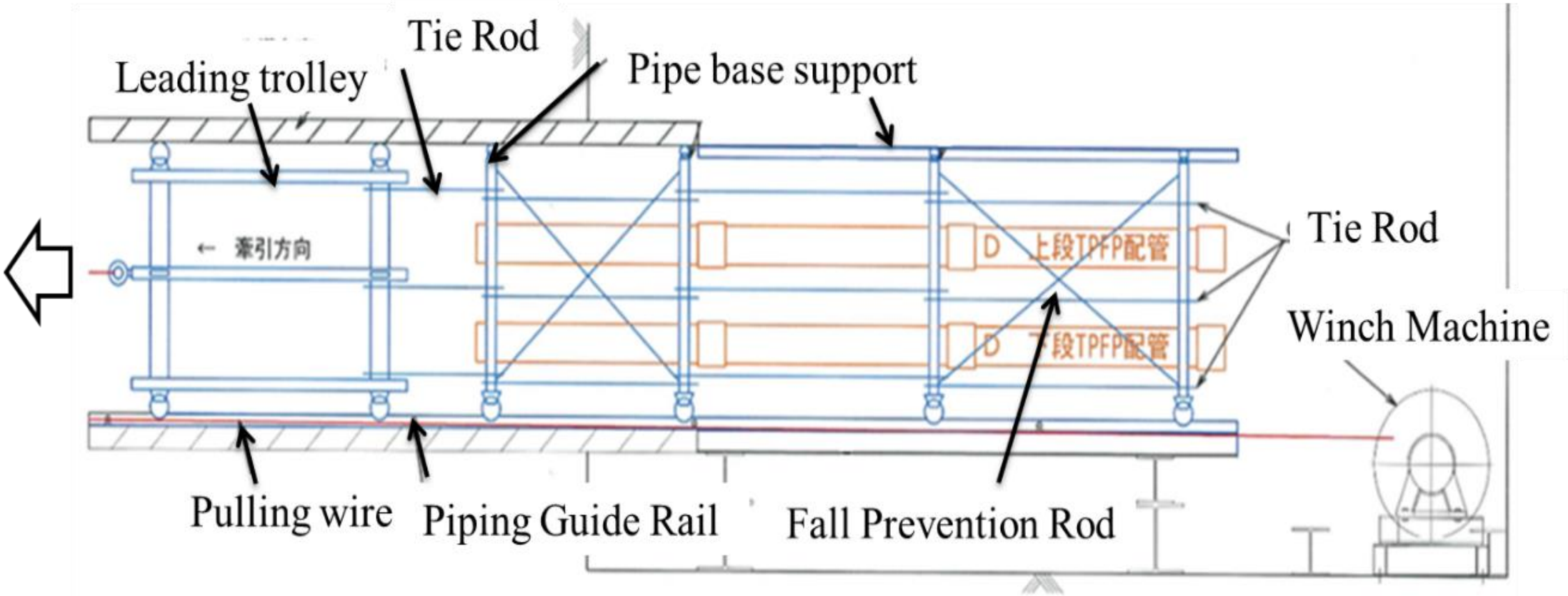


Figure 11 Pipes assembled on a trolley at the entrance of the host pipe

6-9. Challenge 3 (Project B)

Unmanned long-distance piping installation was made possible

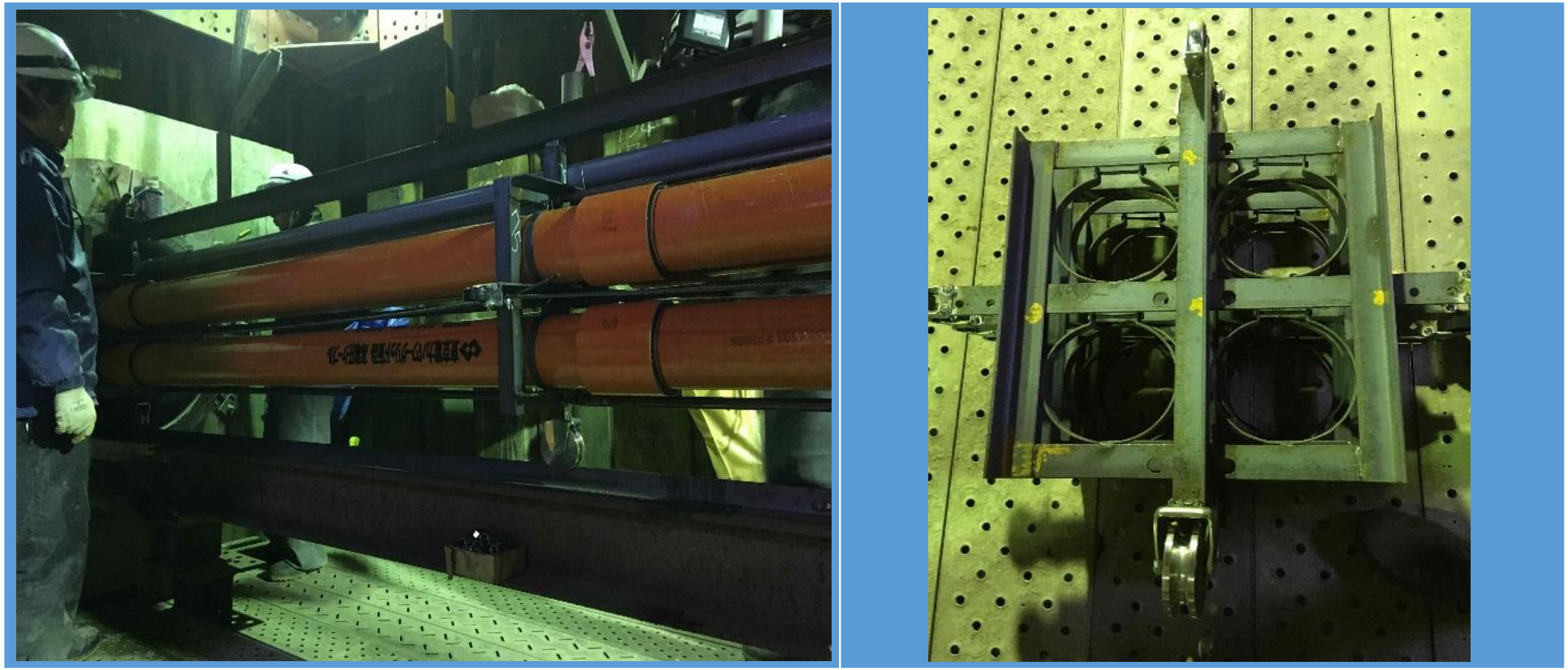


Figure 12 Pipes assembled on a trolley at the entrance of the host pipe (photos)

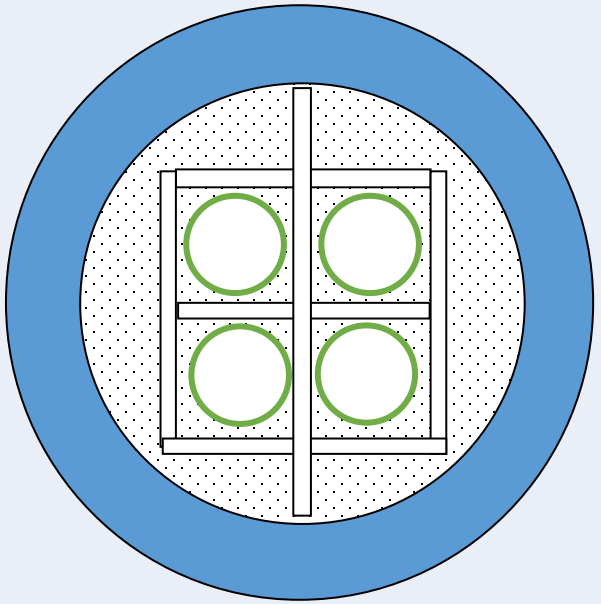
6-10. Challenge 3 (Project B)

In Project B, the piping installation was completed in 12 days over a driving distance of 573 m.

Date		Daily progress (m)	Cumulative progress (m)
Day 1	2019/1/28	30	30
Day 2	2019/1/29	32	62
Day 3	2019/1/30	32	94
Day 4	2019/1/31	58	152
Day 5	2019/2/1	20	172
Day 6	2019/2/4	38	210
Day 7	2019/2/5	40	250
Day 8	2019/2/7	70	320
Day 9	2019/2/8	**88**	408
Day 10	2019/2/12	72	480
Day 11	2019/2/13	58	538
Day 12	2019/2/14	20	558

7．Conclusion

【Measures on steep slopes】

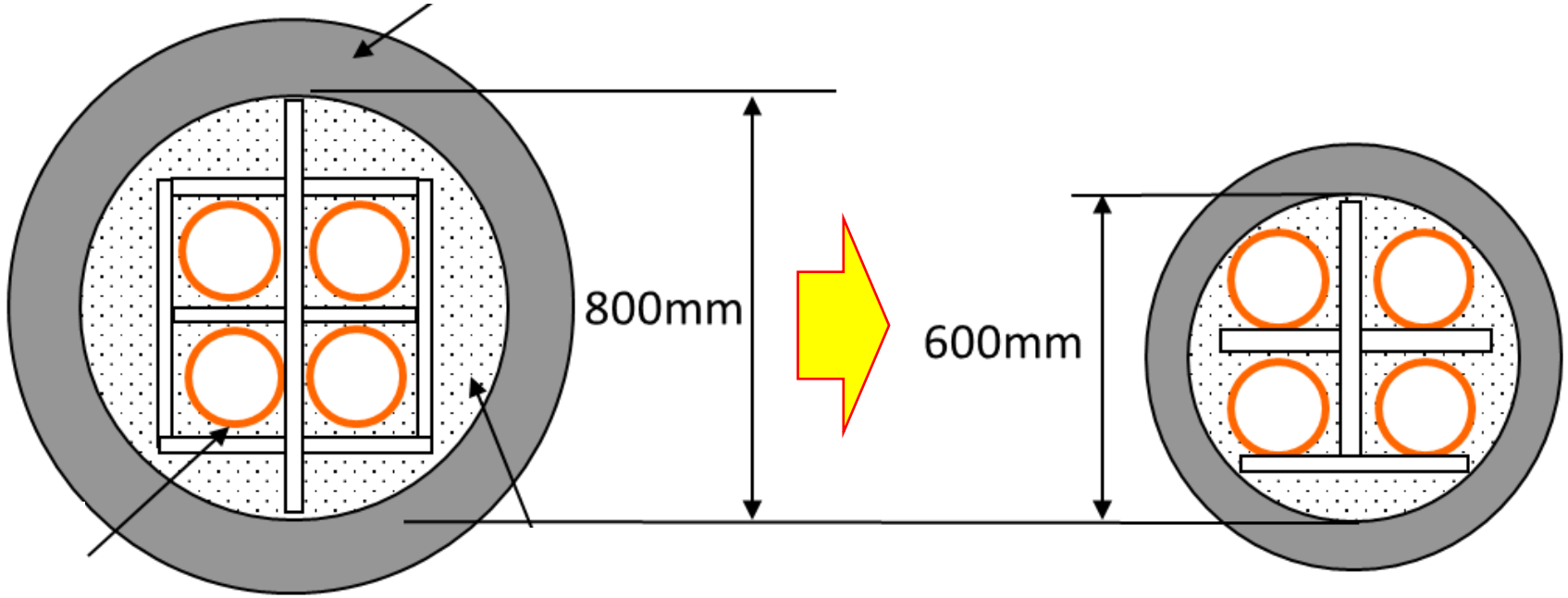
【 1 】	【 2 】	【 3 】
Preventing the clogging of slurry-discharge pipes	**Ensuring work safety**	**Adopting internal parallel piping**
		

7 . Conclusion

【Future efforts】

1 . Realization of smaller diameter micro tunnels

2 . Expand to other infrastructure fields



Thank you for your attention

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