

CONSTRUCTION OF THE BREAKWATER USING BAMBOO PILE AND BAMBOO MATTRESS AS FOUNDATION MATERIAL



TOYO CONSTRUCTION
International division
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AGENDA

1. PROJECT OUTLINE

2. ADOPTION HISTORY OF BAMBOO MATERIAL

3. TRIAL/ACTUAL PILING OF BAMBOO PILE

4. INSTALLATION OF BAMBOO MATTRESS

5. CONCLUSIONS

1. PROJECT OUTLINE

- Project : The Urgent Rehabilitation Project of Tanjung Priok
- Location : Tanjung Priok Port, North Jakarta, Indonesia
- Employer : Direct General of Sea Transportation,
Ministry of Transportation
- Funds : Official Development Assistance of Japan
- Contractor : TOYO・ADHI KARYA JV
- Term : 22nd March 2012 ~ 8th September 2014 (900days)



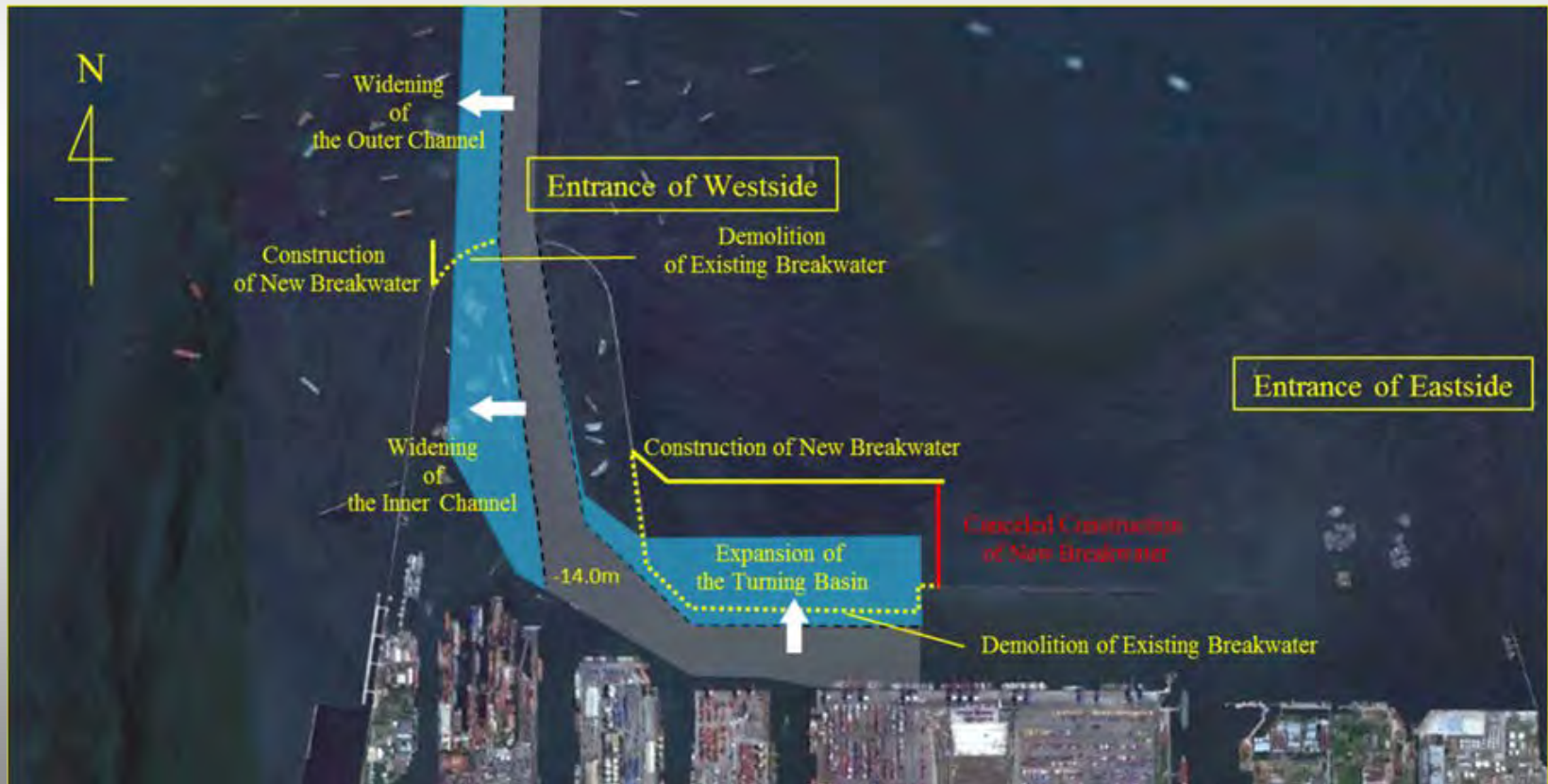
1. PROJECT OUTLINE



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Main Quantity

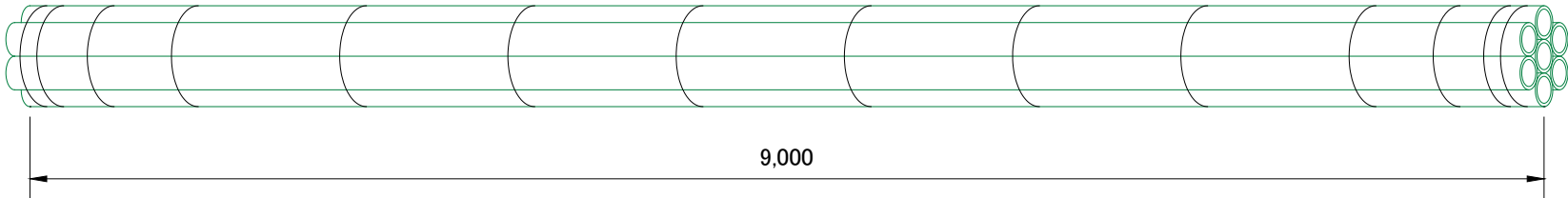
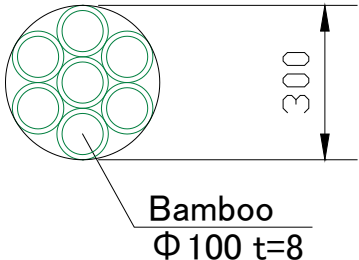
| | | | |
|------------------------------|------------------------|-------------------|--------------------------|
| Removal Existing Breakwater | 2,057 m | Stone Work | 146,990 m ³ |
| Construction New Breakwater | 1,469 m | Coping Block | 718 nos |
| Trench Excavation | 150,270 m ³ | Dissipation Block | 23,286 nos |
| Piling Bamboo Pile | 34,721 nos | Dredging Work | 8,019,000 m ³ |
| Installation Bamboo Mattress | 45,890 m ² | | |



1. PROJECT OUTLINE

What is bamboo pile?

Bamboo Pile Detail

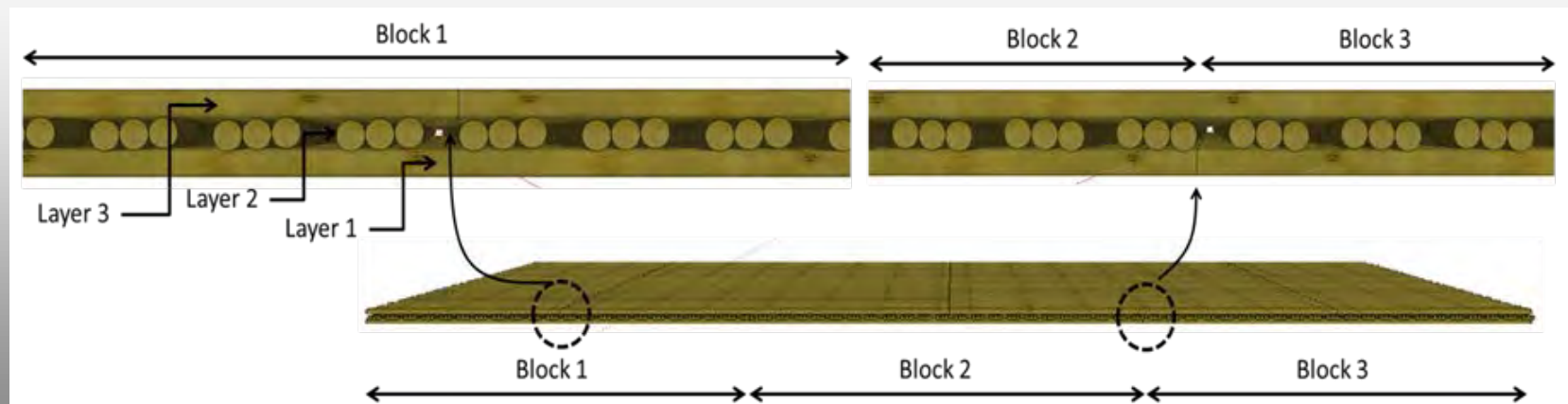


1. PROJECT OUTLINE

What is bamboo mattress?

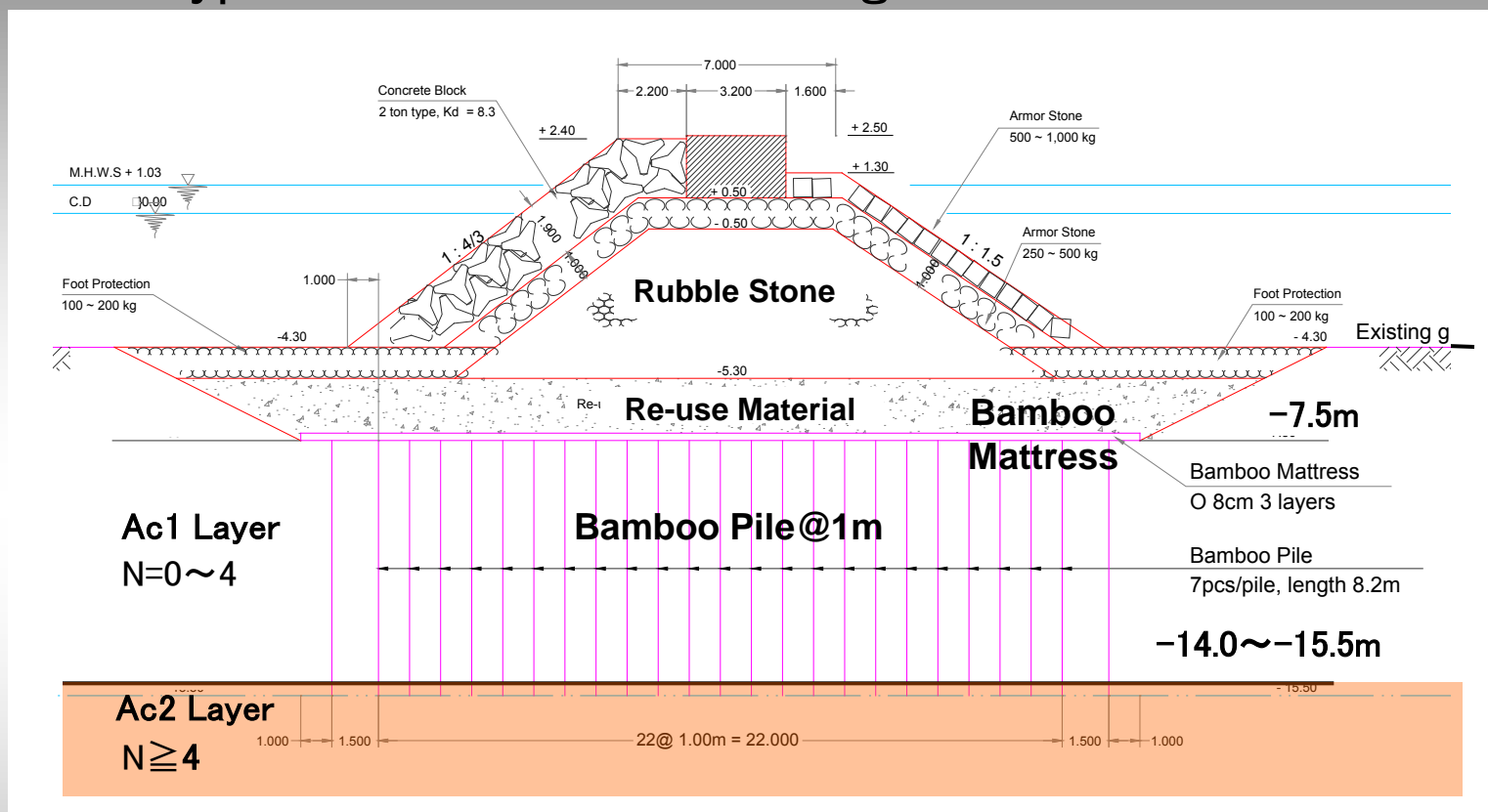


Double Cross Formation



1. PROJECT OUTLINE

Typical Cross Section Using Bamboo Material



The expected effect of bamboo pile and mattress

Shear resistance of bamboo

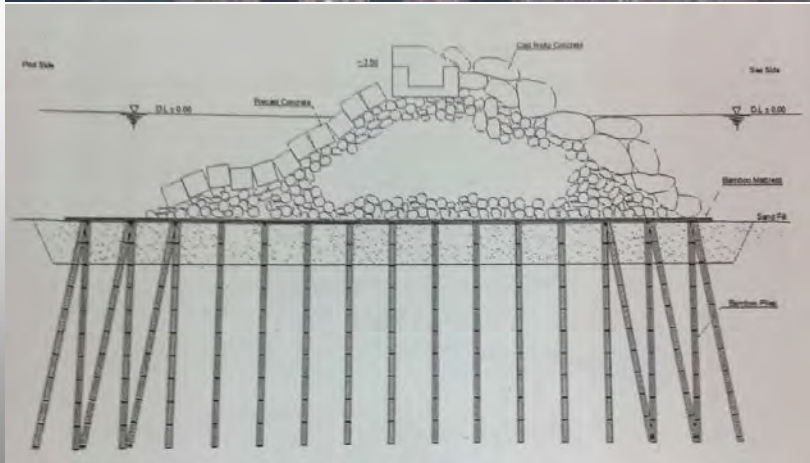
Prevention of rotation slip

The perpendicular strength of bamboo pile

Reduction of settlement

2. ADOPTION HISTORY OF BAMOO MATERIAL

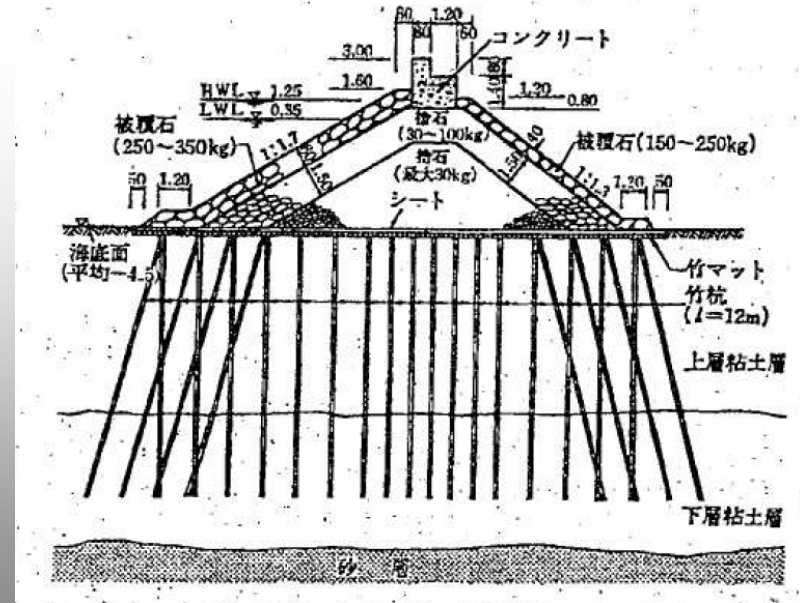
- Operating Experience of Bamboo Material in Tanjung Priok Port -
Breakwater Dam Citra constructed in 1961



Appeared Bamboo Pile in Condition

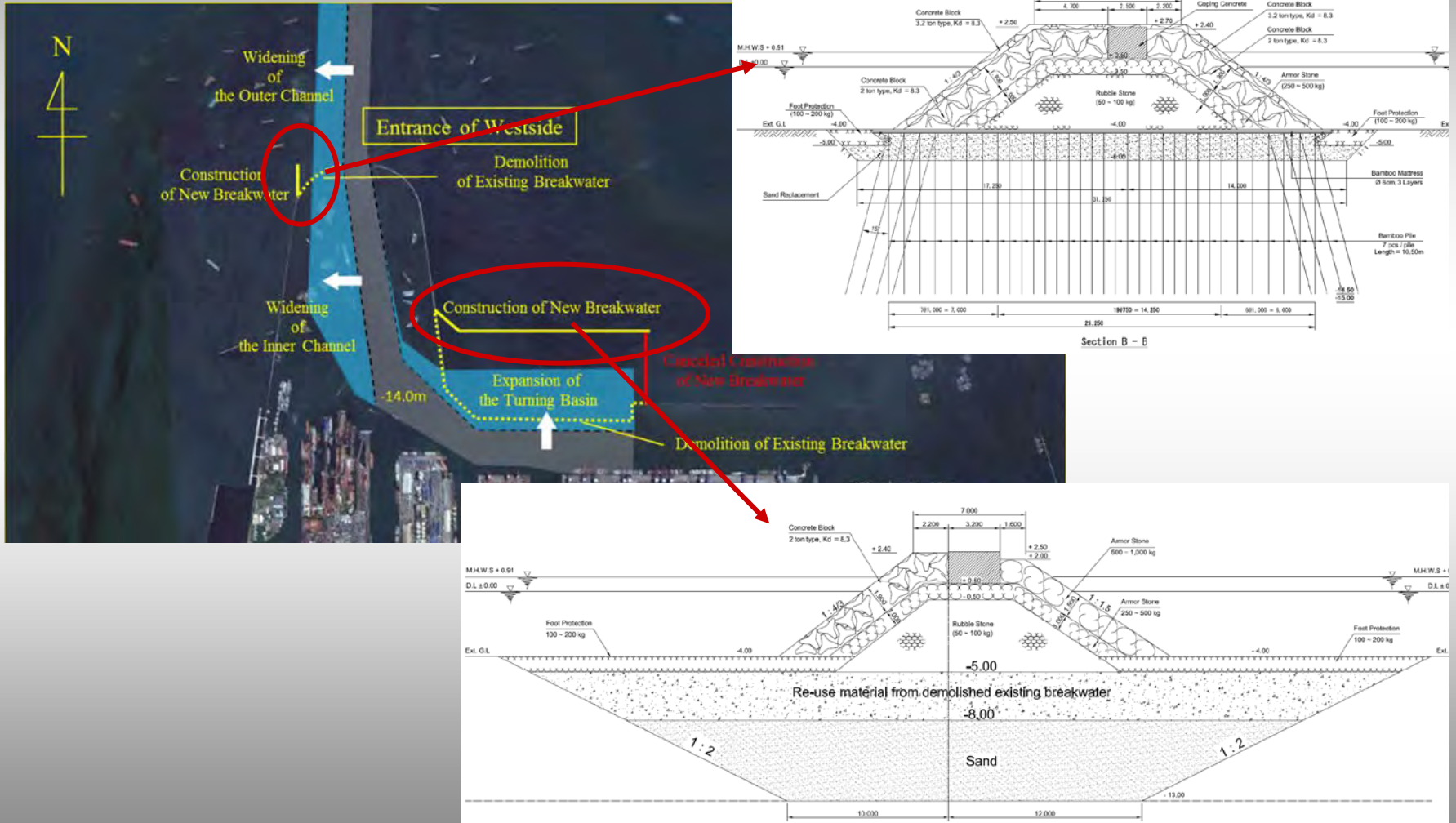
2. ADOPTION HISTORY OF BAMBOO MATERIAL

- Operating Experience of Bamboo Material in Jakarta Fishing Port -



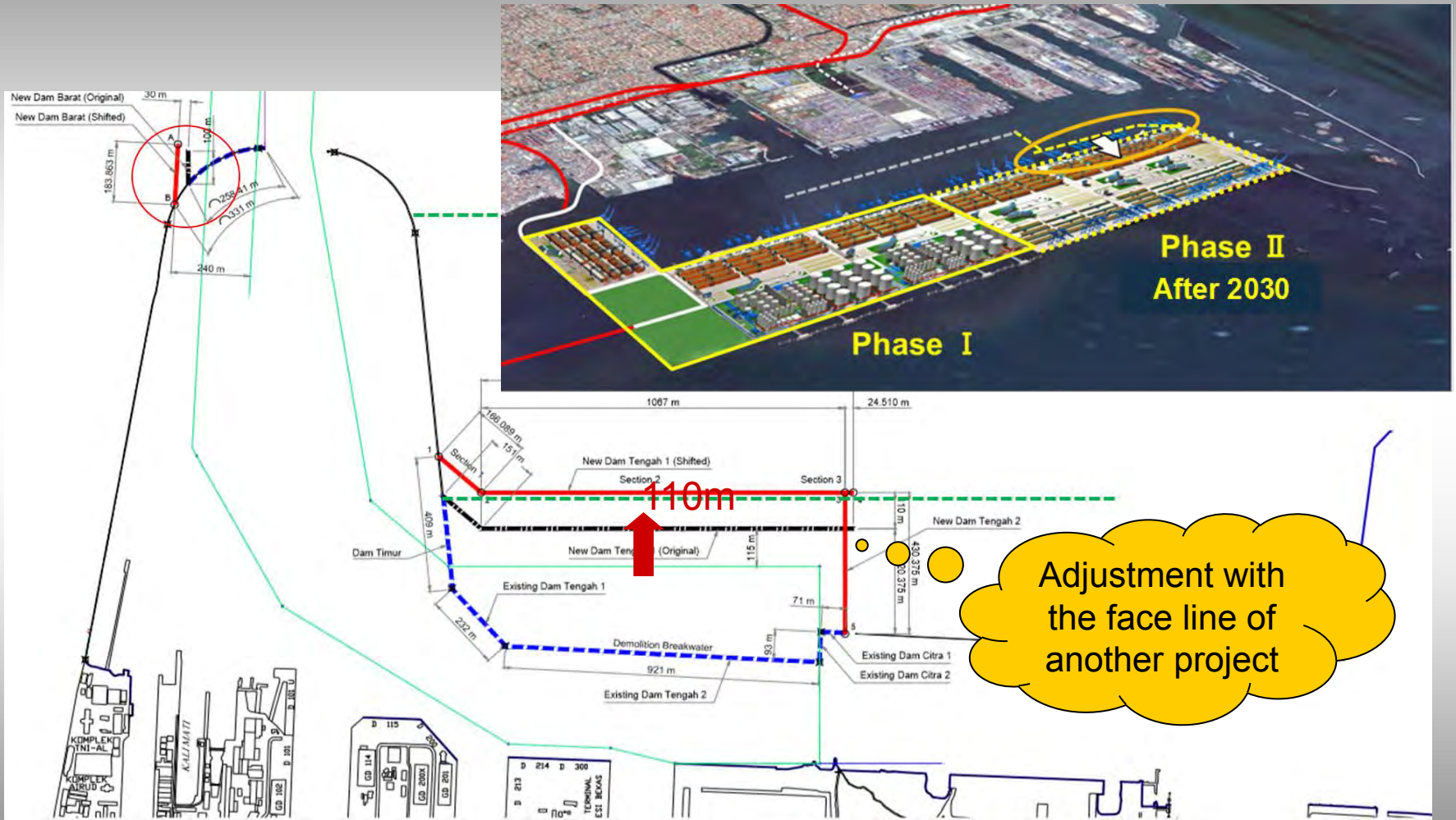
2. ADOPTION HISTORY OF BAMOO MATERIAL

Original design at north new breakwater adopted bamboo material
The specification was referred to the project of Jakarta Fishing Port



2. ADOPTION HISTORY OF BAMOO MATERIAL

Another Container Terminal Project started in the adjacent area



3. TRIAL/ACTUAL PILING OF BAMBOO PILE

Purpose of trial piling of bamboo pile

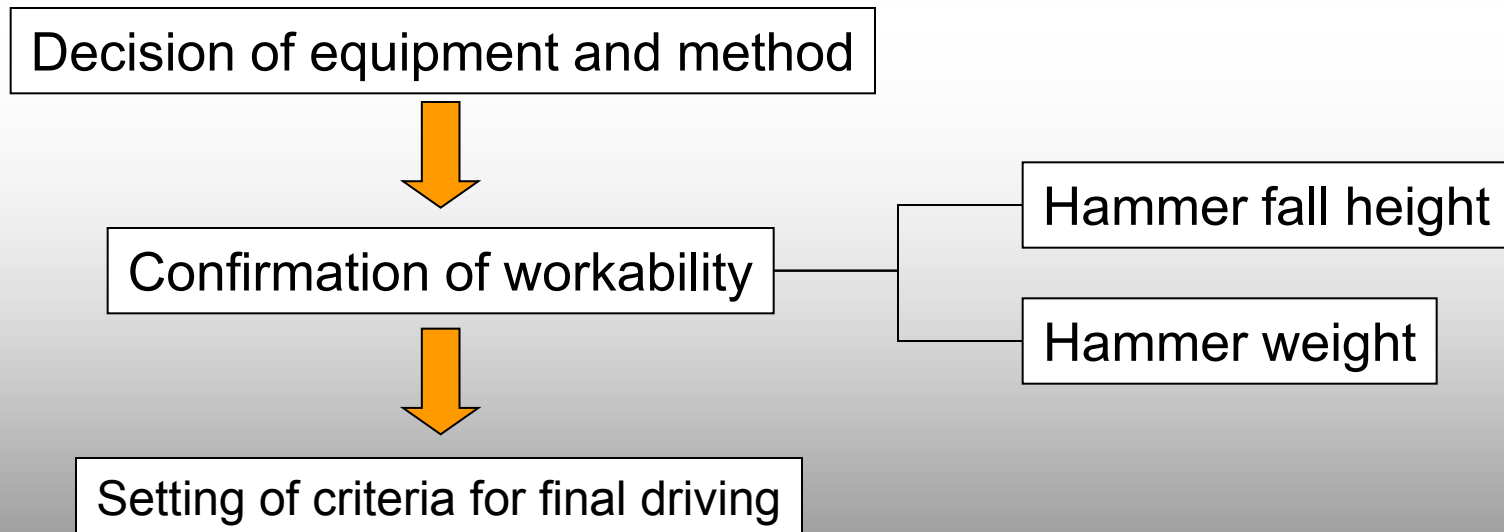
Determine the Criteria

- Confirmation of workability . . . to detailed construction method

- Criteria of final driving

Case of Jakarta fishing port . . . settlement and rotation slip

Trial piling flow

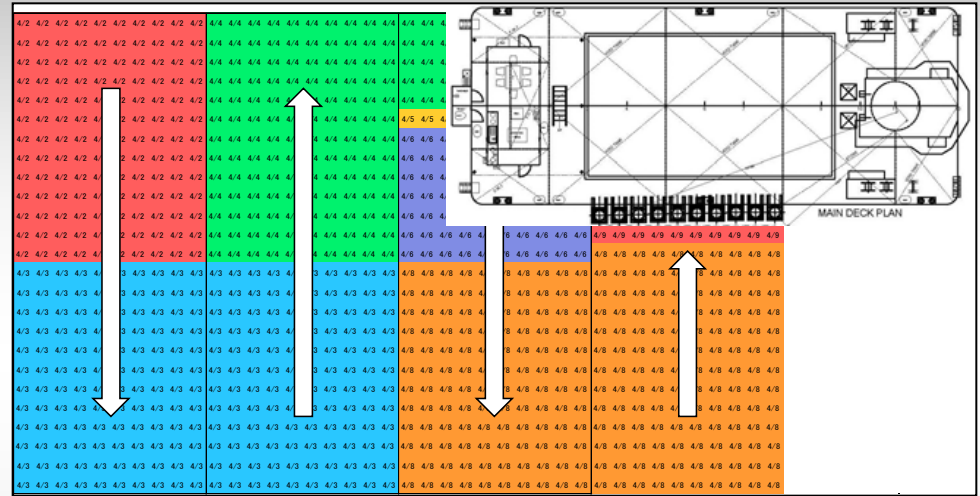
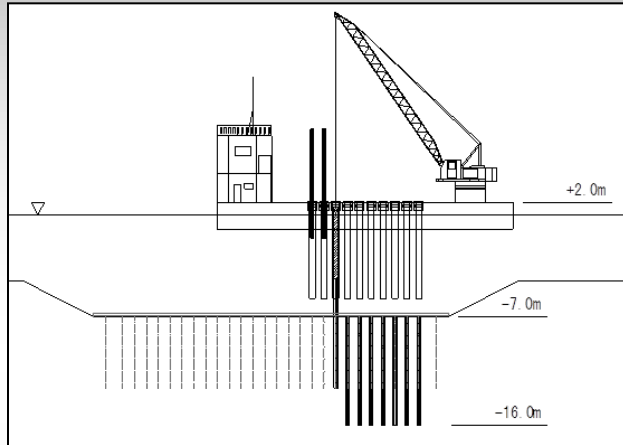


3. TRIAL/ACTUAL PILING OF BAMBOO PILE

① Decision of equipment and method

Equipment : 15t floating crane refitted to decuple casing mount

Method : Drop hammer method refer to Jakarta fishing port

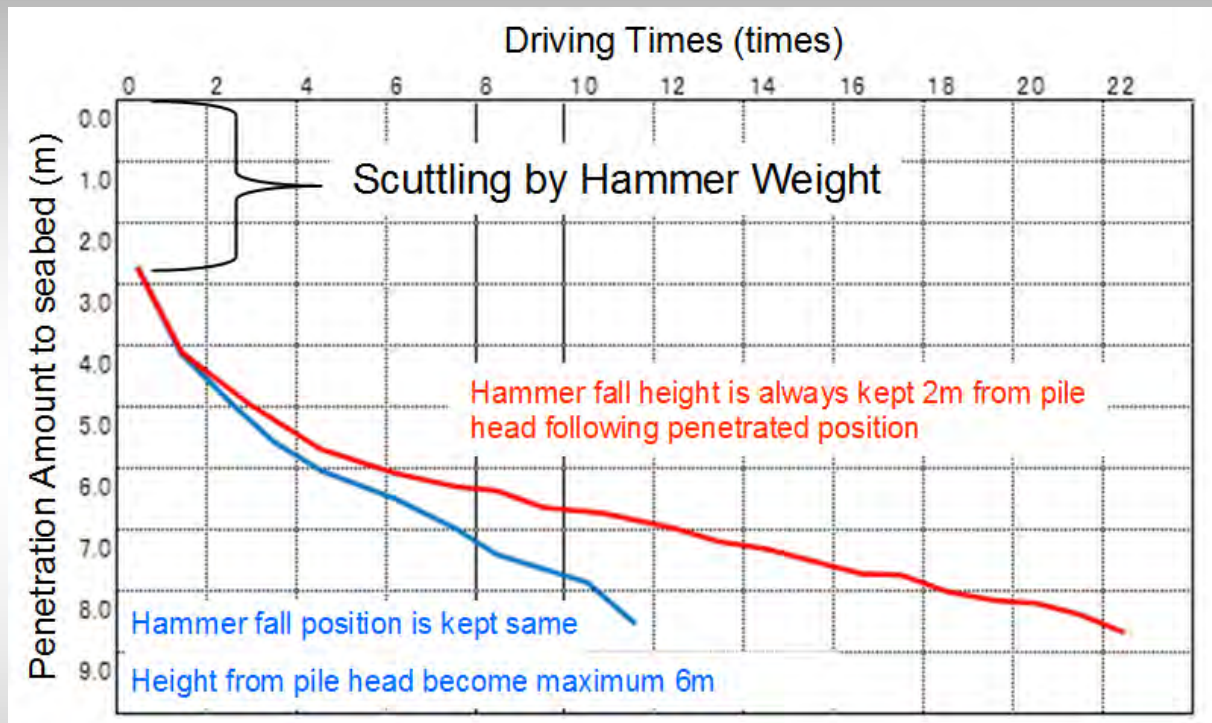


Casing $\phi 50\text{cm}$ L=7m

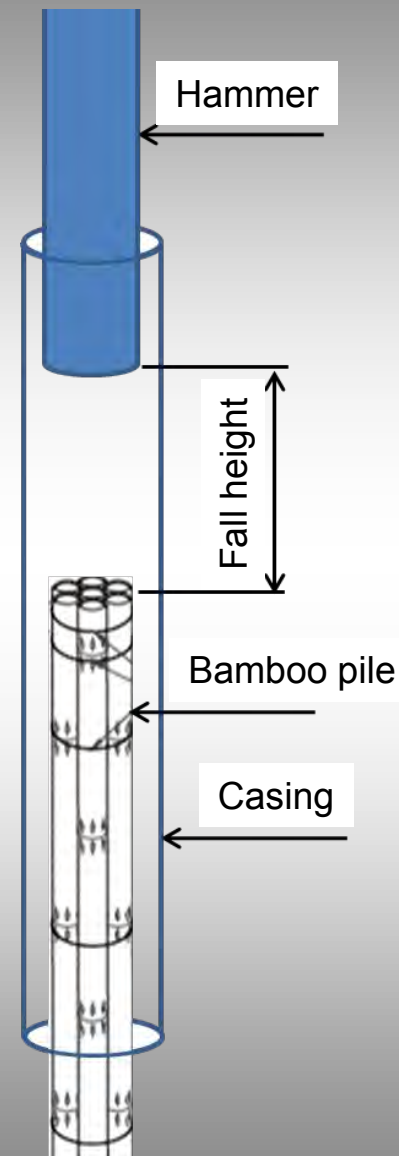
3. TRIAL/ACTUAL PILING OF BAMBOO PILE

② Confirmation of workability

1) Hammer fall height (hammer weight :2.0t)



If fall height become too high



3. TRIAL/ACTUAL PILING OF BAMBOO PILE

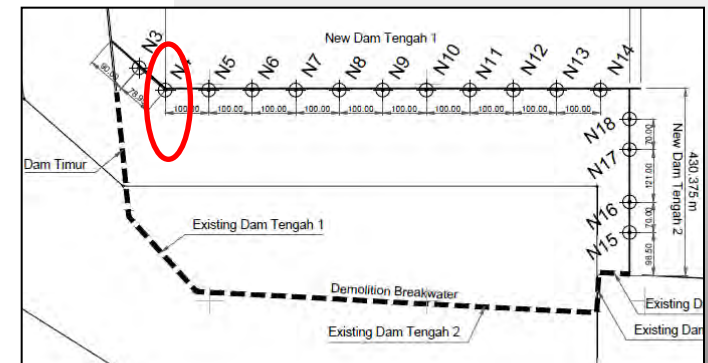
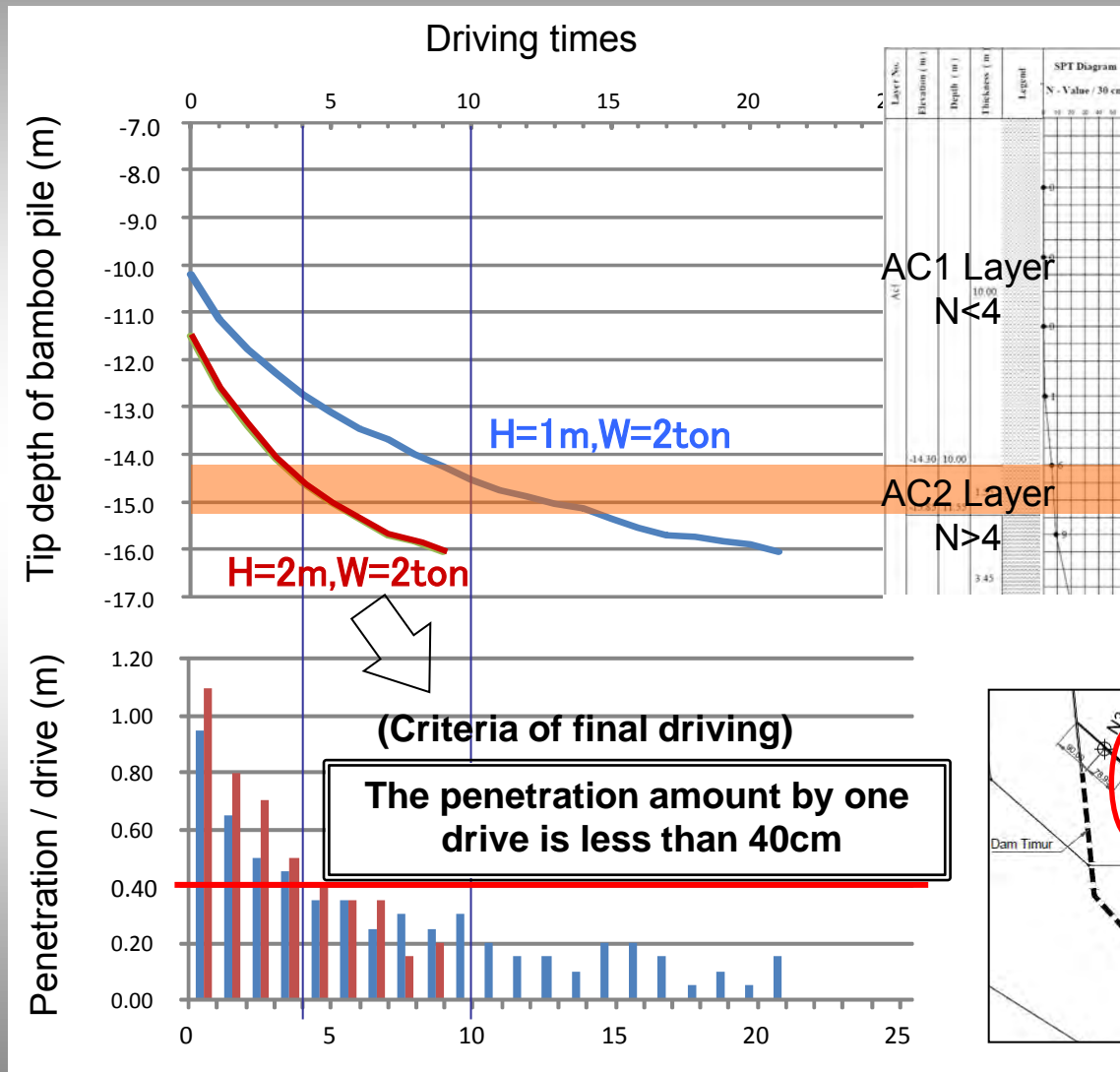
② Confirmation of workability

2) Hammer weight (fall height : 2.0m uniformity)



3. TRIAL/ACTUAL PILING OF BAMBOO PILE

③ Setting of criteria for final driving



3. TRIAL/ACTUAL PILING OF BAMBOO PILE

Summary of trial bamboo pile result

- Hammer weight : 2.0t
- Hammer fall height : 2.0m uniformity
- Criteria of final driving : Penetration less than 40cm/driving



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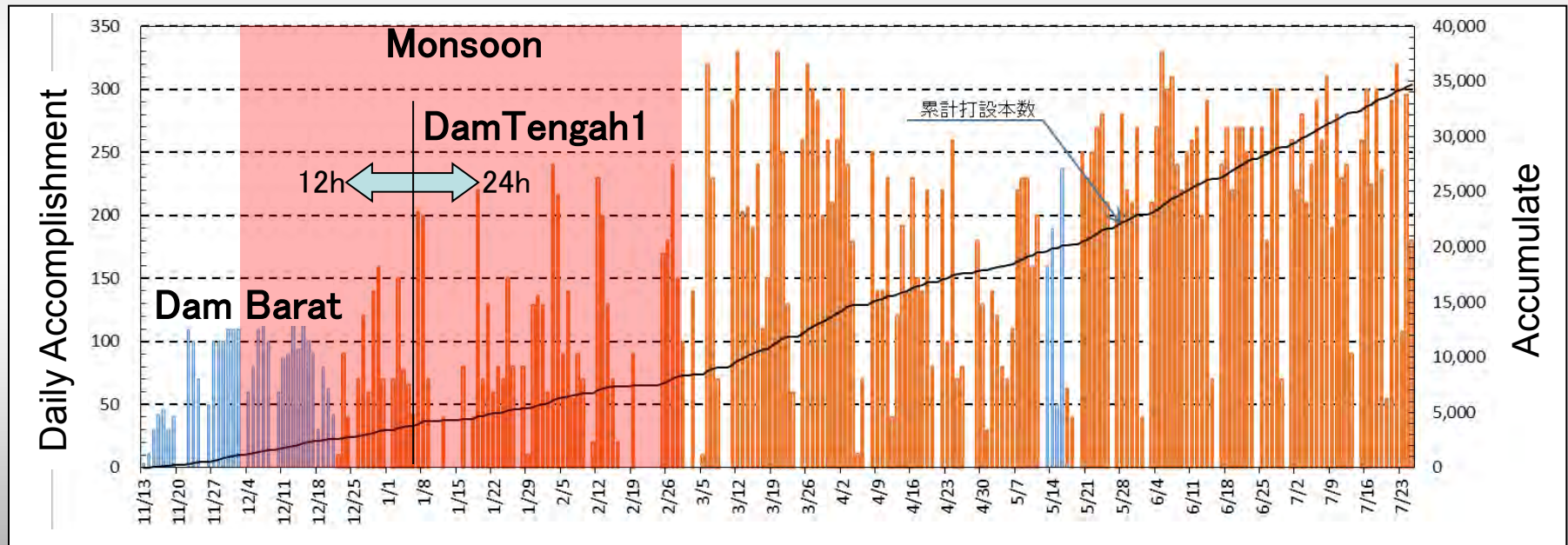


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3. TRIAL/ACTUAL PILING OF BAMBOO PILE

Working record

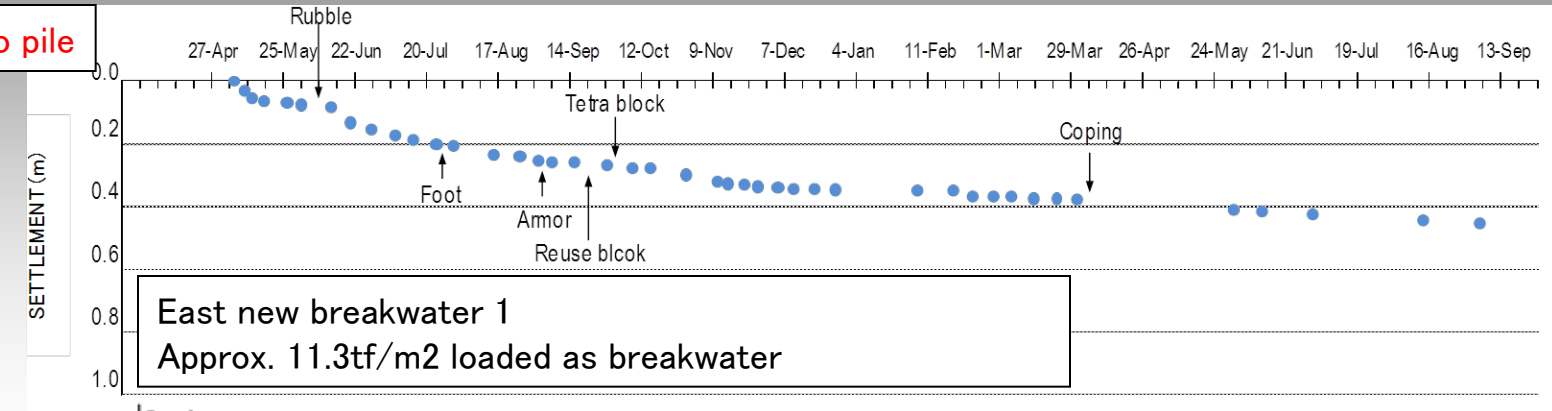
- Execution period : 13th Nov 2013~25th Jul 2014
- Quantity : 34,721 piles
- Operation rate : 0.85 =216 operation days/255 execution period



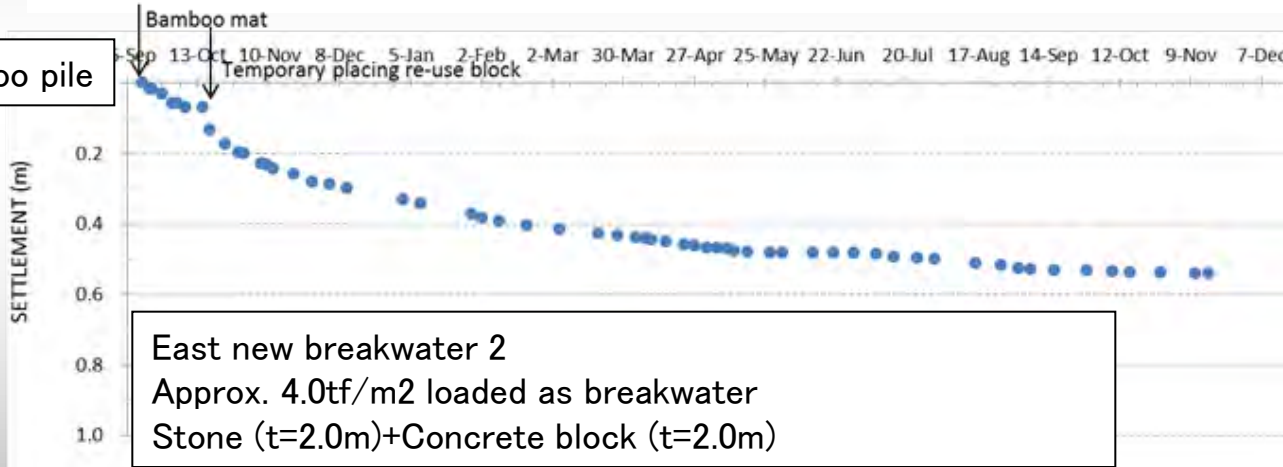
3. TRIAL/ACTUAL PILING OF BAMBOO PILE

Settlement monitoring of breakwater

With bamboo pile



Without bamboo pile



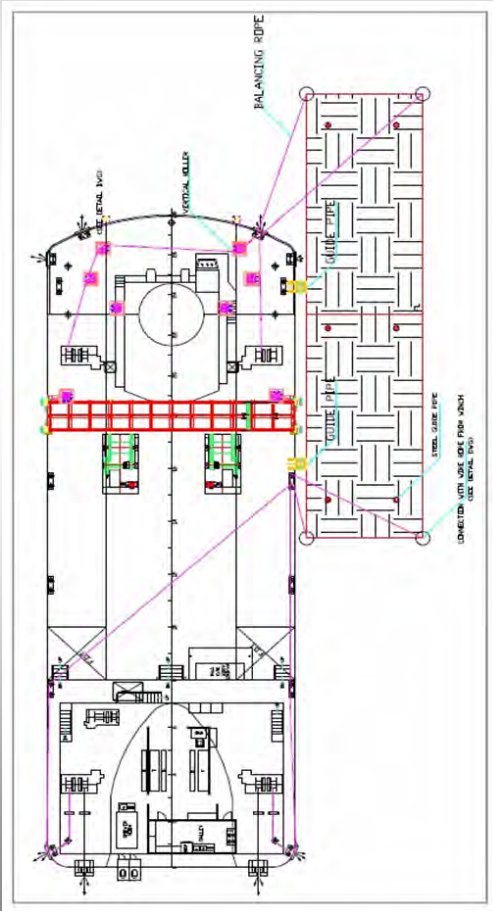
- Affective for reducing the settlement
- Earlier settlement speed than theoretical values
⇒ Drainage effect was promoted along the bamboo pile?

4. INSTALLATION OF BAMBOO MATTRESS

Equipment and method

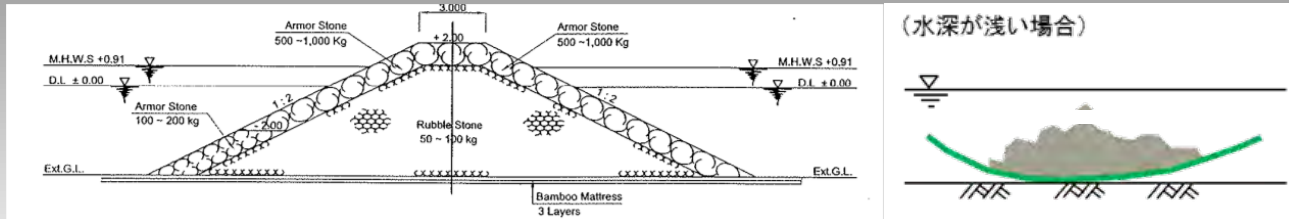
Equipment : Floating crane with 4m³ orange bucket

Method : To place re-use materials as weight on mattress

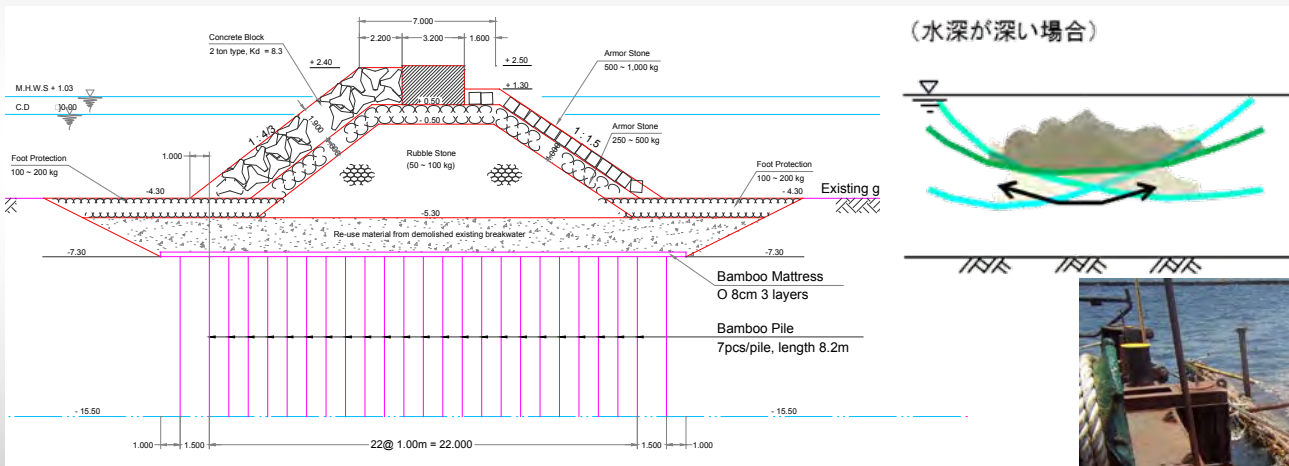


4. INSTALLATION OF BAMBOO MATTRESS

Shallow water area at east new breakwater 2



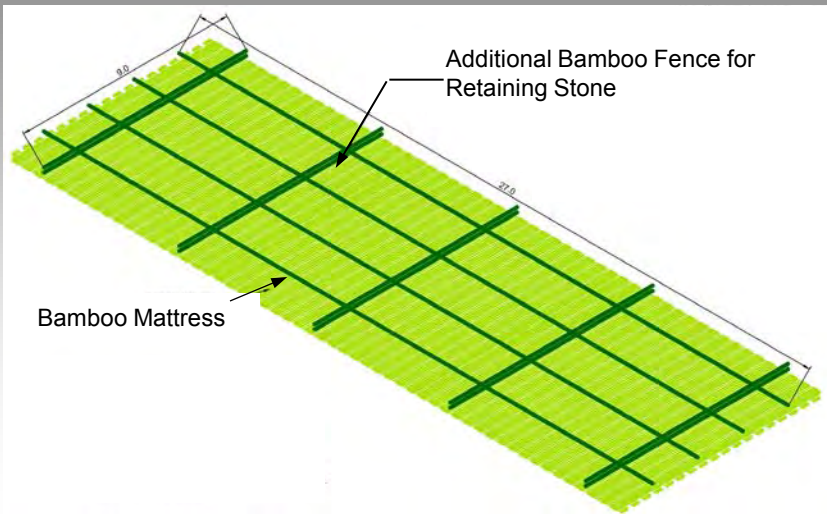
Deep water area at north and east new breakwater 1



In deep water : Mattress unbalanced
Re-use material on it had fallen off
Then mattress re-floated



4. INSTALLATION OF BAMBOO MATTRESS



Assemble bamboo fence

Prevention any fall of re-use material

Rising rigidity of bamboo mattress

Material was used Non-conforming one in acceptance inspection

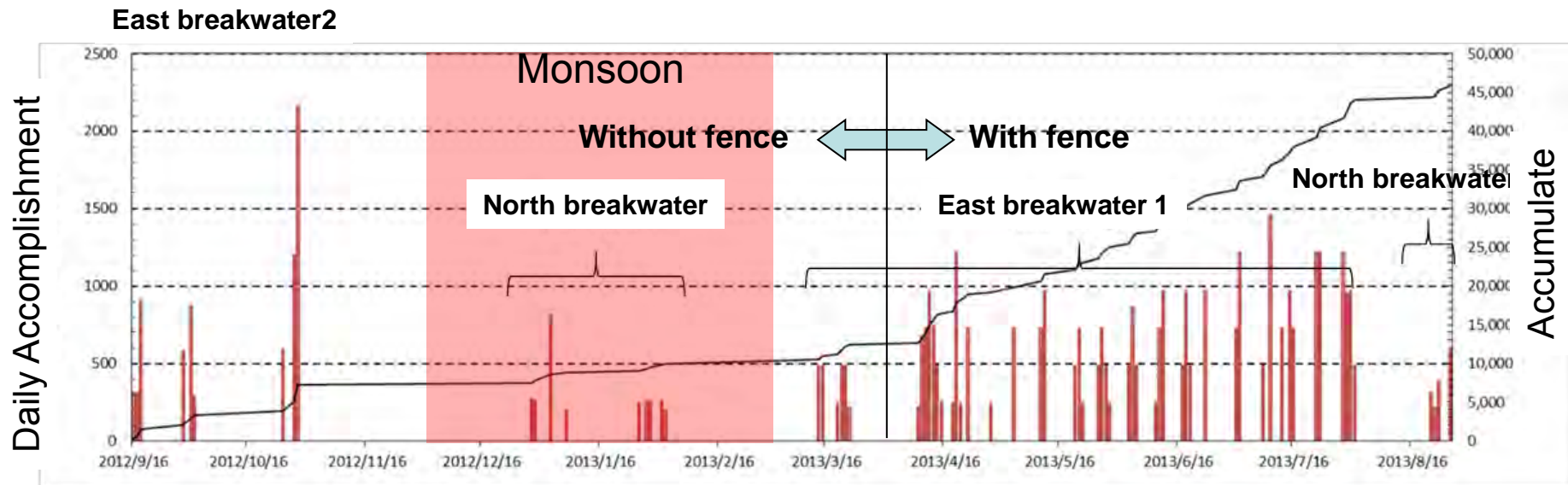
4. INSTALLATION OF BAMBOO MATTRESS

Working record

- Execution period : 16th Sep 2012 ~ 26th Aug 2014
- Quantity : 45,890m²

Day time : Installation bamboo mattress and diver check

Night time : Installation reuse material for prevention re-floating



5. CONCLUSIONS

- High quality by introducing construction management into Indonesian traditional method
- The bamboo pile and mattress method has satisfied the requirements
- Benefit due to using materials which are easily procured locally
- Income generating for the local community by supplying locally available materials to ODA Project