INTRODUCTION OF BASE ENLARGED PRE-BORING METHOD WITH NODULAR PILE

~HYPER-MEGA METHOD~

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Introduction of Hyper-MEGA method

Diameter: φ440-300 ~ φ1200-1000
(nodule diameter – shaft diameter)
Length: The maximum length is up to 68.5m.
There are many cases of more than 60m length.
Material: Nodular pile: PHC & PRC
Spun pile: PHC, PRC, SC, Steel
Concrete strength: 85, 105, 123N/mm² & more

Enlarged ratio ω

Conventional = 1.15
Hyper-Mega = 1.0 ~ 2.0
more than 2 times bearing capacity

ω : enlarged ratio (1 ≤ ω ≤ 2)
ω = De / (Dn + 0.05)
De: enlarged excavation diameter
Dn: nodule diameter
Procedure of Hyper-MEGA method

1. Excavation
2. Expanded blade—enlarged excavation
3. Mixing repeatedly
4. Forming the grouted base—pull out
5. Setting pile

Overview of the Hyper-MEGA method

Welding  Pitching Pile  Setting Pile

Enlarged auger-head  Screw
Equation of vertical bearing capacity

\[ Ru = \alpha N A_p + \left( \beta N L_s + \gamma q_N L_c \right) \psi \]

End bearing capacity factor: \( \alpha \)

<table>
<thead>
<tr>
<th>Soil of pile-toe</th>
<th>Hyper-Mega method</th>
<th>Japanese general pre-boring method</th>
<th>TCXD-205 in Vietnam</th>
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<tbody>
<tr>
<td>sandy and gravelly</td>
<td>( \sigma = 240 \omega^{1.5} + 90 \omega ) (330~858)</td>
<td>250</td>
<td>300 or 400</td>
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<tr>
<td>clayey</td>
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Equation of Hyper-MEGE method

Equation of vertical bearing capacity

\[ Ru = \alpha N A_p + \left( \beta N L_s + \gamma q_N L_c \right) \psi \]

Shaft bearing resistance factor: \( \beta, \gamma \)

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| \( \beta N_s \)
  (sand and gravelly) | 5.0 \( N_s \) (30+5.5\( N_s \)) \( \omega \) | 3.3 \( N_s \) | 2.0\( N_s \) |
| \( \gamma q_u \)
  (clayey) | 0.7 \( q_u \) (20+0.5\( q_u \)) \( \omega \) | 0.5 \( q_u \) | 0.5\( q_u \) |
Result of loading test

Static loading tests were carried out in 53 locations.

These database is used to get license of "ASSESSMENT OF TECHNOLOGY FOR BUILDING CONSTRUCTION GBRC FOUNDATION" (GBRC 05-23A-001~003) and "INFRASTRUCTURE AND TRANSPORTATION MINISTRY" (TACP-0210~0214).

Study of end bearing capacity

**<CONVENTINAL method>**

\[ P_p = \alpha \cdot N \cdot A_p \]

\[ \alpha = 250 \quad (1) \]

**<Hyper-Mega method>**

*Constituted by the combination of resistance \( P_{pp} \) of the pile bottom face and the friction \( P_{pf} \) of the grouted base.*

\[ P_p = \alpha_p + \alpha_f = a \omega^b + c \omega \quad (2) \]
End Bearing Capacity Factor (α)

Sandy & Gravelly: \( \alpha = 240\omega^{1.5} + 90\omega \)

\( \omega = 1.0 \rightarrow \alpha = 330, \quad \omega = 2.0 \rightarrow \alpha = 858 \)

Clayey soil: \( \alpha = 210\omega^{1.25} + 90\omega \)

\( \omega = 1 \rightarrow \alpha = 300, \quad \omega = 2 \rightarrow \alpha = 679 \)
### Shaft Resistance Factor ($\beta$ & $\gamma$) for Nodular pile

**Sandy soil**
- **Hyper-Mega method**
- $F_s = (30 + 5.5N_s) \omega \times D_o \pi L_s$

**Clayey soil**
- **Hyper-Mega method**
- $F_c = (20 + 0.5q_u) \omega \times D_o \pi L_c$

In some cases of spun-pile, friction capacity is determined by between shaft cement slurry and pile.

→ Spun-pile is proportional to pile-diameter.

In case of nodular-pile against that, that is always determined by between shaft cement slurry and soil, **because it can get high adhesion force by nodular**.

→ Nodular-pile is proportional to excavation-diameter.

### Comparison of Calculation and Static load test result

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Static load test result > Calculation 1.24 times
Design Procedure on Vietnam

In Vietnam, it is necessary to confirm the designed bearing capacity in advance in construction site.

Loading test must be carried out using designed piles.

If designed capacity can be obtained by loading test, We have to redesign the pile foundation of building.

<table>
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<tr>
<th>Pile diameter (mm)</th>
<th>Pile Length (m)</th>
<th>Designed capacity (kN)</th>
<th>Minimum planned load (kN)</th>
<th>Ultimate capacity by load test (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>60</td>
<td>9,000</td>
<td>18,000</td>
<td>14,400</td>
</tr>
<tr>
<td>1000</td>
<td>60</td>
<td>7,000</td>
<td>14,000</td>
<td>9,800</td>
</tr>
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</table>

Designed by Cast-in Place Pile

We can surely determine the specification of pile which is satisfied with designed capacity, from advanced loading test.

Design Proposal using Hyper-MEGA Method in Vietnam

The greatest feature of Hyper-MEGA Method is that this method can be changed the vertical bearing capacity by control of the enlargement excavation rate in the range of 1 to 2 times, under the same specification pile.

\[ \omega = 1.0 \quad \omega = 1.2 \quad \omega \geq 1.2 \]

The capacity of pile is designed as \( \omega = 1.0 \).

In investigating the bearing capacity of designed pile, the piles with specification of more than \( \omega = 1.0 \) are constructed in addition to \( \omega = 1.0 \).

Even if the bearing capacity of \( \omega = 1.0 \) is less than designed capacity, another pile can fulfill it.

We can surely determine the specification of pile which is satisfied with designed capacity, from advanced loading test.
Design Proposal using Hyper-MEGA Method in Vietnam

In recent year, a new pre-cast pile installation method for high load-bearing capacity is being actively developed in Japan. This Hyper-Mega method can set the enlargement factor to a pile diameter of 1 to 2 times without keeping a fixed value, and can get bigger friction resistance by nodular pile. Here is the evaluation of vertical bearing capacity through the loading test results.

Because now pre-boring method like the Hyper-Mega method is not general in Vietnam, we want to introduce the Hyper-Mega method to Vietnam.

Thank you very much!

JAPAN PILE CORPORATION

PHAN VIU