Alternative Design Option for Second Sand Layer of Bangkok Clay

Presented by

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Introduction

- Generally, when an engineer designs a structure.
- He has to consider design load based on total load of structure plus factor of safety that specified in Code of Practice.
- There is no particular requirement concerning allowable settlement specified in any code.

Introduction (cont.)

- In practice, allowable settlement is specified by the engineer of that project.
- Mostly a maximum of 25 mm. settlement is used to affirm its stability.
- This limit is given by system engineer who concerns about leaking in piping work due to differential settlement.
- Allowable settlement may be more severe in the case of glass structure which requires zero differential settlement.

Introduction (cont.)

- In order to design a foundation within the allowable limit.
- There are two design methods namely Pile capacity table and Boring results.
- Moreover, past experience of normal practice, site accessibility of equipment, product availability in the market also have to be taken into consideration.

Description of Building

- 23 stories residential Building (*Fig.2*).
- Foundation is sitting on an area about 40 x 60 m. with a total number of 1,038 piles (*Figs.3-5*).
- The thickness of the mat foundation is 2 m.
- The piles are solid square pre-cast concrete pile of 0.40 m. width and 25 m. long
- The minimum distance between two piles is taken equal to 1.2 m.
- Pile capacity is 600 KN/pile with F.S.=2.5

Section Properties

Member	Dimension
Beam — B1(width x height)	30 x 50 cm.
Beam — B2(width x height)	40 x 80 cm.
Column — C1	30 x 30 cm.
Column — C2	40 x 40 cm.
Column — C3	40 x 60 cm.
Column — C4	30 x 100 cm.
Column — C5	40 x 80 cm.
Column — C6	40 x 100 cm.
Column — C7	50 x 70 cm.
Column — C8	50 x 100 cm.
Column — C9	50 x 120 cm.
Column — C10	50 x 150 cm.
Column — C11	50 x 160 cm.
Column — C12	50 x 200 cm.
Column — C13	100 x 80 cm.
Slabs No. SG , SW & SWW	Thickness =25 cm.
Slabs No. SW1 & SWT (S5,S6,S7)	Thickness =15 & 30 cm.
Prestressed Hollow — Core Concrete Slabs No. PS & CPS	Thickness =12 & 15 cm.
Shear Wall	Thickness =30 cm.

Notes ; 1. Specified Concrete Compression Strength, f_c'=24 MPa

2. Bending Reinforcement Yield Stress ,fy =400 MPa.

3. Shear Reinforcement Yield Stress ,fy =400 MPa.

4. Vertical Spring Constant(K) = 3.2×10^5 Kn/m.

5. Modulus of Elastic for Concrete = 25,000 MPa.

6. Soil Density = $18 Kn/m^3$.

Fig 2. Perspective of Three Dimension Finite Element Method of Structure

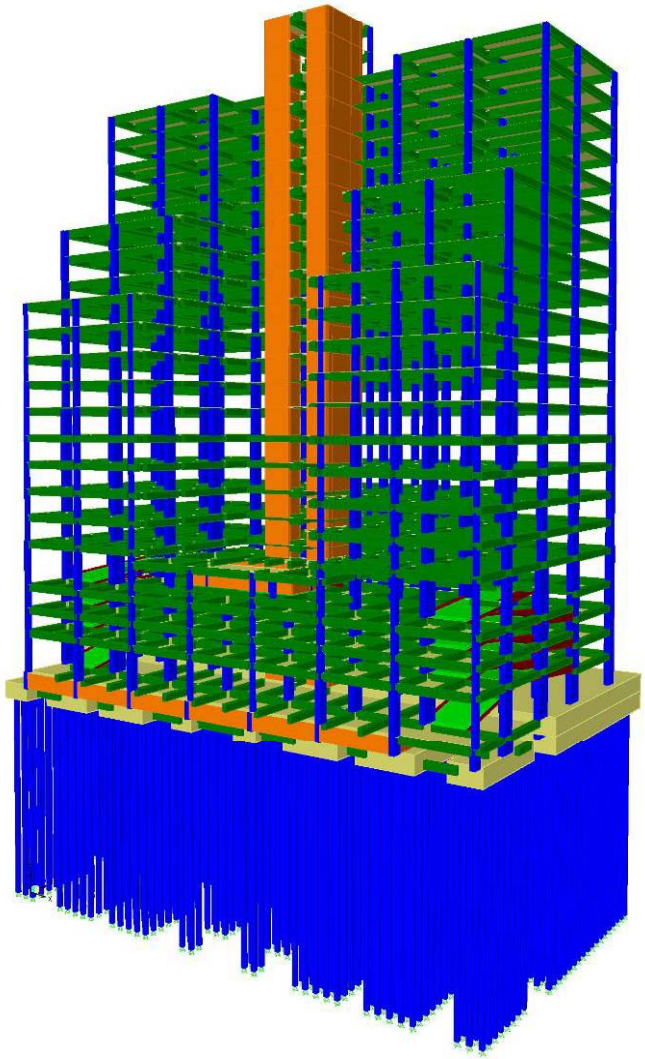


Fig 3. Mat Foundation and Footing Deformed Shape

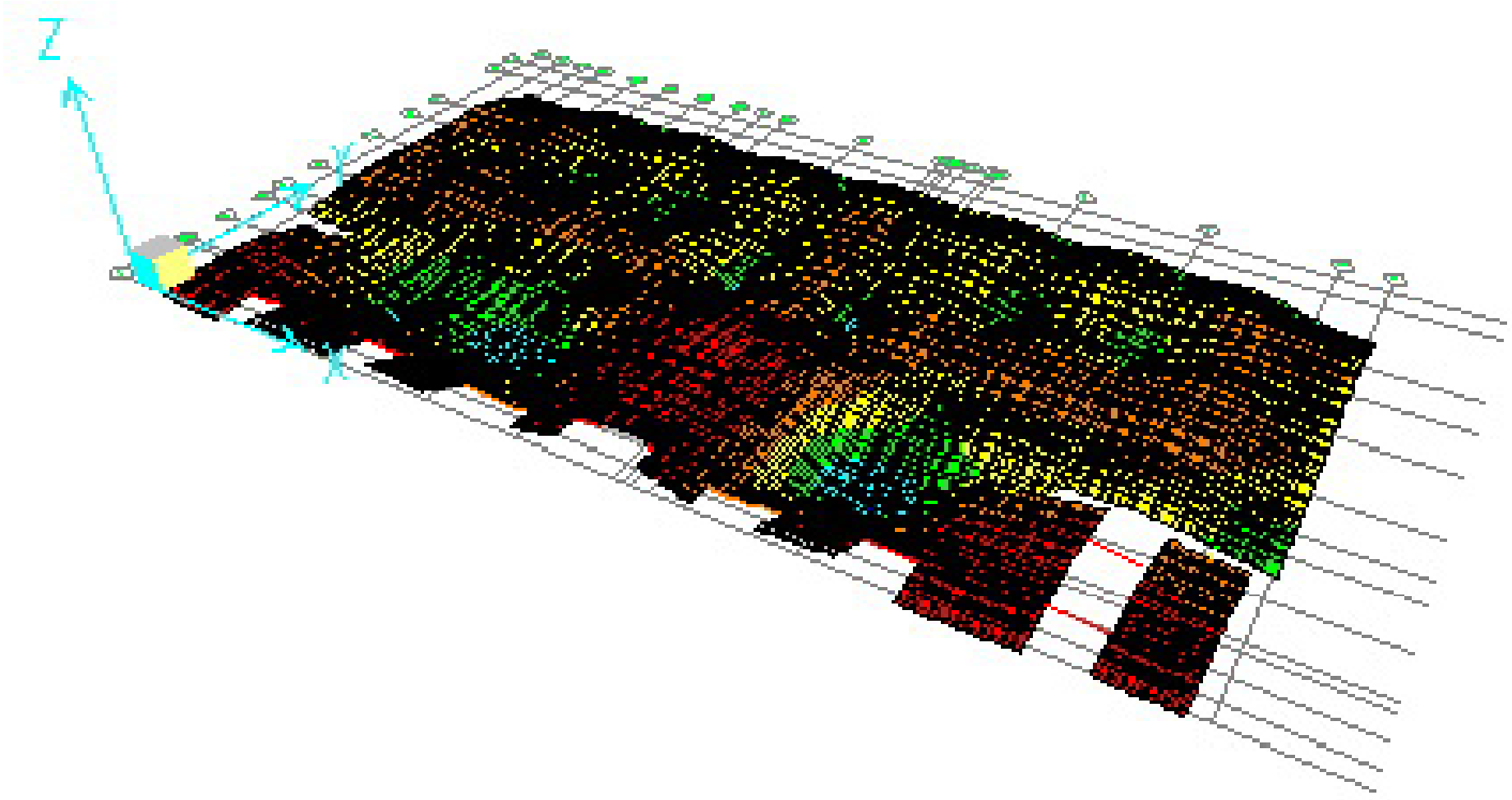
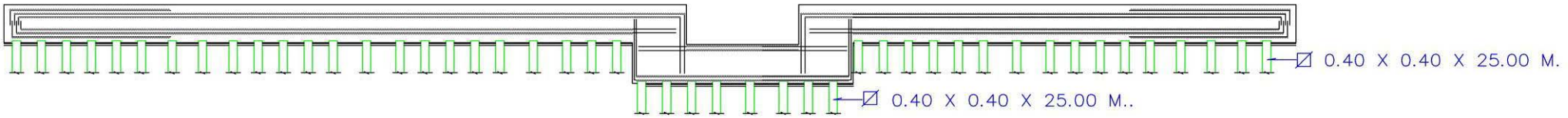


Fig 4. Foundation Plan

NOTES

- FOR F1 — F1 : USED P.C PIPES 0.40x0.40x25.00 M. , PILE TOP −1.8M.,SPACINGS 1.2M. & SAFETY LOAD 600 KN/PILE
- FOR F2 ,F3,F4 F5, F6,F7,F8,F9 : USED P.C PIPES 0.40x0.40x23.50 M. , PILE TOP −3.5M.,SPACINGS 1.2M. & SAFETY LOAD 600 KN/PILE
- FOR F10, & F11 : USED P.C PIPES 0.40x0.40x23.50 M. , PILE TOP −3.5M.,SPACINGS 1.2M. & SAFETY LOAD 600 KN/PILE
- FOR F1 (AT THE LIFT PIT AREA) : USED P.C PIPES 0.40x0.40x25.00 M. , PILE TOP −3.5M.,SPACINGS 1.2M. & SAFETY LOAD 600 KN/PILE

Fig 5. Mat Foundation Sections



SECTION ② – ②
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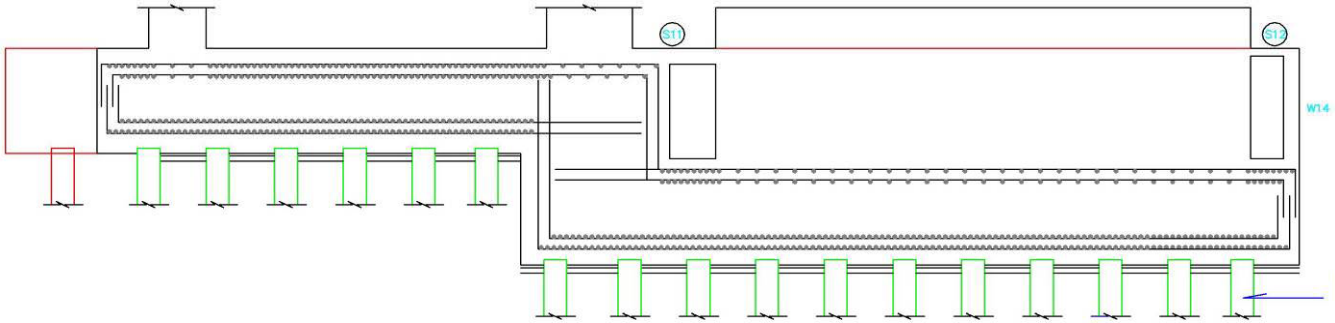

SECTION ⑤ – ⑤
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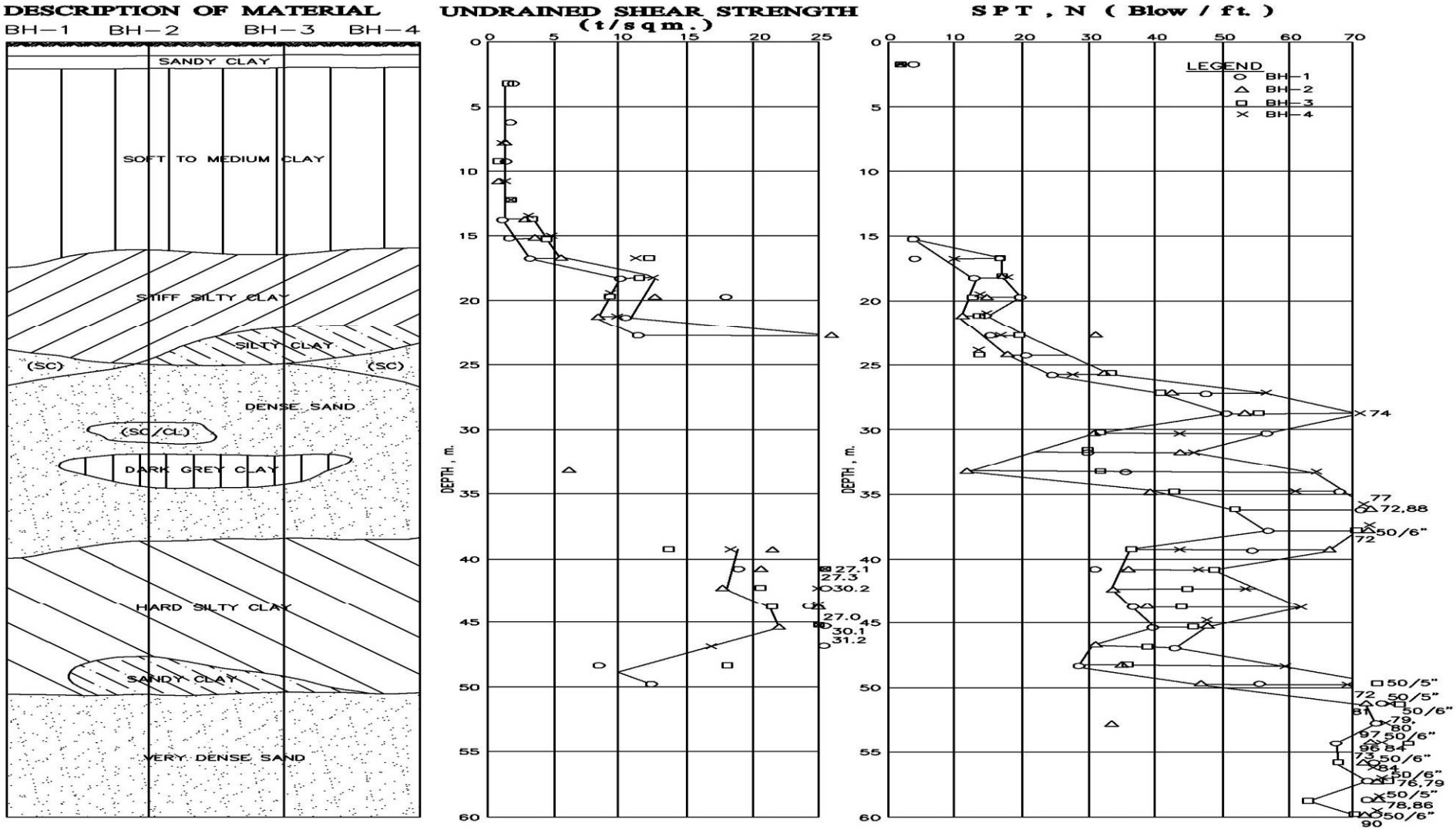
Soil Condition Record

- Four borings were drilled to 60 m. depth(*Fig.6*).
- The soil consists of about 15 m. soft to medium clay.
- Followed by another 10 m. thick of stiff silty clay up to the depth of 25 m.
- A dense sand of about 15 m. thick is located between the depths of 25 m. to 40 m.
- The 15 m. thickness of this layer is more than sufficient to resist majority building loads in Bangkok , If the pile tip is embedded at least 1m.within this layer.

Fig.6 Soil Profile and SPT N values



Piles Condition After Been Driven

- The designer decided to use pile length of 25 m. resting on first dense sand layer rather than a long pile resting on 55 m. depth on very dense sand of second layer.
- The tower of the building is sitting on a mat foundation.
- All piles have been driven satisfactory to a very uniform level with the design blows counts. (*Figs. 7-8*)

Fig. 7

Fig.8

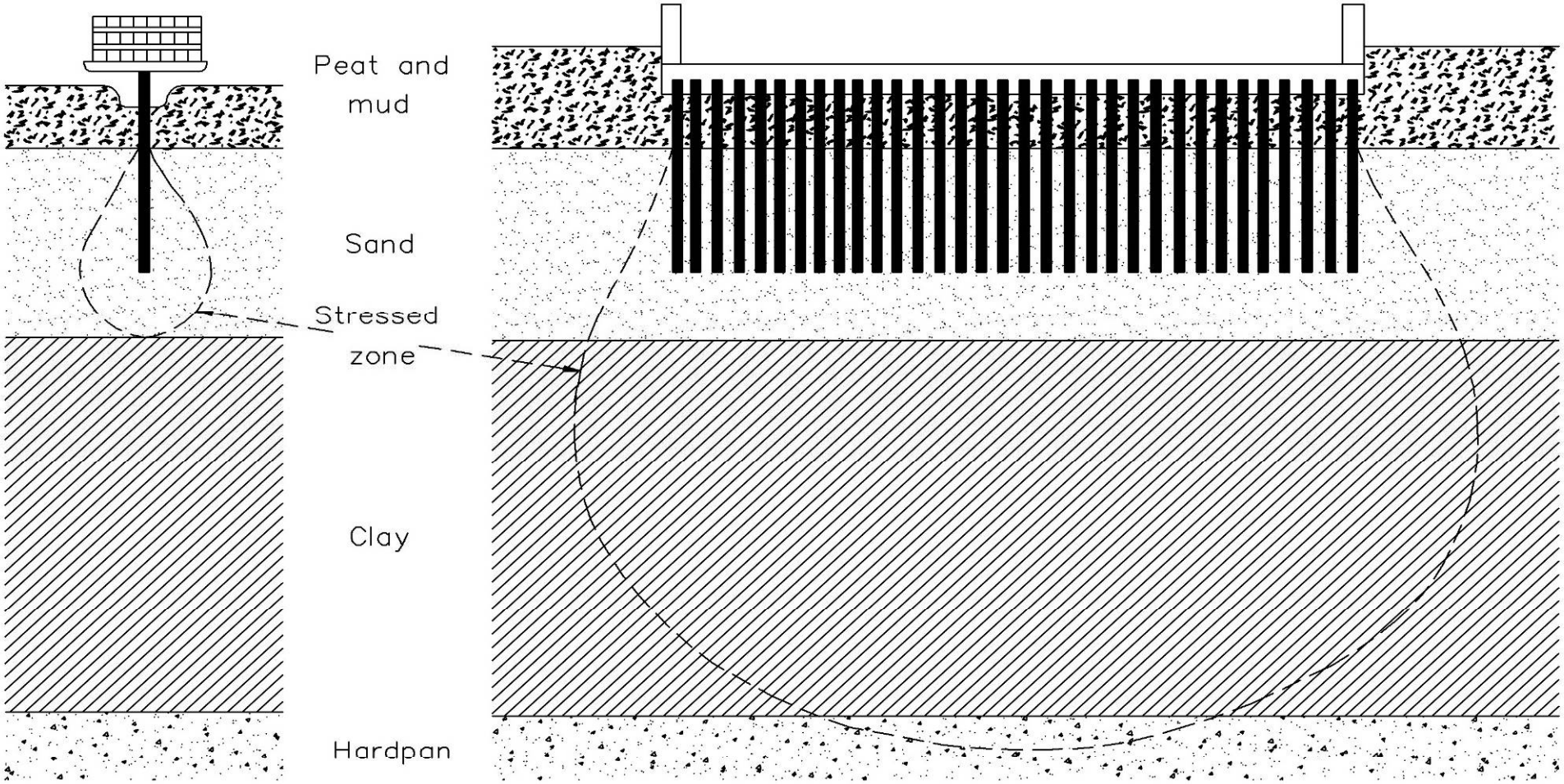
Existing Condition

- This building was built in 1993 and being used for almost 17 years now.
- Present condition of building and surrounding car parks is still in very good condition(*Fig.9*).
- There is no significant crack or differential settlement appear.

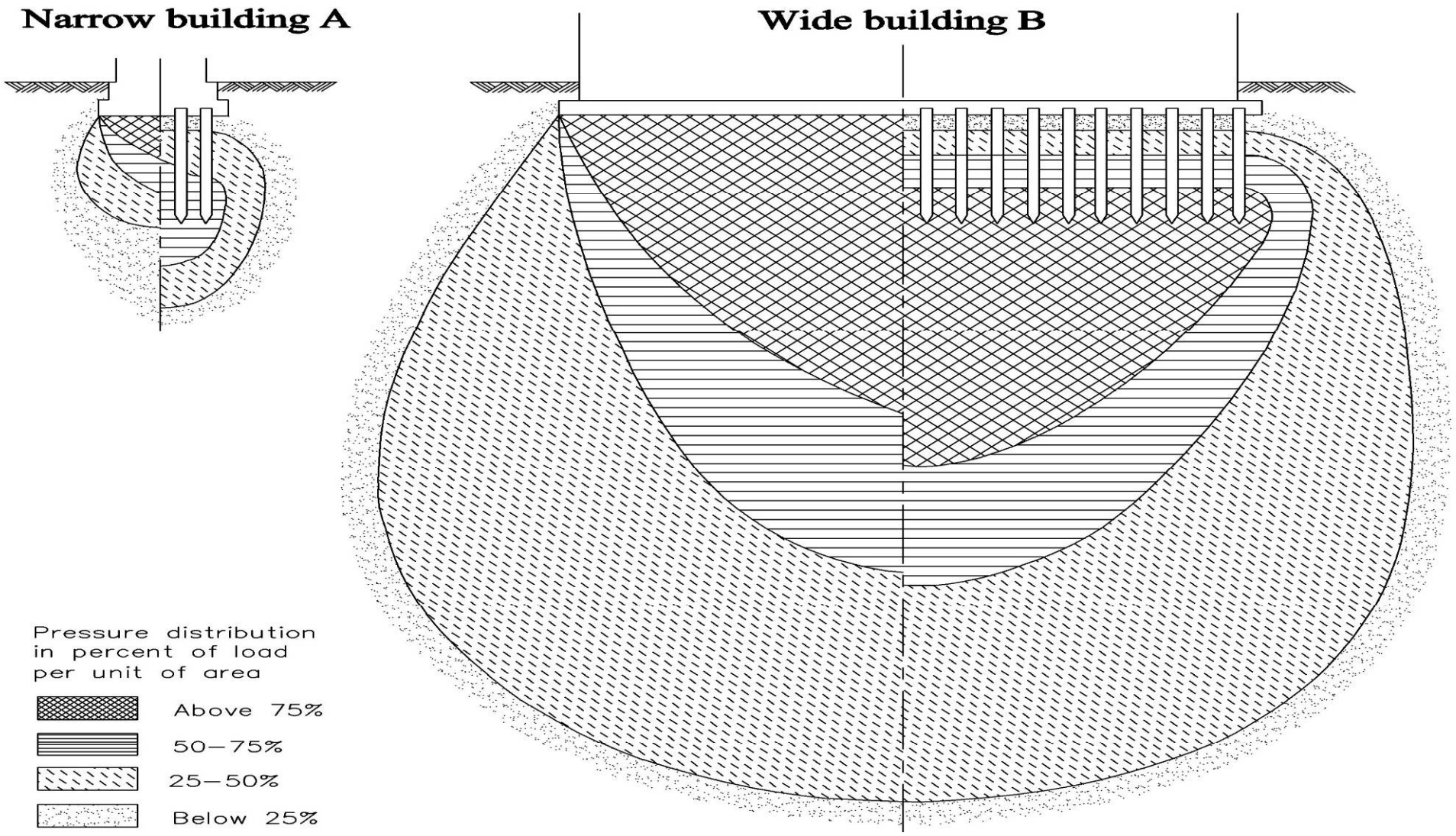
Discussion of Results and Conclusion (cont.)

- Pile foundation on first dense sand layer will act like a pile group effect as shown in *Figs.10* [1]and *11*[1].
- The wider dimensions both width and length will increase the ability of reducing overall and differential settlement[1].
- In this case study, it is confirmed pile foundation on first dense sand layer is also a good alternative option for the client to save cost.

Figs.10 [1] Fallacy of testing the action of a single pile ; under the test pile in (a) the clay is practically unloaded ; under the completed structure in (b) it is heavily stressed.



Figs. 11[1] Effect of relation between width and pile length on pressure distribution.



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