

Usage Wooden Pile Foundation in Tanjung Priok Access Road Construction Project, Phase 2 .

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I. Introduction :

Wooden piles foundation (cerucuk) is one of the foundation that is usually applied in areas with unstable soil conditions which are generally the type of very soft to soft soil or peat with a sufficient high water table. Wooden pile definitively is the arrangement of wooden piles with diameters between 8 and cm vertically inserted or plugged into the soil which aimed to strengthen the load carrying capacity beyond . In the construction of the upper end of the arrangement wooden piles together to unify the composition of wood called the pile cap. The pile cap can be flanking and wooden poles, mats, wire binding, cover boards or beams poer . For design depth and distance between wooden piles should be made based on soil investigation , Cone Penetration Test or Standard Penetration Test .

Until now there has been some geotechnical engineering reseach, how wooden piles system can increase the soil bearing capacity and can't reduce the settlement in soil, but in practice in the field have shown an increase in the carrying bearing capacity of soft soil , when using wooden piles (dolken) a certain distance. Wooden piles foundation development will be more economical, can be justified scientifically, can be implemented easily and in planning can be easily understood by the consultant designer .

The Government through the Ministry of Public Works has issued technical guidelines "Implementation Procedures of Wooden piles foundation on soft soil and and Peat Soil" No.029/T/BM1999. Attachment No. 6 . And decision of the Director General of Highways No. 76/KPTS/Db/1999 Date December of 20th, 1999. From the technical guidelines are unclear about planning / design calculation. **That regulation only expanded about how to used wooden pile foundation for make high way construction only in Soft soil (clay or silt) and peat soil (organic soil).** The technical guidlines document can be found in the appendix at the end of this paper.

2. Using Wooden Piles make Increasing Soil Bearing Capacity in Soft Soil.

Using Terzaghi equation for to calculate Soil bearing capacity, as follows :

$$q_u = C_u N_c + q N_q + 0,5 \gamma B N_\gamma \text{ for continous foundation}$$

Where : C_u = Kohesi Undrained

q = Over Burden Pressure at base foundation. (γD)

D : depth of foundation

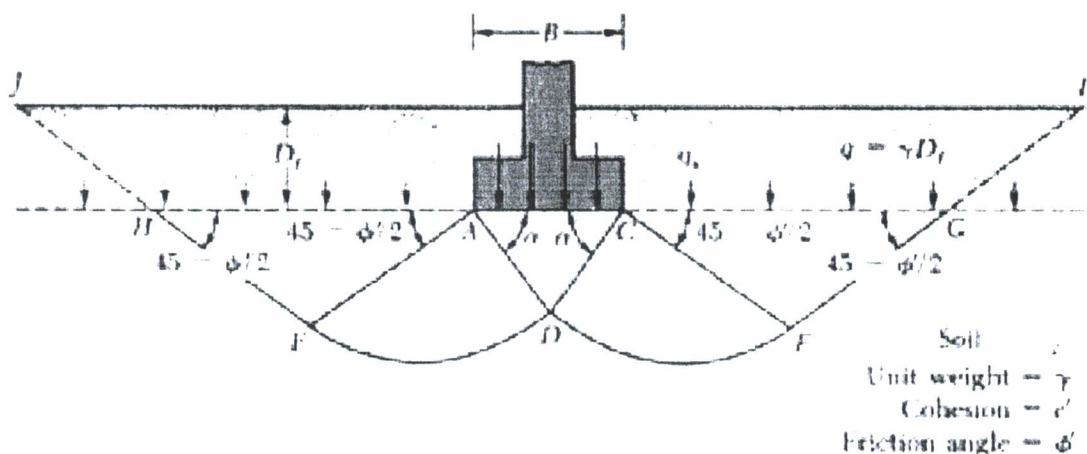
γ = Unit weight of soil

B = Width of foundation

N_c , N_q dan N_γ is bearing capacity factor , funtion of Φ (internal angle friction)

q_u = The ultimate bearing capacity ,

q_a = The allowable bearing capacity $q_a = q_u/SF$, $SF = 2,5$ (savety factor)



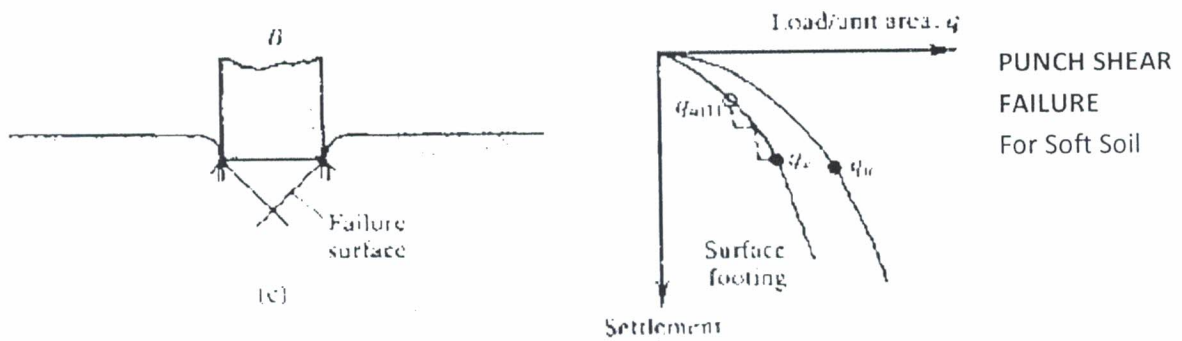
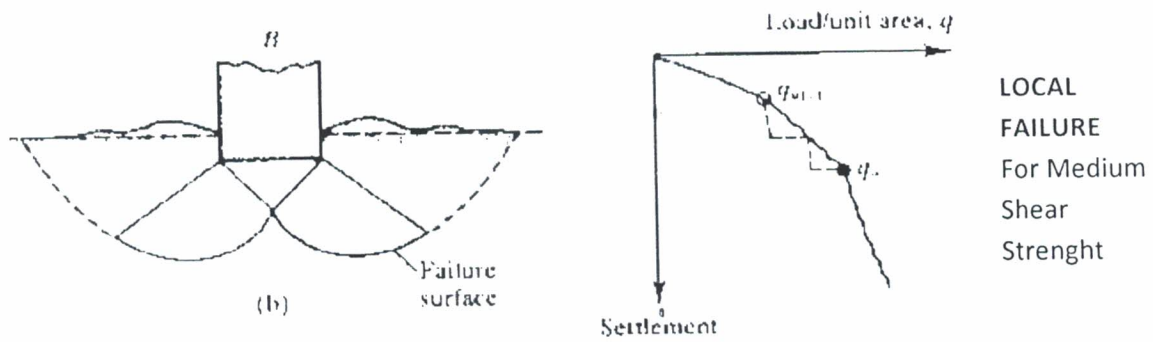
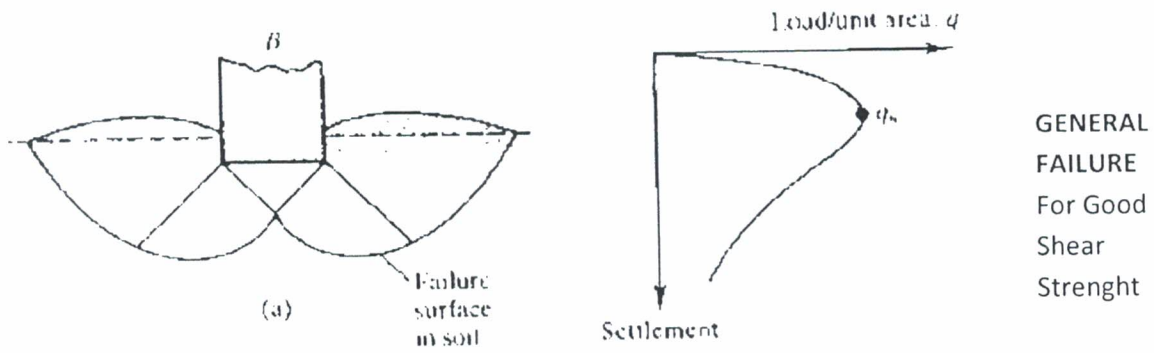
Bearing capacity failure in soil under a rough rigid continuous foundation

The bearing capacity failure of shallow foundation has been described by Mr. Terzaghi, the criteria of general failure such as the picture above.

However, for soft soil, where shear strenght of soil is small, ($\phi = 0$ and Cohesion undrained (C_u) is small), the pattern of failure as shown below.

The carrying bearing capacity of soil is becoming smaller.

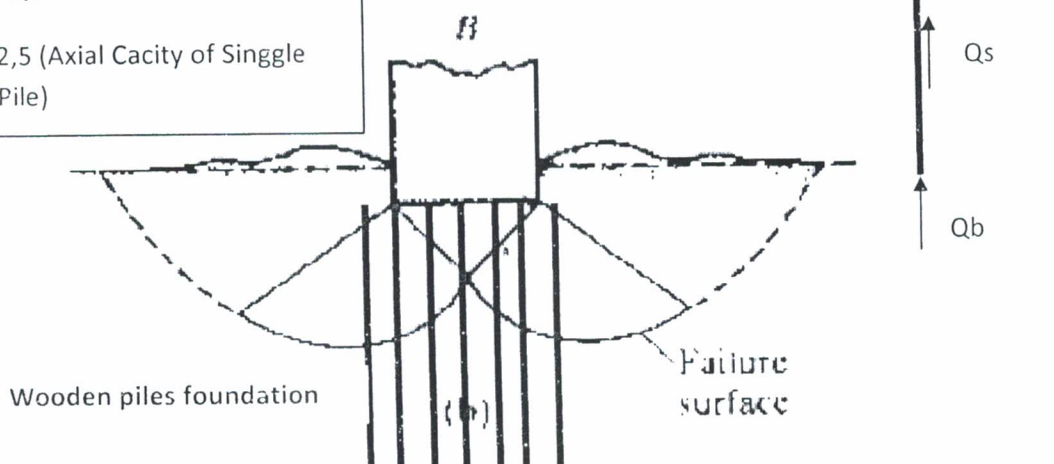
With added wooden piles foundation to a depth below the base foundation and pile wooden certain distance, then slide the pattern failure will cut the wooden piles with better shear strenght r than soft soil, so the bearing capacity of soft soil shall increase with added using the wooden pile foundation.



Using wooden piles to increasing bearing capacity in soft soil

$$Q_u = Q_s + Q_b$$

$$Q_a = Q_u/2,5 \text{ (Axial Capacity of Single Wooden Pile)}$$



With installing wooden piles into soft soil, wooden piles will cut failure surface (sliding plane) so that the soil shear strength as a whole will increase.

III. Special Case Usage Wooden Pile Foundation in Tanjung Priok Access Road Construction Project , Phase 2

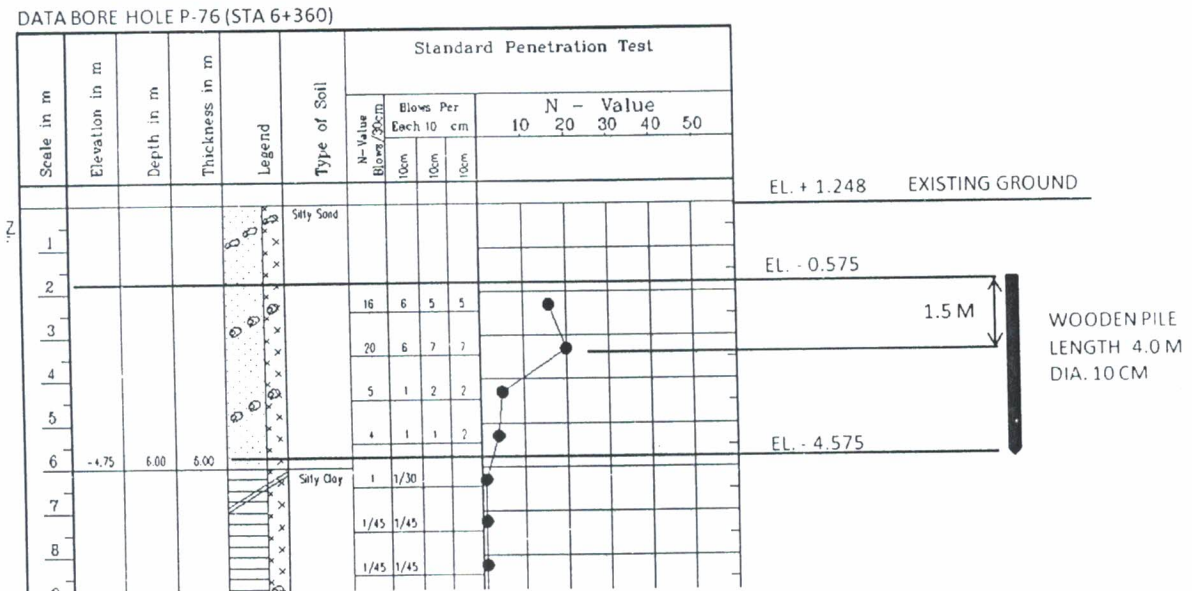
The area being problems :

Segmen area for this case is between STA 6.300 at PT. Bogasari until STA 6.560 or Pier 75 untul Pier 82

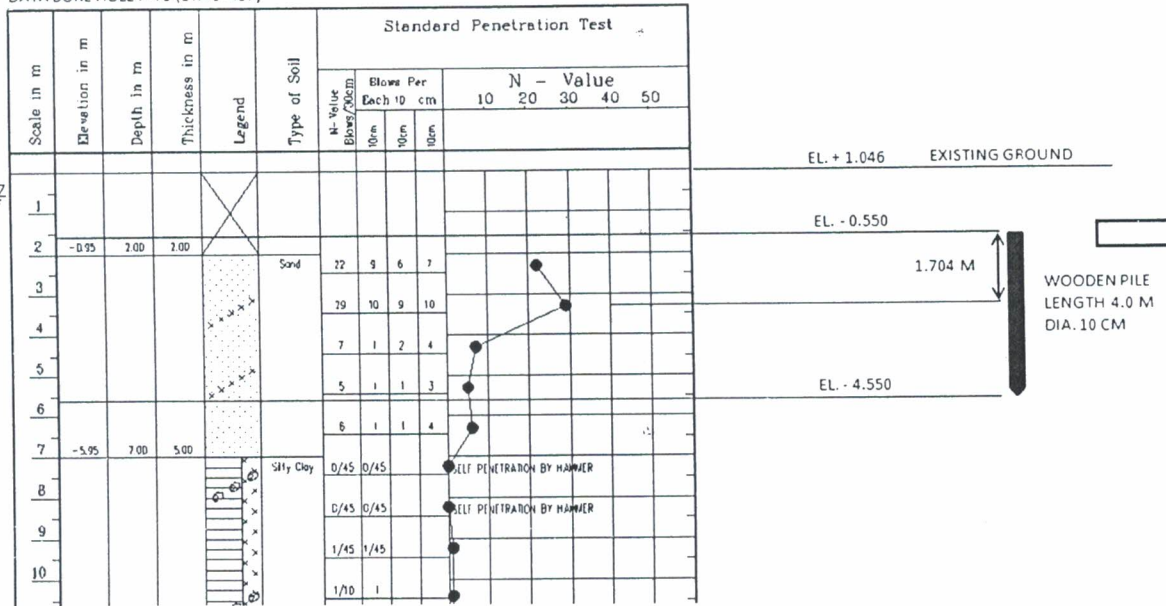
Soil Data :

From Bore Log data :

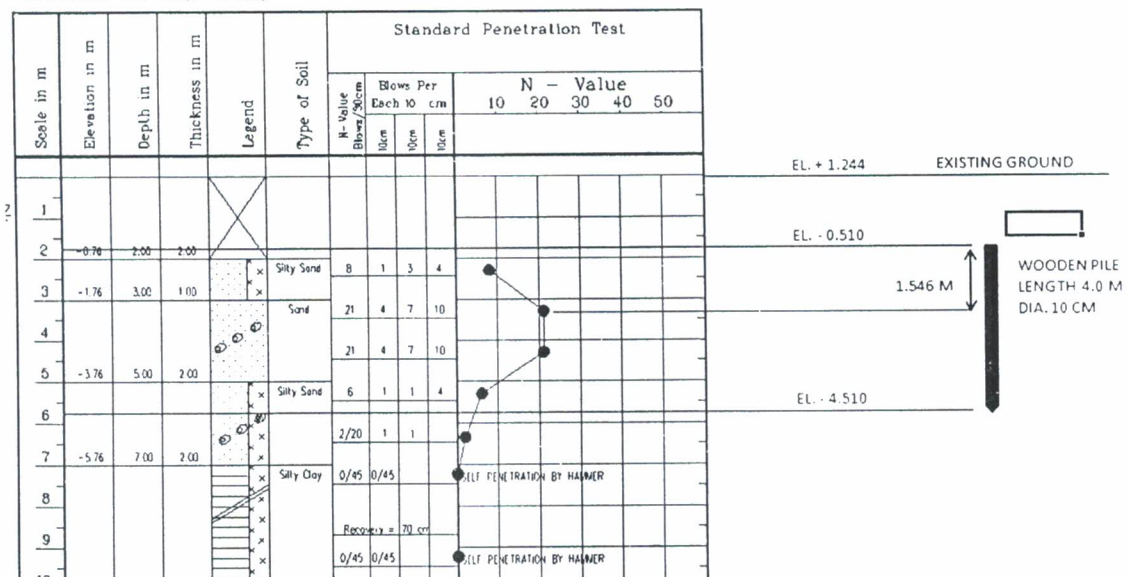
- From existing ground to -4,00 meter depth , it is silty sand or sand with dense to very dense consistency
- From -4,00 meter to -6,00 meter, it is silty sand with medium consistency
- From -6,00 meter depth to -16,00 meter until -19,00 meter it is silty clay (marine clay) with very soft consistency.
- From 16,00 meter untuil -19,00 meter to -24,00 meter it's marine silty clay with medium to very stiff consistency
- Hard layer soil as Clayey Silt with N -SPT more than 30, it's found at -23,00 meyer until 25 meter depth to -31,00 meter (end of depth booring depth)
- Ground water table was founded in – 1,00 meter from the ground surface.



DATA BORE HOLE P-79 (STA 6+457)



DATA BORE HOLE P-81 (STA 6+529)



Wooden piles foundation would be effectively used to increase the bearing capacity of soil if :

1. The condition of the surface soil layers up to 2 meter to 4 meter is soft soil or peat soil
2. The wooden piles foundation be easily done on the condition of the soft soil layer, simply by pressing with the back hoe arm, or by flying hammers are simple to do.
3. The embedded wooden pile is at least medium of soil (clay), in order to effectively increase the carrying bearing capacity of soil. When the soft soil layers deep (deeper than the length of the foundation cerucuk used), then the estimation of the capacity of a single wooden piles calculated only from skin friction of wooden pile.

IV. Conclusion :

Discussion for Usage wooden pile in Tanjung Priok Access Road Construction Project , Phase 2:

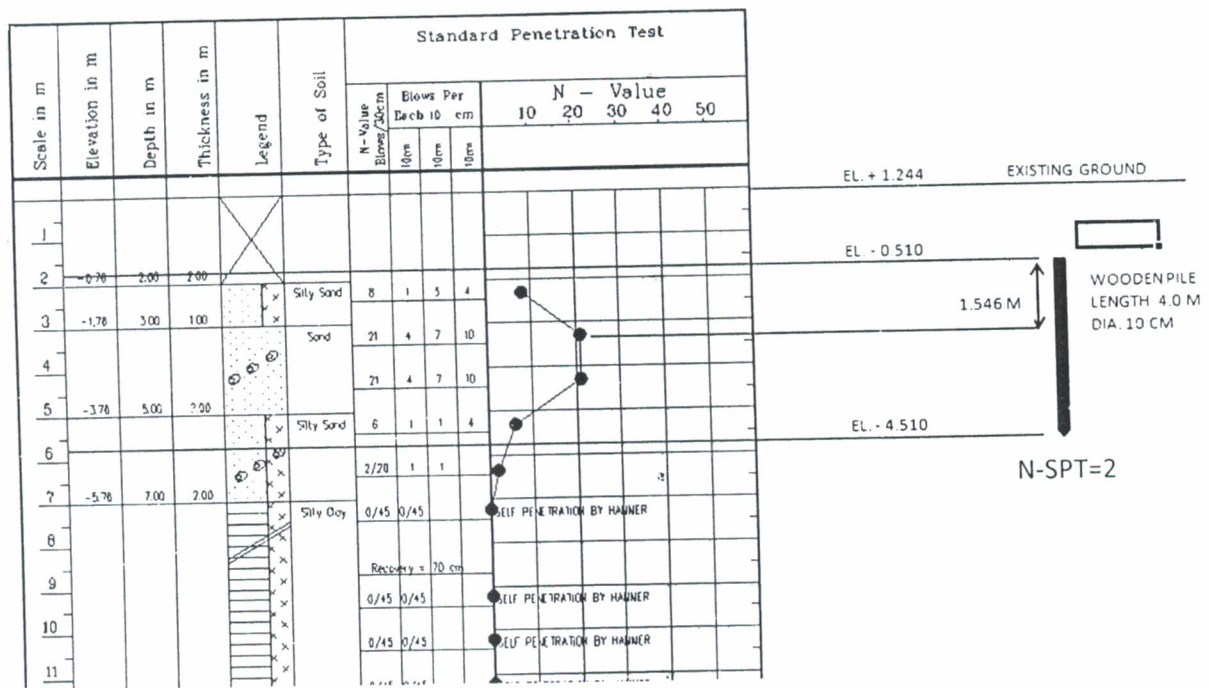
Use wooden piles foundation in subgrade layer with N-SPT values > 15 in the form of a layer of silty sand or sand, this means that the consistency of the soil layer is dense to very dense. In dense sand layer thickness between 1,50 to 2,00 meters, will not be effective in use

This can be explained as follows :

1. The purpose of the wooden piles foundation effective on soft clay, peat soil / organic soil which aims to increase the carrying bearing capacity of soil.
2. The existing ground surface with dense or very dense sand with sufficient thickness layer, so without using wooden piles, the carrying capacity of soil is good, so it does not need to be increased again. Silty sand or sand soil with dense consistency has good shear strength, especially the angle of internal friction, so that the carrying bearing capacity of soil to be high.
3. In the conditions of a dense to very dense consistency layer, it is very difficult to implement the wooden pile foundation in this project. The wooden pile will break if forced suppressed by means of heavy equipment (back hoe arm)
4. Even if the wooden pile insistence that the foundation can be implemented in this project, for example by doing preboring first to penetrate the dense layer of sand, then the carrying capacity results will not be better than without using wooden pile foundation.
5. Not effective on point 4 above, the first since the end of the wooden pile foundation if used 4 meters (-6.00 meters below the original ground surface) will be on the soft soil, so that the end of the foundation bearing capacity of wooden pile so small. Second, by doing preboring before the install wooden pile foundation, the friction in wooden skin pile will be smaller, compared with a drop hammer / pressed with the back hoe arm.

In the end, we were advised that if after the excavated soil from the original ground level to elevation - 0.5 meters, (to be filled subbase material) encountered a layer of sand or silty sand with a dense consistency, it is not necessary to add wooden pile foundation to increase subgrade soil bearing capacity.

But when once excavated to elevation -0.50 meters encountered a layer of soft clay, the wooden pile foundation can be used to increase the carrying bearing capacity of soil.



Can't be installed by driving or pressure

If install wooden pile with Preboring

