GEOTECHNICAL DESIGN OF RAMMED AGGREGATE COLUMN

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1 Installtion Process for Rammed Aggregate Column

Rammed Aggregate column can be install without using any specilized equipments.Indeginous method for Boring and Using of 1500kg to 2000kg rammer shall be sufficient for this type of column.Cost shall be 1/3 of RCC piles.Usually finished pile diameter is 1.5-2 times the casing dia.

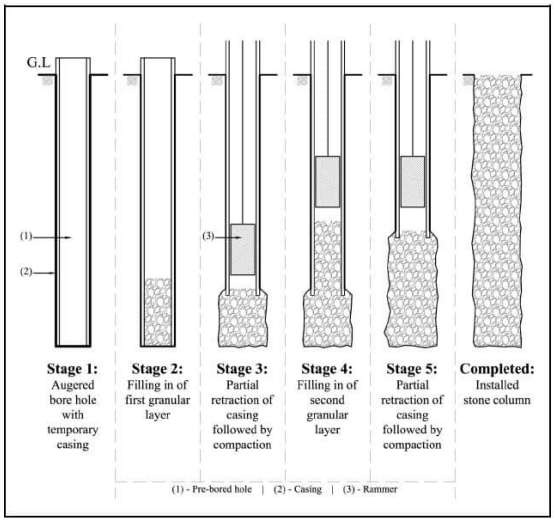

Figure 1: rammed-aggrgate-column-installation-2

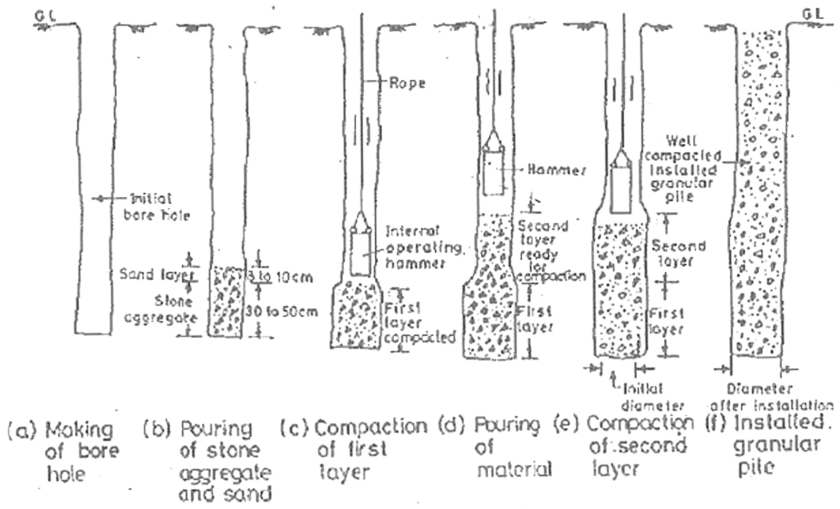

Figure 2: rammed-aggrgate-column$_{i}nstllation2$

2 Bearing Capcity Determination For Rammed Aggregate column

The design procedure for granular columns in cohesive soils involves bearing capacity, settlement, rate of consolidation, and global slope stability. The typical procedure is as follows:

1. Based on undrained shear strength of cohesive soil,calculate the ultimate bearing capacity of natural soilas $5c_u$ (c_u is undrained shear strength of soil).

2. Based on undrained shear strength of cohesive soil,calculate the ultimate bearing capacity of individual columns using Equation (1)

$$q_{ult,c} = K^{'} K_p c_u \tag{1}$$

K$^{'}K_p = 12$ for Sand Comapction Piles
$K^{'}K_p = 20$ for Stone Column
$K^{'}K_p = 25$ for Rammed Aggrgate Column

Calculate the ultimate bearing capacity of the composite foundation by considering ultimate bearing capacities of natural soil and individual columns, and the area replacement ratio using Equation (2) and Equation(3).

$$q_{ult} = q_{ult,c} * a_s + q_{ult,s} * (1 - a_s) \tag{2}$$

$$q_{ult,s} = 5.14 c_u \tag{3}$$

determine pile dia and spacings from equation(4).

$$\frac{s}{d} = \sqrt{\frac{\pi}{4a_s}} \tag{4}$$

3 SPT correlation for Clay Soil Consistency and Untrained Shear Strength

SPT	**Soil Consistency**	$C_u Ksf(KPa)$
< 2	Very Soft	$0.4(20)$
$2 - 4$	Soft	$0.4 - 0.8(20 - 40)$
$4 - 8$	Firm	$0.8 - 1.5(40 - 75)$
$8 - 15$	Stiff	$1.5 - 3(75 - 150)$
$15 - 30$	Very Stiff	$3 - 6(150 - 300)$
> 30	Hard	

Table 1: SPT Correlation of Cohessive Soil

4 Soil Profile for 3-Vent Kjeurdangi Regulator

it is observed from the borlog upto a depth=15.0 siol is soft-clay,below that there is 9.2m medium clay and below that medium to dense sand.it is ob-

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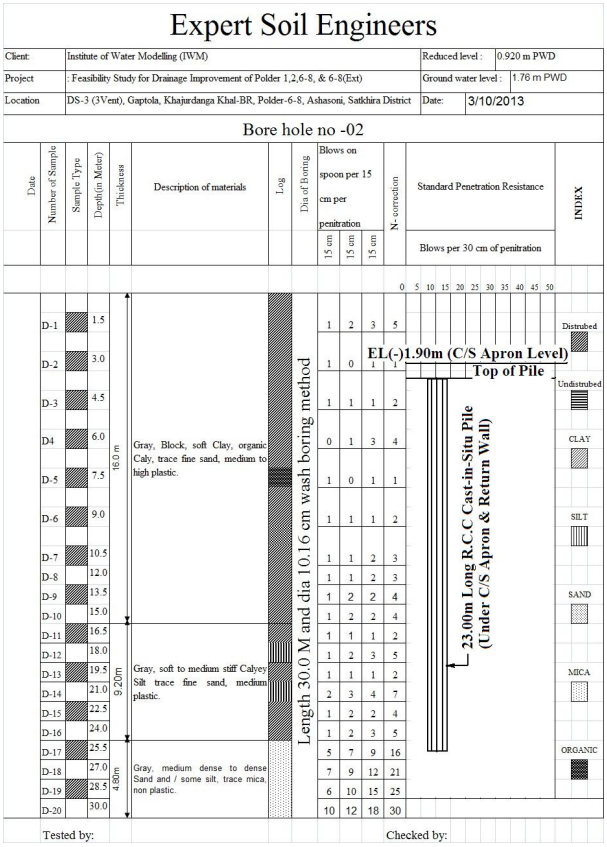

Figure 3: bore log of 3-Vent Khejurdangi Regulator

5 Design Calculation

Bearing Capacity and Settlement of Natural Ground without improvement:

$$q_{ult} = CN_C S_C d_C + 0.5\gamma^{'} N_\gamma d_\gamma + \sigma^{'}_D N_q S_q d_q$$

$$\begin{aligned}
\sigma^{'}_D &= (EGL - FoundationLevel) * \gamma_{Sub} \\
&= (1.5 - (-)3.35) * \gamma_{Sub} \\
&= 4.85 * (15 - 9.81) \\
&= 4.85 * 5.19 \\
&= 25.2
\end{aligned}$$

Assumed Values
$N_\gamma = 0, C = 5.14, S_C = d_C = 1.2, N_q = S_q = d_q = 1$

$$\begin{aligned}
q_{ult} &= CN_C S_C d_C + 0.5\gamma^{'} N_\gamma d_\gamma + \sigma^{'}_D N_q S_q d_q \\
&= 37.5 * 5.14 * 1.2 * 1.2 + 0.5 * 0 * (15 - 9.81) * 1 * 1 + 25.2 * 1 * 1 * 1 \\
&= 302.76KPa
\end{aligned}$$

$$\begin{aligned}
q_{ult,s} &= k^{'} k_p C_u \\
&= 25 * 37.5 \\
&= 937.5KPa
\end{aligned}$$

$$\begin{aligned}
q_{ult,req} &= f_s * FoundationPressure \\
&= 3 * 120 \\
&= 360KPa
\end{aligned}$$

$$
\begin{aligned}
q_{ult,req} &= q_{ult,c} * a_s + (1 - a_s) * q_{ult,s} \\
360 &= 937 * a_s + (1 - a_s) * 302 \\
360 &= 937 * a_s - 302 * a_s + 302 \\
360 &= 635 * a_s + 302 \\
635 * a_s &= 360 - 302 \\
a_s &= \frac{58}{302} \\
a_s &= 0.091
\end{aligned}
$$

$$
\begin{aligned}
\frac{s}{d} &= \sqrt{\frac{\pi}{4a_s}} \\
&= \sqrt{\frac{3.14}{4 * 0.091}} \\
&= 2.94 \\
use, 2.5
\end{aligned}
$$

Use 10m Rammed Aggregate Pile with s/d ratio 2.5 and 0.60m Pile dia

6 Unit Cost Calculation

Khoa Filter: Code: 40-520-20(40mm to 20mm)-4900.41TK
Code: 40-520-30(20mm to 5mm)-5401.45TK
Material Cost=5150
Total cost including Installation Cost and VAT-Tax= 5350*1.33*1.2=8540
unit cost=m^3=164440 BDT=0.0854 lakh BDT

7 Foundation Cost for Regulator

Regulator Foot print Ares=635m^2
depth of improvement=10 m
Total soil volume=6350m^3
Total Pile Volume=0.125*6350=

$$790m^3$$

Total cost=0.0854*790=68 Lakh BDT