L-7745 Window - "cost",

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S.R. Marine Made by AFC Check by — Date 2/22/85 Supv. —

Geotechnical Cost Estimate

talk to (576-7087) Michael Woo - 2-21 gave cost

4 Test Holes on barge 4

2 days per hole × 2

Days Drilling 8

Day Mob+De + 4

Expl Days 12

@ $900/day × 900

Expl. Cost $10,800

Engineering - Design 40 hrs

Review 16 hrs

56 hr × 25 = $1,400

Laboratory Lump Sum $1,000

$13,200 Total

Move in after finish barge at Puget Island - Target Date March 20th

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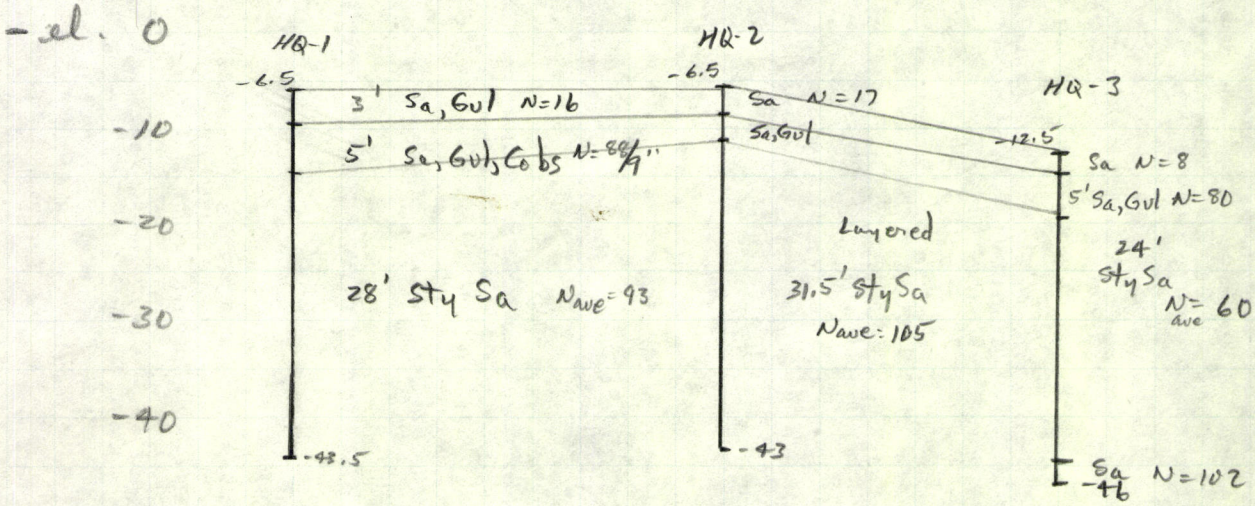
New north slip to be constructed:

Test holes HQ-1, HQ-2, & HQ-3 drilled



Marine plan is to build new dock with prestressed concrete piles.

Soil conditions suitable for;

concrete piles, prestressed, precast, C.I.P. closed end } requires preboring

Pipe pile, open end ?1/2", 16" ϕ } no preboring risk of running

Timber, 40T } requires preboring

Drilled shafts } requires casing to at least 8' below mudline

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S.R. Marvine Made by APK Check by — Date 7/9/85 Supv. —

Pile capacities in excess of 100T per are feasible.

Steel "H" not desirable high risk of "running"

Large Diameter high capacity displacement piles not feasible, lack of penetration.

Construction Constraints

A) From roughly 2' to 8' below mudline gravel and cobbles exist. Apparently very dense.
May be difficult to prebore

B) 3' of loose to medium dense surface soil will slough into prebore holes

C) Drilled shafts must be large enough so cobbles can be handled.

D) Shafts could have problem with sands flowing.

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Options	Type Support	Comments
A	P.C. pile w/ "H" pile extension 120T capacity	corrosion?
B	P.C. pile w/ preboring, 120T capacity	difficult preboring
C	Timber, 40T capacity	life span? difficult preboring
D	Open end pipe pile (70T limit reduce risk "running") (Treat as shaft)	driving through cobbles? piles may "run"?

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Option A P.C. pile w/ "H" pile extension
$q_a = 120^T$

By experience displacement pile will not penetrate very dense glacially loaded soil more than 5 ft.

@ HQ-1 est. tip el. -14
@ HQ-2 est. tip. el. -12
@ HQ-3 est. tip el. -18

Tip extension length to be as needed for minimum penetration. (Assumes no scour @ P.C. pile tip).

Option B P.C. pile w/ preboring
$q_a = 120^T$

Similar to Option A, est. tip. is expected to be approx. 3 ft above depth of prebore (accounts for slough infilling). Prebore hole same diameter as pile).

Option C Timber pile, 40^T Capacity

40^T Capacity will be achieved when pile contacts very dense glacial soil. Will need preboring for minimum penetration requirements.

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S.R. Manville Made by APK Check by — Date 7/9/85 Supv. —

Option D Open end pipe pile

Model as a driven pile;

$q_u = q_p + q_{skin}$

Meyerhof:

Point resistance $P_{pu} = 4 N A_p$ (tons)

Skin resistance $q_s = 0.02 N$ (tsf)

? 1/2 q_s for open end pipe piles

$P_{pu} = 4(90)\pi\left(\frac{16}{12}\right)\left(\frac{0.312}{12}\right)$ $N \geq 90$

$P_{pu} = 39.3$ tons ✓

I get 38.4 T

$q_s = 0.01 N$ (tsf)

$q_s = 0.01(80^+) = 0.8$ tsf

(in glacially loaded soil and pipe pile with cutter shoe skin friction may be less)

$P_u = P_{pu} + q_s$

$P_u = 39^T + 0.8 \text{ tsf}(A_s)$

$P_a = P_u/3$

$P_a = 13^T + \frac{0.8(\pi)\left(\frac{16}{12}\right) l}{3}$

if $P_a = 70^T$

$l = \frac{57}{1.11} = 51$ ft in glacial soil

Dock

tip el. -62

Transfer Span

tip el. -69

✓

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Model pipe pile as a shaft foundation;

$Q_T = Q_B + Q_S$

assume $Q_S = 0$ for case where pile fractures soil and does not develop skin resistance because of thick tip reinforcement.

$Q_T = Q_B$

Base resistance fully mobilized at deflection of tip of 0.05B

allowable settlement individual pile

$s = 1.0$ inches

$w_b/B = 1.0''/16'' = 0.06$ or 6%

Reese Fig. 3.9 using mean line use $q_b/(q_b)_{ult}$ of 1.0. OK this soil is glacially overloaded.

Reese Fig. 3.10 limits $q_{ult} = 40$ tsf for cases where $N_{SPT} \geq 60$

Assuming factor of safety of 2.5

$q_a = \frac{q_{ult}}{F.S.}$

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$q_a = \frac{40 \text{ tsf}}{2.5}$

$q_a = 16 \text{ tsf}$

for 16" ϕ piles,

$Q_a = q_a A$

$Q_a = 16 \text{ tsf} \; \pi \frac{(1.33)^2}{4} \text{ ft}^2$

$Q_a = 22.3$ tons

Glacially loaded granular soil has more capacity than charts meant for, however, can not extrapolate to 40' range or more.

if pile ϕ 24"

$Q_a = q_a A$

$Q_a = 16 \text{ tsf} \left(\pi \frac{4}{4}\right)$

$Q_a = 50.2$ tons

for glacial soil capacity could easily

be 70T with settlement < 1 inch.

Alternate Analysis

Drilled Pier Foundations

Woodward-Clyde

$P_b = a_b \sigma_v' N_q'$

if 15' into glacial soil

$\sigma_v' = 65 \text{ pcf } (15 \text{ ft})$
(γ_{sub})

$\sigma_v' = 975 \text{ psf or } 0.49 \text{ tsf}$

$N_q' = 250$ (Berezantsev)
for $\phi = 42°$

for 16" ϕ pile

$P_b = \pi \frac{1.33^2}{4} (0.49) 250$ (tons)

$P_b = 170^T$

for F.S. = 2.5

$P_a = 68$ Tons

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Alternate Analysis Meyerhof

$P_b = p_b A$

$P_b = 360 \text{ tsf} (A)$

for 16" ϕ pile

$A = \pi \frac{1.33^2}{4}$

$A = 1.39 \text{ ft}^2$

$p_b = 4N$ (tsf)

assumes (1) $L/d_s > 10$

(2) soil is saturated sands

pile tip in $N > 90$ soil

$p_b = 4(90) = 360$ tsf

then

$P_b = 360 \text{ tsf } (1.39) \text{ ft}^2$

$P_b = 500$ tons

if FS = 4 for Meyerhof

$R_{allow} = 125$ tons

Meyerhof may be non conservative in this case, if open-ended pile driven without plug forming, and pile is filled with concrete.

requires embedment in glacial soil

$L \geq 10 d_s$

$L \geq 10 (\frac{16}{12})$

$L \geq 13^+$ ft

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Recommend 16" ϕ open end pipe pile

A) Drive to bearing 70T

or

B) Drive to tip elevation ....
-25 along new dock
-35 at transfer span

and treat as shaft foundation with no friction. Fill with concrete to within 1 ft of pipe tip.

70 T bearing Yes

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