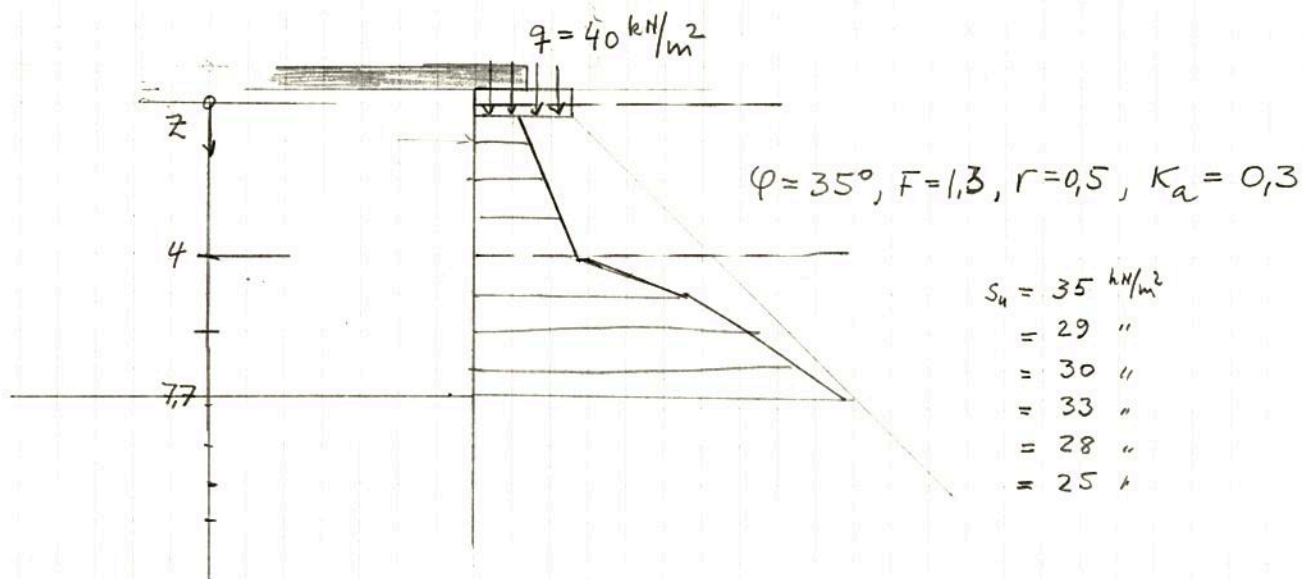


## PROFIL km 4,95



Aktivt jordtrykk:

$$z = 0, \quad p_a = 0,3 \cdot 40 = 12 \text{ kN/m}^2$$

$$z = 3,99, \quad p_a = 0,3 \cdot 19 \cdot 4,0 + 12 \cdot \frac{2,5}{6,4} = 22,8 + 4,7 = 27,5 \text{ kN/m}^2$$

$$z = 4,01, \quad p_a = 19 \cdot 4,0 + 40 \cdot \frac{2,5}{6,4} - \frac{2 \cdot 35}{1,3} \cdot 1,15 = 76 + 16 - 62 = 30 \text{ kN/m}^2$$

$$z = 5,0, \quad p_a = 19 \cdot 5,0 + 40 \cdot \frac{2,5}{7,4} - \frac{2 \cdot 29}{1,3} \cdot 1,15 = 56 \text{ kN/m}^2$$

$$z = 6,0, \quad p_a = 19 \cdot 6,0 + 40 \cdot \frac{2,5}{8,4} - \frac{2 \cdot 30}{1,3} \cdot 1,15 = 73 \text{ "}$$

$$z = 7,7, \quad p_a = 19 \cdot 7,7 + 40 \cdot \frac{2,5}{10,0} - \frac{2 \cdot 33}{1,3} \cdot 1,15 = 98 \text{ "}$$

Passivt jordtrykk:

Når utgraving er foretatt til følgende nivåer:

$$z = 4,01, \quad p_p = \frac{2 \cdot 35}{1,3} \cdot 1,15 = 62 \text{ kN/m}^2$$

$$p_p - p_a = 62 - 30 = 32 \text{ kN/m}^2$$

$$z = 5, \quad p_p = \frac{2 \cdot 29}{1,3} \cdot 1,15 = 51$$

$$p_p - p_a = 51 - 56 = -5 \text{ kN/m}^2$$

$$z = 6, \quad p_p = 53 \text{ kN/m}^2$$

$$p_p - p_a = 53 - 73 = -20 \text{ "}$$

$$z = 7,7, \quad p_p = 58 \text{ "}$$

$$p_p - p_a = 58 - 98 = -40 \text{ "}$$

## Avstivning.

1. avstivning  $z = 1,0$ .

2. avstivning  $z = 4,0$

Forutsetter graving til  $z = 4,5$ .

$$z = 4,5, \quad p_a = 40 \text{ kN/m}^2$$

$$p_p = \frac{2 \cdot 32}{1,3} \cdot 1,15 = 57 \text{ kN/m}^2$$

$$p_p - p_a = 17 \text{ kN/m}^2$$

$$z = 5$$

$$p_p - p_a = 51 - 40 = 11$$

$$z = 6$$

$$p_p - p_a = 53 - 40 = 13$$

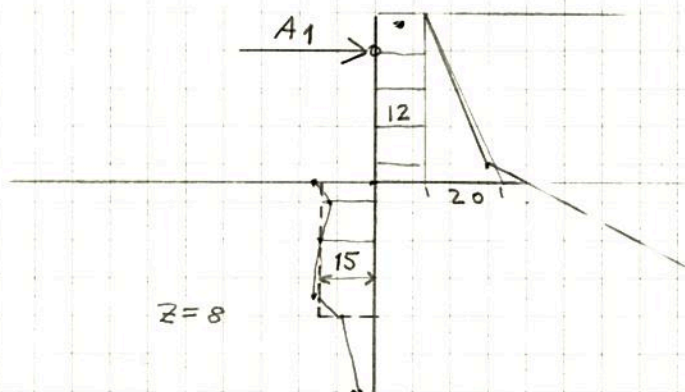
$$z = 7,7$$

$$p_p - p_a = 58 - 40 = 18$$

$$z = 10,0$$

$$p_p = 2 \cdot \frac{25}{1,3} \cdot 1,15 = 44$$

$$p_p - p_a = 4 \text{ kN/m}^2$$

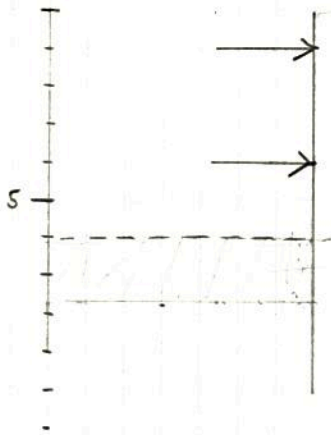


Momentlikevekt om  $A_1$  :

$$\begin{aligned} \sum M_{A_1} &= P_p \cdot a_p - P_a \cdot a_a = 15 \cdot 4,5 \cdot \left( \frac{4,5}{2} + 3,5 \right) - 12 \cdot 4,5 \cdot \left( \frac{4,5}{2} - 1,0 \right) \\ &\quad - 0,5 \cdot 20 \cdot 4,5 \cdot \left( \frac{2}{3} \cdot 4,5 - 1,0 \right) \\ &= 388 - 68 - 90 = 230 \text{ kNm/m} \end{aligned}$$

OK!

$$N_c = \underline{6,5}$$



Sikkerhet mot bunnopp-pressing :

$$z = 6,0$$

$$\left. \begin{array}{l} B/L \approx 0 \\ D/B = 6/8 = 0,75 \end{array} \right\} N_c = 6,2$$

$$\underline{F} = \frac{N_c \cdot s_u}{z + 9} = \frac{6,2 \cdot 29}{19 \cdot 6 + 12} = \underline{1,43}$$

$$(s_u = \frac{29 + 30 + 33 + 28 + 25}{5} = 29 \text{ kN/m}^2)$$

$$z = 7,7$$

$$\left. \begin{array}{l} B/L = 0 \\ D/B = 7,7/8 \approx 1,0 \end{array} \right\} N_c = 6,5$$

$$\underline{F} = \frac{6,5 \cdot 29}{19 \cdot 7,7 + 10} = \underline{1,21} \quad \leftarrow \underline{1,3}$$

Seksjonsvis graving og støping :

$$L = 8 \text{ m}$$

$$B/L = 1,0$$

$$D/B = 1$$

$$\left. \begin{array}{l} L = 8 \text{ m} \\ B/L = 1,0 \\ D/B = 1 \end{array} \right\} N_c = 7,7$$

$$\text{„Modifisert“ } N_c \approx 6,5 + (7,7 - 6,5) \cdot \frac{1,7}{7,7} = 6,5 + 0,3 = \underline{6,8}$$

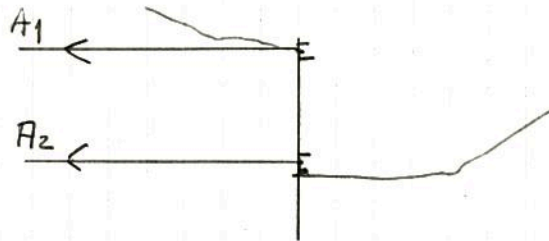
$$\underline{F} = 6,8 \cdot \frac{1,21}{6,5} = \underline{1,27} \approx 1,3$$

Inneblår seksjonsvis utførelse nedre 2 m.



## Stadium 2

Andre forankring montert.

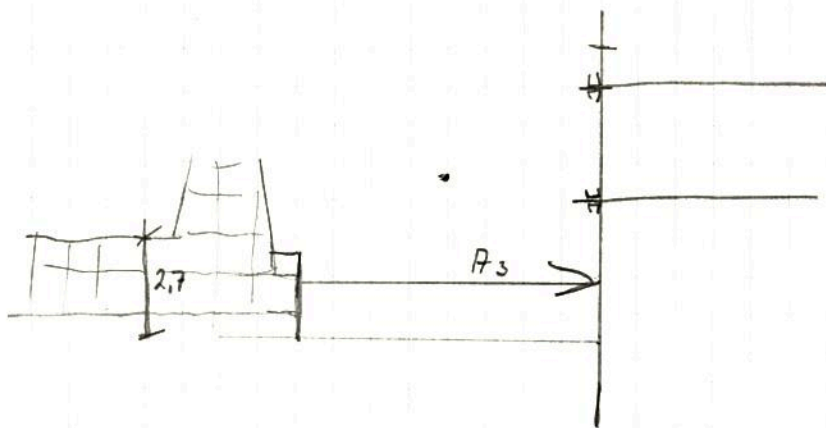


$$A_1 + A_2 = 109 + 155 = 264 \text{ kN/m}$$

$\Sigma A$  er mindre enn det som kan mobiliseres av mottrykk. OK!

## Stadium 3.

Tredje avstivning montert



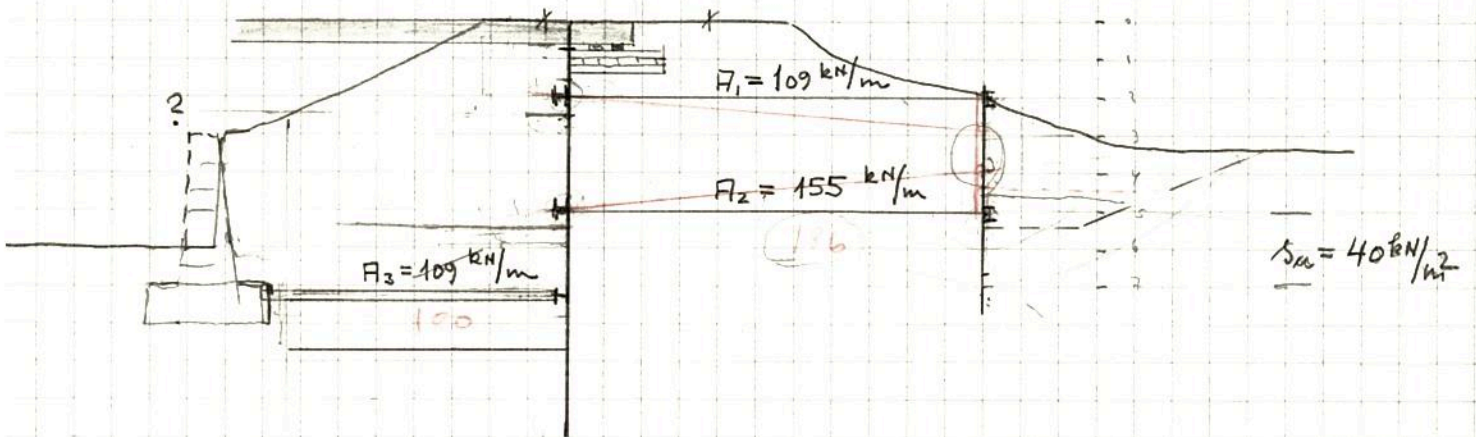
$$A_3 = 109 \text{ kN/m}$$

$$P_{pmin} = 4 \cdot 2.7 \cdot 19 \cdot \frac{2.7}{2} = 277 \text{ kN/m} > \underline{A_3}$$

OK!

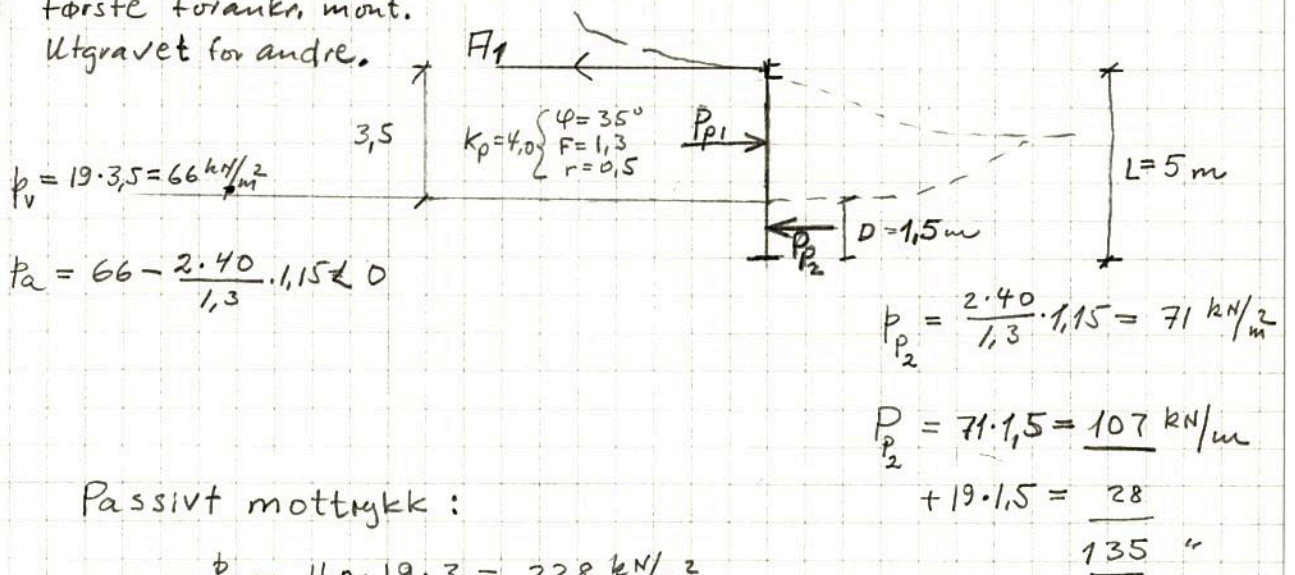
## Utförelse av avstivning.

Forutsetter at de to øverste avstivninger må skje ved forankring bakover, mens den tredje utføres som tverraust, mot murfundament.



## Forankringsvegg:

Stadium 1: Første forankr. mont.  
Utgravet for andre.



Passivt mottrykk:

$$p_p = 4,0 \cdot 19 \cdot 3 = 228 \text{ kN/m}^2$$

$$P_p = 0,5 \cdot 225 \cdot 3 = 338 \text{ kN/m, Max. mobilisierbar.}$$

$$P_p > A_1 + P_{p2} = 109 + 135 = 244 \text{ kN/m}$$

$$M_{A_1} = P_{P_2} \cdot a_2 - P_{P_1} \cdot a_1 = 135 \cdot 4,2 - P_{P_1} \cdot 2,0 = 0.$$

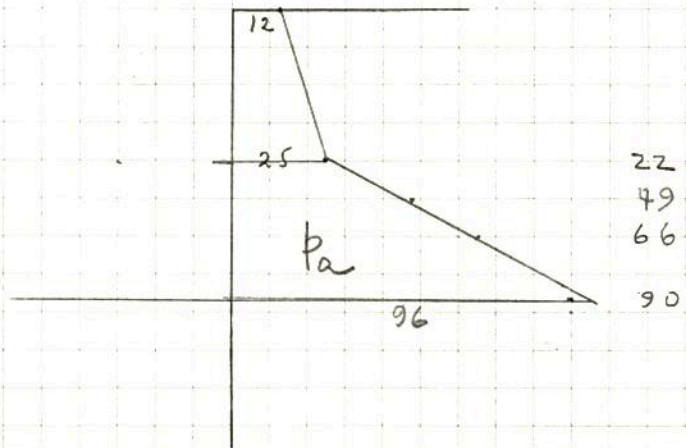
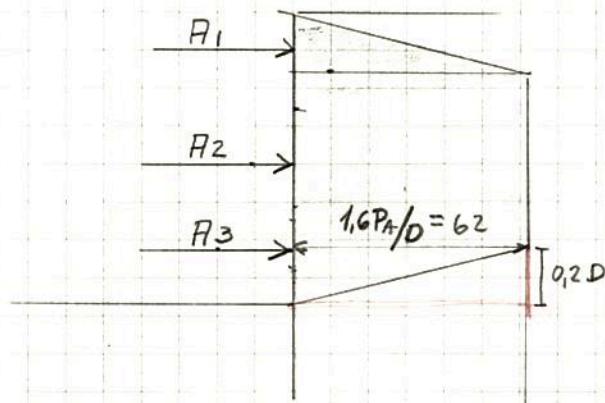
$$P_{p1} = \frac{135 \cdot 4,2}{2} = 284 \text{ kN/m}$$

$$A_1 < P_{p_1} - P_{p_2} = 284 - 135 = \underline{149 \text{ kN/m}} > 109 = A_1$$

OK!



## Avstivningskrefter.



Total aktiv jordtrykksresultant,  $P_A$ , beregnes for  $r=0$  og  $F=1,0$

$$P_A = \frac{12+25}{2} \cdot 4 + \frac{25+96}{2} \cdot 3,7 = 74 + 224 = \underline{298 \text{ kN/m}}$$

$$\frac{1,6 \cdot P_A}{D} = \underline{62 \text{ kN/m}^2}$$

$$H_1 = 0,5 \cdot 1,5 \cdot 62 + 1,0 \cdot 62 = \underline{109 \text{ kN/m}}$$

$$H_2 = 2,5 \cdot 62 = \underline{155 \text{ kN/m}}$$

$$A_{\text{aktiv}} = 186 \text{ kN/m}$$

$$H_3 = 1,0 \cdot 62 + 0,5 \cdot 1,5 \cdot 62 = \underline{109 \text{ kN/m}}$$

$$A_{\text{idiv}} = A_{\text{aktiv}}$$

Når  $A_3$  fjernes etter at bunnplaten er støpt, økes  $A_2$  til  $62 \cdot 3,0 = \underline{186 \text{ kN/m}}$ .

$$A_3 = (1,1 + 1,9) \cdot 62 = \underline{180 \text{ kN/m}}$$

## Utførelse.

### Fase 1.

Graving til dybde 2,5m under s.v.o. ( $z=1,5$ )

Første avstiver monteres, dybde 2,0m

### Fase 2.

Graving til dybde 5,5m under s.v.o. ( $z=4,5$ )

Andre avstiver monteres, dybde 5,0m.

### Fase 3.

Seksjonsvis graving. Seksjonslengde  $L=8m$

Tredje avstivning monteres, 1,5m over bunn.

Bunnplata støpes. (Etter herding kan tredje avstiver fjernes)

Neste seksjon kan utføres.

NB! Bunnplata støpes mot spuntea.

# PROFIL E-E

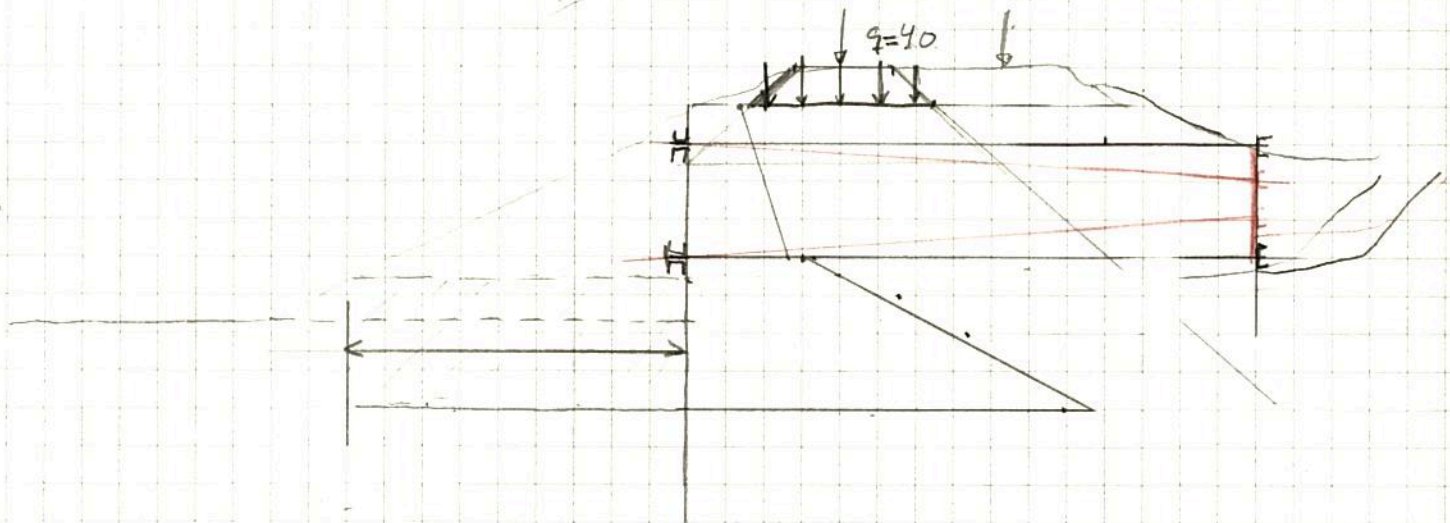
1.12

4.5

10

7.5

1.5



Sikkerhet mot bunnappressing:

$$\left. \begin{array}{l} D/B = 1,0 \\ B/L = 0,5 \end{array} \right\} N_c = 7,0$$

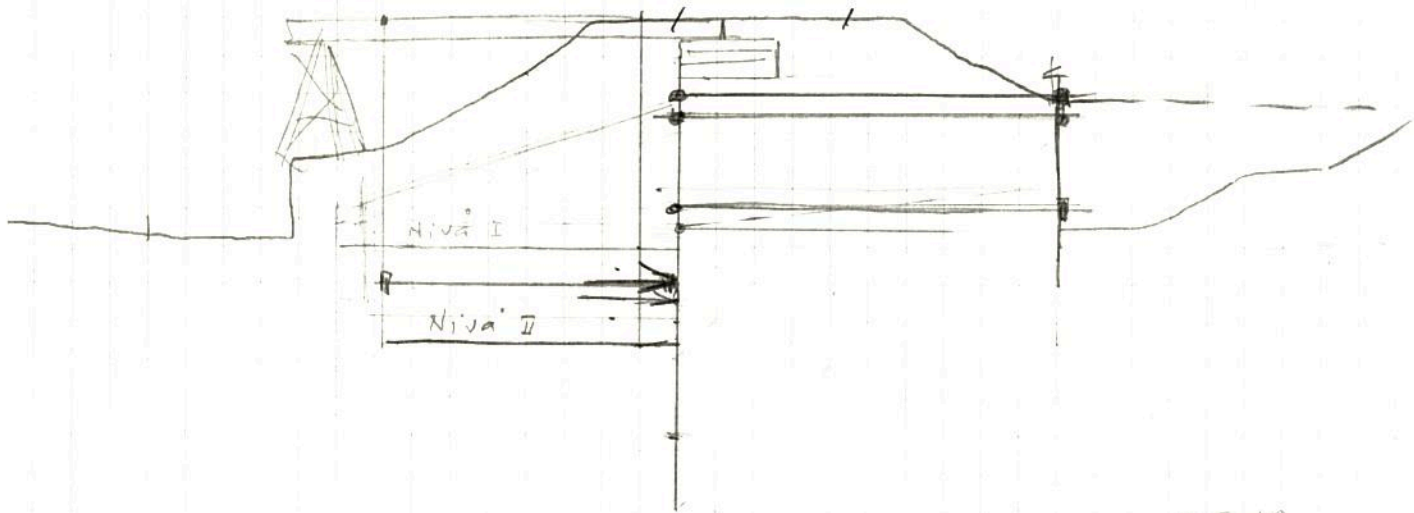
$$F = \frac{7,0 \cdot 29}{19 \cdot 8 + \frac{40 \cdot 4,5}{16}} = \underline{\underline{1,24}}$$

$$\left. \begin{array}{l} B/L = 0 \\ D/B = 0 \end{array} \right\} N_c = 5,2$$

$$F = \frac{5,2 \cdot 29}{5,75 \cdot 19 + \frac{40 \cdot 4,5}{14}} = \underline{\underline{1,23}}$$



Profil km 4,958.



Niva I

$$D/B = \frac{5}{8} = 0,6$$

$$B/L = 0 \Rightarrow N_c = 6$$

$$F = \frac{6 \cdot 3}{1,9 \cdot 5} = \underline{1,9}$$

$$4 \cdot 7 = 28 \text{ m} \cdot 1,5 = \underline{42}$$

$$28/3 = \underline{9,3} \text{ m} \cdot 1,2 = \underline{10,6}$$

$$7,5 \cdot 1,9$$

$$\begin{array}{r} 10,6 \\ - 9,5 \\ \hline 1,1 \end{array}$$

$$\underline{0,35}$$

Niva II

$$D/B = \frac{8,0}{8} \approx 1$$

$$B/L = 0 \Rightarrow N_c = 6,5$$

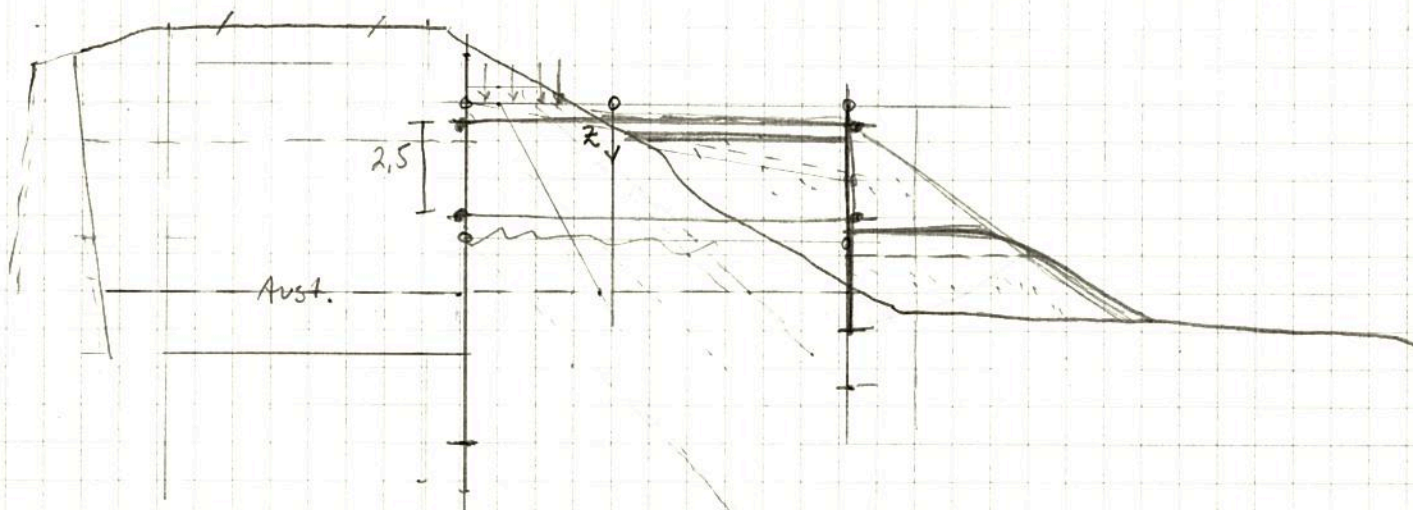
$$\frac{6,5 \cdot 3}{1,9 \cdot 8,0} = \underline{1,28}$$

$$B/L = 0,5 \Rightarrow N_c = 7,0$$

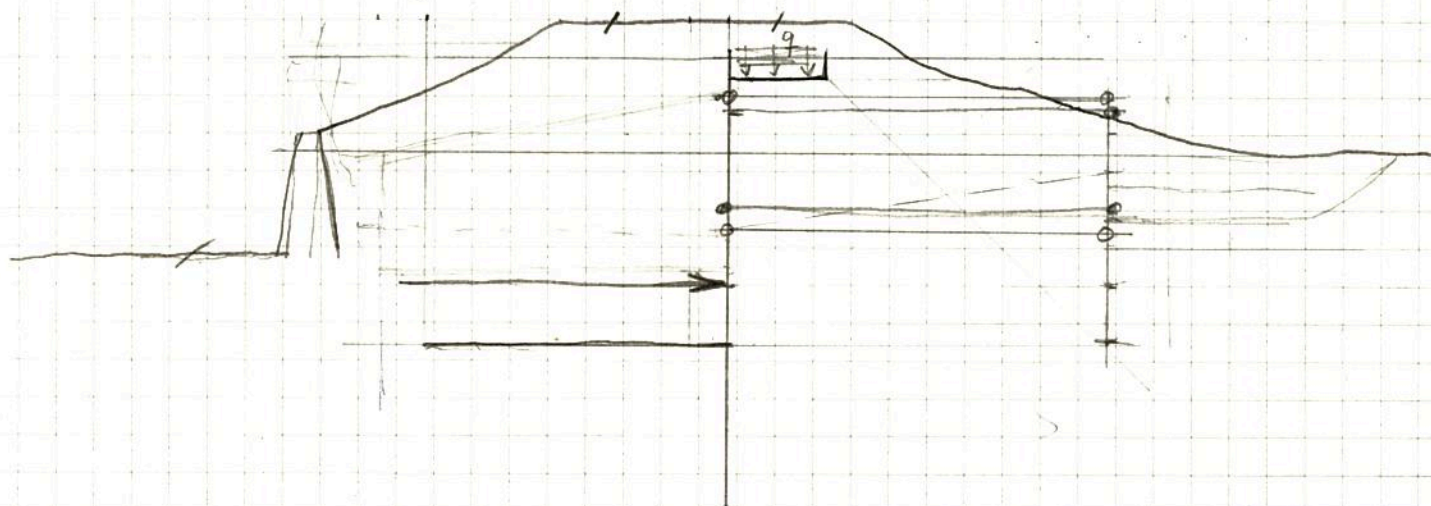
$$\frac{7 \cdot 3}{1,9 \cdot 8} = \underline{1,38}$$

# Undergang for godstogsfor. Brygv.

Profil km 4,94.



Profil km 4,95





rem-Oslo Spm Oslo-Lillestrøm

488 skille ok H. 86,910

Spm godsspor

89 skille ok H. 86,910

Spm

91+5 skille ok H. 87,130

94 skille ok H. 87,300

Tverrprofiler  
Km 488-494 Utgangsh. 80  
Oslo-Lillestrøm  
M=1:200

Lillestrøm

18.1 78 M. Hovc



Spm Lillestrøm-OSLO      Spm OSLO-Lillestrøm  
Km 4,80      sville ok H=86,120

Spm Side spor

82      sville ok H=86,410

Spm

84      sville ok H=86,650

Spm

86      sville ok H=86,780

Spm

S



Spm Lillestrøm-OSLO

Spm OSLO Lille  
5,02 Sviller OK H=

Spm

04

Sviller OK H=

Spm

06

Sviller OK H=

Spm

08

Sviller OK H=8

Spm

5,10

Sviller OK H=82

Spm



Spm Lillestrøm-OSLO

Spm OSLO-LILLEstrøm

495

sville ok. H=87,320

Spm godsspor

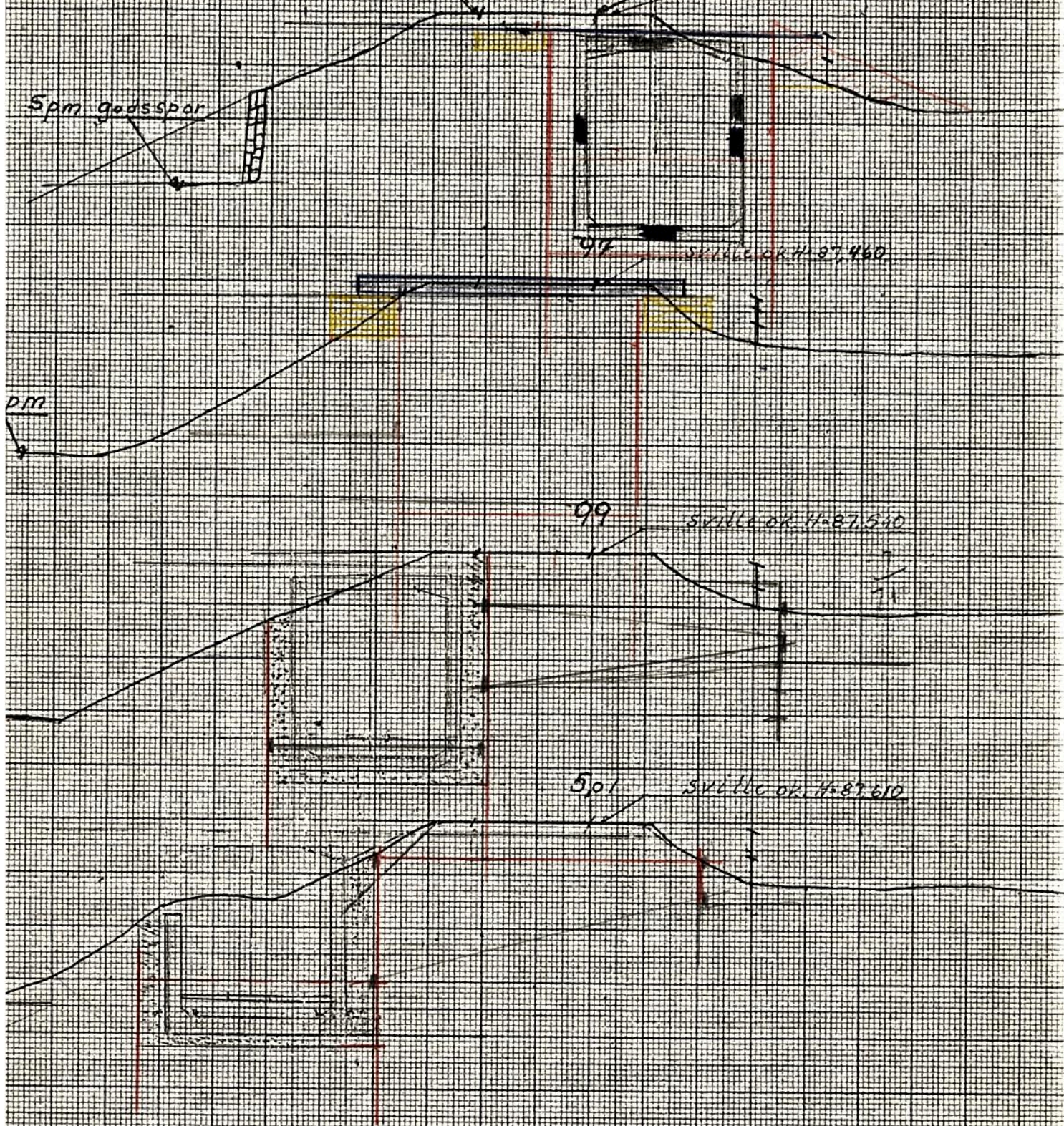
DM

99

sville ok. H=87,540

501

sville ok. H=87,610





$$\frac{2 \cdot 20}{1,3} \cdot 1,15 = \underline{\underline{53 \cdot 40}}$$

$$\begin{array}{r} 3,5 \\ 0,75 \\ \hline 4,25 \end{array}$$

$$13 \cdot 1,5 (1,5/2 + 3,5)$$

83

$$2,5 (2,5/2 + 3,5)$$

$$\begin{array}{r} 1,25 \\ 3,5 \\ \hline 4,75 \cdot 2,5 \cdot 12 \end{array}$$

$$0,5 \cdot 4 \cdot 3 \cdot 19 \cdot 3 = \underline{\underline{342}}$$

$$\begin{array}{r} 109 \\ 155 \\ \hline 264 \end{array}$$

φ 32 Dyrvidag stag 85/105, Karakteristisk styrke 540 kN

$$540 / 155 = \underline{\underline{3,48 \text{ m}}}$$

$$540 / 189 = \underline{\underline{2,86}}$$

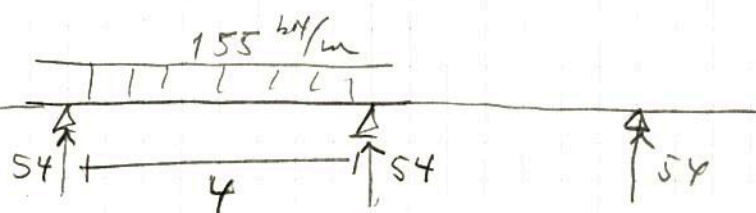
c/c stag 3,5 m

$$540 / 109 = \underline{\underline{4,95}}$$

4,5 m for A<sub>1</sub>  
c/c 5,0 m

Velger c/c stag

~~2,5 - 3 m~~  
3,5 - 4,0 m for A<sub>2</sub>



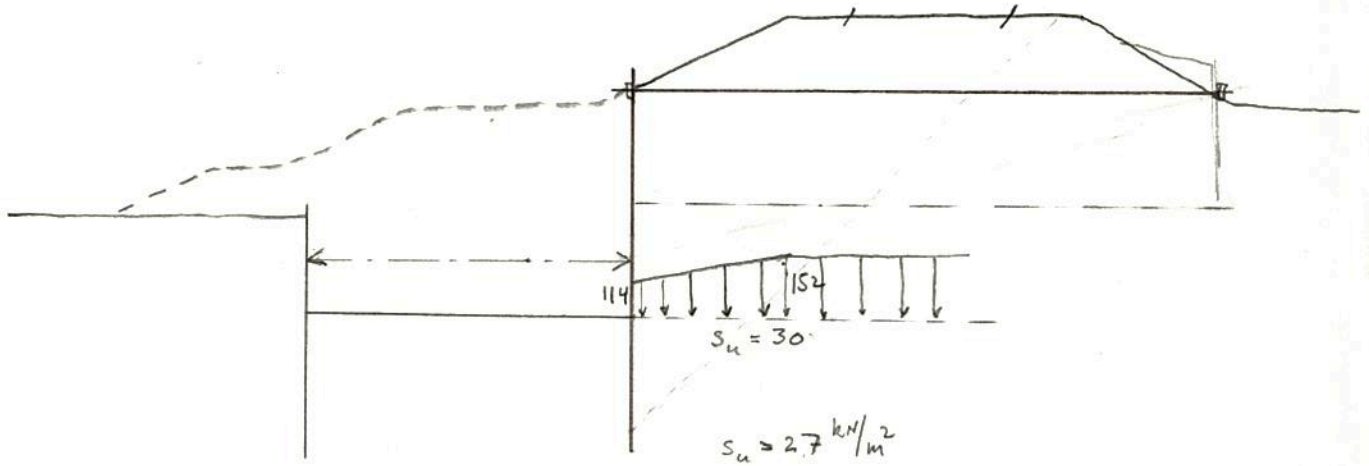
$$\frac{155 \cdot 4^2}{8} = \underline{\underline{310 \text{ kNm}}}$$

UNP 26

$$W_x = \underline{\underline{371 \text{ cm}^3}}$$

$$\frac{310000 \text{ kp cm}}{371 \text{ cm}^3} = 835 \text{ kp/cm}^2$$

$$\underline{\underline{k_m 5,02}}$$



Sikkerhet mot bunnoppressing :  $F = \frac{N_c \cdot s_u}{\gamma D + q} = \frac{6 \cdot 30}{150} = \underline{1,2}$

Jordtrykk v/ gravebunn :  $p_A = 150 - \frac{2 \cdot 30}{1,3} \cdot 1,15 = \underline{97 \text{ kN/m}^2}$

$$p_p = \underline{53 \text{ kN/m}^2}$$

NB! Nódv. med mer enn ett avstøvningsnivå.

$$\varphi = 35^\circ$$

$$\delta = 19^\circ$$

