

D. N. UNDRILL

B.E. (CIVIL) M.L.P.E.N.Z. REGD. ENG.

18 HATHAWAY AVENUE

LOWER HUTT NZ

CONSULTING STRUCTURAL ENGINEER

TEL/FAX: (04) 567-0433

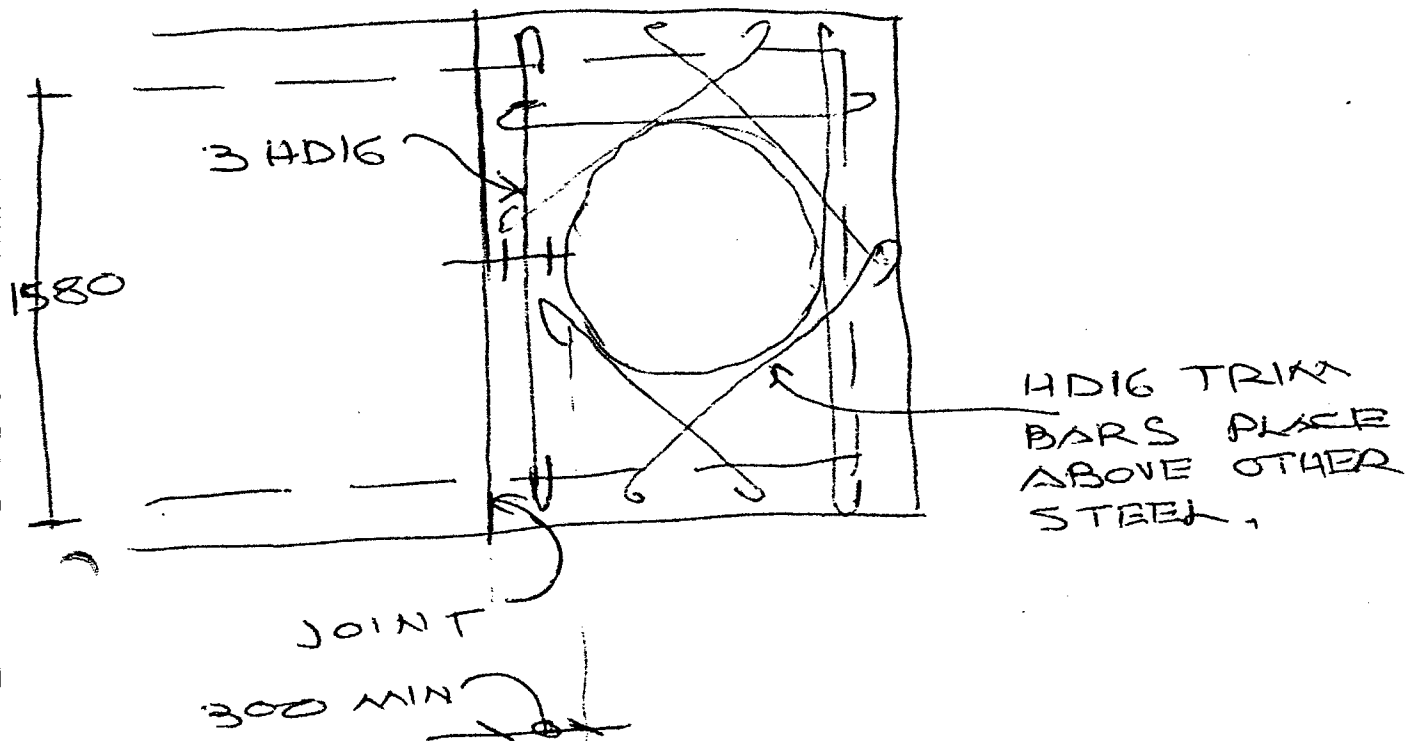
18-3-97

REDCAR.

API SEPARATORS.

1025 Ø MANWAY

ROOF WITH JOINT



HD 12 AT 200 LONGIT } AS BEFORE
HD 12 AT 150 TRANS }
AROUND MANWAY EXCEPT WHERE
3 HD16 REPLACE THIS

ROOF WITHOUT JOINT

TRIM BARS ADDED.
CLOSE UP HD12 TO 50 CRS EACH SIDE
OF MANWAY - SAME TOTAL NUMBER OF
BARS AS IF SLAB CONTINUED,

D. N. UNDRILL

B.E. (CIVIL) M.L.P.E.N.Z. REGD. ENG.

CONSULTING STRUCTURAL ENGINEER

(1)

18 HATHAWAY AVENUE
LOWER HUTT NZ

TEL/FAX: (04) 567-0433

7-4-97

REDKAR ASSOCIATES

API SEPARATORS

TO BP DWG 45T2-216B

LID

1580 SPAN

175 THICK - 8^{1/2}T AXLE LOADS.

$$U = 1.2G + 1.6Q$$

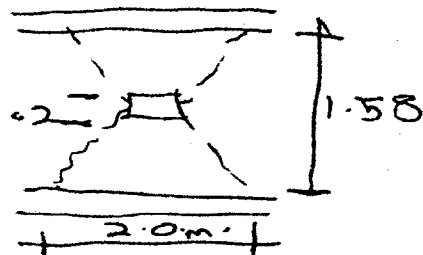
$$1.2 \times 175 \times 24 = 5.04 \text{ kPa.}$$

$$M_D = \frac{wL^2}{8} = \frac{5.04 \times 1.58^2}{8} = 1.69 \text{ kNm/m}$$

1.6 x Q (USE SINGLE WHEEL AT 8.5T)
(TRI AXLE SET GIVES 9T/SIDE
ON GREATER LENGTH)

SINGLE WHEEL - SUPER SINGLE
AT POINT OF OVERTURNING.

$$1.6 \times 85 = 136 \text{ kN} \\ = 68 \text{ kN/m.}$$



$$M = \frac{P.L}{4} = \frac{68 \times 1.38}{4} \\ =$$

23.5 kNm

25.2 kNm

FOR $\gamma d = 0.135$

$$T = 25.2 / 0.135 = 186 \text{ kN}$$

$$A_s = \frac{T}{\phi_{ss}} = \frac{186 \times 10^3}{0.9 \times 430} = 481 \text{ mm}^2/\text{m}$$

HAVE HD12 AT 200 = 565 mm²/m.
- OK,

WALLS

1600 HIGH,

SOIL LOAD AT 18 kN/m³

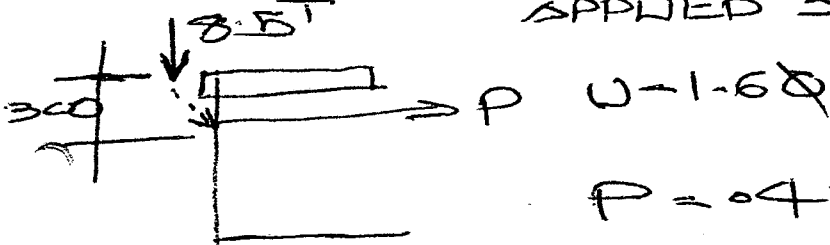
$$\phi = 0.6$$

$$U = 1.2G.$$

$$M = \frac{wL^3}{6} = \frac{0.6 \times 1.6^3}{6} = 6.6 \text{ kNm}$$

WHEEL LOAD

APPLIED 300 OUT FROM EDGE,



$$P = 0.4 \times 85 \times 1.6 = 54 \text{ kN}$$

$$M = 54 \times 1.5 = 82 \text{ kNm}$$

FOR 45° LOAD SPREAD

$$m \text{ AT WALL BASE} \rightarrow 82 = \text{ kNm/m}$$

TOTAL kNm/m.

IF NO HORIZONTAL SPAN EFFECT,
AND NO LOAD TRANSFER TO NID,

HORIZONTAL SPAN, 5500 mm INSIDE

$$M = \frac{wL^2}{16}$$

FOR TOP METRE 4 kN/m^3 AV. PRESSURE
 $\times 1.2 = 4.8 \text{ kPa}$

$$M = \frac{4.8 \times 5.5^2}{16} = 9 \text{ kNm}$$

WHEEL LOAD.

$$M = \frac{Pl}{8} = \frac{54 \times 5.5}{8} = 37 \text{ kNm} \quad (19 \text{ kNm/m})$$

$$19 + 9 = 28 \text{ kNm/m TOTAL}$$

VERTICAL WALL CAPACITY.
HD 12 @ 200

$$A_s = 565 \quad T = \frac{565 \times 0.9 \times 430}{103} \\ = 219 \text{ kN}$$

$$M = T \cdot j \cdot d = 219 \times 0.83 = 18 \text{ kNm/m}$$

HORIZ WALL CAPACITY
HD 12 @ 250

$$T = 175 \text{ kN}$$

$$M = 175 \times 0.65 = 11.4 \text{ kNm/m}$$

SO USING ALL VERTICAL CAPACITY
PROVIDES FOR $\frac{18}{29.1} = 62\%$ OF REQD.

38% REMAINING

$$38\% \text{ OF } 28 \text{ kNm/m} = 10.6 \text{ kNm/m}$$

SO < HORIZ STEEL CAN PROVIDE

SO WALLS ARE OK,

THIS IS CONSERVATIVE
WITH ROOF IN PLACE

LIFTING

4 EYES,

STAY 200 kN

$$1.6 \times 5.8 \times 4.8 = 45 \text{ kN.}$$

$$1.6 \times (11.3 + 3.5) \times 3.6 = \frac{85}{130 \text{ kN.}}$$

$$M = \frac{130 \times 1.2 \times 0.4}{4}$$

$$= 15.6 \text{ kNm.}$$

$$T = 219 \text{ kN}$$

$$M = 219 \times 155 = 33 \text{ kNm/m} - \text{OK.}$$

MIN STEEL

$$.0016 \times 200 \times 1000 = 320 \text{ mm}^2/\text{m.}$$

SO TOP LAYER IN BASE

D12 @ 300 BOTH WAYS.

D. N. UNDRILL

BE (Civ) NIPENZ (Structure) CPEng

Consulting Structural Engineer

18 Hathaway Avenue Lower Hutt New Zealand Tel: 64 4 567 0433 Fax: 64 4 567 0952 Email: undrill@clear.net.nz

11 - 4 - 2006.

~~REDESIGN~~

API SEPARATOR WALLS

1600 HIGH

FOR $\phi = 35^\circ$

$$K_A = 0.27$$

$$P = \frac{1}{2} K_A \gamma H^2$$

$$= \frac{1}{2} \times 0.27 \times 18 \times 1.6^2 = 6.2 \text{ kN/m}$$

$$M = \frac{P \times H}{3} = \frac{6.2 \times 1.6}{3} = 3.3 \text{ kNm/m}$$

FOR $U = 1.2$

ϕ = STRENGTH REDUCTION FACTOR

$$M_U = 6.6 \text{ kNm/m}$$

— AS ORIGINAL CASE

SEPARATOR MID.

8-5T ~~WHEEL~~ LOAD \rightarrow 4.3T/WHEEL.

$$M = \frac{P \times L}{4} = \frac{43 \times 1.58}{4} = 17 \text{ kNm}$$

$$M_U = 1.6 \times 17 = 27 \text{ kNm}$$

SPREAD OVER 2m WIDTH
 $= 13.5 \text{ kNm/m}$

DESIGN IS FOR 2x THIS LOAD.