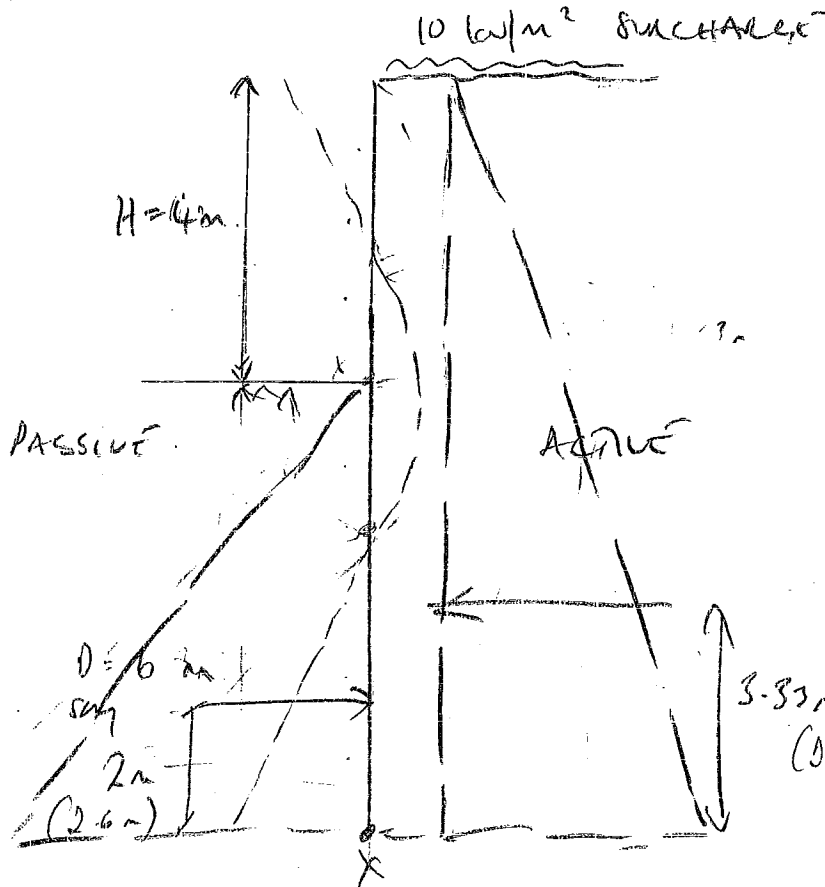


APPENDIX E

STRUCTURAL CALCULATIONS



MADE SANDS
 $\gamma_s = 18 \text{ kN/m}^3$
 $\phi = 23$
 $c_u = 40 \text{ kPa}$

CLAY
 $\gamma_s = 20 \text{ kN/m}^3$
 $\phi = 23-26$
 $c_u = 50 \rightarrow 5m$
 $100 \rightarrow 8m$
 $c' = 0-2 \text{ kPa}$

Soil Depth of Embedment = 6m (total pile length = 10m)

Soil as loose clay pore water pressure at sign bottom
 \rightarrow ignoring effect of water at this stage \rightarrow no water table in J.F.

$$K_A = \tan^2(45 - \phi/2) = 0.438$$

$$K_P = \tan^2(45 + \phi/2) = 2.233$$

Taking moments about X:

(1)	$10 \times 4 \times 0.438 \times 4.38$	$= 14.38$	$D=8m$
(2)	$20 \times 10 \times 0.438 \times 3.33$	$= 291.71$	4.38
(3)	$20 \times 6 \times 2.233 \times 2$	$= 535.92$	420.48
			296.1
			424.86
			928.93

$$\therefore \text{fos} = \frac{535.92}{296.1} = 1.8$$

$\rightarrow \text{fos} > 2.0 \therefore$ Try $D=8m$

$$\therefore \text{fos} = \frac{928.93}{424.86} = 2.186 > 2.0 \text{ -ok} \quad \text{Soil cl} = 8m$$

\therefore Pile $\leq 12m$

Check piles for bending moment:

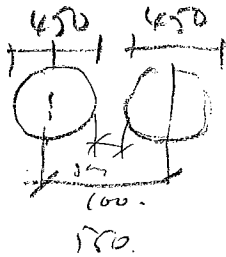
say rotation 1/3 way into embedded depth.

∴ @ 6m deep. & assume clay 'infinitely stiff'
below i.e. fixed cantilever @ 6m.

$$BM = 10 \times 0.438 = 4.38$$

$$+ 20 \times 6 \times 0.438 \times 2 = 105.12$$

$$\underline{109.5 \text{ kNm}}$$



@ 550 mm c/c

∴ on one pile = 60.23 kNm

(as in reality pile is also 'plunged' @ 4m.)

→ 6 H 25 for Eurocode spread sheet.

Also look at 'Rock & Unconsolidated' guidance. (see over)

→ 10m pile

3.7% reinforcement = 588 mm² reinforcement

→ only 6 H 12 (679 mm²)

→ 12m ^{450 φ} PILES WITH 6 H 25; BEING APPROPRIATE

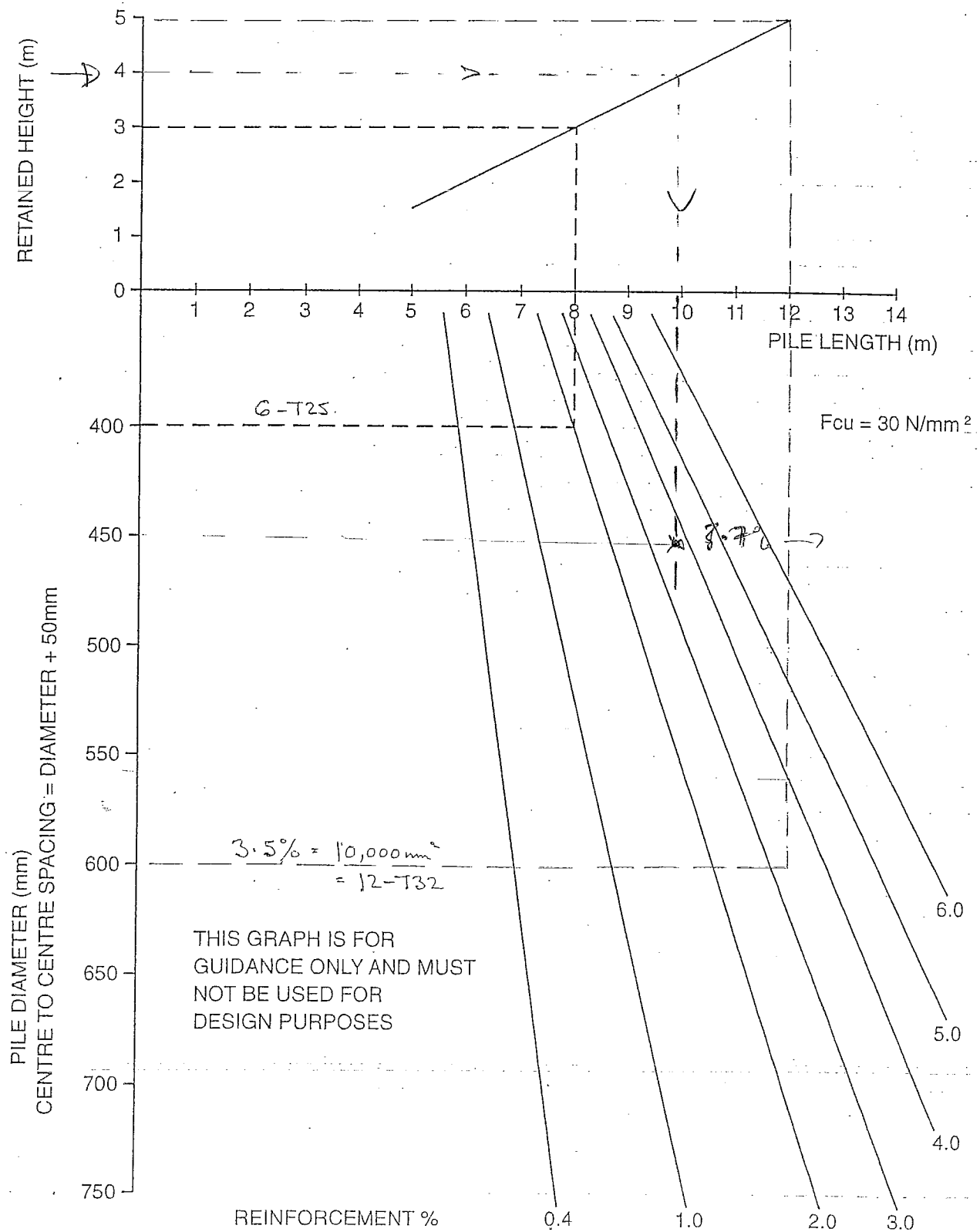
AT THIS STAGE.

→ DEFLECTION WILL BE THE CRITICAL FACTOR TO BE ESTABLISHED BY FE ANALYSIS AT THE DETAILED DESIGN STAGE, HOWEVER AS THE WALL WILL NOT BE SUPPORTING AN EXISTING BUILDING, FURTHER

ANALYSIS AT THIS STAGE IS BEYOND THE SCOPE OF A REASONABLY SMALL LIGHTWEIGHT ADJACENT GROUND BOUND BUILDINGS

GUIDANCE NOTE 5

GRAPHICAL EXAMPLE SHOWING TYPICAL RELATIONSHIP BETWEEN RETAINED HEIGHT, PILE LENGTH, PILE DIAMETER & REINFORCEMENT AREA FOR A CONTIGUOUS BORED PILE RETAINING WALL



GRAPH 1.



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MATERIALS

fck	<u>30</u>	N/mm ²	γ _s	1.15	steel	Cover	<u>50</u>	mm
fyk	<u>500</u>	N/mm ²	γ _c	1.5	concrete	dg	<u>20</u>	mm
φ	<u>2.43</u>		φ _{ef}	<u>1.46</u>		Δ _{c,dev}	<u>5</u>	mm
Steel class	<u>A</u>							

DESIGN SECTION

h	<u>450</u>	mm
with	<u>6</u>	bars

RESTRAINTS

L =	<u>4000</u>	mm
Top	<u>E</u>	Fixed
Btm	<u>E</u>	Fixed
Braced	<u>Y</u>	.

CONNECTING BEAMS/SLABS

	b (mm)	h (mm)	L (m)	Remote end (F) or (P)
Top left	<u>350</u>	<u>500</u>	<u>7.5</u>	<u>E</u>
Top right	<u>350</u>	<u>500</u>	<u>6</u>	<u>E</u>
Bottom left	<u>350</u>	<u>500</u>	<u>7.5</u>	<u>E</u>
Bottom right	<u>350</u>	<u>500</u>	<u>6</u>	<u>E</u>

Beam stiffnesses are 70% of uncracked stiffness
 Column above? Y Col below? Y

BAR ARRANGEMENTS

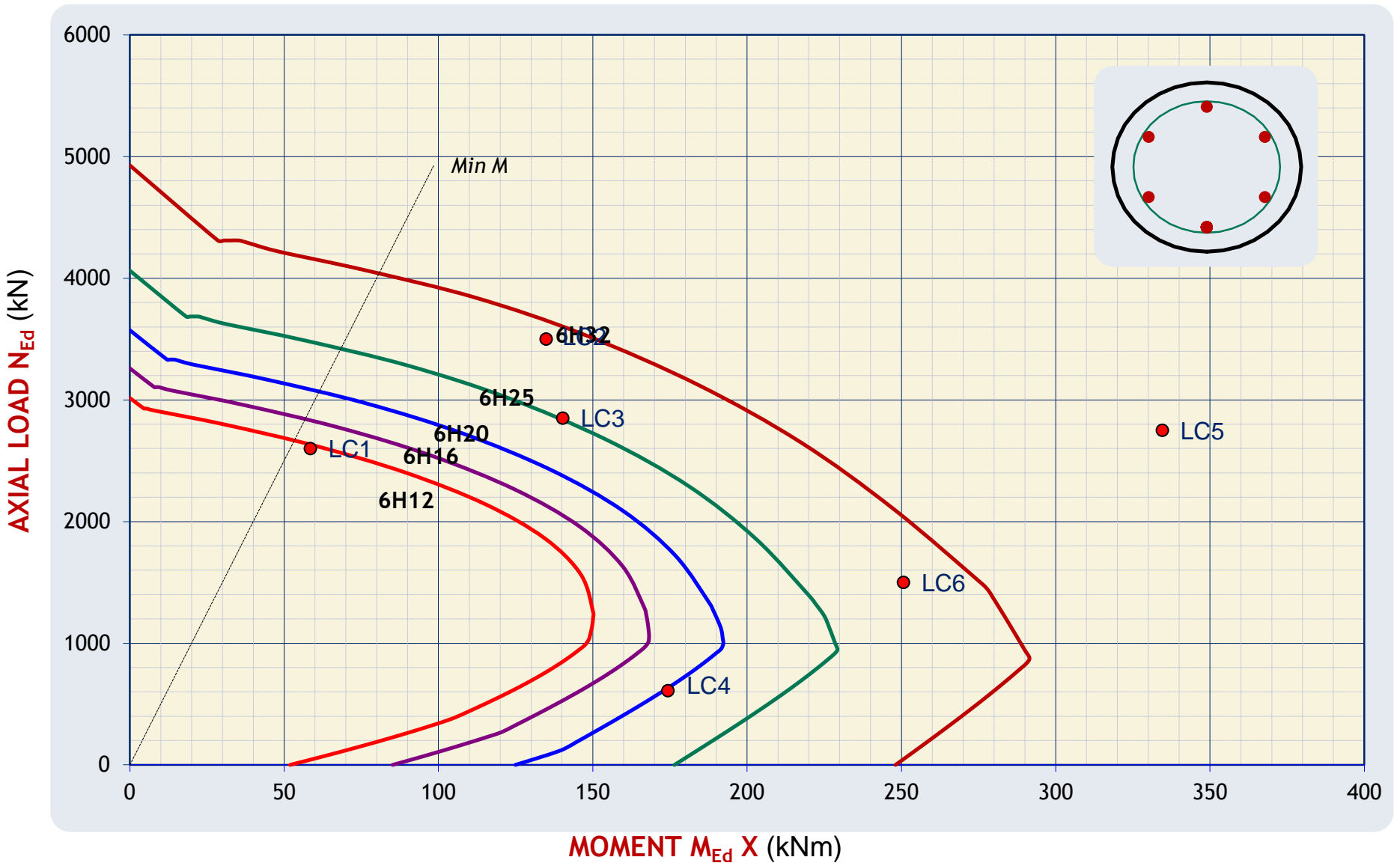
Data on connecting beams only affects loadcases, not charting.

Type	Bar Ø	Asc %	Link Ø	Bar c/c	N _{bal} (kN)	N _{uz} (kN)
H	40	4.74	10	193.7		
H	32	3.03	8	196.9	878.4	4928.3
H	25	1.85	8	198.7	946.5	4061.5
H	20	1.19	8	200.0	997.9	3572.7
H	16	0.76	8	201.1	1057.1	3259.9
H	12	0.43	8	202.1	1254.2	3016.6

Checks
Asc > max %
ok
ok
ok
ok
ok

N:M interaction chart

for 450 diameter column, grade C30/37 concrete and 50 mm cover



LOADCASES

Double curvature? Yes

Loadcase	N _{Ed} (kN)	m _{0e} (kNm)	M _{Ed} (kNm)	
1	<u>2600</u>	<u>40</u>	58.5	6 H12
2	<u>3500</u>	<u>110</u>	134.9	6 H32
3	<u>2850</u>	<u>120</u>	140.3	6 H32

Loadcase	N _{Ed} (kN)	m _{0e} (kNm)	M _{Ed} (kNm)	
4	<u>610</u>	<u>170</u>	174.3	6 H25
5	<u>2750</u>	<u>315</u>	334.6	No Fit
6	<u>1500</u>	<u>240</u>	250.7	6 H32