4. Design pressure $= n.\rho g h = 2\times10^3 \times 9.81 \times 200 = 3.92$ MPa
Solve for D/t the equation :-

$p/S = 3.92/400 = \pi(1+30t/D)(t/D)^2$ gives
$D/t = 26.21$ where D is the mean diameter.

A nominal size of 100 mm corresponds to an O.D. of 114.3mm (AS 2129 e.g) , therefore
$D_o/t = (D+t)/t = D/t + 1 = 27.21$ – this is a maximum.

Considering parameters when pipe is new:

$t = 114.3/27.21 = 4.20$
$\therefore T \geq t + 2c$ (inside & outside corrosion)
$= 6.3$ mm (AS 1835).

or, considering parameters at end of life:

$D_o = 114.3 - 2c = 112.3$ mm
$\therefore t = 112.3/27.21 = 4.13$ mm
i.e. $D_i = D_o - 2t = 104.0$ mm
and so the as-new $D_i = 104.0 - 2t = 102.0$mm
which corresponds to a thickness
$T \geq (114.3 - 102.0)/2 = 6.3$ (AS 1835)

So both as-new and end-of-life considerations require a thickness of 6.3 mm

5. Use eq (h)-(i) which corresponds to a straight column with eccentric load:

$1/\theta = 1 + \eta \sec \frac{\pi}{2}\sqrt{\phi}$; $\theta = \bar{\sigma}/\hat{\sigma} = \bar{\sigma}/S$, $\phi = \bar{\sigma}/\sigma_c$

i.e. solve by trial-and-error for $\bar{\sigma}$:

$\bar{\sigma}/S\,[1 + \eta \sec \frac{\pi}{2}\sqrt{\bar{\sigma}/\sigma_c}\,] = 1$

in which $L = k_L . L_{actual}$; $k_L = 2$
$A = \frac{\pi}{4}d^2$; $I = \frac{\pi}{64}d^4$ $\therefore r = \sqrt{I/A} = d/4$

		(a)	(b)	(c)	(d)
L_{actual}	mm	200	200	400	200
$L = k_L L_{actual}$	mm	400	400	800	400
d	mm	20	10	20	20
r	mm	5	2.5	5	5
$\rho = L/r$		80	160	160	80
$\sigma_c = E(\pi/\rho)^2$	MPa	319	79.8	79.8	319
$\eta = \hat{e}\hat{y}/r^2$ ($\hat{y} = d/2$)		0.4	0.8	0.4	0.8
so, by trial: $\bar{\sigma}$	MPa	118	52.9	62.4	91.0
$\therefore F = A\bar{\sigma}/n$ ($n=1$)	kN	37.1	4.2	19.6	28.6

Note : – the marked effect of reducing the diameter
– the difficulty in finding $\bar{\sigma}$ from (h)(i) compared with (h)(iii).