8 From (7) the profile shift limits are:

$z_1 = 19 \qquad \check{s}_1 = \max\left(-0.5, \frac{30-19}{40}\right) = 0.275 \qquad \hat{s}_1 = 0.6$

$z_2 = 35 \qquad \check{s}_2 = \max\left(-0.5, \frac{30-35}{40}\right) = -0.125 \qquad \hat{s}_2 = 0.6$

From (8), for module m

$C = m\left[\tfrac{1}{2}\Sigma z + \Sigma s\right]$

i.e. $\check{C} = 4\left[\frac{19+35}{2} + 0.275 - 0.125\right] \le C \le 4\left[27 + 0.6 + 0.6\right]$ mm

or $108.6 \le C \le 112.8$ mm

Base further calcs. on unit module, i.e. $s_1 = \frac{1.5}{4} = 0.375$ and $s_2 = 2/4 = 0.5$ (no units, dimensionless)

Applying (9) $\left(1 + 2(0.375+0.5)/(19+35)\right)\cos\alpha' = \cos 20°$

$\Rightarrow \alpha' = 24.47°$

Applying (10) $\varepsilon_\gamma = 1.42$

9 Gear ratio $\rho = \sqrt{2} \pm 0.5\%$ i.e. $1.407 \le \rho \le 1.421$

Select tooth numbers (columns A & B) which give ρ within these limits. The minimum profile shifts (C & D) are from (7); maxima are $\hat{s}_1 = \hat{s}_2 = 0.6$

A	B	C	D	E	F	
z_1	z_2	$\check{s}_1$	$\check{s}_2$	$\check{m}$	$\hat{m}$	
12	17	0.45	0.325	12.7	13.1	×
17	24	0.325	0.15	9.2	9.5	×
19	27	0.275	0.075	8.3	8.6	×
22	31	0.2	-0.025	7.2	7.5	×
24	34	0.15	-0.1	6.6	6.9	×
27	38	0.075	-0.2	6.0	6.2	✓

The limiting modules (E & F) follow from (8) as:

$\check{m} = \check{C}/(\tfrac{1}{2}\Sigma z + \Sigma\hat{s})$

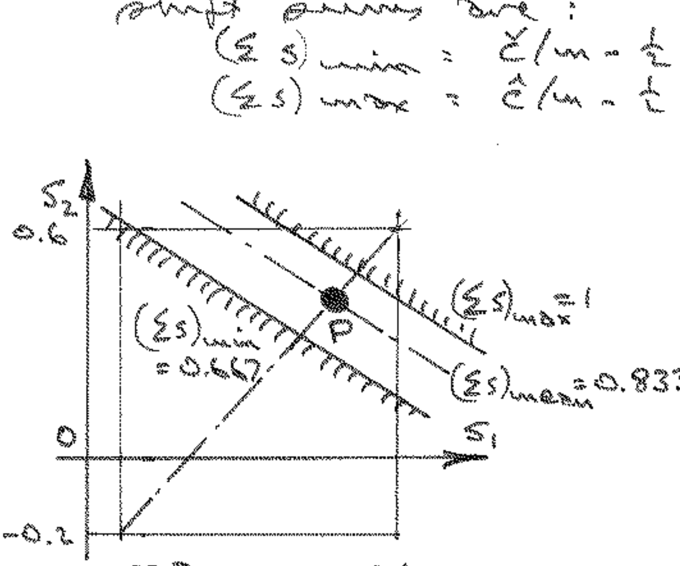
$\hat{m} = \hat{C}/(\tfrac{1}{2}\Sigma z + \Sigma\check{s})$

where $\check{C} = 199$ mm, $\hat{C} = 201$ mm

Only the last module limits bracket a common module, so select m = 6 mm. In order to give the necessary centre distance, updated profile shift sums are:

$(\Sigma s)_{min} = \check{C}/m - \tfrac{1}{2}\Sigma z = 199/6 - \frac{27+38}{2} = 0.667$

$(\Sigma s)_{max} = \hat{C}/m - \tfrac{1}{2}\Sigma z = 201/6 - 32.5 = 1.00$



The solution space is sketched. Assume a solution, P, at intersection of diagonal between minimum & maximum limits and the mean $\Sigma s = (1 + 0.667)/2 = 0.833$

i.e. $s_1 = 0.45 \quad s_2 = 0.38$

check contact ratio via (10)

$z_1 = 27$; $s_1 = 0.45$; $z_2 = 38$; $s_2 = 0.38$

$\Rightarrow \varepsilon_\gamma = 1.49$ – no problem.

CONT'D