2 (concl'd) From motor tables, $J_m = 0.012$ kg m², and max. no. of starts is 6700 per hour. From (4b)

$$T_e = T\left[1 - (1 + J_e/J_m)\, x/\hat{x}\right]^{-1/2}$$

$$= 25\left[1 - (1 + 0.2/0.012)\,90/6700\right]^{-1/2} = 28.4 \text{ Nm}$$

Since this is greater than the continuous fu~~ll~~ load torque of 27 Nm, the motor is unsuitable.

So try next larger motor, 132 S for which $J_m = 0.018$ kg m² and max starts/hour is 4900.

$$T_e = 25\left[1 - (1 + 0.2/0.018)\,90/4900\right]^{-1/2} = 28.4 \text{ Nm still}$$

But $T_f = 37$ Nm $> T_e$, so motor is OK.

3 Air power $= Q.\Delta p = \underset{\frac{m^3}{s}}{10}\left(\underset{m}{0.12} \times \underset{\frac{kg}{m^3}}{10^3} \times \underset{\frac{m}{s^2}}{9.81} \times \underset{kgm}{\frac{1}{Ns^2}}\right) = 11.8$ kW

Shaft power = air power/efficiency $= 11.8/0.78 = 15.1$ kW

& Friction losses $= \underset{Nm}{10} \times \underset{rad/s}{(1450 \times 2\pi/60)} = 1.5$ kW

∴ Total power required = 16.6 kW, which may be had from $\underline{\underline{180\text{ M}}}$ motor ($P_f = 18.5$ kW)

To find running speed and acceleration time, we have to prepare torque speed curves for load & motor.

$T_L = T_0 + T_2 (n/1450)^2$ since 1:1 drive

where T_2 corr. to 15.1 kW & $= \dfrac{15.1 \times 10^3 \times 60}{1450 \times 2\pi} = 99.4$ Nm

& $T_M = T_b / [1 + (s - s_b)^2 (a/s - bs^2)]$

where $T_b = 2.9 \times 120 = 348$ Nm $\quad s = 1 - \dfrac{n\,(\text{rpm})}{1500}$

& from tables $s_b = 0.179 \quad a = 1.500 \quad b = 1.113$

Hence plot below.

Solving, for $T_L = T_M$, $n_r = 1472$ rpm

n trial	1470	1475	1472
T_L Nm	112	113	112
T_M Nm	120	103	113