exponential LEAP
ONLINE REVIEW

Answer Key

MACHINE DESIGN

Refresher 03

1

exponential LEAP
ONLINE REVIEW

$$S_{ds} = \frac{F}{\pi D t}$$

Factor of safety is insignificant because your intention is to shear the plate

$$34800\ \text{lb/in}^2 = \frac{83654\ \text{lbs}}{\pi D\left(1/8''\right)}$$

$$D = 6.1214\ \text{in}$$

Hence;

$$\text{no of holes} = \frac{6.1214\ \text{in}}{1\ \text{in}}$$

$$\boxed{\text{no of holes} = 6\ \text{holes}}$$

2

Bearing Pressure

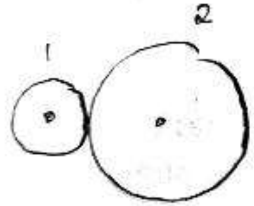
$$P = \frac{F}{bt} \; ; \; F = \frac{4500 \text{ kg}}{2} = 2250 \text{ kg}$$

force carried by each bearings

$$P = \frac{2250 \text{ kg}\left(\dfrac{9.81 \text{ m/s}^2}{1000 \frac{\text{kg-m}}{\text{kN-s}^2}}\right)}{(0.155 \text{ m})(0.290 \text{ m})}$$

$$\boxed{P = 491.0456 \text{ kPa}}$$

3



$$\frac{N_1}{N_2} = 3 = \frac{D_2}{D_1}$$

$$C = 35\ \text{in}$$

$$D_2 = 3D_1$$

$$C = \frac{D_1 + D_2}{2}$$

$$35\ \text{in} = \frac{D_1 + 3D_1}{2}$$

$$D_1 = 17.5\ \text{in}$$

$$\boxed{D_2 = 52.5\ \text{in}}$$

4

Exponential LEAP ONLINE REVIEW

$$S_c = kE(t_2 - t_1)$$

$$= \left(13 \times 10^{-6}\ m/m\text{-}°C\right)\left(206786 \times 10^{3}\ kPa\right)\left(85\ °C\right)$$

$$\boxed{S_c = 228498.53\ kPa}$$

On the surface of the shaft

6

Brown

7

Nickel

Malleabilizing

9

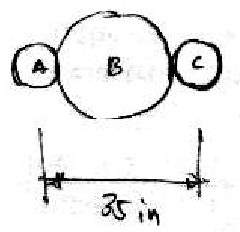
Polar moment of inertia

$$J = \frac{bh(b^2 + h^2)}{12} \; ; \quad b = 3.5 \text{ in}, \quad h = 6.0 \text{ in}$$

$$J = \frac{(3.5\text{ in})(6.0\text{ in})\left[3.5^2 + 6.0^2\right]\text{in}^2}{12}$$

$$\boxed{J = 84.4375 \text{ in}^4}$$

10



$A : B : C = 4 : 3 : 5$

$$C = \frac{D_A}{2} + D_B + \frac{D_C}{2} \quad ; \quad D_A N_A = D_B N_B \quad ; \quad D_B N_B = D_C N_C$$

$$D_A(4) = D_B(3) \quad ; \quad D_B(3) = D_C(5)$$

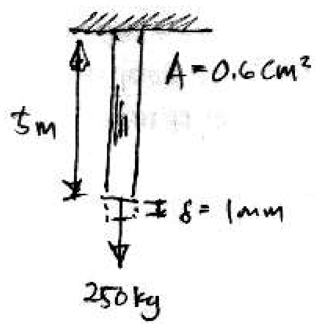
$$D_A = \frac{3}{4} D_B \quad ; \quad D_C = \frac{3}{5} D_B$$

subst;

$$35\text{ in} = \frac{3}{8} D_B + D_B + \frac{3}{10} D_B$$

$$\boxed{D_B = 20.8955\text{ in}}$$

exponential LEAP
ONLINE REVIEW



$$\delta = \frac{FL}{AE}$$

$$1\,mm = \frac{(250\,kg)\left(\frac{9.81\,m/s^2}{1\,\frac{kg\text{-}m}{N\text{-}s^2}}\right)(5000\,mm)}{(0.6\,cm^2)\left(\frac{10\,mm}{1\,cm}\right)^2 E}$$

$$E = 204375\ MPa$$

$$\boxed{E = 204\ GPa}$$

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exponential LEAP
ONLINE REVIEW

$$S_s = KE\,(t_2 - t_1)$$

$$= \left(11.7 \times 10^{-6}\ \frac{m}{m\text{-}^{\circ}C}\right)(206{,}789\ MPa)(98-35)\ ^{\circ}C$$

$$\boxed{S_s = 152.4242\ MPa}$$

13

$$S_s = \frac{F}{\pi D t}$$

$$F = d\,t\,80 \;;\; \text{tons}$$

$$= (1\text{-}3/4 \text{ in})(1\text{-}1/2 \text{ in})(80)$$

$$\boxed{F = 210 \text{ tons}}$$

14

$$S_s = kE(t_2 - t_1)$$

$$\Delta°C = \frac{5}{9}\Delta°F$$

$$55°C = \frac{5}{9}\Delta°F$$

$$\Delta°F = 99°F$$

$$= \left(6\times10^{-6}\ \frac{in}{in\text{-}°F}\right)\left(3\times10^{7}\ \frac{lb}{in^2}\right)(99°F)$$

$$\boxed{S_s = 17820\ psi}$$

15

0.37/0.44

16

$a^4/12$

17

Nickel

18

SAE 3xxx

19

$$\mu = \frac{\Delta d / d}{\Delta L / L} \quad ; \quad \delta = \frac{FL}{AE}$$

$$\frac{\delta}{L} = \frac{F}{AE} = \frac{600\,000 \text{ N}}{\frac{\pi}{4}(25.4\text{mm})^2 (206\,786 \text{ MPa})}$$

$$\frac{\delta}{L} = 5.7263 \times 10^{-3}$$

subst;

$$0.30 = \frac{\Delta d / 25.4 \text{ mm}}{5.7263 \times 10^{-3}}$$

$$\Delta d = 0.04363 \text{ mm}$$

$$\boxed{\Delta d = 43.63 \times 10^{-3} \text{ mm}}$$

20

Cobalt

21

$$S_s = \frac{F}{\pi D t}$$

$$45000\ \frac{lb}{in^2} = \frac{F}{\pi(0.85\ in)(0.65\ in)}$$

$$\boxed{F = 78107.8474\ lbs}$$

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Exponential LEAP ONLINE REVIEW

$$S_t = \frac{F}{\frac{\pi d^2}{4}} \quad ; \quad S_t = \frac{S_u}{FS}$$

$$\frac{S_u}{FS} = \frac{4F}{\pi d^2}$$

$$\frac{62000\ \text{lb/in}^2}{3} = \frac{4(5000\ \text{lbs})}{\pi d^2}$$

$$\boxed{d = 0.5550\ \text{in}}$$

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$$P = \frac{2\pi T N}{60};$$

$$v = \pi D N$$

$$\left(22\,\frac{m}{s}\right)\left(\frac{60\,s}{1\,min}\right) = \pi(0.31\,m)\,N$$

$$N = 1355.3840\ rpm$$

Subst;

$$P = \frac{2\pi(5\,kN\text{-}m)(1355.3840\,rpm)}{60}$$

$$\boxed{P = 709.6774\ kW}$$

24

$$D_1 N_1 = D_2 N_2$$

$$N_2 = N_1 \left(\frac{D_1}{D_2}\right)(1 - \%\,slip)$$

$$= 620\,rpm \left(\frac{15\,cm}{25\,cm}\right)(1 - 0.06)$$

$$\boxed{N_2 = 349.68\,rpm}$$

25

$$L = 2C + 1.57(D_2 + D_1) + \frac{(D_2 - D_1)^2}{4C}$$

$$= 2(75\,cm) + 1.57(14 + 7)cm + \frac{(14 + 7)^2 cm^2}{4(75\,cm)}$$

$$\boxed{L = 184.49\,cm}$$

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Exponential LEAP ONLINE REVIEW

All of the above

Arc of recess

28

SAE 1030

29

Safety gloves

30

$$\theta = \pi - \frac{D_2 - D_1}{C} = \pi - \frac{(12 - 6)\ in}{70\ in}$$

$$= (3.0559\ rad)\left(\frac{180^\circ}{\pi\ rad}\right)$$

$$\boxed{\theta = 175.0889^\circ}$$

31

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ONLINE REVIEW

$$\gamma_2 = \tan^{-1}\left(\frac{N_1}{N_2}\right)$$

$$= \tan^{-1}\left(\frac{4}{1}\right)$$

$$\boxed{\gamma_2 = 75.9638^\circ}$$

$$T = F\left(\frac{D_m}{2}\right)$$

$$D_m = D - f \sin \gamma$$

$$= 15\text{in} - (5\text{in}) \sin 40°$$

$$D_m = 11.7861 \text{ in}$$

substi

$$8500 \text{ in-lb} = F\left(\frac{11.7861 \text{ in}}{2}\right)$$

$$\boxed{F = 1442.3817 \text{ lbs}}$$

33

$$D_m = D - f \sin \gamma$$

$$= 14 \text{ in} - (2.75 \text{ in}) \sin 37.5°$$

$$\boxed{D_m = 12.3259 \text{ in}}$$

34

$$\tan \phi_n = \tan \phi \cos \psi$$

$$= (\tan 20^\circ)(\cos 24^\circ)$$

$$\boxed{\phi_n = 18.3921^\circ}$$

35

exponential LEAP ONLINE REVIEW

$$P_{cn} = P_c \cos \psi$$

$$P_c = \frac{\pi D}{T} = \frac{\pi (8 in)}{28 \text{ teeth}} = 0.8976$$

$$P_{cn} = (0.8976)(\cos 23^\circ)$$

$$\boxed{P_{cn} = 0.8262}$$

Embeddability

37

Lead

38

Iron

39

Alloy steel

40

$$P_d = \frac{T}{D} = \frac{20 \text{ teeth}}{7 \text{in}}$$

$$\boxed{P_d = 2.8571}$$

Blanking

42

Aluminum

Mechanism

Cubic boron nitride

45 to 47

$$P = 2\pi T N$$

$$(410\ hp)\left(\frac{550\ \frac{ft-lb}{sec}}{1hp}\right)\left(\frac{12in}{1ft}\right) = \frac{2\pi T(3500rpm)}{60}$$

$$\boxed{T = 7382.9704\ in-lbs}$$

$$T = F\left(\frac{D_m}{2}\right)$$

$$7382.9704\ in-lbs = F\left(\frac{50in}{2}\right)$$

$$\boxed{F = 295.3188\ lbs}$$

Power delivered by Strocket

$$\eta_o = \frac{P_{out}}{P_{IN}} * 100\%$$

$$P_{out} = (410\ hp)(0.80)$$

$$\boxed{P_{out} = 328\ hp}$$

48

exponential LEAP
ONLINE REVIEW

$$\tan \alpha = \frac{L}{\pi D_w}$$

$$\tan(7.25^\circ) = \frac{L}{\pi(5.5\,in)}$$

$$L = 2.1981\ in$$

Hence;

$$L = 2P$$

$$2.1981\ in = 2P$$

$$\boxed{P = 1.0991\ in}$$

49

$$S_t = \frac{PD_i}{2t} \quad ; \quad F.S. = \frac{S_u}{S_{au}}$$

$$\frac{295 \text{ mPa}}{4} = \frac{(10 \text{ mPa})(60 \text{ in})\left(\frac{25.4 \text{ mm}}{1 \text{ in}}\right)}{2t}$$

$$t = (103.3220 \text{ mm})\left(\frac{1 \text{ in}}{25.4 \text{ mm}}\right)$$

$$\boxed{t = 4.0678 \text{ in}}$$

50

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$$S_t = \frac{PD_i}{4t}$$

$$37000\ \frac{lb}{in^2} = \frac{(1800\ lb/in^2)(55\ in)}{4\ t}$$

$$\boxed{t = 0.6689\ in}$$

Collet attachment

52

Idler

53

30 years

54

Higher values

55

Exponential LEAP ONLINE REVIEW

$$\frac{D}{t} = \frac{12\text{ in}}{0.5\text{ in}} = 24$$

"Thin-walled"

$$S_t = \frac{PDi}{4te}$$

$$65000\ \frac{lb}{in^2} = \frac{P(12\text{ in})}{4(\tfrac{1}{2}\text{ in})(0.85)}$$

$$\boxed{P = 9208.3333\ lb/in^2}$$

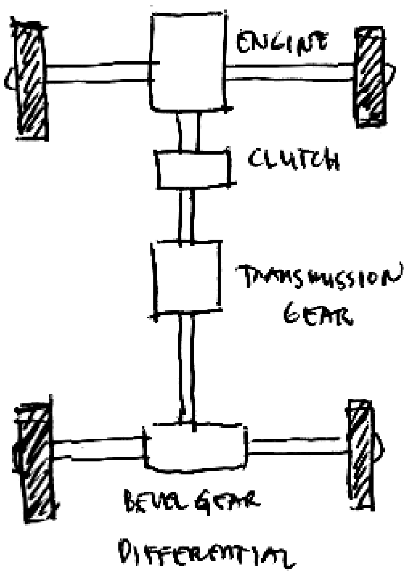
56

$$v = \pi D N$$

$$= \pi (1.75\,in)\left(\frac{1\,ft}{12\,in}\right)(120\,rpm)$$

$$\boxed{v = 54.9779\ fpm}$$

57 to 58



Torque at wheels

$$T = F\left(\frac{D_m}{2}\right) = 18500\,lbs\left(\frac{50\,in}{2}\right)$$

$$T = 462500 \text{ in-lbs}$$

Power at wheels

$$P = 2\pi TN \quad ; \quad n_o = \frac{P_{OUT}}{P_{IN}}$$

$$(0.85)(600hp)\left(\frac{550\,\frac{ft\text{-}lb}{sec}}{1hp}\right) = \frac{2\pi(462500\text{ in-lbs})\left(\frac{1ft}{12in}\right)N_w}{60}$$

$N_w = 69.4982$ rpm speed of wheels

and;

N_s = speed of shaft

$$\frac{N_s}{N_W} = \frac{T_W}{T_S}$$

$$\frac{N_s}{69.4982\,rpm} = \frac{52\text{ teeth}}{34\text{ teeth}}$$

$$N_s = 106.2914\,rpm$$

Hence;

$$\text{Transmission Gear Ratio} = \frac{1800\,rpm}{106.2914\,rpm}$$

$$\boxed{\text{Transmission Gear Ratio} = 16.9346 : 1}$$

57 to 58 cont…

Exponential LEAP ONLINE REVIEW

$$\text{Torque per wheel} = \frac{462500 \text{ in-lbs}}{2} = 231250 \text{ in-lbs}$$

$$S_s = \frac{16T}{\pi D^3}$$

$$13000 \frac{lb}{in^2} = \frac{16(231250 \text{ in-lbs})}{\pi D^3}$$

$$D = 4.4913 \text{ in}$$

$$\boxed{D = 4\text{-}\frac{1}{2} \text{ in}}$$

59

$$\Delta KE = \frac{1}{2}\frac{m}{g_c}\left(v_2^2 - v_1^2\right)$$

$$v_1 = \pi D N_1 = \pi (1m)\left(\frac{160\ rpm}{60}\right) = 8.3776\ m/s$$

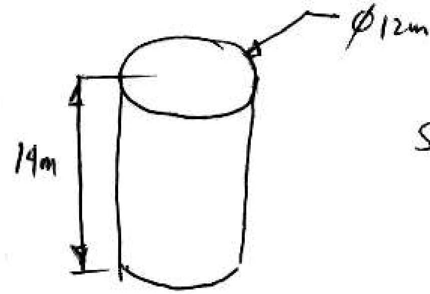
$$v_2 = \pi D N_2 = \pi (1m)\left(\frac{220\ rpm}{60}\right) = 11.5192\ m/s$$

subst;

$$\Delta KE = \frac{1}{2}\frac{(360\ kg)}{\left(1000\ \frac{kg-m}{kN-s^2}\right)}\left(11.5192^2 - 8.3776^2\right) m^2/s^2$$

$$\boxed{\Delta KE = 11.2514\ kJ}$$

60



$$S_t = \frac{PD_i}{2t}$$

$$P = \gamma h = \left(9.81\ \frac{kN}{m^3}\right)(14m)$$

$$P = 137.34\ kPa$$

$$60\ MPa = \frac{(0.13734\ MPa)(12000\ mm)}{2t}$$

$$\boxed{t = 13.734\ mm}$$

Endurance limit

exponential LEAP ONLINE REVIEW

Double VEE block

Basic profile of thread

64

Buttress

65

exponential LEAP
ONLINE REVIEW

$P = d\,t\,80$, tons

$= (3\text{ in})(\tfrac{1}{4}\text{ in})(80)$

$\boxed{P = 60 \text{ tons}}$

Bilateral tolerance

exponential LEAP
ONLINE REVIEW

Polar Section Modulus

$$Z_p = \frac{\pi/32\,(D_o^4 - D_i^4)}{D_o/2} = \frac{\pi/32\,(8^4 - 6^4)\,in^4}{8\,in/2}$$

$$\boxed{Z_p = 68.7223\ in^3}$$

68

$$P = \frac{2\pi T N}{60}$$

$$(18\,hp)\left(\frac{550\,\frac{ft\text{-}lb}{sec}}{1\,hp}\right) = \frac{2\pi T\,(130\,rpm)}{60}$$

$$T = 727.2157\ ft\text{-}lb$$

Solving for Diameter;

$$\frac{\theta}{L} = \frac{T}{JG} \quad ; \quad J = \frac{\pi}{32} D^4$$

$$\left(0.08\,\frac{deg}{ft}\right)\left(\frac{\pi}{180^\circ}\right) = \frac{(727.2157\ ft\text{-}lb)}{\frac{\pi}{32} D^4 \left(12\times10^6\,\frac{lb}{in^2}\right)}$$

$$D = (0.8154\ ft)\left(\frac{12\,in}{1\,ft}\right)$$

$$\boxed{D = 9.7848\ in}$$

69

ONLINE REVIEW

$$P = \frac{D^3 N}{80} = \frac{\left[(60\text{ mm})\left(\frac{1\text{ in}}{25.4\text{ mm}}\right)\right]^3 (250\text{ rpm})}{80}$$

$$P = (41.1910\text{ hp})\left(\frac{746\text{ W}}{1\text{hp}}\right)$$

$$P = 30728.486\text{ W}$$

$$\boxed{P = 30.7285\text{ kW}}$$

70

Length of cut = (cutting rate)(time)

$$(4\text{ ft})\left(\frac{12\text{ in}}{1\text{ ft}}\right) = \left(\frac{10\text{ in}}{\text{min}}\right)\left(\frac{1\text{ min}}{60\text{ sec}}\right)\text{time}$$

$$\boxed{\text{time} = 288\text{ sec}}$$

Bronze rim with cast steel spider

72

Mps

73

8 to 12

exponential LEAP
ONLINE REVIEW

$$P = \frac{2\pi T N}{60}$$

$$(80\,hp)\left(\frac{550\ \frac{lb\text{-}ft}{sec}}{1\,hp}\right) = \frac{2\pi T\,(860\,rpm)}{60}$$

$$T = 488.5687\ lb\text{-}ft$$

for the force, F

$$T = F\left(\frac{D}{2}\right)$$

$$(488.5687\ lb\text{-}ft)\left(\frac{12\ in}{1\,ft}\right) = F\left(\frac{14\,in}{2}\right)$$

$$F = 837.5463\ lbs$$

for the width;

$$W = \frac{F}{75\ lb/in} = \frac{837.5463\ lbs}{75\ lb/in}$$

$$\boxed{W = 11.1673\ in}$$

75

Exponential LEAP ONLINE REVIEW

$$P = \frac{DNd^{2.3}}{50}$$

$$5hp = \frac{(1.5\text{ in})(800\text{ rpm})d^{2.3}}{50}$$

$$d = 0.5056\text{ in}$$

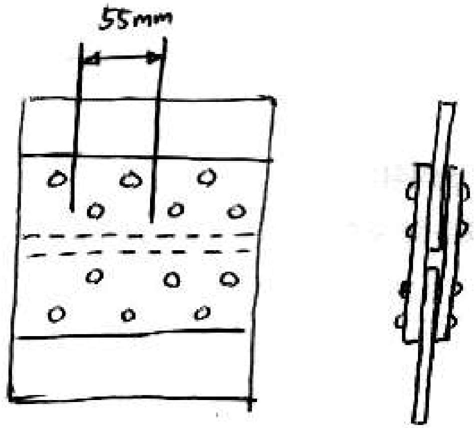
Hence;

$$\#\text{ of set screws} = \frac{0.5056\text{ in}}{3/8\text{ in}}$$

$$\#\text{ of set screws} = 1.3483$$

$$\boxed{\#\text{ of set screws} = 2}$$

76 to 78



$$S_t = \frac{P D_i}{2 t e}$$

$$170\ MPa = \frac{(3\ N/mm^2)(1800\ mm)}{2t(0.80)}$$

$$\boxed{t = 19.8529\ mm}$$

76 to 78 cont…

Diameter of the rivets

Tensile strength of plate between rivets

$$S_{dp} = \frac{F_t}{A} = \frac{F_t}{t(55mm - d)}$$

$$170\,MPa = \frac{F_t}{(19.8529mm)(55mm - d)}$$

$$F_t = 3374.993(55 - d)$$

total shear stregh of rivets

$$S_{sr} = \frac{F_s}{A} = \frac{F_s}{4\left(\frac{\pi d^2}{4}\right)}$$ (note: double riveted & 2 straps)

$$220\,MPa = \frac{F_s}{4\left(\frac{\pi d^2}{4}\right)}$$

$$F_s = 220\pi d^2$$

Equating F_t & F_s & solving for d

$$3374.993(55 - d) = 220\pi d^2$$

$$\boxed{d = 14.1275\ mm}$$ (diameter of rivet hole)

76 to 78 cont…

The efficiency of longitudinal joint

strength of unpunched plate

$$S_p = \frac{F}{A}$$

$$170\text{ MPa} = \frac{F}{(55\text{ mm})(19.8529\text{ mm})}$$

$$F = 185624.615\text{ N}$$

Force that cause tension in plate between rivets

$$F_t = 3374.993(55 - 14.1275) = 137944.4019\text{ N}$$

Force that cause shearing of rivets

$$F_s = 220\pi(14.1275)^2 = 137944.1176\text{ N}$$

Hence;

$$\text{Joint efficiency} = \frac{137944.1176\text{ N}}{185624.615\text{ N}} * 100\%$$

$$\boxed{\text{Joint efficiency} = 74.31\%}$$

79 to 81

EXponential LEAP ONLINE REVIEW

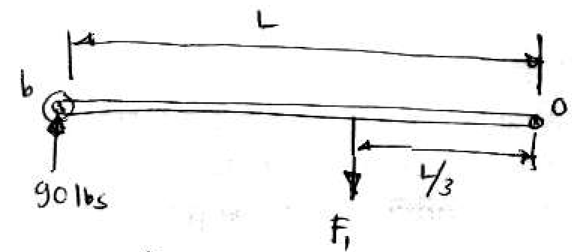
$$S_s = \frac{8K_w F D_m}{\pi d^3}$$

$$K_w = \frac{4c-1}{4c-4} + \frac{0.615}{c} \quad ; \quad c = \frac{D_m}{d} = 8.0$$

$$= \frac{4(8)-1}{4(8)-4} + \frac{0.615}{8}$$

$$K_w = 1.1840$$

Solving for the maximum force on the spring, by summation of moments about the pivot point;



$$[\Sigma M_o = 0]$$

$$(90\,\text{lbs})(L) - F_1\left(\frac{L}{3}\right) = 0$$

$$F_1 = 270\ \text{lbs}$$

substi

$$60500\,\frac{\text{lb}}{\text{in}^2} = \frac{8(1.1840)(270\,\text{lbs})(8d)}{\pi d^3}$$

$$\boxed{d = 0.3281\ \text{in}}$$

79 to 81 cont…

outside diameter of Spring

$$D_m = D_o - d$$

$$8d = D_o - d$$

$$D_o = 9d = 9(0.3281\,in)$$

$$\boxed{D_o = 2.9529\text{-}in}$$

79 to 81 cont…

Exponential LEAP ONLINE REVIEW

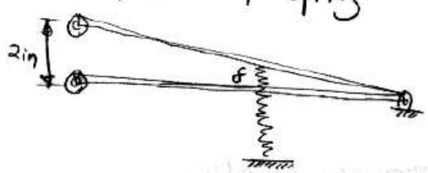
Number of coils

$$\delta = \frac{8Fc^3n}{Gd}$$

solving for spring deflection

Vertical displacement of roller $= (4.5+1)\,in - (4.5-1)\,in = 2\,in$

let δ = deflection of spring



$$\frac{2}{L} = \frac{\delta}{L/3}$$

$$\delta = \frac{2}{3}\,in$$

Solving for the minimum force on the spring by summation of moments about pivot point;

$$[\Sigma M_o = 0]$$

$$(60\,lbs)(L) - F_2\left(\frac{L}{3}\right) = 0$$

$$F_2 = 180\,lbs$$

Hence; (Considering low & high position)

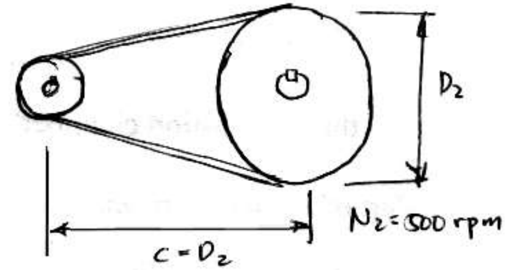
$$(\delta_1 - \delta_2) = \frac{8F_1C^3n}{Gd} - \frac{8F_2C^3n}{Gd}$$

$$\frac{2}{3} = \frac{8(270\,lbs)(7)^3(n)}{\left(11600000\,\frac{lb}{in^2}\right)(0.3281\,in)} - \frac{8(180\,lbs)(7)^3(n)}{\left(11600000\,\frac{lb}{in^2}\right)(0.3281\,in)}$$

$$\boxed{n = 10.2742 \text{ active coils}}$$

82 to 83 cont…

$N_1 = 1200\,rpm$
$D_1 = 205\,mm = 8.0709\,in$
$65\,hp$



$$L = \frac{\pi}{2}(D_2 + D_1) + 2c + \frac{(D_2 - D_1)^2}{4c}$$

from; $D_1 N_1 = D_2 N_2$

$$(205\,mm)(1200\,rpm) = D_2(500\,rpm)$$

$$D_2 = (492\,mm)\left(\frac{1\,in}{25.4\,mm}\right)$$

$$D_2 = 19.37\,in$$

subst;

$$L = \frac{\pi}{2}(19.37 + 8.0709)\,in + 2(19.37\,in) + \frac{(19.37^2 - 8.0709^2)\,in^2}{4(19.37\,in)}$$

$$\boxed{L = 85.8458\,in}$$

82 to 83 cont…

Number of belts required

$$\text{Rated hp} = \left[4.737\left(\frac{10^3}{v_D}\right)^{0.09} - \frac{13.962}{K_d D_1} - 0.0234\frac{v_D^2}{10^6}\right]\frac{v_D}{10^3}$$

$$v_D = \pi D_1 N_1 = \pi(8.0709\text{ in})\left(\frac{1\text{ ft}}{12\text{ in}}\right)(1200\text{ rpm})$$

$$v_D = 2535.5480\text{ fpm}$$

$$\text{Rated hp} = \left[4.737\left(\frac{10^3}{2535.5480\text{ fpm}}\right)^{0.09} - \frac{13.962}{(1.13)(8.0709\text{ in})} - 0.0234\frac{(2535.5480\text{ fpm})^2}{10^6}\right]\frac{2535.5480\text{ fpm}}{10^3}$$

$$\text{Rated hp} = 6.78298\ \frac{\text{hp}}{\text{belt}}$$

82 to 83 cont…

EXPONENTIAL LEAP
ONLINE REVIEW

$$\text{Adjusted rated hp} = k_\theta k_L (\text{rated hp}) = (0.90)(1.02)\left(6.78298 \frac{hp}{belt}\right)$$

$$\text{Adjusted rated hp} = 6.2268 \frac{hp}{belt}$$

and;

$$\text{Design hp} = N_{SF} (\text{transmitted hp}) = (2.0)(65\ hp)$$

$$\text{Design hp} = 130\ hp$$

Hence; Number of belts

$$N = \frac{\text{Design hp}}{\text{Adjusted rated hp}} = \frac{130\ hp}{6.2268\ hp/belt}$$

$$N = 20.8775$$

$$\boxed{N = 21 \text{ belts}}$$

84

Oak tanned

85

Partial quenching

86

Tempering

Proportional to the modulus of elasticity and moment of inertia

88 to 92

$$D_1 = \frac{P}{\sin\left(\frac{180^\circ}{T_1}\right)} = \frac{0.5\text{ in}}{\sin\left(\frac{180^\circ}{18\text{ teeth}}\right)}$$

$$\boxed{D_1 = 2.8794\text{ in}}$$

Number of teeth for larger sprocket

$$\frac{T_2}{T_1} = \frac{N_1}{N_2}$$

$$\frac{T_2}{18\text{ teeth}} = \frac{1800\text{ rpm}}{300\text{ rpm}}$$

$$\boxed{T_2 = 108\text{ teeth}}$$

Diameter of larger sprocket

$$D_2 = \frac{P}{\sin\left(\frac{180^\circ}{T_2}\right)} = \frac{0.5\text{ in}}{\sin\left(\frac{180^\circ}{108\text{ teeth}}\right)}$$

$$\boxed{D_2 = 17.1912\text{ in}}$$

Recomended center distance

$$C = D_2 + \frac{D_1}{2}$$

$$C = 17.1912\text{ in} + \left(\frac{2.8794\text{ in}}{2}\right)$$

$$\boxed{C = 18.6309\text{ in}}$$

Length of chain

$$L = 2C + \frac{T_2 + T_1}{2} + \frac{(T_2 - T_1)^2}{4\pi^2 C}$$

$$C = \frac{18.6309\text{ in}}{0.5\text{ in}} = 37.2618\text{ pitches} = 38\text{ pitches}$$

substi

$$L = (2)(38\text{ pitches}) + \frac{(108 + 18)\text{ teeth}}{2} + \frac{(108 - 18)^2\text{ teeth}}{4\pi^2(38\text{ pitches})}$$

$$L = 144.3995\text{ pitches}$$

$$L = 146\text{ pitches}$$

Hence;

$$L = (146\text{ pitches})(0.5\text{ in})$$

$$\boxed{L = 73\text{ inches}}$$

Exponential LEAP ONLINE REVIEW

93

Safety notices in markers/boards

94

½

95

80

96

Design stress = ultimate stress divided by factor of safety

97 to 99

exponential LEAP ONLINE REVIEW

$$c = \frac{b + \sqrt{b^2 - 32(D_2 - D_1)^2}}{16}$$

$$b = 4L - 6.28(D_2 - D_1)$$

$$= 4(1557\,mm) - 6.28(210\,mm - 120\,mm)$$

$$b = 5662.8\,mm$$

$$c = \frac{5662.8\,mm + \sqrt{(5662.8\,mm)^2 - 3(210\,mm - 120\,mm)^2}}{16}$$

$$\boxed{c = 707.7159\,mm}$$

97 to 99

Arc of contact on the small sheave

$$\theta_1 = \pi - \frac{D_2 - D_1}{C}$$

$$= \pi - \frac{(210 - 120)\,mm}{707.7159\,mm}$$

$$\theta_1 = (3.0144\,rad)\left(\frac{180°}{\pi}\right)$$

$$\boxed{\theta_1 = 172.7137°}$$

Arc of contact on larger sheave

$$\theta_2 = \pi + \frac{D_2 - D_1}{C}$$

$$= \pi + \frac{(210 - 120)\,mm}{707.7159\,mm}$$

$$\theta_2 = (3.2688\,rad)\left(\frac{180°}{\pi}\right)$$

$$\boxed{\theta_2 = 187.2863°}$$

100

Planing