FLAT, CHAIN, ROPE AND V-DRIVE

1. Power is transmitted using a V-belt drive. The included angle of V-groove is $30°$. The belt is $20\ mm$ deep and maximum width is $20\ mm$. If the mass of the belt is $0.35\ kg$ per meter length and maximum allowable stress is $1.4\ MPa$, determine the maximum power transmitted when the angle of lap is $140°$. $\mu = 0.15$.

2. A compressor, requiring $90\ kW$ is to run at about $250\ r.p.m$ The drive is by $V - belts$ from an electric motor running at $750\ r.p.m$. The diameter of the pulley on the compressor shaft must not be greater than 1 meter while the center distance between the pulleys is limited to $1.75\ m$. The belt speed should not exceed $1{,}600\ r.p.m$

   Determine the number of V-belts required to transmit the power if each belt has a cross-sectional area of $375\ mm^2$, density $1{,}000\ kg/m^3$ and an allowable tensile stress of $2.5\ MPa$. The groove angle of the pulley is $35°$. The coefficient of friction between the belt and the pulley is 0.25. Calculate also the length required of each belt.

3. A chain drive is used for reduction of speed from $240\ r.p.m.$ to $120\ r.p.m.$ The number of teeth on the driving sprocket is 20. Find the number of teeth on the driven sprocket. If the pitch circle diameter of the driven sprocket is $600\ mm$ and center to center distance between the two sprockets is $800\ mm$, determine the pitch and length of the chain.

4. An engine, running at $150\ r.p.m.,$ drives a line shaft by means of a belt. The engine pulley is $750\ mm$ diameter and the pulley on the line shaft being $450\ mm$. A $900\ mm$ diameter pulley on the line shaft drives a $150\ mm$ diameter pulley keyed to a dynamo shaft. Find the speed of the dynamo shaft, when 1. there is no slip, and 2. there is a slip of 2% at each drive.

5. The power is transmitted from a pulley $1\ m$ diameter running at $200\ r.p.m.$ to a pulley $2.25\ m$ diameter by means of a belt. Find the speed lost by the

driven pulley as a result of creep, if the stress on the tight and slack side of the belt is $1.4\ MPa$ and $0.5\ MPa$ respectively. The Young's modulus for the material of the belt is $100\ MPa$.

6. A shaft which rotates at a constant speed of $160\ r.p.m.$ is connected by belting to a parallel shaft $720\ mm$ apart, which has to run at 60, 80 and $100\ r.p.m.$ The smallest pulley on the driving shaft is $40\ mm$ in radius. Determine the remaining radii of the two stepped pulleys for.

7. A casting weighing $9\ kN$ hangs freely from a rope which makes 2.5 turns around a drum of $300\ mm$ diameter revolving at $20\ r.p.m.$ The other end of the rope is pulled by a man. The coefficient of friction is 0.25. Determine: The force required by the man, and the power to raise the casting.

8. Find the power transmitted by a belt running over a pulley of $600\ mm$ diameter at $200\ r.p.m.$ The coefficient of friction between the belt and the pulley is 0.25, angle of lap $160°$ and maximum tension in the belt is $2{,}500\ N$.

9. Two pulleys, one $450\ mm$ diameter and the other $200\ mm$ diameter are on parallel shafts $1.95\ m$ apart and are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley.

   What power can be transmitted by the belt when the larger pulley rotates at $200\ r.p.m$, if the maximum permissible tension in the belt is $1\ kN$, and the coefficient of friction between the belt and pulley is 0.25 ?

10. A shaft rotating at $200\ r.p.m.$ drives another shaft at $300\ r.p.m.$ and transmits $6\ kW$ through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m.

    The smaller pulley is $0.5\ m$ in diameter. Calculate the stress in the belt, if it is: An open belt drive, and A cross belt drive. Take $\mu = 0.3$.

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11. A leather belt is required to transmit $7.5\,kW$ from a pulley $1.2\,m$ in diameter, running at $250\,r.p.m.$ The angle embraced is $165°$ and the coefficient of friction between the belt and the pulley is 0.3. If the safe working stress for the leather belt is $1.5\,MPa$, density of leather $1\,Mg/m^3$ and thickness of belt $10\,mm$, determine the width of the belt taking centrifugal tension into account.

12. Determine the width of a $9.75\,mm$ thick leather belt required to transmit $15\,kW$ from a motor running at $900\,r.p.m.$ The diameter of the driving pulley of the motor is $300\,mm.$ The driven pulley runs at $300\,r.p.m.$ and the distance between the center of two pulleys is $3\,meters$. The density of the leather is $1000\,kg/m^3$. The maximum allowable stress in the leather is $2.5\,MPa.$ The coefficient of friction between the leather and pulley is 0.3. Assume open belt drive and neglect the sag and slip of the belt.

13. A pulley is driven by a flat belt, the angle of lap being $120°$. The belt is $100\,mm$ wide by $6\,mm$ thick and density$1000\,kg/m^3$. If the coefficient of friction is 0.3 and the maximum stress in the belt is not to exceed $2\,MPa$, find the greatest power which the belt can transmit and the corresponding speed of the belt.

14. An open belt drive connects two pulleys $1.2\,m$ and $0.5\,m$ diameter, on parallel shafts $4\,meters$ apart. The mass of the belt is $0.9\,kg$ per meter length and the maximum tension is not to exceed $2000\,N$.The coefficient of friction is 0.3. The $1.2\,m$ pulley, which is the driver, runs at $200\,r.p.m.$ Due to belt slip on one of the pulleys, the velocity of the driven shaft is only $450\,r.p.m.$ Calculate the torque on each of the two shafts, the power transmitted, and power lost in friction. What is the efficiency of the drive?

15. In a flat belt drive the initial tension is $2000\,N$. The coefficient of friction between the belt and the pulley is 0.3 and the angle of lap on the smaller pulley is $150°$. The smaller pulley has a radius of $200\,mm$ and rotates at $500\,r.p.m.$ Find the power in kW transmitted by the belt.

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16. Two parallel shafts whose center lines are $4.8\,m$ apart, are connected by open belt drive. The diameter of the larger pulley is $1.5\,m$ and that of smaller pulley $1\,m$. The initial tension in the belt when stationary is $3\,kN$. The mass of the belt is $1.5\,kg/m$ length. The coefficient of friction between the belt and the pulley is 0.3. Taking centrifugal tension into account, calculate the power transmitted, when the smaller pulley rotates at $400\,r.p.m.$
17. An open flat belt drive connects two parallel shafts 1.2 meters apart. The driving and the driven shafts rotate at $350\,r.p.m.$ and $140\,r.p.m.$ respectively and the driven pulley is $400\,mm$ in diameter. The belt is $5\,mm$ thick and $80\,mm$ wide. The coefficient of friction between the belt and pulley is 0.3 and the maximum permissible tension in the belting is $1.4\,MN/m^2$. Determine: Diameter of the driving pulley, Maximum power that may be transmitted by the belting, and Required initial belt tension.

18. An open belt running over two pulleys $240\,mm$ and $600\,mm$ diameter connects two parallel shafts 3 meters apart and transmits $4\,kW$ from the smaller pulley that rotates $at\ 300\,r.p.m.$ Coefficient of friction between the belt and the pulley is 0.3 and the safe working tension is $10N\ per\ mm\ width.$ Determine, Minimum width of the belt, Initial belt tension, and Length of the belt required.

19. The following data refer to an open belt drive:
    Diameter of larger pulley $= 400\,mm$; Diameter of smaller pulley $= 250\,mm$; Distance between two pulleys $= 2\,m$; Coefficient of friction between smaller pulley surface and belt $= 0.4$; Maximum tension when the belt is on the point of slipping $= 1200\,N$.
    Find the power transmitted at speed of $10\,m/s$. It is desired to increase the power. Which of the following two methods you will select?

20. A rope drive transmits $600\,kW$ from a pulley of effective diameter 4 m, which runs at a speed of $90\,r.p.m.$ The angle of lap is $160°$; the angle of

groove $45°$; the coefficient of friction 0.28 ; the mass of rope $1.5\ kg\ /m$ and the allowable tension in each rope $2{,}400\ N$. Find the number of ropes required.

21. A pulley used to transmit power by means of ropes has a diameter of $3.6\ meters$ and has 15 grooves of $45°$ angle. The angle of contact is $170°$ and the coefficient of friction between the ropes and the groove sides is 0.28. The maximum possible tension in the ropes is $960\ N$ and the mass of the rope is $1.5\ kg$ per meter length. What is the speed of pulley in $r.p.m.$ and the power transmitted if the condition of maximum power prevails?