MIET2510

Mechanical Design

Week 8 – Belt and Chains – Tutorial

School of Science and Technology, RMIT Vietnam

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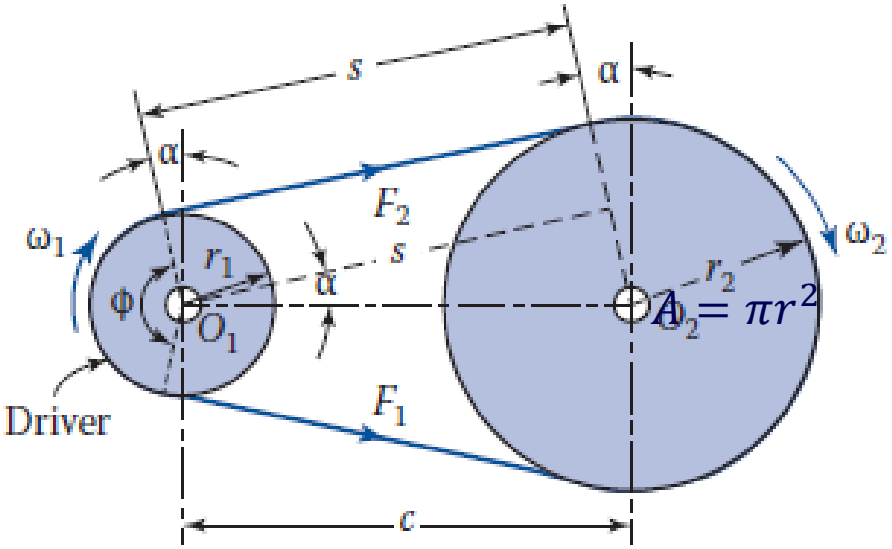
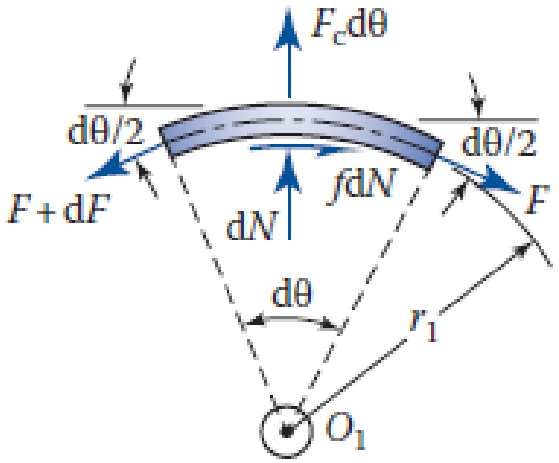
Belt Calculations





The net force acting on the pulley;

$$F_n = F_1 - F_2$$

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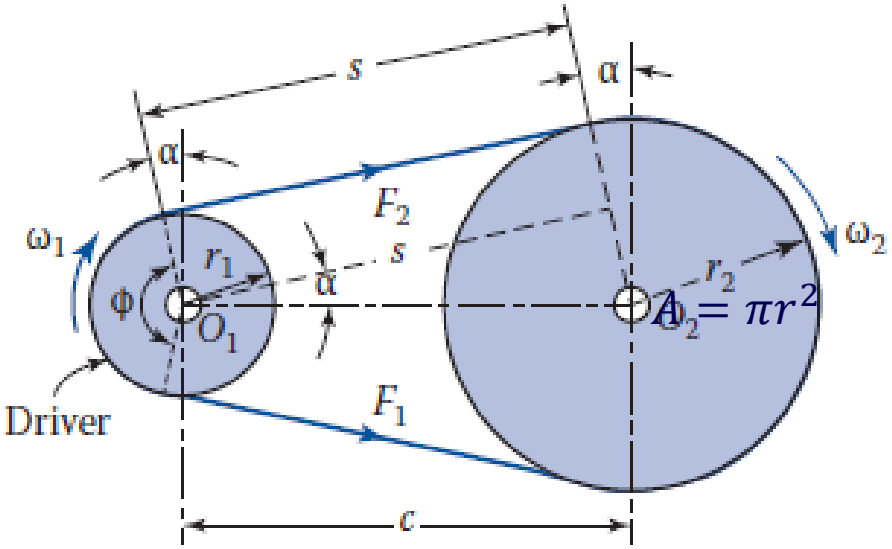

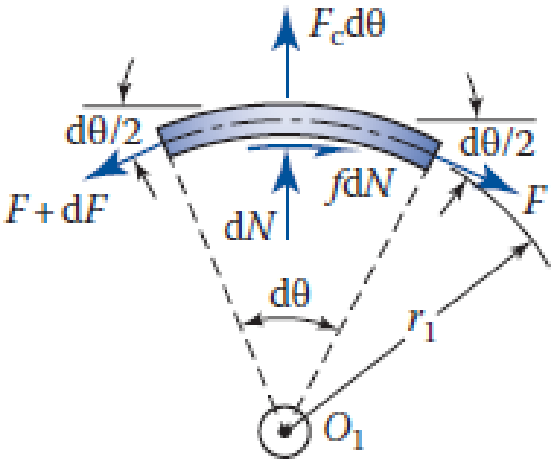

The torque on a pulley is given by;

$$T = (F_1 - F_2)r$$

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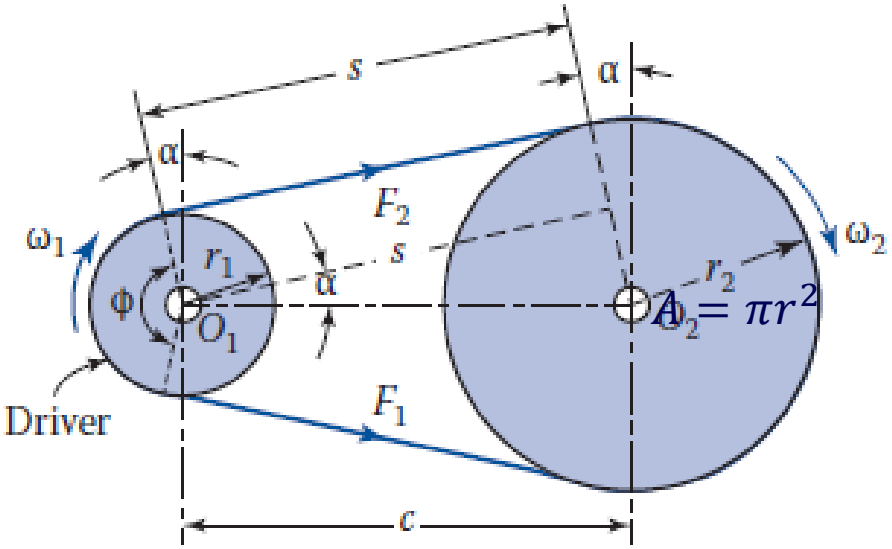

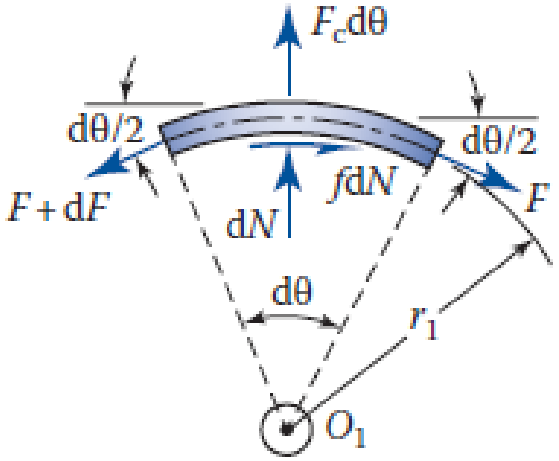

The power transmitted by the belt is;

$$P = (F_1 - F_2)V$$

where;

$$V = \frac{\pi D_p N}{60}$$

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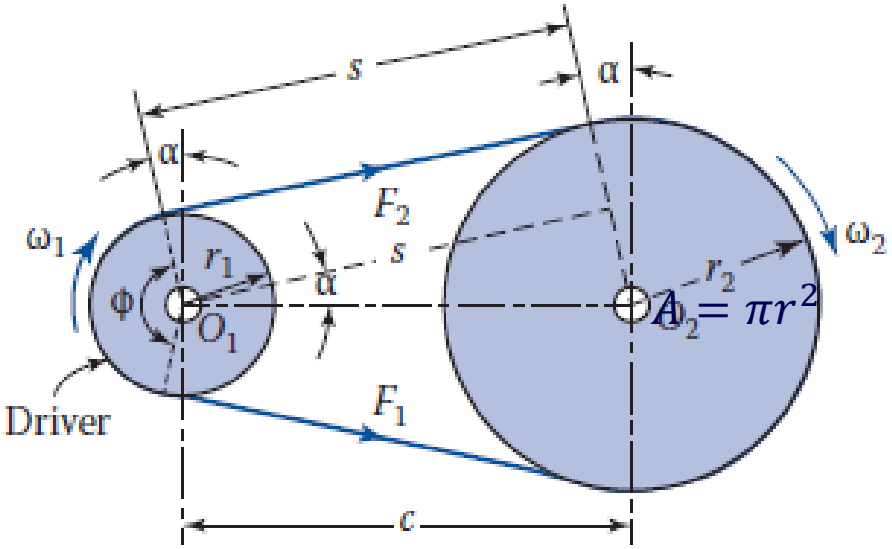

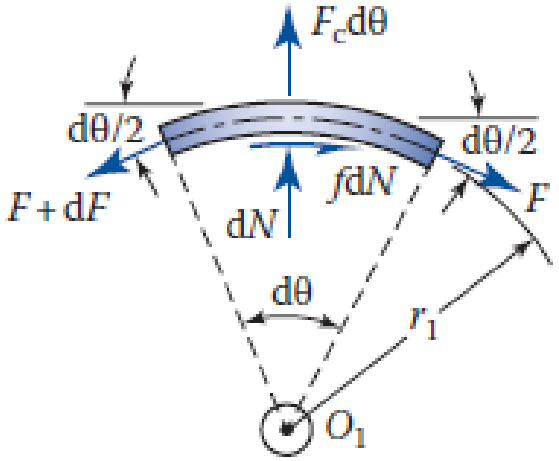

The wrap angle of the belt on the small pulley is;

$$\phi = \pi - 2\alpha$$

The wrap angle of the belt on the large pulley is;

$$\phi = \pi + 2\alpha$$

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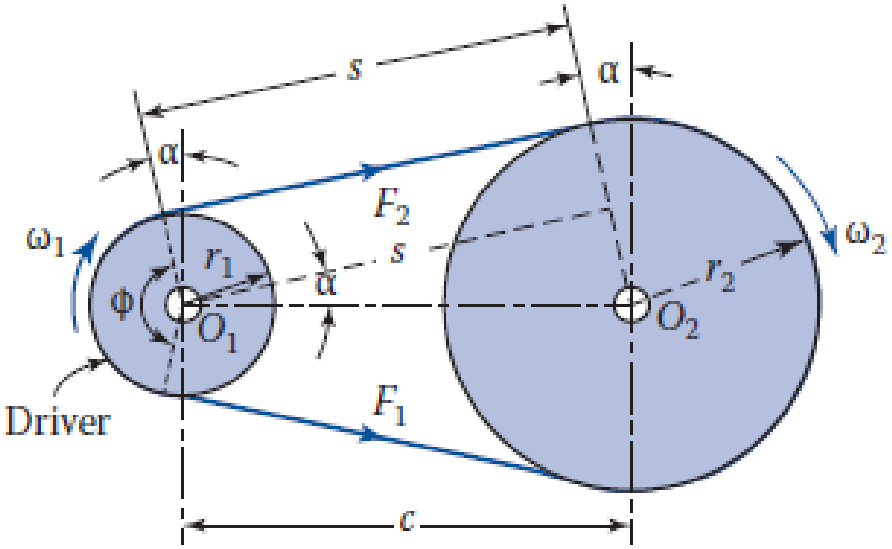
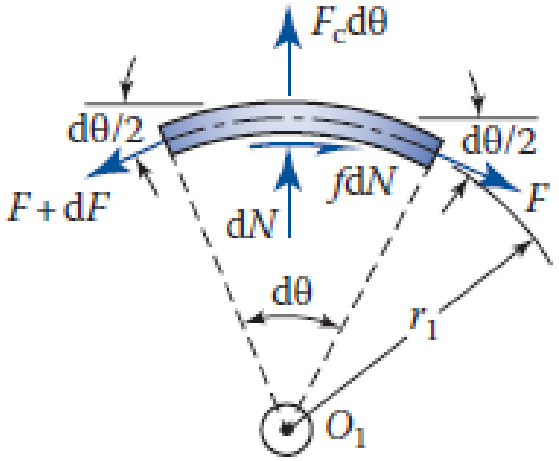
Belt Calculations





The belt contact angle is given by;

$$\sin\alpha = \frac{r_2 - r_1}{c}$$

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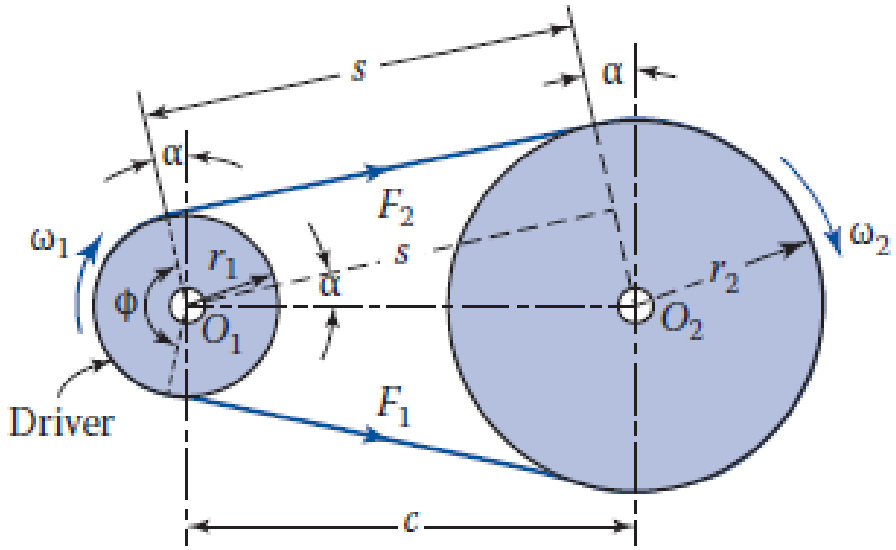
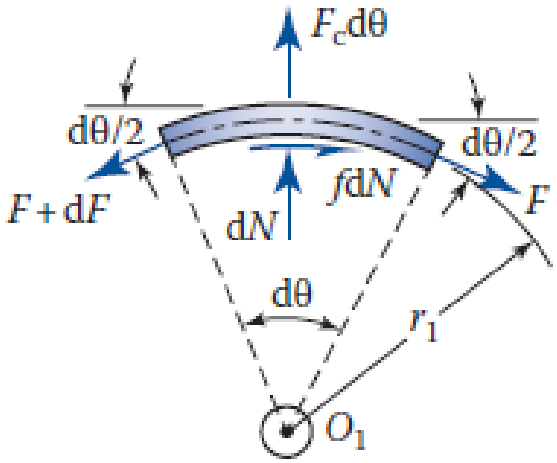
Belt Calculations





The belt length can be calculated;

$$L = 2[c^2 - (r_2 - r_1)^2]^{\frac{1}{2}} + r_1(\pi - 2\alpha) + r_2(\pi + 2\alpha)$$

Which can be approximated using a simpler expression;

$$L = 2c + \pi(r_1 + r_2) + \frac{1}{c}(r_2 - r_1)^2$$

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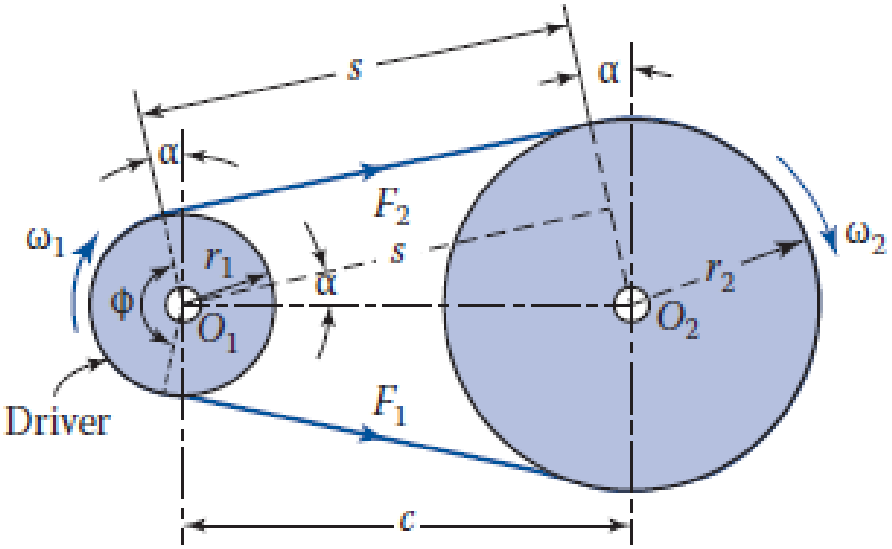
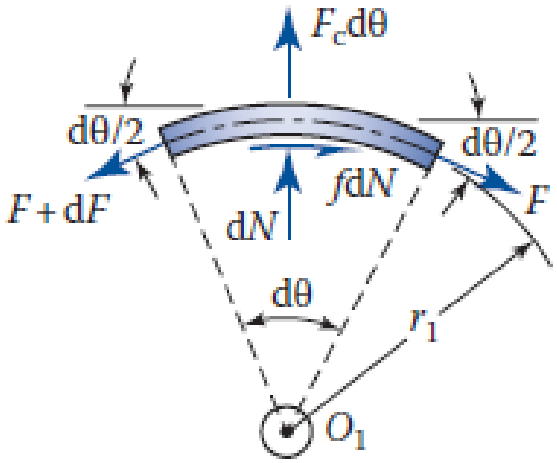
Belt Calculations





From which the center distance can be approximated;

$$c = \frac{1}{4}[L - \pi(r_2 + r_1) + \sqrt{b^2 - 8(r_2 - r_1)^2}$$

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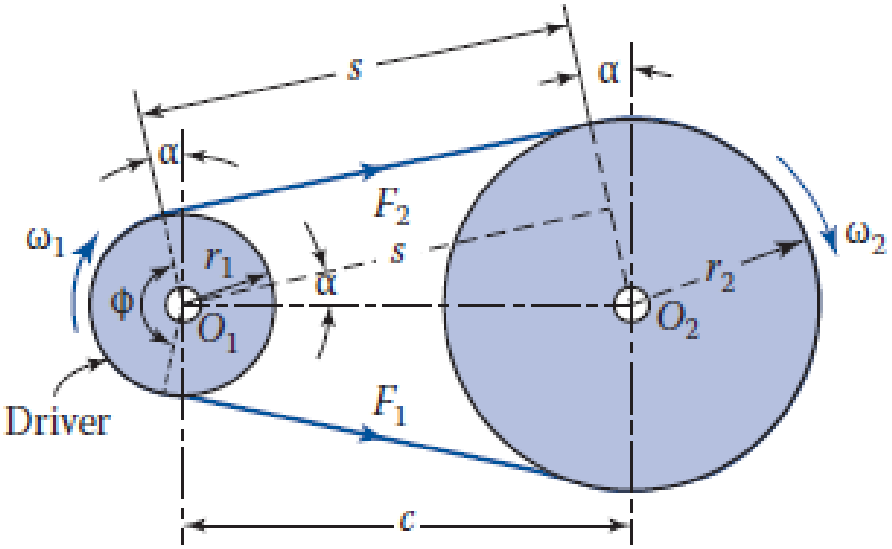

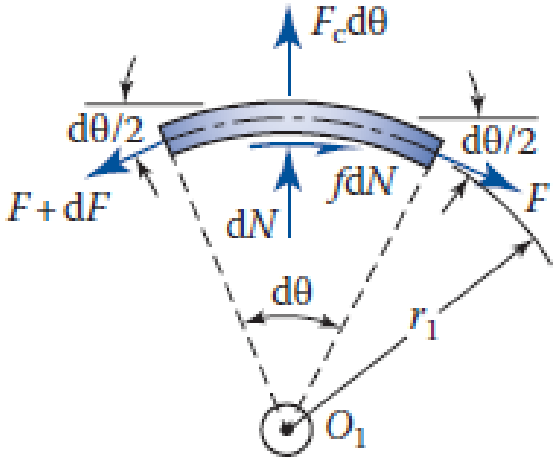

The centrifugal force acting on the belt is calculated;

$$F_c = \frac{w}{g} V_2$$

where w is the belt weight per unit length

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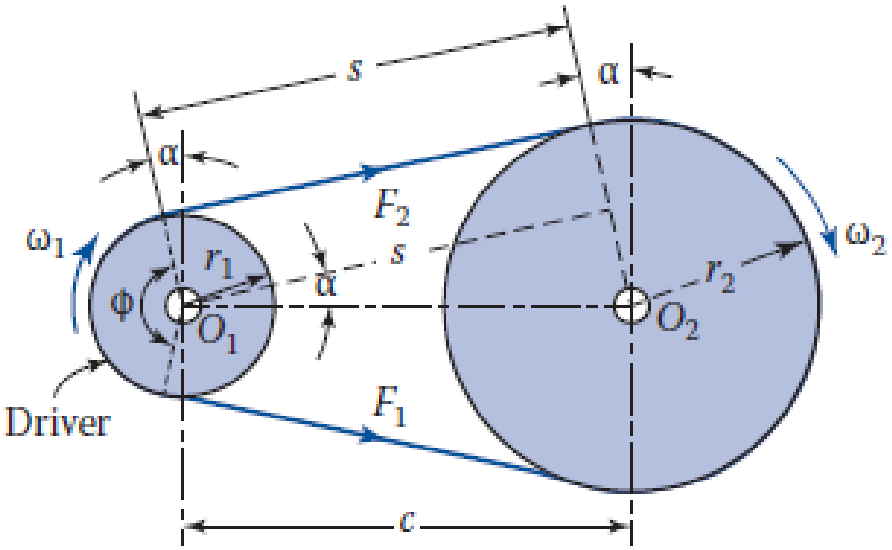
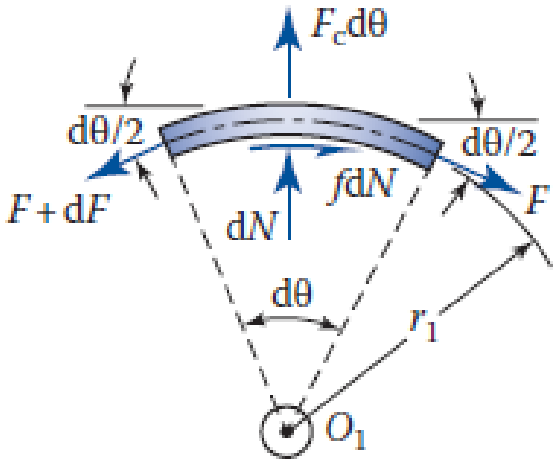
Belt Calculations





F_2 (slack side) is minimum tension and F_1 (tight side) is the maximum. It can be shown that;

$$\frac{F_1 - F_c}{F_2 - F_c} = e^{f\phi}$$

From which maximum and minimum belt tensions can be calculated.

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Thank you for your attendance :D

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Reference

- *Mechanical Design of Machine Components (2nd) by Ansel C.Ugural.*
- *Mechanical Engineering Design (10th) by Richard G.Budynas and J. Keith Nisbett.*
- *Theory of Machines and Mechanisms (5th) by John J.Uicker, Gordon R.Pennock, Joseph E. Singley.*

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