Taibah University
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Sheet (2) Problems on Couplings and Keys

Problem (1)

A pulley is keyed to a **24 mm** shaft with a square key of dimensions **6x36 mm**. If the allowable shear strength of the key material is **100 MPa** and the yielding strength is **180 MPa**, find the maximum torque which can be transmitted through that key?

Problem (2)

A key of dimensions **10 mm** width, **12 mm height** and **65 mm** length is used to transmit power of **120 kW** from electric motor to a pump. The maximum speed of the shafts is **1500 RPM**. Find the following:

a- Shaft diameter (use steel **1020** for the shaft material and safety factor=**3**)
b- Maximum shear stress and maximum compressive stress in the key.

Problem (3)

A belt pulley is fastened to a **40 mm** shaft running at a **200 RPM** by means of a rectangular key of **12 x 15 mm** and length of **60 mm**. The permissible stresses of the key material are **50 MPa** for shear and 7**5 MPa** for crushing. Determine the maximum power which can be transmitted through that connection without failure of any components. (the shaft material is **steel 1020**).

Problem (4)

The following figure shows a flanged coupling transmit a power of **20 HP** at a speed of **1000 RPM**. If the diameter of shafts is **50 mm**, find the following:-

a- The key dimensions which can be used in that coupling (key material is steel 37 with $\mathbf{S_y}$**= 200 MPa**), *take **F.S.= 3** for key design.*
b- Coupling dimensions (hub diameter, PCD, outer diameter)
c- Number of bolts and their size for connecting the two flanges of coupling (use bolts' of grade **5.6** and **F.S.=2**).

Problem (5)

A muff coupling is connecting two shafts for transmitting **650 Nm** torque. The shafts' diameter is **45 mm** and the square key dimensions are **14 mm** width and **110 mm** length. Find the following:-

a- Muff outer diameter (its material is cast iron of **30 MPa** allowable shear strength)

b- Key stresses (shear and crushing)

Problem (6)

Two **35 mm** shafts are connected by a flanged coupling. The flanges are fitted with **6** bolts on **105 mm** bolt pitch circle diameter. The shafts transmit a torque of **800 Nm** at **500 RPM.** For the safe stresses mentioned below, Find the following:-

a- diameter of bolts

b- thickness of flanges

c- key dimensions

d- hub length

e- power transmitted.

Safe shear stress for shaft material = ***63 MPa***

Safe stress for bolt material = ***56 MPa***

Safe stress for cast iron coupling = ***10 MPa*** *and*

Safe stress for key material = ***46 MPa***.