Lecture 5 Keys and keyways

5-1 Introduction
A key, Fig. 5.1, is usually made from steel and is inserted between the joint of two parts to prevent relative movement; it is also inserted between a shaft and a hub in an axial direction, to prevent relative rotation.

A keyway, Figs. 5.2, 5.3 and 5.4, is a recess in a shaft or hub to receive a key, and these recesses are commonly cut on key-seating machines or by broaching, milling, planning, shaping and slotting. The proportions of cross-sections of keys vary with the shaft size, and reference should be made to BS 4235 for the exact dimensions. The length of the key controls the area of the cross-section subject to shear, and will need to be calculated from a knowledge of the forces being transmitted or, in the case of feather keys, the additional information of the length of axial movement required.

Fig 5-1
Edge-milled keyway

End-milled keyway

Keyway in hub
5-2 Sunk keys

Examples of sunk keys are shown in Fig. 5.5, where the key is sunk into the shaft for half its thickness. This measurement is taken at the side of the key, and not along the centre line through the shaft axis. Figure 5.5 shows useful proportions used for assembly drawings. Square and rectangular keys may be made with a taper of 1 in 100 along the length of the key; Fig. 5.6 shows such an application. Note that, when dimensioning the mating hub, the dimension into the keyway is taken across the maximum bore diameter.

A gib head may be added to a key to facilitate removal, and its proportions and position when assembled are given in Fig. 5.7. A feather key is attached to either the shaft or the hub, and permits relative axial movement while at the same time enabling a twisting moment to be transmitted between shaft and hub or vice versa. Both pairs of opposite faces of the key are parallel.

A double-headed feather key is shown in Fig. 5.8 and allows a relatively large degree of sliding motion between shaft and hub. The key is inserted into the bore of the hub, and the assembly is then fed on to the shaft, thus locking the key in position.

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**Fig 5-5**

- **Rectangular key**
  - $W = \frac{D}{4}$
  - $T = \frac{D}{6}$

- **Square key**
  - $W = \frac{D}{2}$
  - $T = \frac{D}{2}$
A **peg feather key** is shown in Fig 5.9, where a peg attached to the key is located in a hole through the hub.

Figure 5.10 illustrates a **feather key** which is screwed in position in the shaft keyway by two countersunk screws.
Woodruff keys

A Woodruff key, Fig. 5.11, is a segment of a circular disc and fits into a circular recess in the shaft which is machined by a Woodruff keyway cutter. The shaft may be parallel or tapered, Figs 5.12 and 5.13 showing the method of dimensioning shafts for Woodruff keys where the depth of the recess from the outside of the shaft is given, in addition to the diameter of the recess.

Fig 5.11 Woodruff key

Fig 5.12 Dimensions required for a Woodruff key in a parallel shaft

Fig 5.13 Dimensions required for a Woodruff key in a tapered shaft
The deep recess for a Woodruff key weakens the shaft, but there is little tendency for the key to turn over when in use. Where lighter loads are transmitted and the cost of cutting a keyway is not justified, round keys and flat or hollow saddle keys as shown in Fig. 5.14 can be used.

![Diagram of Woodruff key and saddle keys]

Fig 5.14

Saddle keys are essentially for light duty only, overloading tending to make them rock and work loose on the shaft. Both flat and hollow saddle keys may have a taper of 1 in 100 on the face in contact with the hub. The round key may either be tapered or, on assembly, the end of the shaft and hub may be tapped after drilling and a special threaded key be screwed in to secure the components.