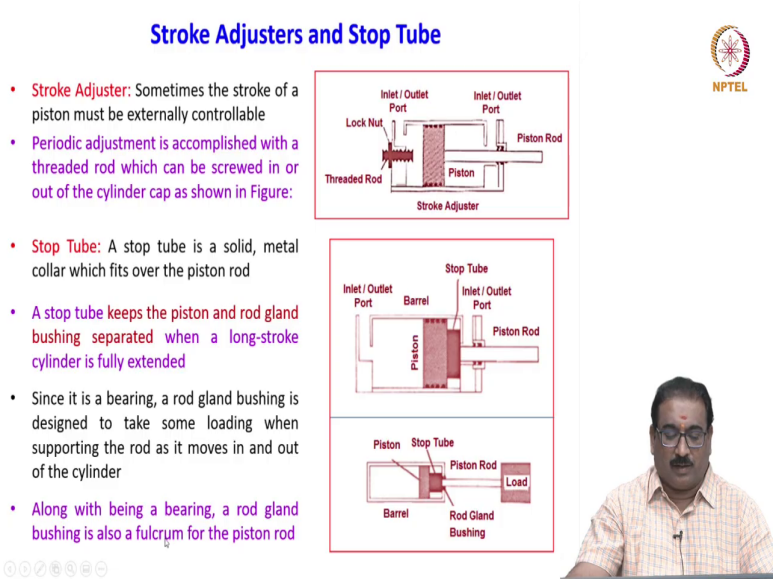
Oil Hydraulics and Pneumatics
Prof. Somashekhar S
Department of Mechanical Engineering
Indian Institute of Technology, Madras

Part 3: Stroke adjuster and Stop tube, Piston rod bucking, Cylinder mounting, Mechanical linkages, Types of cylinder loads
Lecture – 53
Hydraulic Cylinders

(Refer Slide Time: 00:23)



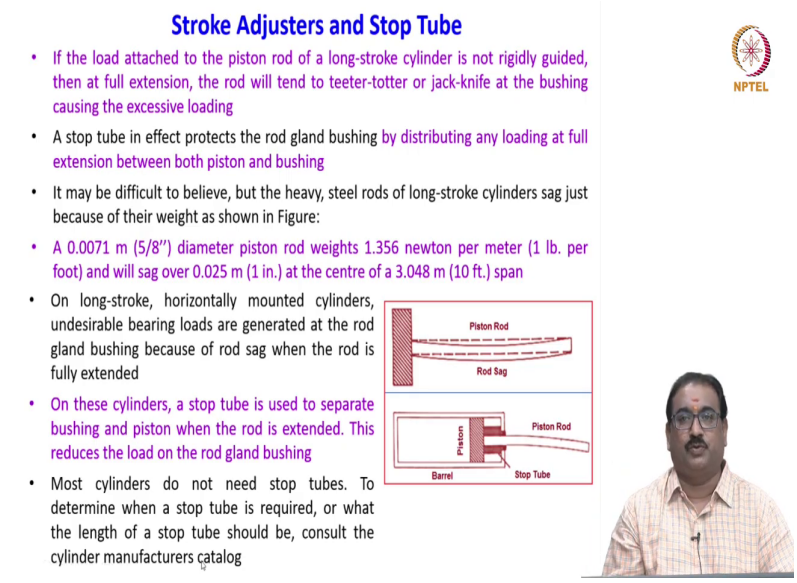
My name is Somashekhar, course faculty for this course. Then we will see some more arrangements are there in the cylinders the Stroke adjusters and Stop tube. What is this stroke adjuster? Sometimes the stroke of a piston must be externally controlled. You will see here this is a threaded rod, lock nut, inlet outlet port, this is a barrel, inlet outlet port piston with seals and you will see here this can be moved in and out with a threaded rod with lock nut.

Meaning the periodic adjustment is accomplished with a threaded rod which can be screwed in or out of the cylinder cap as shown in the figure. This is used for stroke adjustment meaning how much it will extend. Then stop tube you will see the figure here again I have shown you the figure, here see the end is stop tube. Again inlet outlet, barrel, these are common piston, piston rod all are common here extra is a, the stop tube.

Here you will see the at the end rod gland bushings when the piston rod comes out of the, the end caps.

A stop tube, this is a stop tube is a solid, a metal collar which fits over the piston rods. A stop tube keeps the piston and the rod gland bushing separated when a long-stroke cylinder is fully extended. Since it is a bearing, a rod gland bushing is designed to take some loading when supporting the rod as it moves in and out of the cylinder. Along with being a bearing, a rod gland bushing is also a fulcrum for the piston rods.

(Refer Slide Time: 02:41).



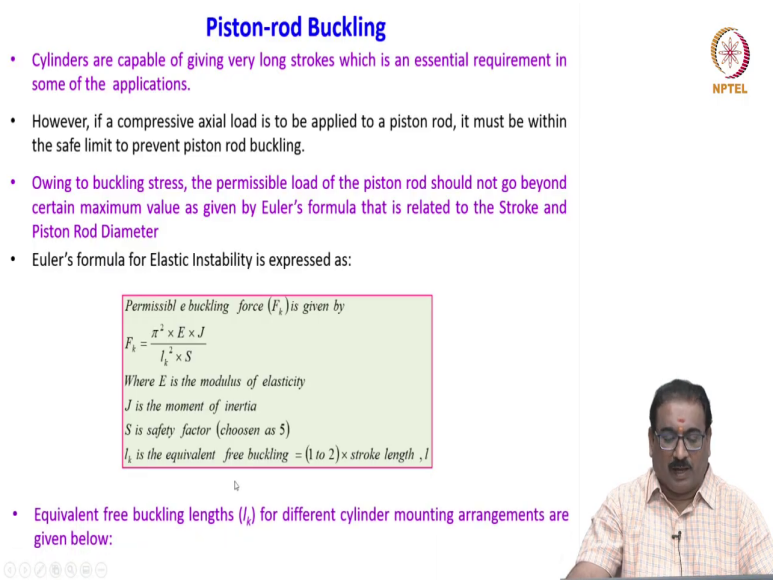
If the load attached to the piston rod of a long-stroke cylinder is not rigidly guided, then the full extension, the rod will tend to teeter-totter or a, jack-knife at the bushing causing the excessive loading. A stop tube in effect protects the rod gland bushing by distributing the any loading at full extension between both piston and bushing. It may be difficult to believe, but the heavy, steel rods of long-stroke cylinders sag just because of their weight as shown in the figure.

You will see whenever the piston rods are bigger in diameter and stroke length is very bigger outside when they will come out of the end they will sag due to the self weight. A 0.0071 meter diameter piston rod weighs these many Newton per meter and we will sag over these much meter at the centre of this span. On long-stroke, horizontally mounted cylinders,

undesirable bearing loads are generated at the rod gland bushing because of rods sag when the rod is fully extended we will see here how it is sags.

On these cylinder, a stop tube is used to separate the bushing and a piston when the rod is extended. This reduces the load on the rod gland bushing alone because it distributed over the stop tubes. Most cylinders do not need a stop tubes. To determine when a stop tube is required, or what the length of the stop tube should be, consult the cylinder manufacturers catalog. They will specify when will go for the stop tubes based on the sags and also length of the cylinder rod and diameter.

(Refer Slide Time: 05:24).

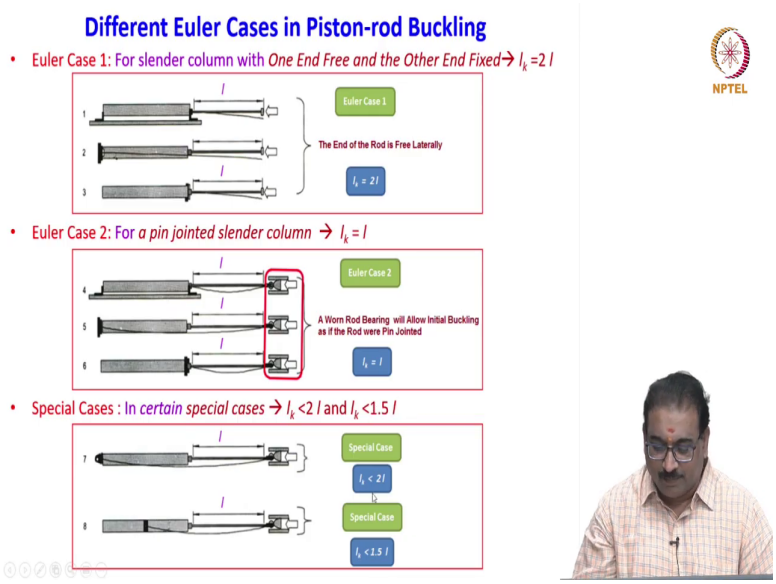


As I have told you cylinders are capable of giving a very long strokes which is an essential requirement in some of the applications. However, if the compressive axial load is to be applied to the piston rod, it must be within the safe limit to prevent the piston rod buckling.

Owing to buckling stress, the permissible load of the piston rod should not go beyond the certain maximum value as given by the Euler's formula that is related to the Stroke and the Piston Rod Diameter.

The Euler's formula for elastic instability is expressed as; permissible buckling force is given by F k equal to pi square E J divided by l k square into S. Here E is the elastic modulus of elastic modulus and J is a moment of inertia and S is the safety factor generally chosen as a 5 and l k is a, equivalent length for the buckling. This is 1 to 2 into stroke length l. Equivalent free buckling length l k for a different cylinder mountings are given below here.

(Refer Slide Time: 07:00)



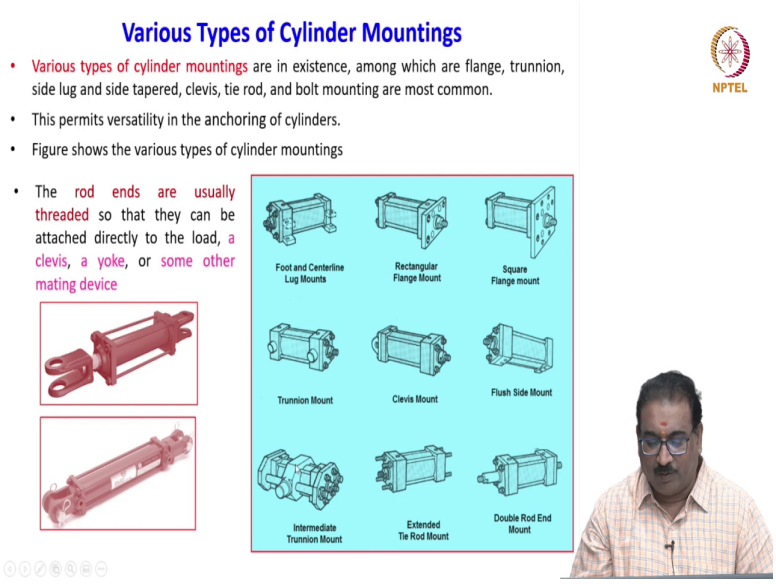
You will see the different cases are there for the mounting, the Euler case 1 here you will see the ends of the rod is free lateral. For a slender column with one end free and the other end

fixed, l k free buckling length l k equal to 2 into l, l is a stroke complete stroke. Euler case 1 l k equal to 2 l.

The Euler case 2 meaning for a pin jointed slender column. Pin jointed slender column l k equal to l. Meaning here you will see the worn rod bearings will allow the initial buckling as if the rod were pin jointed, in such cases you will use l k equal to l meaning equal to stroke length.

The special cases, you will see the special cases in a certain special cases the l k is less than 2 l and l k is less than 1.5 times l. These are the special cases in both the cases you will see. The effective length l k is how to take as an empirical value when they will mount like this.

(Refer Slide Time: 08:26)



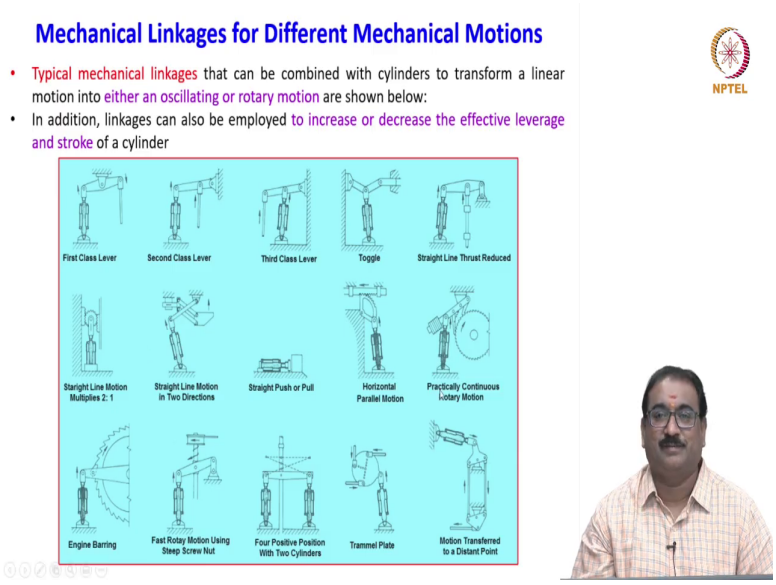
The various types of cylinder mountings are in existence among which are a flange, trunnion, side lug and a side tapered, clevis, tie rod and a bolt mounting are most common. I will show you some of the cylinder mounting here these are permits the versatility in the anchoring of the cylinders.

Figure shows the various types of cylinder mountings. The rod ends are usually threaded, so that they can be attached directly to the loads, here or a clevis or a yoke are some other mating device they are used here. You will see friends here the different types of cylinder mountings.

Please note here it is a foot and central line lug mounting here, you will see the rectangular, flange mounting here you will t square flange mounting, here a trunnion mounting, here you will see the clevis mounting flush side mounting and intermediate trunnion mounting, intermediate trunnion mounting, the extended tie rods mounting tie rods, a double rod end mounting.

There are various types of mountings are there when you are installing the cylinder be careful for the mounting based on the pressure requirement movement working cycles all these are very very important.

(Refer Slide Time: 10:12)



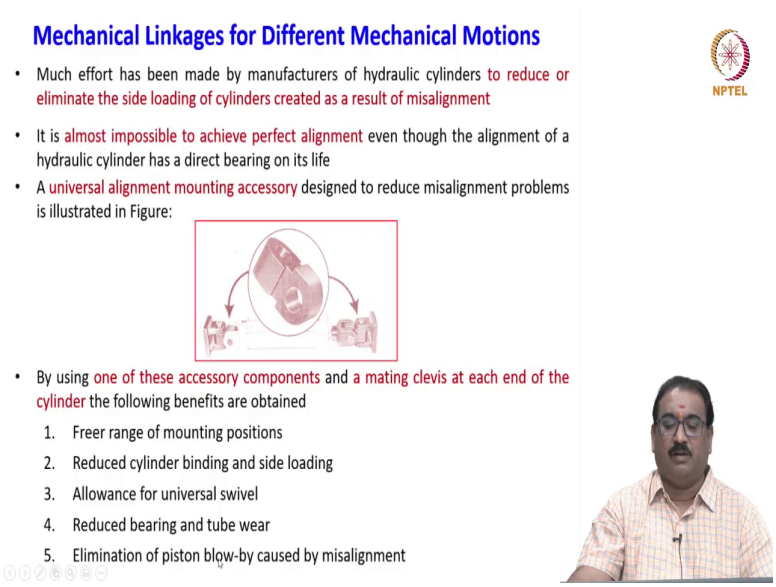
Then we will discuss some of the mechanical linkages for different mechanical motions. Typical mechanical linkages that can be combined with cylinders to transfer a linear motion into either an oscillatory or rotary motion as shown in the figure below. In addition, the linkages can also be employed to increase or decrease the effective leverage and a stroke of the cylinder.

See here, the different types of linkages are I have shown here along with the cylinders, these are all called a cylinders and these are the linkages to get the different motions when the cylinder will move in the same direction up and down or a vertical, but we will get to the different forms of motion using the various linkages.

You will see here the first class linkage. Meaning cylinder will move up and down this is pinned here you will get movement here.

Similarly second class arrangement see the arrangement fixed here, third class arrangement, when it will move how it will move. You see the arrangement the toggle, straight line thrust reducer, like this there are different types of linkages are used along with the cylinders to get the required motions. But cylinder motion is only the linear motion, but you will get the any types of motion you will see here based on the, a linkages how we are using.

(Refer Slide Time: 12:01)

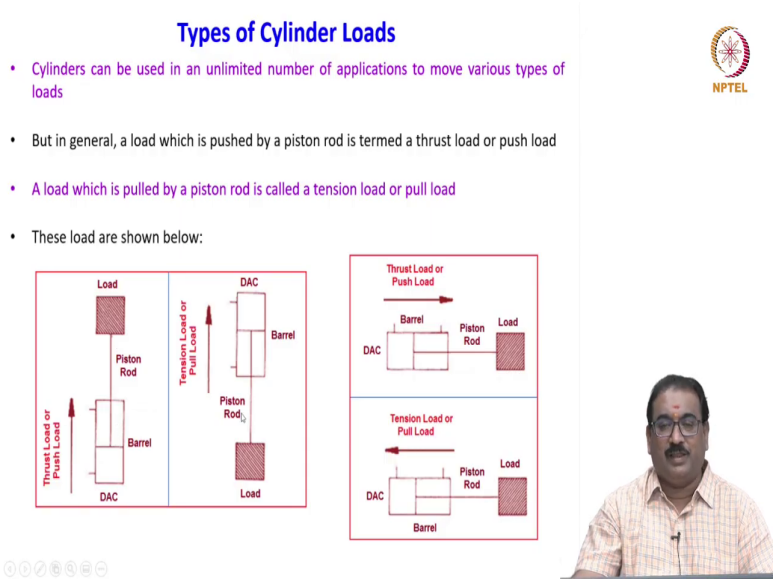


Much effort has been made by the manufacturer of hydraulic cylinder to reduce or eliminate the side loading of the cylinder created as a result of the misalignment. It is almost impossible to achieve the perfect alignment even though the arrangements of a hydraulic cylinders has a direct bearing on its life. A universal alignment mounting, here you will see this is a cylinder

two sides. A universal alignment mounting accessory designed to reduce the misalignment problem is illustrated here the two sides.

By using one of these accessory components and a matching clevis at each end of the cylinder the following benefits can be achieved. Freer range of mounting positions, reduced cylinder binding and side loading, allowance for universal swivel, reduced the bearing and a tube wear, elimination of piston blow-by caused by the misalignment.

(Refer Slide Time: 13:29)



Now, quickly we will see the different types of cylinder loads. Cylinders can be used in an unlimited number of application to move the various types of loads. But in general, a load which is pushed by the piston rod is termed as a thrust load or a push load. A load which is pulled by a piston rod is called a tension load or a pull load. You will see the cylinder load

two types; push type and a pull type push type is also known as a thrust load pull type is also known as a tension load.

Here I have shown you here friends these loads. You will see the vertically mounted. What I am using the fluid pressure is used to push this, meaning the thrust load here. Here you will see arrangement the fluid pressure is used to pull, meaning the tension load or a pull load. Please understand the meaning.

Here also we will see the fluid pressure is used to push this; meaning it is a push loads meaning cylinder will extend and push the load here. The cylinder will retract here the, what I am using fluid pressure is used to pull it the tension load. Please understand these things.