Oil Hydraulics and Pneumatics
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Part 5: Construction, Operation, and Application of Tandem, Diaphragm, Bellows, Impact cylinders
Lecture - 55
Hydraulic Cylinders

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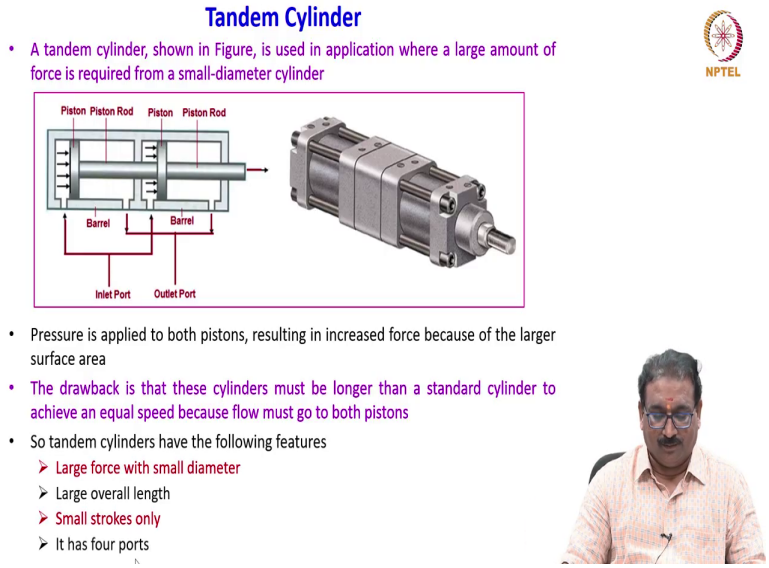

My name is Somashekhar, course faculty for this course. After knowing some of the applications of the telescopic cylinder let us we will move to one more type of cylinder, a tandem cylinder.

What is this we will see. A tandem cylinder is shown in figure is used in application where a large amount of force is required from a small diameter piston rods. What is the arrangement

you will see friends here, this is the piston rod connected to the piston of the next cylinder and piston rod.

Meaning you will extension as well as retraction you will see the areas will be get added up. Then you will get the large amount of force from a small diameter cylinders. Now, we will see here pressure is applied to both pistons resulting in increased force because of the larger surface area.

Now, we will see the extension. I have shown here the fluid the inlet from the inlet fluid will enters here as well as here, which will generate the larger force to push the loads. The drawback is that these cylinders must be a longer than the standard cylinder to achieve an equal speed because flow must go to both sides. So, tandem cylinders have the following features large force with a small diameter, large overall length, small stroke.

You will see friends here two inlets and two outlets, outlet port; when it is retracting that time these two are the inlet these two are the outlet remember this. Meaning it has the 4 ports 2 inlet ports for the extension two another two ports for the retraction.

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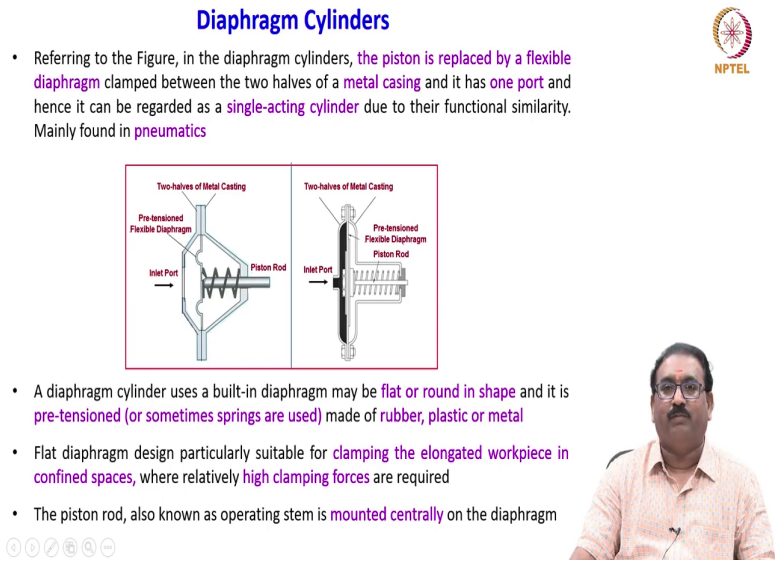

Now, we will see one more cylinder diaphragm cylinders. This referring to the figure, the diaphragm cylinders, the piston is replaced by a flexible diaphragm clamped between the two halves of the metal casing and it has one port and hence it can be regarded as a single acting cylinder due to their functional similarity the mainly found in pneumatics.

This figure you will see friends here, here the one halve and another halve then this is the piston rods. There is no piston here, here only it is a the flexible diaphragm. Then only one inlet when fluid enters it the pre tensioned flexible diaphragm will push the rods. Then you will see when the fluid will cut off it will come back because it is a pre tensioned sometimes they are using the spring.

A diaphragm cylinder uses a built in diaphragm. Maybe the flat or a round in shape and it is pre-tensioned or sometimes spring are used maybe made of rubber, plastic or a metal. A flat

diaphragm design particularly suitable for clamping the elongated work pieces in a confined spaces, where relatively high clamping force are required. The piston rod also known as the operating stem is mounted centrally in the diaphragm.

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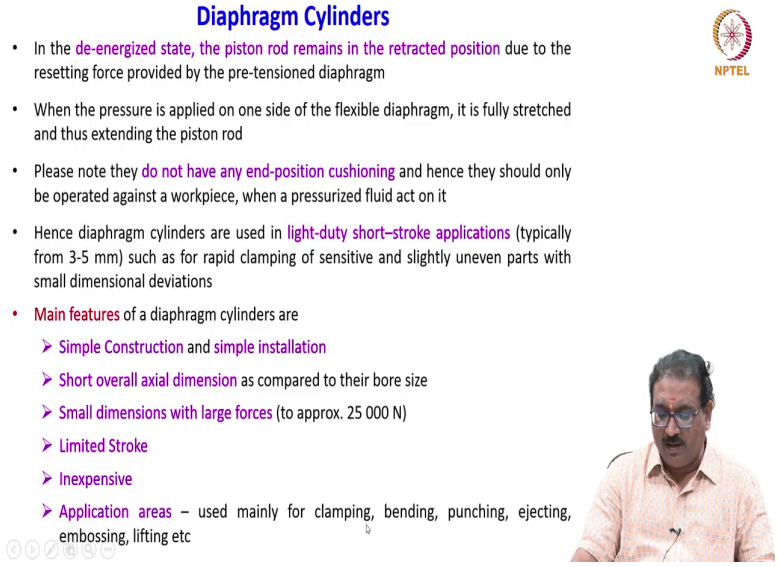

In the de-energized state, the piston rod remains in the retracted position due to the resetting force provided by the pre tension diaphragm. When the pressure is applied on one side of the flexible diaphragm it is fully stretched and thus extending the piston rod. Please note they do not have any end position cushioning and hence they should only be operated against the workpiece, when a pressurized fluid acts on it.

Hence diaphragm cylinders are used in a light-duty short-stroke applications typically 3 to 5 mm only such as rapid clamping of sensitive and a slightly uneven parts with a small dimensional deviations. Main features of a diaphragm cylinders are: simple construction

simple installation, short overall axial dimension as compared to their bore size, small dimension with large forces approximately here 25000 Newton force, limited stroke, inexpensive.

Application areas used mainly for: clamping, bending, punching, ejecting and embossing and lifting.

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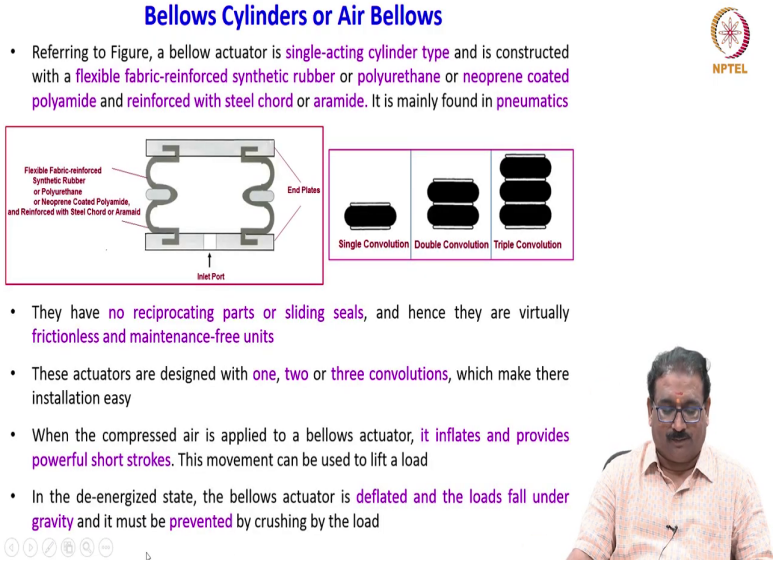

Now, we will see one more type bellow cylinder also known as air bellows. Referring to the figure, a bellow actuator again here it is a single-acting cylinder type and is constructed with the flexible fabric-reinforced synthetic rubber or a polyurethane or a neoprene coated with polyamide and reinforced with steel chord or a aramide.

Again here this is also mainly used in the pneumatics. They have no reciprocating parts or a sliding seals, and hence they are virtually frictionless and maintenance-free units. These are the endplates it is. When the air will enter here they will deflate the movement is very small, but a strong impact. These actuators are designed with one, two or three convolutions which make their installation easy.

Here you will see single convolution two convolution and again the endplates triple convolution and endplates. When the compressed air is applied to the bellow actuators, it inflates and provides a powerful strokes very short. This movement can be used to lift the load. In the de-energized state, the bellows actuator is deflated and the loads fall under the gravity and hence it must be prevented by crushing the load.

It because it is crushed by the loads it will fall on it. In the de-energised state, the bellows actuator is deflated and the loads fall under a gravity and it must be prevented by crushing by the loads.

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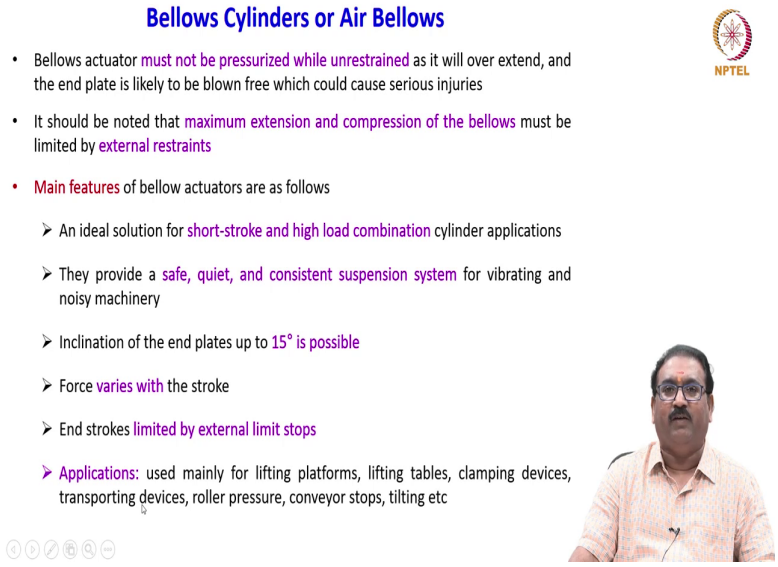

Bellow actuators must not be pressurized while unrestrained as it will over extent and the end plates is likely to be blown free which could cause a serious injuries. It should be noted that maximum extension and a compression of the bellows must be limited by external restraints. Main features of the bellow actuators are as follows.

An ideal solution for a short-stroke high load combination cylinder applications. They provide a safe, quiet, and a consistent suspension system for vibration and noisy machinery. Inclination of the end plate up to 15 degree is possible. Force varies with stroke, end strokes limited by external limit stops.

Applications: used mainly for lifting platforms, lifting tables, clamping devices, transporting devices, roller pressure, conveyor stops, tilting and many more.

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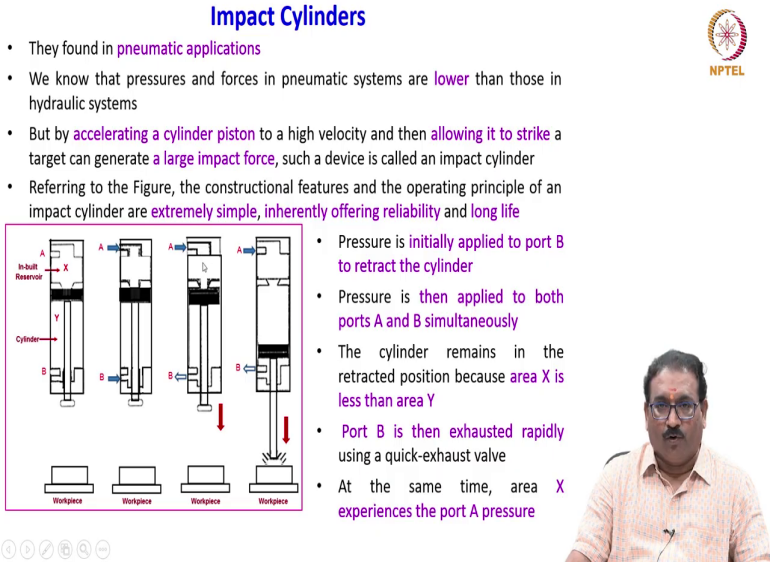

Then we will see the impact cylinders. Again they have found wide applications in pneumatics. We know that the pressures and forces in pneumatic systems are lower than in hydraulic systems. But by accelerating the cylinder piston to a very high velocity and then allowing it to strike a target can generate a larger impact force, such a device is called a impact cylinder.

Referring to the figure the constructional features and the operating principle of an impact cylinders are extremely simple, inherently offering reliability and a long life. You will see here friends again it is a double acting cylinder mounted vertically. Then you will see what is the arrangement here. Here you will see this is a cylinder body having the area Y, on the top of the piston you will see we are having the inbuilt reservoir which will stores the air.

These are the work pieces different positions I have shown. I will explain to you how it will work. The arrangement is very simple double acting cylinder because it is having the two ports and backside of the piston there is a reservoir. The pressure is initially applied to the port B to retract the cylinder. The pressure is then applied to both the cylinders simultaneously. The cylinder remain in the retracted position because the area X is less than the area Y, here X and Y, where I have marked.

Port B is then exhausted rapidly using the quick exhaust valve. As we have discussed in previous class while discussing the direction control valves. At the same time, the area X is experiences the fluid pressure.

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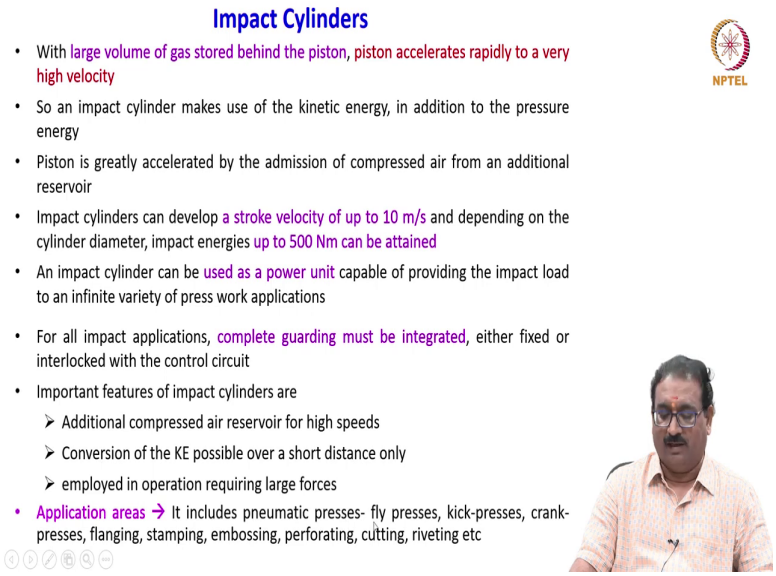

With a large volume of gas stored behind the piston, the piston accelerates rapidly to a very high velocity. So, an impact cylinder makes use of kinetic energy, in addition to the pressure

energy. Piston is greatly accelerated by the admission of compressed air from an additional reservoir here.

Impact cylinders can develop a strong impact cylinders can develop a stroke velocity of up to 10 meters per second and depending on the cylinder diameter, impact energies up to 500 Newton meter can be attained. An impact cylinder can be used as a power unit capable of providing the impact load to an infinite variety of press work applications.

For all impact applications, complete guarding must be integrated, either fixed or interlocked with the control circuit. Important features of the impact cylinders are: additional compressed air reservoir for high speeds, conversion of the kinetic energy possibly over a short distance only, employed in operation requiring large forces. Application areas, it includes pneumatic presses: like fly presses, kick presses, crank presses, flanging, stamping, embossing, perforating, cutting and riveting operations.

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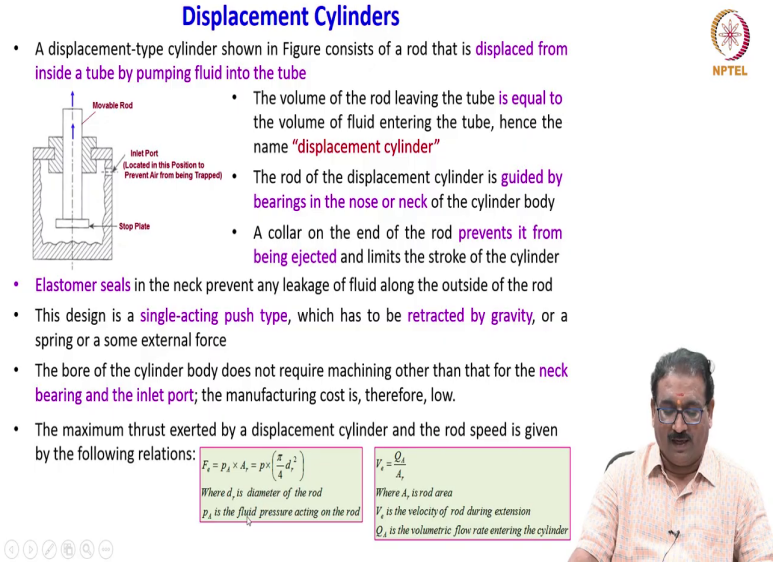

Now, we will see one more type displacement cylinders. This is the displacement cylinder see the constructional feature here how it is. A displacement-type cylinder shown in figure consists of a rod that is displaced from inside a tube by pumping a fluid into the tube. See here meaning, there is no piston here only the movable rod the rod will be moved by the fluid. Meaning here the volume of the rod leaving the tube is equal to the volume of fluid entering the tube hence the name displacement cylinder.

The rod of the displacement cylinder is guided by the bearing in the nose or a neck of the cylinder body. A collar on the end of the rod prevents it from ejecting and limits the stroke of the cylinder that is why it is a stop plate. Elastomer seals in the neck prevents any leakage of fluid along the outside of the rod. This design is a single-acting push type, which has to be retarded by gravity, or by spring or some other external force.

The bore of the cylinder body does not require machining other than that of the neck bearing and the inlet port; the manufacturing cost is therefore, it is a low for the displacement cylinders. Here only requires where this arrangement is there you know require the fine machining other places is not required in the displacement cylinders because there is no mating here.

The maximum thrust exerted by the displacement cylinder and the rod speed is given by the equations, for extension p A into A r then A r is a pi by 4 d r square meaning only rod area comes into picture, p A is the fluid pressure acting on the rod, similarly the velocity for the extension Q A by A r here A r is the rod area V is the velocity of the rod during the extension, Q A is the volumetric flow rate entering the cylinder.

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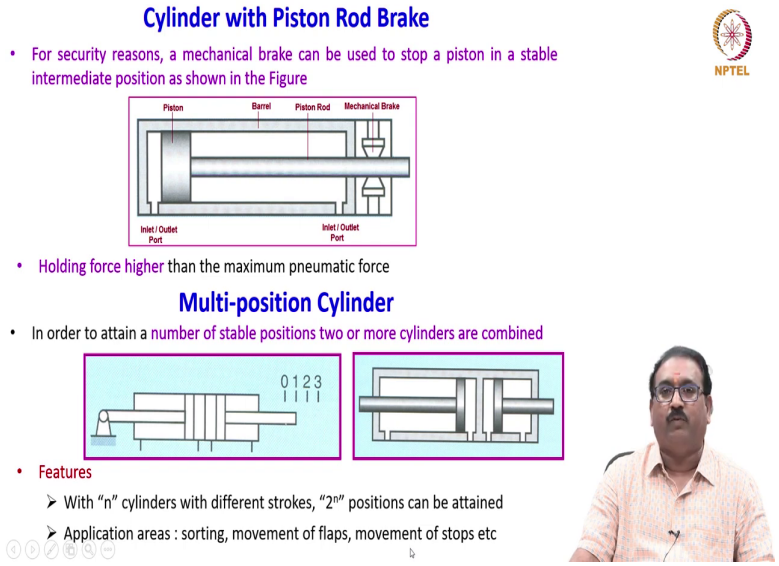

Now, we will see some more types cylinder with piston rod brake. For security reasons, a mechanical brake can be used to stop a piston in a stable intermediate position as shown in the figure here. Here you will see it is a similarly it is a double acting cylinder, but an arrangement is made for breaking the piston rod during the motion.

Holding force higher than the maximum pneumatic force then you will see some more arrangement here the multi position cylinders 0, 1, 2, 3 they will achieve. In order to attain a number of stable positions 2 or more cylinders are combined. Meaning features are: with n cylinders with different strokes, "2" to the power of n positions can be attained using the multi position cylinders. Application area: sorting, movement of flaps, movement of stops etcetera.

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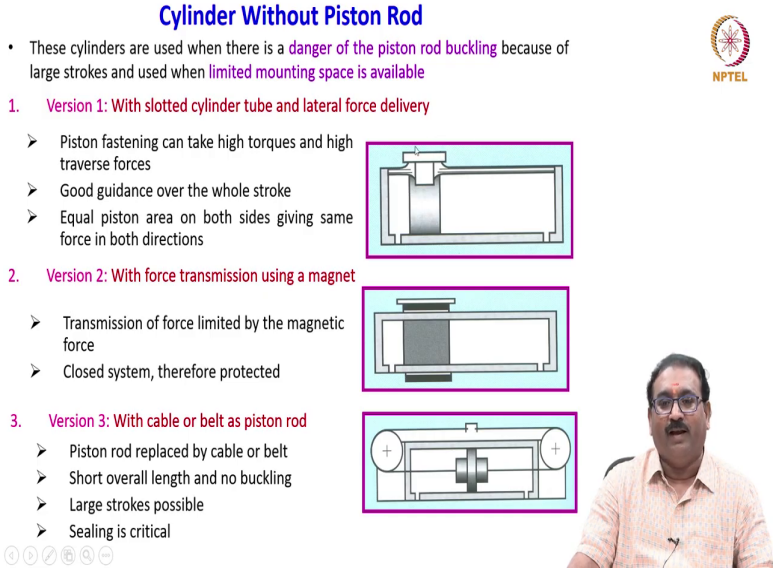

Now we will see quickly the cylinder without the piston rod previously the piston rod where the load is attaching it will do the extension interaction of the load for positioning applications or many applications, but here now there is no piston rods. Then you will see the different versions available in this category.

These cylinders are used when there is a danger of the piston rod buckling because of the larger strokes and used when limited mounting space is available that time they will well suit. There are different versions are there; 3 main versions I will show you here, no piston rod here. You will see the version 1 is with a slotted cylinder tube and a lateral force delivery.

Piston fastening can take high torques and high traverse forces. Good guidance over the whole stroke. Equal piston area on both sides giving the same force on both direction. Here the inlet outlet it is the cylinder barrel here you will see the area over which the fluid acts the same in both the sides, that is why giving the same force in the both directions.

The version 2 you will see here with a force transmission using the magnet. Transmission of force limited by the magnetic force closed system, therefore protected. The version 3 you will see with a cable or a belt as a piston rod. Piston rod is replaced by a belt or a cable. You will see the arrangement how they are made.

Short stroke length and no buckling large stroke possible. Sealing is critical here. Here you will see whatever the items you will place here it will move left and right easy here also same. Here, also same it is here there is no piston rods, that is why cylinders without piston rod are also available in the market.

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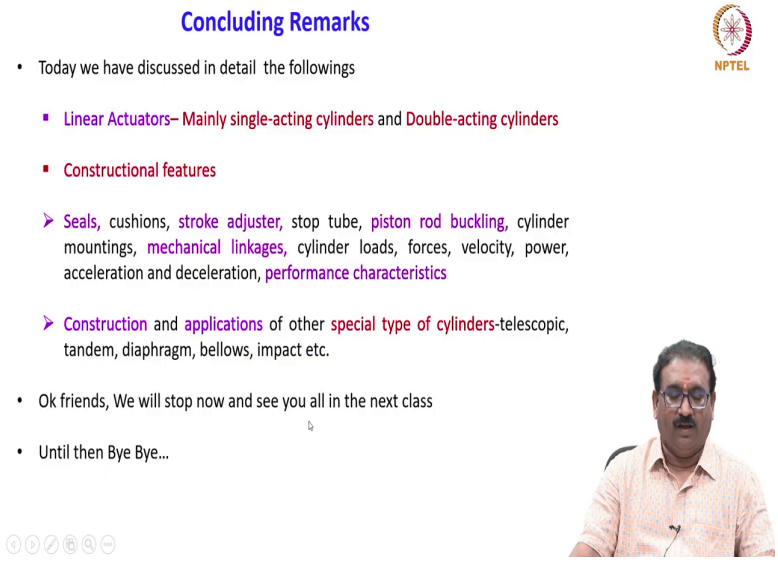

Now we will conclude today's lecture. Today we have discussed in detail the followings: linear actuators here mainly we are seen single-acting cylinders and double-acting cylinders. Please see friends here these whatever we discussed cylinders today they are meant for both hydraulics as well as a pneumatics. Only the media will be different.

Constructional features you are seen here the role of seals, cushions, stroke adjuster, stop tube, piston rod buckling, cylinder mountings, mechanical linkages, cylinder rods, forces, velocity, power, acceleration and deceleration, performance characteristics. And also we have seen the construction and applications of special type of cylinders like: a telescopic cylinder, tandem cylinder, diaphragm, bellows, impact and many others.

Specifically they are used in the pneumatic applications. Ok friends, we will stop now and see you all in the next class until then bye bye.

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Thank you one and all for your kind attention. [FL].