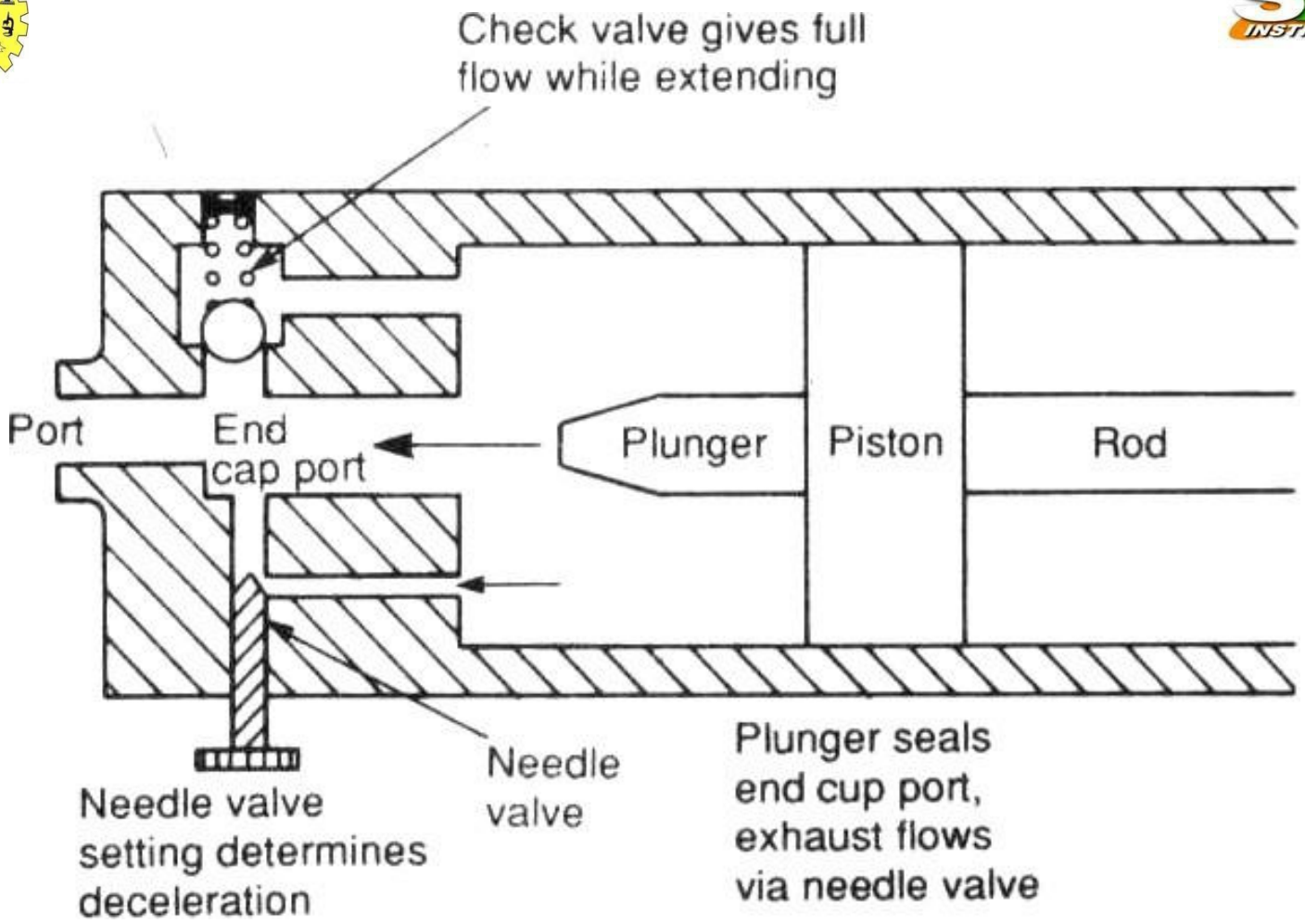
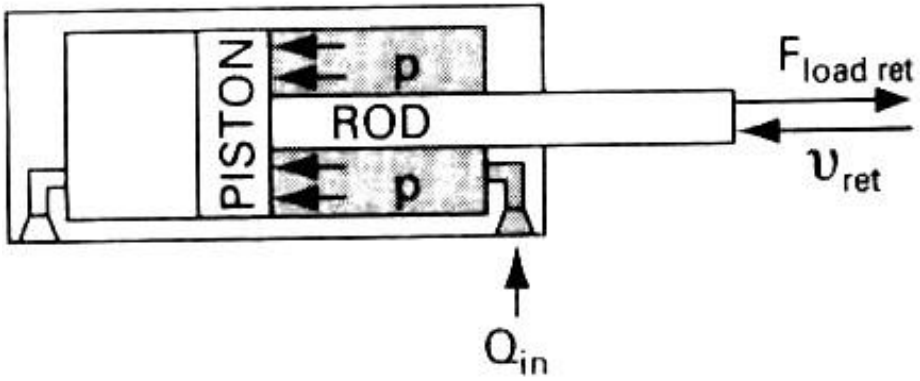
Unit II

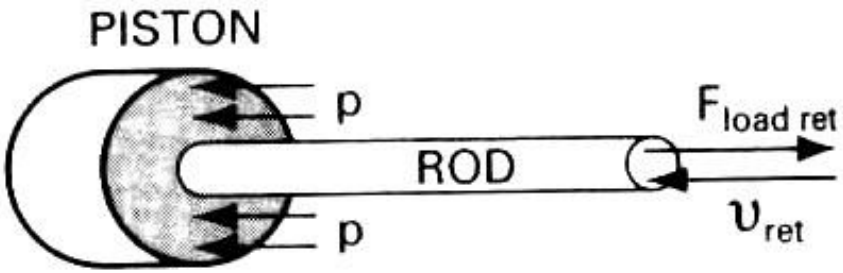
ROTARY ACTUATORS

COUSHIONED CYLINDER

- End caps (base cap) have to withstand shock loads (fluid pressure or from kinetic energy of the moving parts) at extremes of piston travel
- Reduction of shock loads with the help of cushion valves build in end caps
- Exhaust fluid flow is unrestricted until plunger enters the cap
- As plunger enters end cap port fluid experiences blockage, passes through deceleration valve (adjustable needle valve) which in turn reduces speed & the end of travel impact
- Deceleration valve is adjustable to allow the deceleration rate to be set
- A check valve is included in the end cap to bypass the deceleration valve & give near full flow as the cylinder extends


Check valve gives full flow while extending
Port
End cap port
Plunger
Piston
Rod
Needle valve
Needle valve setting determines deceleration
Plunger seals end cup port, exhaust flows via needle valve





DURING RETRACTION, ONLY THE ANNULAR AREA AROUND THE ROD (A_p-A_r) WHICH IS SHOWN SHADED, IS EXPOSED TO FLUID PRESSURE.

$$F_{ret}(\mathrm{N}) = p\,(\mathrm{Pa}) \times (A_p - A_r)\mathrm{m}^2$$

$$\upsilon_{ret}(\mathrm{m/s}) = \frac{Q_{in}(\mathrm{m^3/s})}{(A_p - A_r)\mathrm{m}^2}$$

Extension force is greater than the retraction force for the same operating pressure

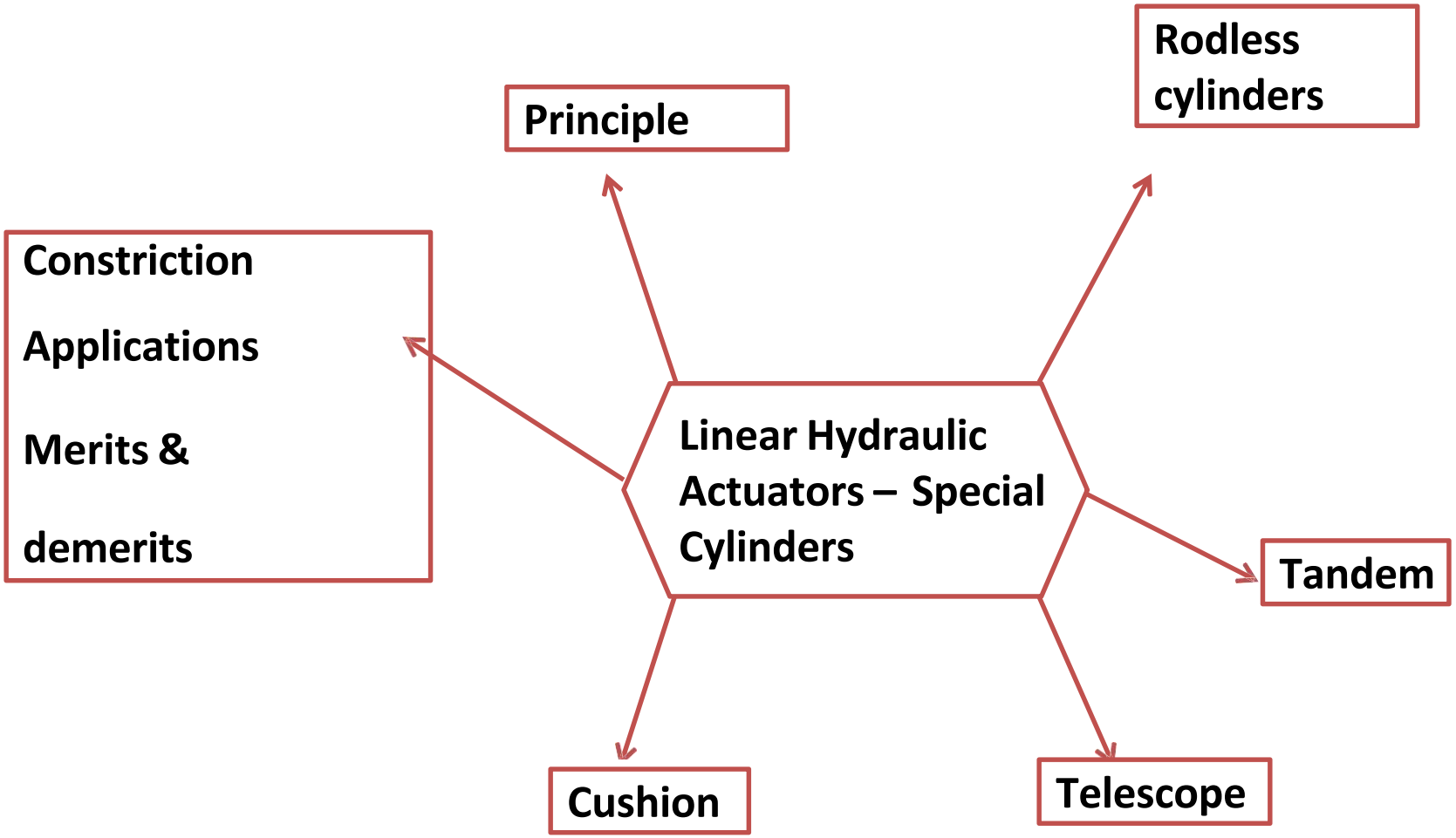
Retraction velocity is greater the extension velocity for the same input flow rate

$$\text{Power (HP)} = \frac{\upsilon_p\,(\mathrm{ft/s}) \times F\,(\mathrm{lb})}{550} = \frac{Q_{in}\,(\mathrm{gpm}) \times p(\mathrm{psi})}{1714}$$

$$\text{Power (kW)} = \upsilon_p\,(\mathrm{m/s}) \times F\,(\mathrm{kN}) = Q_{in}\,(\mathrm{m^3/s}) \times p(\mathrm{kPa})$$

Questions

1. What is meant by cylinder cushioning ?
2. What is the purpose of a cylinder cushion ?
3. What is a telescopic cylinder ? When do you use it ?
4. What are tandem cylinders ? When are they normally used ?
5. What do you mean by double-rod cylinders ?


Linear Hydraulic Actuators – Special Cylinders
Principle
Rodless cylinders
Constriction
Applications
Merits &
demerits
Tandem
Cushion
Telescope

Summary

- Telescopic cylinder is used to produce long strokes
- Rodless cylinder is used to produce short strokes
    - sealing band cylinder with slotted cylinder barrel
    - cylinder with magnetically coupled slide
    - band or cable cylinder
- Tandem cylinder combine two or more piston with a single rod.
- Cylinder cushions are used to reduce the impact of the piston on the cylinder casing
  - Fixed
  - Adjustable

Assessment

1. A double rod end cylinder with the same pressure at either end can have:

A. equal force and speed in both directions of travel. B. higher force in one direction of travel. C. either of the above.

D. Slower speed in both direction

2. With the same pressure at either end a single rod end cylinder has:

A. equal force in both directions of travel. B. more force extending. C. more force retracting. D. Less force in both directions of travel

3. Cable cylinders are:

A. twice as long as their stroke. B. three times as long as their stroke. C. slightly longer than their stroke..

4. Tandem cylinders can have almost_____the force as a single cylinder.

A. One time B. Twice C. three times D. four times

5. A cylinder with an actual 2:1 rod in a regeneration circuit will:

A. extend twice as fast as retract. B. extend and retract at the same speed. C. cannot regenerate a 2:1 rod cylinder.

Answer

1. A double rod end cylinder with the same pressure at either end can have:

A. equal force and speed in both directions of travel. B. higher force in one direction of travel. **C. either of the above.**

D. Slower speed in both direction

2. With the same pressure at either end a single rod end cylinder has:

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5. A cylinder with an actual 2:1 rod in a regeneration circuit will:

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Higher Order Question

- Rolls of paper are lifted into a calender by a lifting device. The lifting device is driven by a plunger cylinder (single-acting cylinder). When the hydraulic power pack is switched on, the pump output flows directly to the cylinder. A 2/2-way valve, which is closed in its normal position, is fitted in a branch line leading to the tank. A non-return valve is used to ensure that the pump is protected against the oil back-pressure. A pressure relief valve is fitted upstream of the non-return valve to safeguard the pump against excessive pressures.