CVG 3116 Fall 2017

Hydraulics – Tutorial 4
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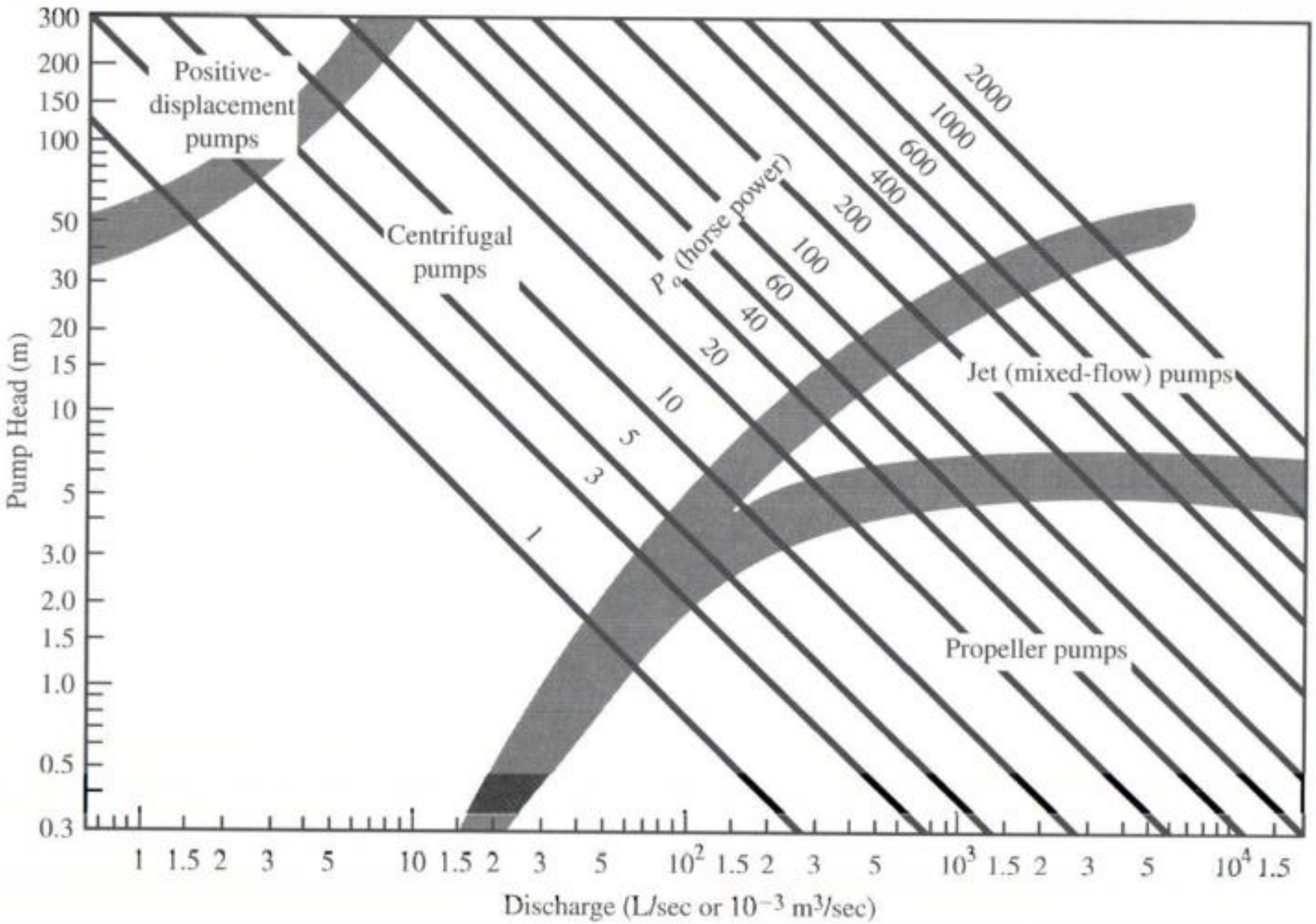
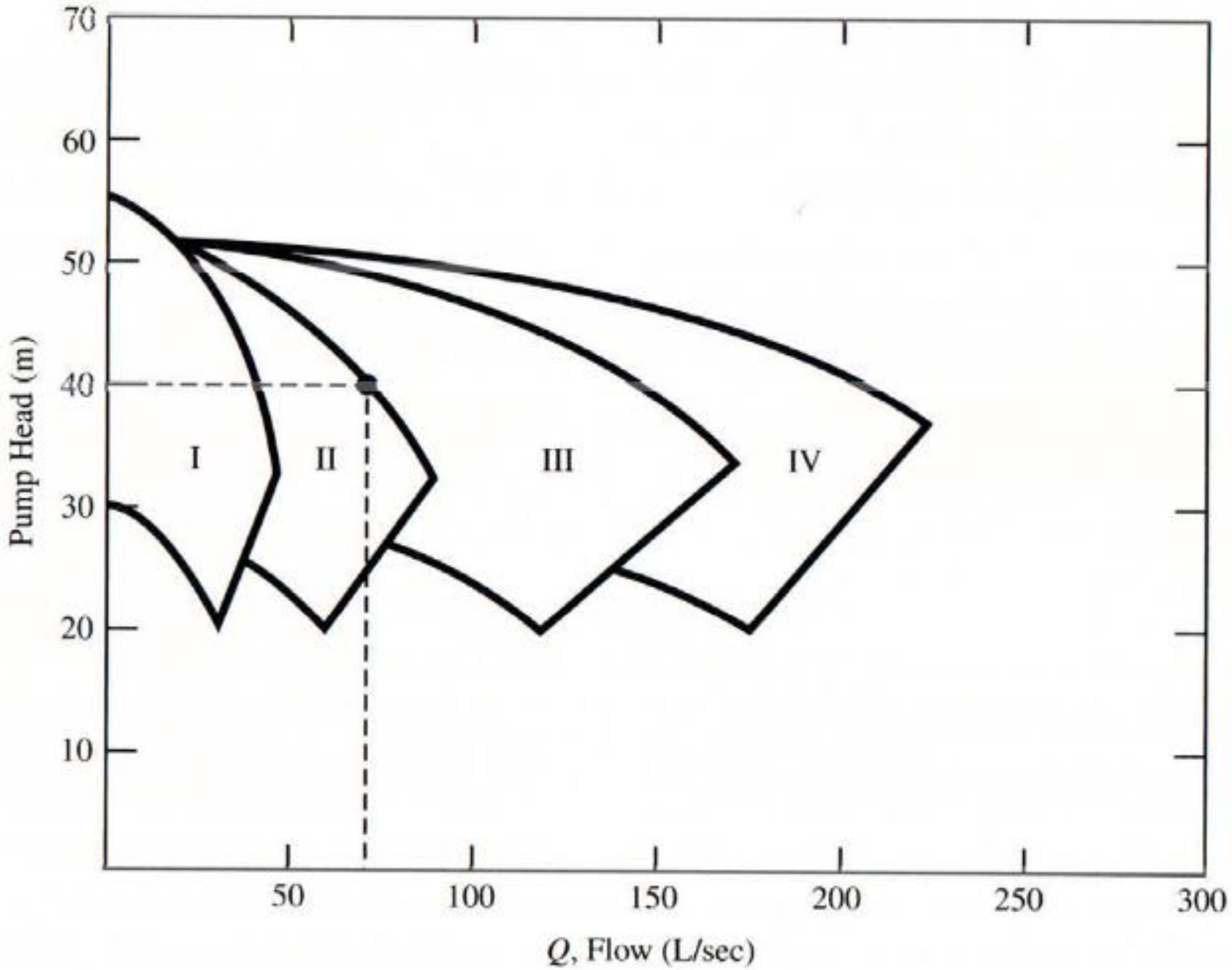
Lecture 5: Pump selection

- Pump Type



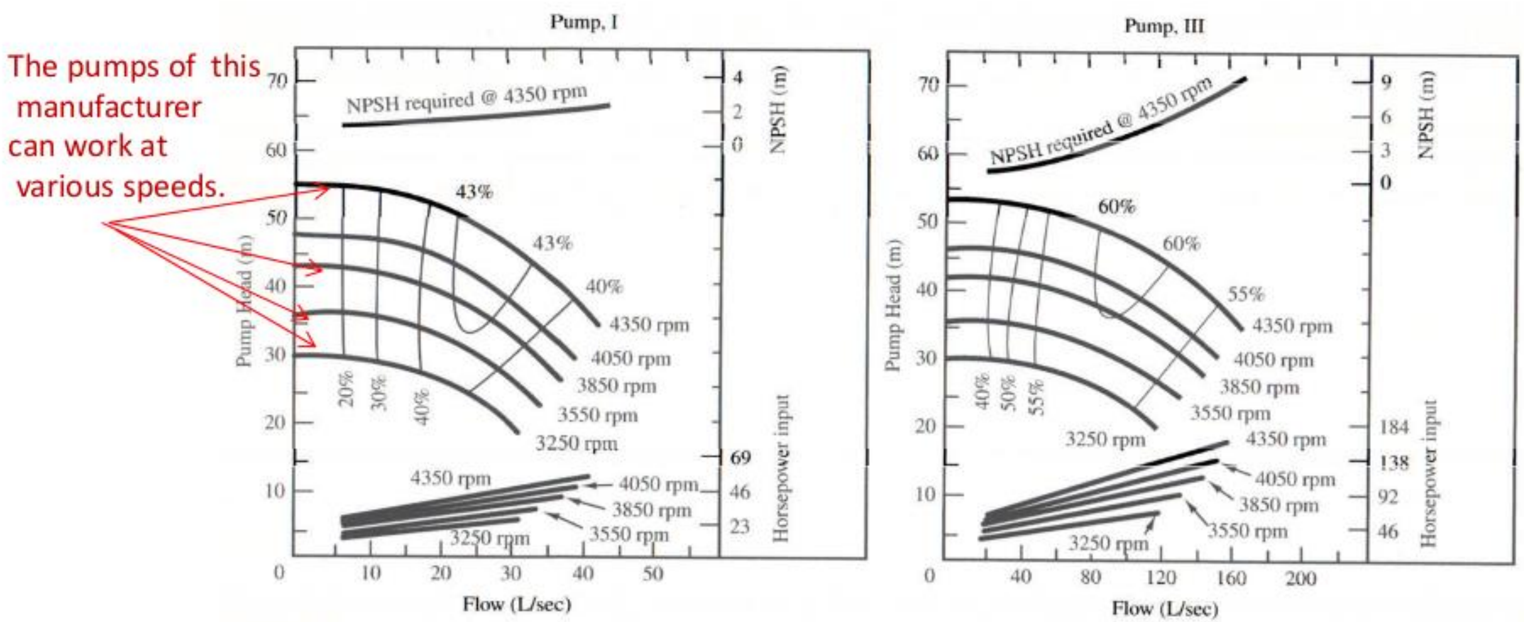
Lecture 5: Pump selection

- Pump Model



Lecture 5: Pump selection

- Based on the discharge and pump head requirements
- Select Pump Type (e.g. centrifugal)
- Based on the manufacturer products chose the pump model (e.g model II)
- Additional information (e.g. efficiency, NPSH crit) provided by manufacturers



Lecture 6: Pumps (continued)

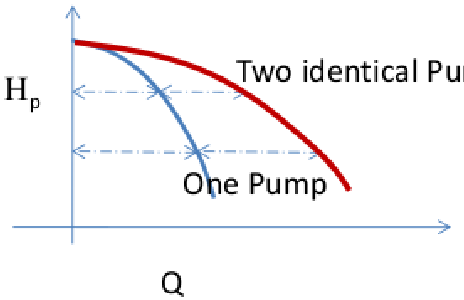
- Pumps in parallel and series

Lecture 6: Parallel Pumps

When some pumps work in parallel, their heads are equal and their discharges are added:

$$H_{Pt} = H_{P1} = H_{P2} = \ldots$$

$$Q_{Pt} = Q_{P1} + Q_{P2} + \ldots$$



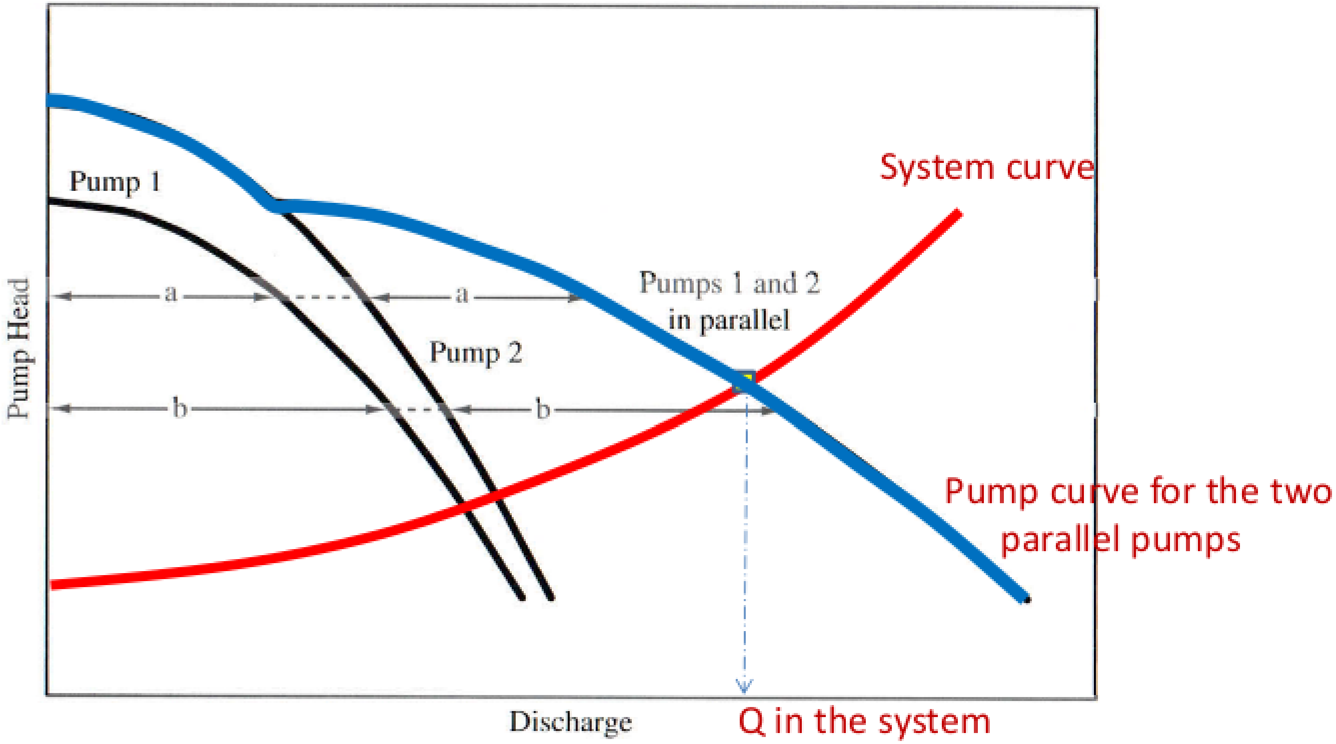
- Parallel pumps are used to generate high discharges
- Another benefit of such a system is that extra pumps may be shut off to save energy when they are not needed
- Moreover, the system can continue to work if one pump encounters a problem

If *n* pumps work together in parallel, the efficiency of the system at the discharge $\sum_i Q_i$ is given by:

$$\eta_t = \frac{\sum_{i=1}^{n} Q_i}{\sum_{i=1}^{n} \frac{Q_i}{\eta_i}}$$

Lecture 6: Parallel Pumps

When the two pumps are not identical, the pump curve is not smooth.
The combined pump curve is the sum of all curves in the horizontal direction.

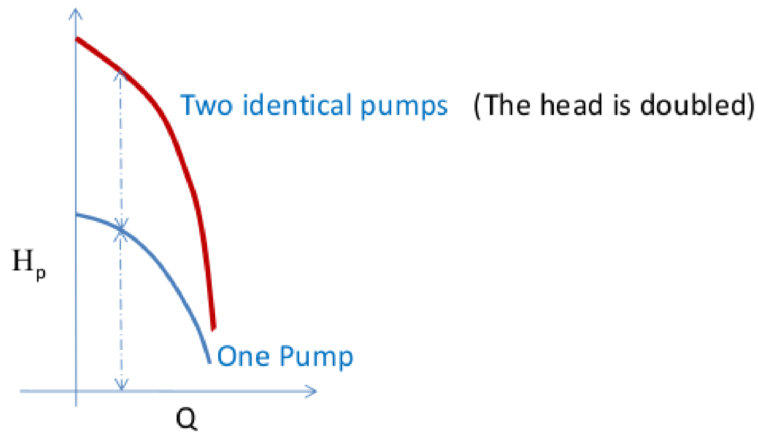


When you have parallel pumps, first obtain the *pump curve* for the combination of the two pumps and then, as before, the intersection with the system curve gives the operating Q and H_p of the *duty point.*

Lecture 6: Pumps in series

In this case, the head of pumps are added and their discharges are equal.

$$H_{P_t} = H_{P1} + H_{P2} + \ldots$$
$$Q_{P_t} = Q_{P1} = Q_{P2} = \ldots$$



Applications:

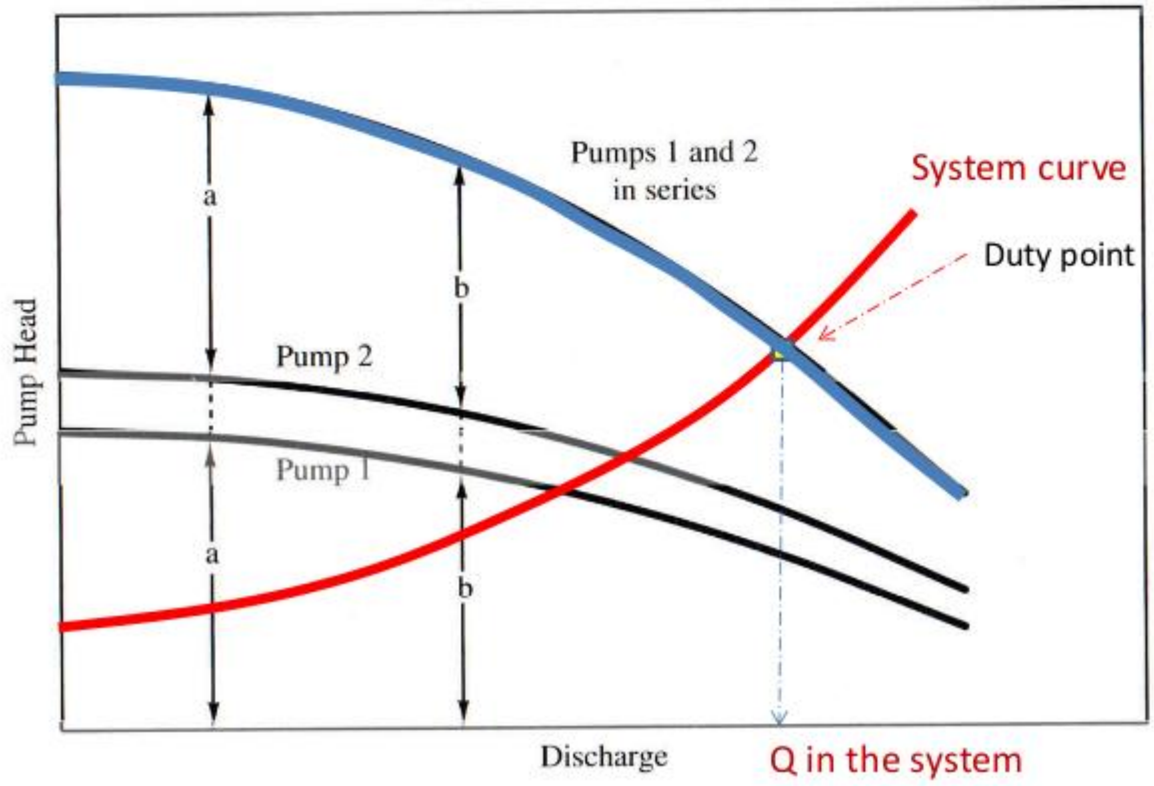
- To generate high pressures
- To increase the pressure gradually in long pipes

If *n* pumps work together in series at the discharge Q , the efficiency of the system at the discharge Q is given by:

$$\eta_t = \frac{\sum_i H_{pi}}{\sum_i \frac{H_{pi}}{\eta_i}}$$

Lecture 6: Pumps in series

The combined pump curve for pumps in series is obtained by adding individual pump curves in the vertical direction:



Lecture 6: Efficiency

- Parallel

$$\eta_t = \frac{Q_1 + Q_2}{\frac{Q_1}{\eta_1} + \frac{Q_2}{\eta_2}}$$

Note: for two identical pumps in parallel, since $Hp_1=Hp_2$ then $Q_1=Q_2=Q_t/2$, thus
$\eta_t= \eta_1= \eta_2$
Thus the same efficiency curve can be used, at $Q=Q_t/2$

- Series

$$\eta_t = \frac{H_{p1} + H_{p2}}{\frac{H_{p1}}{\eta_1} + \frac{H_{p2}}{\eta_2}}$$

Note: for two identical pumps in series, since $Q_1=Q_2=Q_t$ then $Hp_1=Hp_2=Hp_t/2$, thus
$\eta_t= \eta_1= \eta_2$
Thus the same efficiency curve can be used, at $Q=Q_t$