FIRE PUMP SUCTION PIPE SIZING

- **CALCULATION SHEET (NFPA-20 COMPLIANCE)**

Project: ais Bangalore, Fire Protection System

Pump Capacity: 2850 LPM (750 GPM)

Pump Suction Nozzle Size: 150 mm

Applicable Standard: NFPA-20 (Latest Edition)

- **1. DESIGN BASIS**
- Fire pump rated flow = **2850 LPM**
- Purpose of calculation:
  To verify adequacy of suction piping size with respect to **velocity and hydraulic performance** as required by NFPA-20.
- Design philosophy:

  - Minimize suction losses
  - Improve NPSH available
  - Ensure reliable fire pump operation
- **2. FLOW CONVERSION**

$$Q = 2850 \text{ LPM}$$
$$Q = \frac{2850}{1000 \times 60} = 0.0475 \text{ m}^3/\text{s}$$

3. NFPA-20 REQUIREMENTS (REFERENCE)

  - Suction pipe shall be sized to provide **adequate flow with minimum friction loss**
  - No requirement that suction pipe be same size as pump suction nozzle
  - Good engineering practice limits suction velocity to **1.0–1.5 m/s**
  - Maximum allowable velocity (upper limit): **15 ft/s (4.6 m/s)**

- **4. VELOCITY CHECK – 150 mm SUCTION PIPE**

Assumptions
- Internal diameter (D) ≈ **0.15 m**

Area calculation

$$A = \frac{\pi}{4} \times (0.15)^2 = 0.0177 \text{ m}^2$$
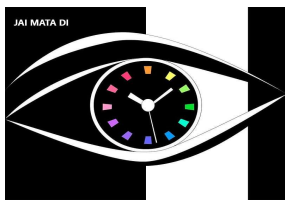
Velocity calculation

$$V = \frac{Q}{A}$$
$$V = \frac{0.0475}{0.0177} = 2.68 \text{ m/s}$$

Result
- Suction velocity = **2.68 m/s**
- This value is:
  - Below NFPA maximum limit
  - **Above recommended suction velocity for fire pumps**

❌ **150 mm suction pipe not preferred due to higher velocity and friction loss**
- **5. VELOCITY CHECK – 200 mm SUCTION PIPE**

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Assumptions
- Internal diameter (D) ≈ **0.20 m**

Area calculation

$$A = \frac{\pi}{4} \times (0.20)^2 = 0.0314 \text{ m}^2$$

Velocity calculation

$$V = \frac{0.0475}{0.0314} = 1.51 \text{ m/s}$$

Result
- Suction velocity = **1.51 m/s**
- Within recommended range for suction piping
- Results in:
  - Lower friction loss
  - Improved NPSH available
  - Reduced cavitation risk

✅ **200 mm suction pipe acceptable and recommended**

- **6. REDUCER REQUIREMENT**

- Pump suction nozzle: **150 mm**
- Suction pipe: **200 mm**
- Reducer type:
  - **Eccentric reducer (flat on top)**
- Purpose:
  - Prevent air pocket formation
  - Maintain full bore flow at suction

✓ Fully compliant with NFPA-20

- **7. CONCLUSION**

Although the fire pump suction nozzle size is **150 mm**, hydraulic analysis shows that:
- 150 mm suction pipe results in **high velocity (2.68 m/s)**
- Increasing suction pipe size to **200 mm** reduces velocity to **1.51 m/s**
- Reduced velocity ensures:
  - Lower friction losses
  - Improved NPSH conditions
  - Reliable fire pump performance

- **8. DESIGN STATEMENT (FOR SUBMISSION)**

"The fire pump suction piping has been increased from the pump suction nozzle size of 150 mm to 200 mm to limit suction velocity to approximately 1.5 m/s at a flow rate of 2850 LPM. This complies with NFPA-20 requirements for minimizing suction losses and ensuring reliable fire pump operation. An eccentric reducer (flat on top) is provided at the pump suction."

✅ **FINAL DESIGN ADOPTED**
- **Pump suction nozzle**: 150 mm
- **Suction piping provided**: **200 mm**
- **Standard**: NFPA-20 compliant