FM

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the spiral casing—

also known as the volute or scroll casing—

surrounds the runner and directs water uniformly into the guide vanes:

- **As water enters the casing, it is distributed around the circumference. To maintain a consistent flow velocity**
- water progresses along the casing, its cross-sectional area decreases uniformly
  thus cross sec area dec — thus velo inc → to create a pressure diff
    - Q = A x V. [Qinc. Ainc but. V=const]

- It helps recover some of the **kinetic energy** that would otherwise be **wasted** at discharge.

🔷 Function as a Diffuser

- A draft tube acts as a **diffuser**, reducing the **fluid velocity** at the outlet.
- This helps **increase pressure** and **improve efficiency**.

🔷 Design Considerations

- The draft tube should be **divergent** (increasing cross-sectional area).
- The **divergence angle** between the tube walls should be **limited to ~8°** to:
    - Avoid **flow separation**
    - **Minimize energy losses**
- **Cavitation Risk**:

    - The minimum pressure p2p_2p2 **must not fall below the vapor pressure** of the fluid to **avoid cavitation**, which can damage the turbine.
- **Advantage of Draft Tube**:
    - Allows the **runner to be positioned above** the tail race.
    - Does **not reduce available head**, as the vacuum compensates for the height.
    - Enhances energy recovery by slowing down fluid in a controlled way.

inlet design of a Francis runner:

1. **Inlet Blade Angle (β1):** This internal angle of the runner blades at the inlet varies over a wide range, typically from **45° to 120°**.
2. **Guide Vane Angle (α1):** This angle, which directs the flow onto the runner, is adjusted within a range of **10° to 40°**.
3. **Blade Width to Runner Diameter Ratio (B/D):** This ratio at the inlet is not fixed but **depends on the required specific speed** of the turbine. Its value typically ranges from **1/20 to 2/3**.