6.3.1.1 *Bypass Tunnels*

A bypass tunnel conveys the water and sediment carried by floods around a reservoir for release downstream of the dam. A schematic illustrating the configuration of a bypass tunnel is shown in Figure 6.4. A diversion weir is constructed on the upstream end of the reservoir, which divert floods with high sediment loads into a tunnel for discharge downstream of the dam.

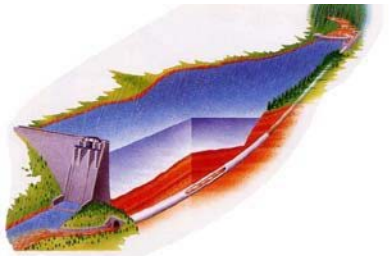

Figure 6.4. Sketch illustrating the bypass tunnel concept.

During average flow conditions, the water is allowed to flow over the diversion weir into the reservoir, instead of into the tunnel. Average river flows contain low sediment loads, resulting in low volumes of deposited sediment within the reservoir. By following this operational procedure it is possible to store water in the reservoir during low flow conditions and route sediment around the reservoir during high flow conditions, when the sediment loads are high.

Five known bypass tunnel schemes exist in Switzerland and four in Japan, with others planned. These schemes are suited to mountainous regions with relatively high river slopes (1% to 4% slopes) and relatively small reservoirs. Typical tunnel lengths range from about 250m to 4,300m.

The earliest example of the successful implementation of a bypass tunnel is located at Nunobiki Dam in Japan. Soon after the dam was built in 1900 it was realized that sedimentation will rapidly reduce its reservoir volume. The dam owners decided to construct a bypass tunnel, which was completed in 1908. If not for this tunnel the reservoir would have been filled with sediment by 1926. Instead, by using the bypass tunnel to pass sediment during floods a constant reservoir storage volume has been maintained since 1908. The bypass tunnel and reservoir is still in use at this time.

日本の排砂バイパスシステムは
外国のテキストにも紹介されている
（美和ダム、布引五本松ダム）

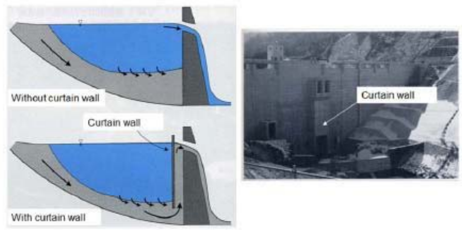

Figure 6.11. Density current venting provisions at Katagiri Dam, Japan. In the absence of a low-level outlet the ability to vent density currents was enhanced by adding a curtain wall. Once the density current reaches the dam, it is directed upwards into the space between the dam and the curtain wall to, eventually, flow over the dam spillway.

密度流排出（カーテンウォール方式）
（片桐ダム）

まとめ

- ダムによる環境影響は、流域面積に対するダム貯水池の大きさによって大きく相違
- 個々のダムが流況、流砂変化に与える特性を分析し、必要な影響緩和措置を検討すべき
- フラッシュ放流と土砂還元は、現在最も現実的な影響緩和方策
- フラッシュ放流の実施時期・規模・頻度を、利水制約と環境改善効果の両面から検討
- 土砂還元の量と粒度分布を、貯水池長寿命化、環境改善効果、経済性の面から検討
- 重要なポイント
  - 時間が立ってからではなく、ダム建設・管理開始と同時に進めること
  - これにダム建設・管理者は手間・時間・費用をかけること
  - ダムから土砂を出すことに下流の流域関係者も支持して欲しいこと

    （黒部川の土砂管理は大きく進歩、黒部川や排砂バイパス（美和ダム、旭ダムに世界は注目している）