Vertical slot fishways

The basic design of a vertical slot fishway is a rectangular channel partitioned by baffles into resting pools. When the water is flowing the fish swim from pool to pool through vertical slots that are orientated vertically. The advantage of this design is that passage is possible at a variety of water levels (Plate 21, Fig. 14). Passage of small, bottom dwelling species can be achieved by lining the floor of the channel with rocks. For surface orientated weak swimmers the velocity between the slots can be adjusted and/or baffles installed along the wall of the fishway at the appropriate level.

Plate 21: Vertical slot fishway retrofitted to a small power plant.

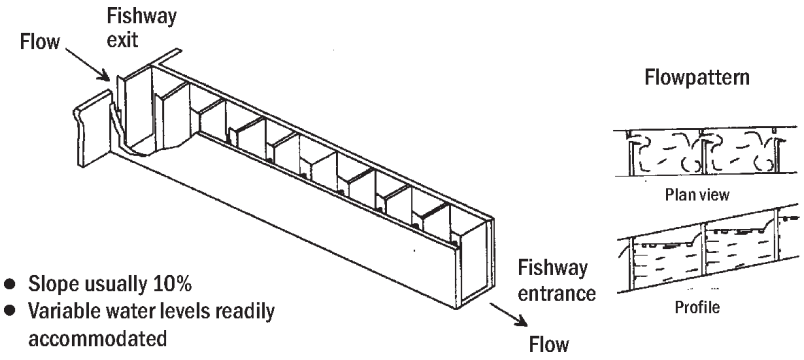


Figure 14: Characteristics of a vertical slot fishway (from Office of Technology Assessment 1995).

Plate 22: Denil fishway.

Denil fishways

The Denil fishway is essentially an artificially roughened channel. The basic design of a Denil fishway is a rectangular chute with baffles pointing upstream extending from the sides and bottom. (Plate 22, Fig. 15). The design can be adjusted to allow passage of weak swimmers.

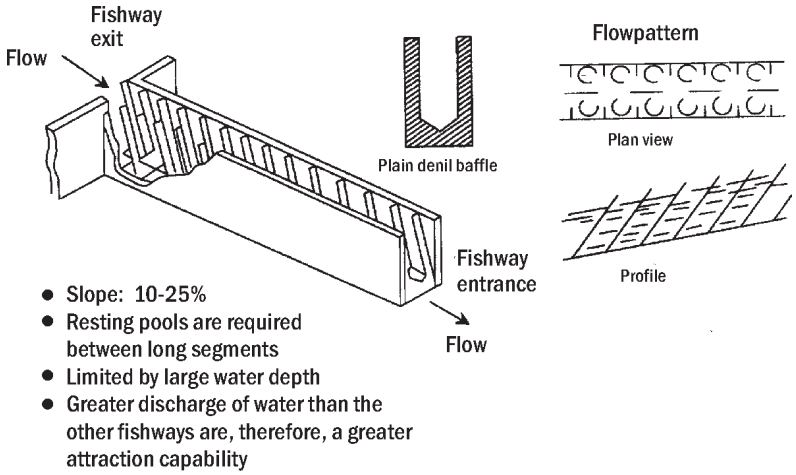


Figure 15: Characteristics of a Denil fishway (from Office of Technology Assessment 1995).

Eel ladders

Eel ladders are rectangular channels lined with gravel or projections through which fish weave their way upstream (Plate 23, Fig. 16). The projections can be nylon bristles or pins mounted onto a base vertically, and spaced at a distance that is appropriate for the target species. Different spacing regimes within the same channel may be used if required. The channel can be made of wood, plastic, or metal, and should preferably be set at an incline to allow for changes in water depths. Water for the pass can enter directly into the pass at the exit or be pumped into it. It is essential to include an attraction flow at the bottom of the pass. Trials undertaken in New Zealand have shown that such passes are effective for climbing galaxiids such as banded kokopu. When positioned at a low slope eel ladders can allow the passage of bullies over short distances.

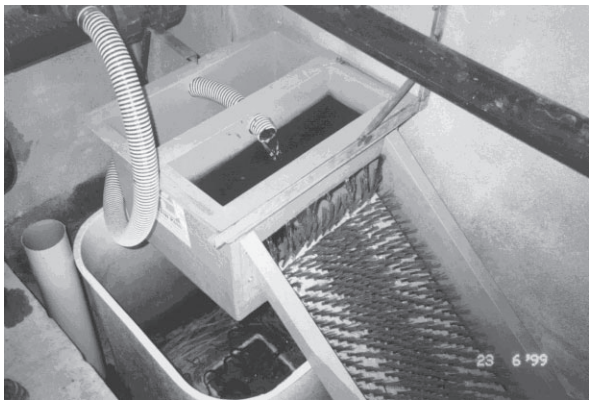
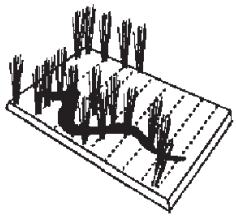
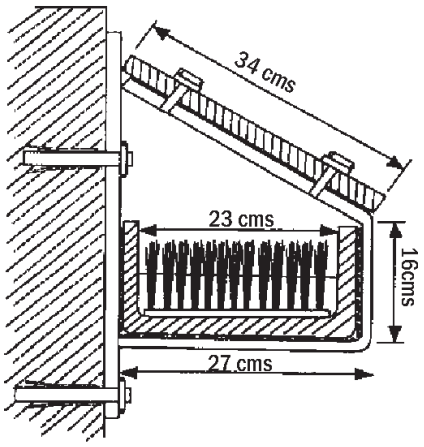


Plate 23: Eel ladder and trap.



Eel ascending through bristles



X-section through fishway

Figure 16: The basic principle of the eel ladder (taken from Clay 1995).

2) Nature-like fishways

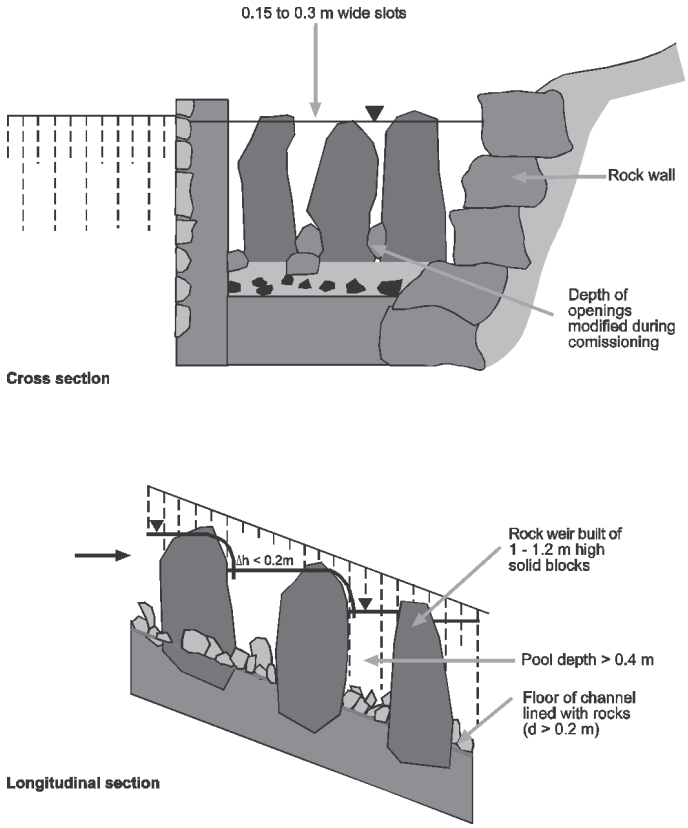
There are three basic designs for nature-like fishways:

- rock-cascade fishways (Fig 17).
- ramp type fishways (Plate 24).
- nature-like bypass channels (Fig 18 and Plate 25).

Rock-cascade fishways

The rock-cascade fishway combines elements of fish ramps and pool-type fishways (Fig. 17). The construction is similar to pool-type fishways, but the baffles are made of boulders and the flow passes through vertical slots between the boulders. The main advantage of this type of pass is that it allows for both the upstream and downstream passage of a variety of species, especially those using the anguilliform type of locomotion. Generally these types of fishways are much cheaper to build and maintain than traditional fish passes.

Figure 17: Principle of the rock-cascade fishway.



Ramp type fishways

These fishways consist of boulder ramps that either cover the whole width or a section of the barrier (Plate 24). The main advantage of this type of fishway is that it blends into the surrounding landscape. This type of fishway is ideal where the catchment is prone to flood and erosion. The construction materials (rocks) should be readily available (Harris et al. 1998). Where the catchment is subjected to periods of low flows, the rocks must be grouted to ensure that water is flowing over (and not through) the structure at all times. Low flow channel(s) must be incorporated into the ramp design.

Plate 24: Rock ramp type fishway over a spillway section of an irrigation dam. Note the low flow channel.

Nature-like bypass channels

Bypass channels offer an alternative route around a weir with a nature-like stream (Fig. 18 and Plate 25). This type of fishway has a range of applications and is suitable for all barriers if there is sufficient space. Nature-like bypass channels are particularly useful for upgrading existing installations. These types of fishways are considerably cheaper to construct than traditional fish passes. They are negotiable by most fish species and blend into the surrounding landscape. Care must be taken to ensure that the velocity at the channel inlet and outlet can be negotiated by all species. This is particularly important where flow control devices (e.g. gates) are installed.

Plate 25: Upper section of a nature-like bypass channel constructed to allow passage of indigenous fish species over a weir. Note the low velocities along the margins.

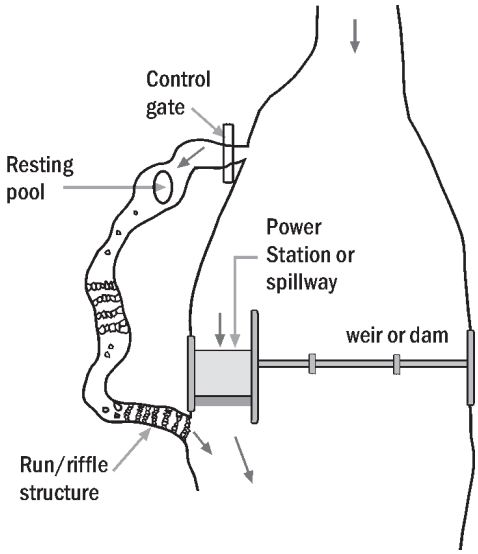


Figure 18: Principle of the nature-like bypass channel.

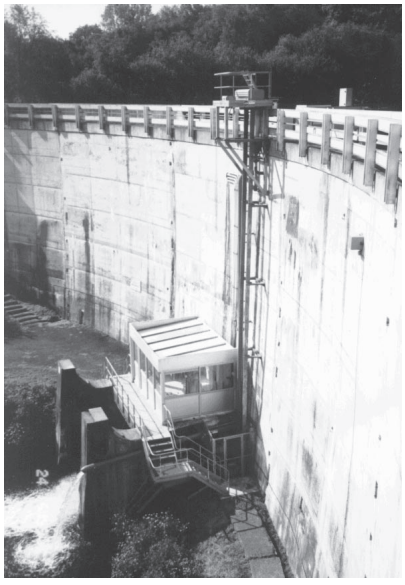
3) Fish lifts and fish locks

Experience both here and overseas has shown that fish lift and fish locks are the most effective type of fish passes for high dams. Catch and transfer operations that are successfully operating throughout New Zealand are based on this system. The concept is to attract and trap fish into an enclosure that either automatically transfers the catch upstream, or transfers it to a holding facility for manual transfer upstream. The later system is particularly useful where there are other barriers upstream. In its simplest form, the trap and transfer system consists of a trap (at most a ramp and holding bin) and a bucket for upstream transfer.

Fish lifts

Fish lifts can be defined as any mechanical means of transporting fish upstream over a dam (Plate 26). Fish pumps may also be included in this category.

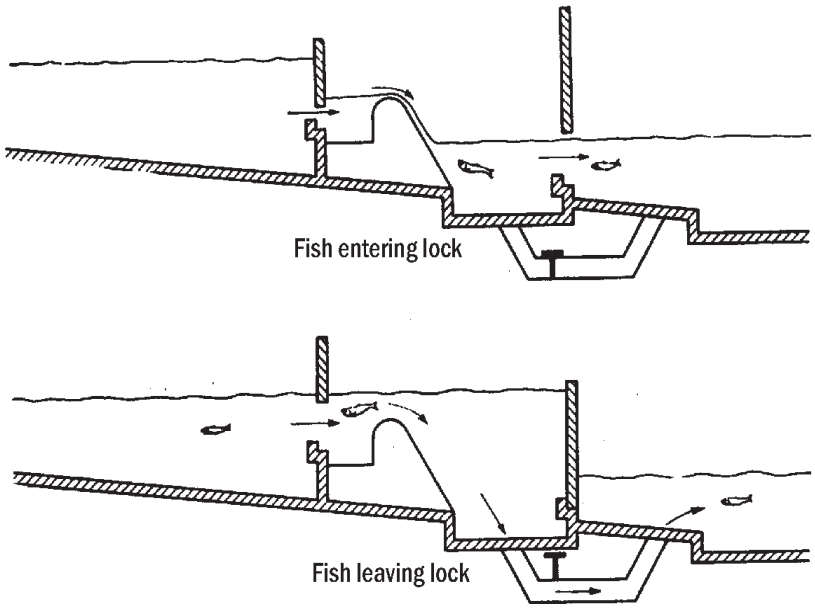
Plate 26: Elver fish lift on the Arguenon Dam, France.



Fish locks

A fish lock is a device that raises fish over dams by filling a chamber containing the fish with water until the water surface in the lock reaches or comes close enough to the reservoir level to let the fish swim into the reservoir above the dam (Fig. 19). Fish locks have a range of applications including situations where passage is required over a high dam, and where space and water are limited. The disadvantages of this method include high construction costs and ongoing operational and maintenance costs. The advantages include low water consumption. Fish locks are suitable for salmonids and weak swimming species, and less suitable for bottom-living and small fish.

Figure 19: Schematic drawing illustrating the basic operation of a fish lock (taken from Clay 1995).



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