Requirements for installation of an Aquantic Logie fish counter

1 Introduction and Principle of Operation

The Logie fish counter is used in conjunction with an electrode set to detect the upstream and downstream passage of fish in the body of water in which the electrode set is installed.

The electrode set comprises 3 similar corrosion-resistant metal conductors placed in a parallel alignment to form an open array configuration for weir use or a closed tube configuration for tunnel use.

The electrodes, in association with the water in which they are immersed, constitute a resistive transducer. For a given constant water depth, water temperature and water conductivity, the resistance measured between an electrode pair will be constant. A fish swimming through the array displaces its own volume of water; its body mass is considerably less resistive than the volume of water which it displaces. Thus the passage of the fish causes a transient reduction in the resistance detected between an electrode pair. If the fish is moving upstream, first the centre-lower then the centre-upper resistance will show a reduction; if the fish is moving downstream the centre-upper resistance drops first followed by the centre-lower.

The instrument continuously monitors these resistances and from them derives a signal that defines the instantaneous relative magnitude of one to the other. The perturbation of this signal by a fish swimming through the array allows the counter firstly to detect its passage and secondly to gauge it's swimming direction and approximate size.

Wide variations can be expected in those factors that determine inter-electrode resistance, namely depth, temperature and conductivity. It is not unusual for inter-electrode resistances to vary by hundreds of percent. An extremely important subsidiary function of the Logie fish counter is to regularly measure those factors affecting bulk resistance and to automatically adjust the sensitivity of its signal processing path in order to compensate for any change. On sites where moderate to high water conductivities prevail, the standard counter is able to make this adjustment. On sites where low water conductivities occur the adjustment is made with the aid of precise conductivity data supplied from the optional environmental card. The result of these compensatory adjustments is a good correlation between the size of the fish and processed signal magnitude if a constant swimming depth is assumed. It is therefore possible for the user to set threshold levels that define a size below which a fish will not be counted. It is also possible for the counter to sort fish into approximate size groupings.

2 Installation

The resistivity method of fish counting is well established, having a development history dating from 1949.

As explained in section 1 the method depends on the body mass of a fish being considerably less resistive than the volume of water which it displaces; thus when a fish traverses a pair of adjacent electrodes a momentary reduction in the resistance between them can be detected. The fish counter must therefore be used in association with a set of electrodes installed in the water channel through which the fish are passing.

The attention of novice users of fish counting equipment is drawn to the publication "Fish counting stations – Notes for guidance in their Design and Use" by R B Bussell (Department of the Environment, November 1978). As the title suggests, this contains comprehensive advice on the design of and equipment for a fish counting installation.

A brief summary of important points from the publication is included here for preliminary guidance only.

The counter is intended for use in fish counting stations where electrode strips have been installed in a tube, channel or downstream face of a "Crump" weir. "Crump" describes a triangular section weir on which the upstream face is inclined at 1 in 2 and the downstream, face at 1 in 5. (See Figure 1, which illustrates a typical Crump weir).

It is not essential that the exact design of a "Crump" weir be followed. Advantage may be taken of an existing installation such as a gauging weir, that may be modified to make it suitable for fish counting purposes.

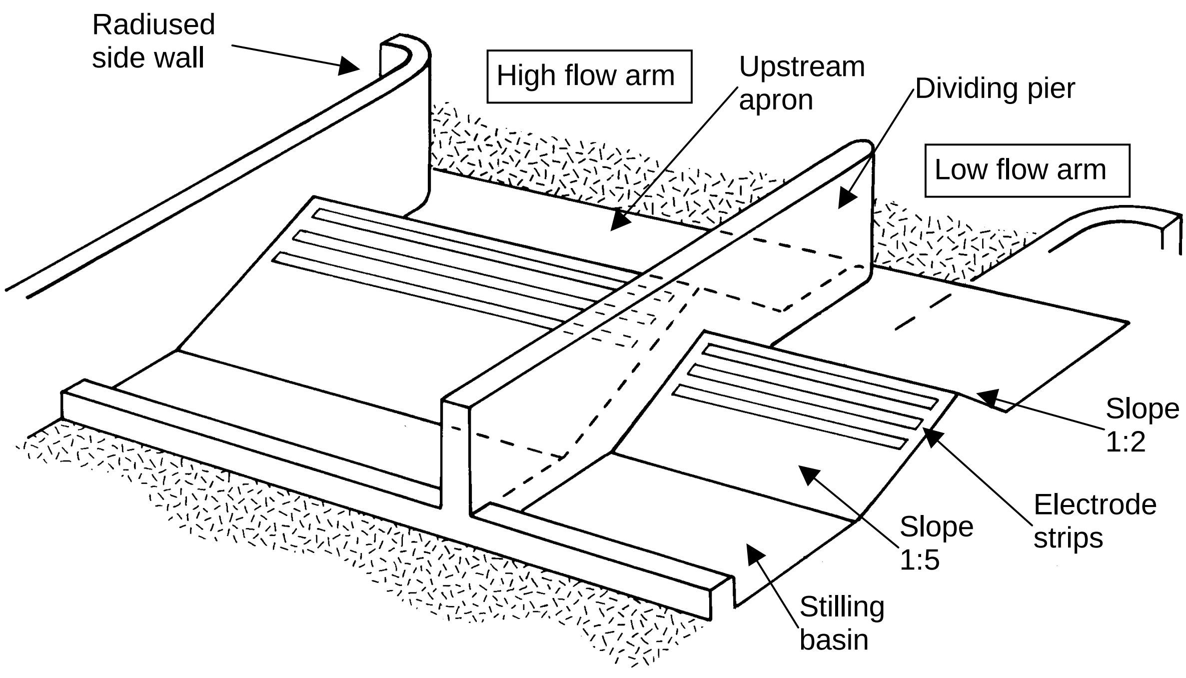

Fig 1: General appearance of a Crump weir (after Bussell)

On virgin sites the design and construction of the weir depends on local conditions and the desired working life of the installation. For example, a permanent fish counting site on a major river involves a substantial civil engineering operation with flow being diverted to allow a mass concrete structure to be constructed. However, on lesser rivers, particularly if the fish counting study is to be made over only a few seasons, it is possible to achieve success with a much more modest structure. On one such site the structural frame of the weir is constructed from stout larch timbers bolted to larch battens secured to the bed of the stream. The frame carries a marine ply deck covered by a pre-formed fibreglass skin that in turn carries the electrodes. Alternatively it may be possible to make use of pre-cast epoxy based concrete pads with slots for the electrodes.

The hydraulic design of the installation should be such as to promote as near-optimum laminar water flow as is possible. In particular, structural surfaces should be as smooth as possible to avoid entrapment of air, an adequate water depth should be maintained to encourage the passage of fish and an adequate water velocity should be maintained to discourage loitering. On weirs the upper electrode should be placed some way below the water crest while the lower electrode should be sited above the standing wave. The water level over the upper electrode should be at least equal to, and preferably greater than, the water level over the lower electrode.

The structural design of the installation should preclude the use of any significant metal components near the electrodes. In particular any concrete work should avoid the use of reinforcing bars or related steelwork. Under no circumstances should any conducting material be permitted to be in proximity to the electrodes. This not only includes metal components as mentioned above, but also standard concrete which is alkaline and can adversely affect the operation of the counter.

If the weir is to be constructed having a standard concrete face onto which the electrodes are to be installed then it is essential that some insulating material be placed between them and the surface of the weir. Existing installations of the Logie counter have used insulating material such as:

- A fibreglass skin on the face of a weir
- Proprietary epoxy based (non-conducting) concrete (Nito-Mortar, previously sold as Reeba-fill)
- Marine ply

Electrodes should be of stainless steel; typical cross-sections being in the range 50mmx3mm to 50mmx6mm depending on the strength of fixing employed. Note that the electrodes should not be connected to any conducting material used in the weir construction, such as standard concrete. Some examples of fixing methods are shown in Figure 2. Separation of the electrodes depends on the size of fish to be counted but is normally in the range 300-600mm. Electrode strips may have a continuous length of up to 20m, although the maximum depends on local conditions. (The Logie counter has a specified minimum inter-electrode resistance of 10 ohms. The inter-electrode resistance reduces as strip length increases and so a maximum length of 20m can only be accommodated where the local conductivity range permits). For installations where there is a risk of the weir resistance falling to the minimum and beyond, the weir should be physically divided into separate sections with a different fish counter channel responsible for each.

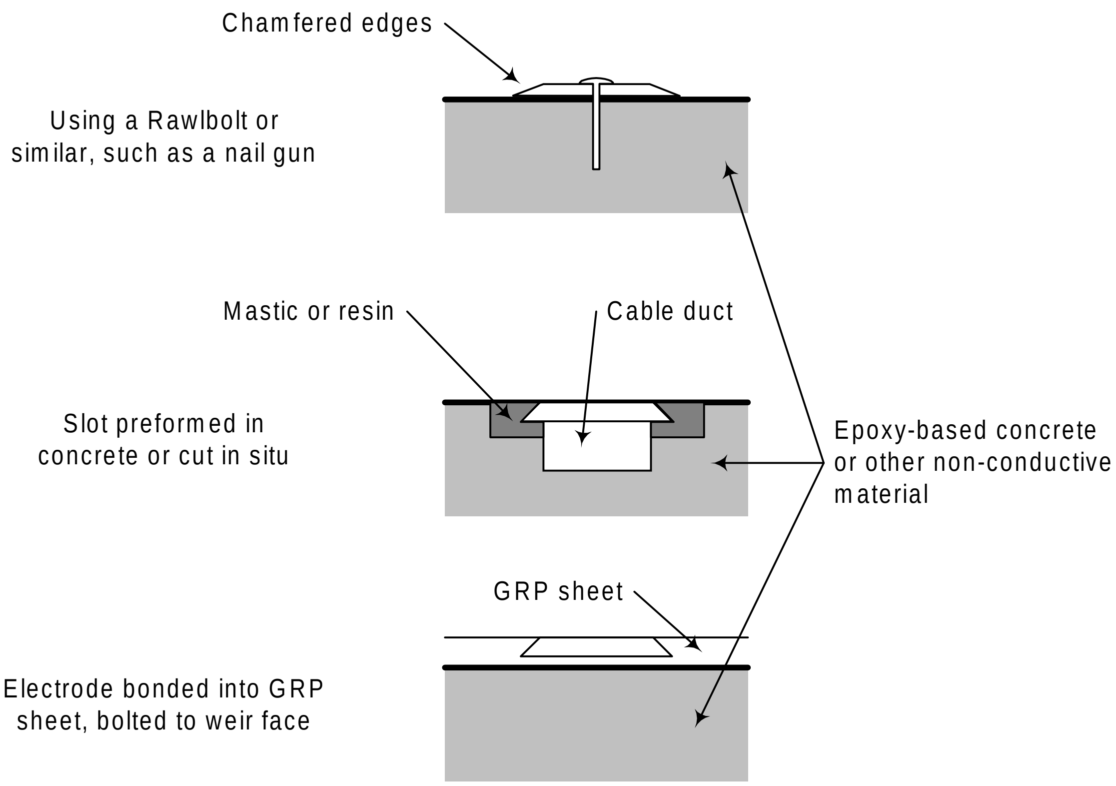

Figure 2: Examples of fixing methods

To avoid electrochemical problems, the making of dissimilar metal connections under water should be avoided. Thus connection to the stainless steel electrodes should be by welded-on stainless steel rods which can then be taken to a point above highest water level where insulated joints to copper cable can be made.

Interconnecting cables between the electrodes and the instrument should be maintained in a waterproof condition. They should either be of an armoured type that can be buried or be contained within a robust weatherproof duct. The interconnection should as far as possible be proof against vandalism.

The gauge of the interconnecting wire should be such that the resistance is negligible compared to the lowest value of inter-electrode resistance that is likely to be encountered. This indicates the use of heavy gauge wire with the length of cable run kept to a minimum.

(For example a 2.5mm copper conductor has a resistance of approximately 0.04 ohms/m. Applications of the Logie counter to installations near the 10 ohm limit suggest a maximum cable run of 25m using this gauge of conductor).

The fish counter is not constructed to be used outdoors where it may be exposed to the elements, and should be housed in an instrument cabinet or building which can be ventilated in summer and, if necessary, heated in winter in order that the specified operating temperature range is maintained.

Counter performance can be seriously affected by the accumulation of debris or weed in the vicinity of the electrodes. Regular visits to the station should be made so that any such accumulations can be removed.