

# Culvert Specification for Irish Road Projects

*Arup Report Highlights the Need for Clearer Specifications*

by Brian Ó Murchú

The Irish Concrete Federation recently commissioned Arup Consulting Engineers to produce an independent Consultants Report on the perceived inconsistencies that exist in the specification of steel and concrete culverts, as contained in the NRA DMRB specifications. This report concluded that it is impossible to consider steel and concrete culverts on a 'like for like' basis, unless the inverts of steel culverts are paved and regular maintenance can be guaranteed.

## **Purpose of the Report**

The purpose of the report was to address the ways in which the specifications may need to be changed to ensure that all culverts achieve the design life of 120 years, which is demanded by the Standard Specifications. Prior to commissioning Arup, the Irish Concrete Federation reviewed the current specifications and

formed the opinion that significant inconsistencies and anomalies exist in how concrete and steel culverts are currently specified.

A design life of 120 years can be readily achieved by concrete culverts designed and constructed in accordance with current specifications. However, maintenance is a key issue with respect to Corrugated Steel Culverts, yet the economic implications do not seem to be taken into account to achieve a 120 year life, at design stage. According to the current specifications, regular maintenance of certain Corrugated Steel Culverts is required. Evidence discovered in international studies highlights corrosion in situations where maintenance may not have been carried out effectively.

Protecting the invert of a Corrugated Steel Culvert is an important aspect in determining whether a steel culvert will

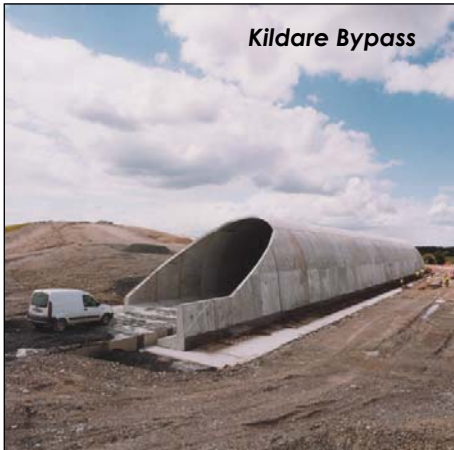
reach its specified design life of 120 years. The specifications suggest various methods of protection. However, if these are not effectively applied and maintained, it is difficult to see how the culvert will reach its intended design life, especially when installed in a harsh environment. The design standard which forms the basis of the National Roads Authority Specification has recently been updated.

BD 12/01 was introduced in November 2001. On first reading the new edition, BD 12/01 would not appear to be greatly different to that which it replaces. However, more detailed study and interpretation of the Standard's intent suggests that the changes are significant and may be intended to reflect, more accurately, 'in service' experience of the performance of culverts in practice.

Although this new version no longer places reliance on general inspection and



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maintenance there remains the need to inspect and maintain inverts for localised corrosion damage. Previous editions of the Standard and Reports produced by TRL, have consistently highlighted such localised

corrosion as a problem and it would seem that the potential for this problem still persists.

BD 12/01 recommends 'paving' along the wetted perimeter, as a mandatory 'invert protection' in all water carrying corrugated steel culverts. For large flows, the wetted perimeter of the culvert could be the entire bottom half of the interior of the culvert. Formwork would be needed in this instance and installation of the concrete protective 'paving' could end up proving difficult to carry out and very costly. In addition, it would appear to be very difficult to place properly specified and compacted concrete to any level above the immediate invert without the use of formwork.

The new edition still makes no reference to any recommended procedures for maintenance of protective coatings and paved inverts applied to Corrugated Steel Culverts.

The new version of the standard suggests alternative methods of invert protection. It

is questionable if some of these methods of protection are suitable for water carrying structures, and they certainly would not seem to be relevant in the context of a design life of 120 years.

Paving blocks placed on a sand bed do not appear to be appropriate for culverts with significant flows. Water flowing with any significant velocity could be enough to remove this type of protection. This may be more suited to pedestrian underpasses. Precast slabs or natural stone set into mass concrete, having a minimum thickness of 300mm, which are another alternative suggested, would seriously reduce the capacity of a culvert.

A concrete lining of the thickness recommended, in class 30 concrete with nominal mesh reinforcement, as suggested in the Standard, could not normally be expected to provide a design life of 120 years. The minimum concrete grade specified in BS 8110 for such conditions is grade 40.

It is not easy to carry out maintenance on a live culvert, and such maintenance can only be carried out during periods of reduced flow. This minimum flow needs to be defined and relate to the average summer flow for a sensible return period. This flow should not exceed a maximum acceptable depth above the invert in order for inspection/maintenance to be carried out in a safe manner in accordance with current Health & Safety requirements.

In order to properly compare concrete and steel culverts it is necessary to allow for the cost of inspection/maintenance of steel culverts over their design life of 120 years. The report recommends that specifiers take all of these costs into account at the selection stage.

The report also recommends that the roads authorities put in place proper procedures to ensure that necessary inspection/maintenance of steel culverts takes place in accordance with the code requirements.



**Steel Culvert Corrosion at the Wet/Dry Line**