Introduction

Concrete barriers can offer some significant benefits over the standard steel and wire rope alternatives. With concrete barrier:

- The risk of cross-over accidents is greatly reduced.
- Central reserve widths are minimised and land-take is reduced.
- Maintenance is rarely required following accidents. This:
  - reduces whole life maintenance costs.
  - reduces the need for lane closures.
  - reduces the risk of subsequent accidents occurring due to the lane restrictions.

Background

Concrete barrier had been widely adopted throughout Europe for high speed roads and motorways. However, in the UK only about 40km of concrete barrier has been built to date. Most of this is on the busy M25, where the benefits of the system have been fully realised.

Rather than adopting the same shape barrier as is used throughout the rest of Europe, in the UK, it was argued that a different shape was required. This was required in order to maintain the improved safety standards and statistics that exist in the UK. The adopted UK barrier shapes have been extensively tested and proven at the MIRA test facilities.

Whilst the Highways Agency have accepted the use of concrete barrier, it has published only one "Highway Construction Detail" (HCD) drawing "SB/34" [1] to describe the system.

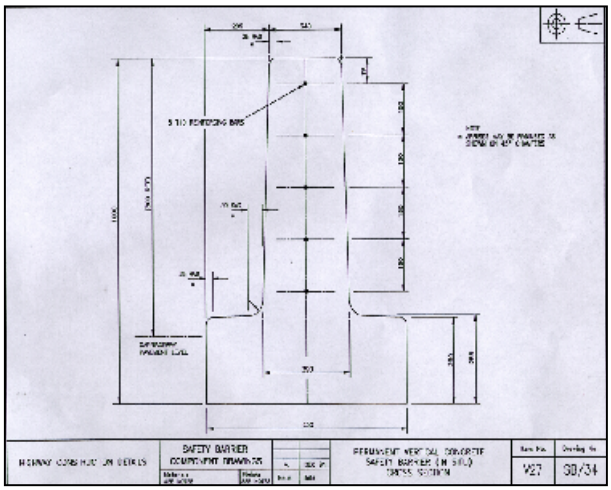
Technical Guidance Sheet S1:- *Vertical Concrete Barriers*

Clause 411 of the "Specification for Highway Works" [2] refers to the HCD, but provides no further details for the specification of the system. A "Higher Vertical Concrete Barrier" is referred to in the "Notes for Guidance on the Specification for Highway Works" [3], but again no details are provided.

The purpose of this guidance sheet is to provide designers and construction contractors with the necessary information to properly specify and build the system and to ensure that a uniform approach is adopted nationwide.

Construction Details

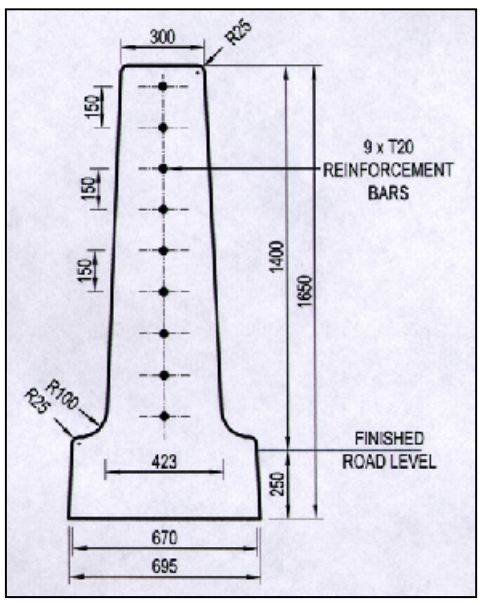
There are two standard forms of in-situ permanent vertical concrete safety barrier.



"Highway Construction Detail SB/34"

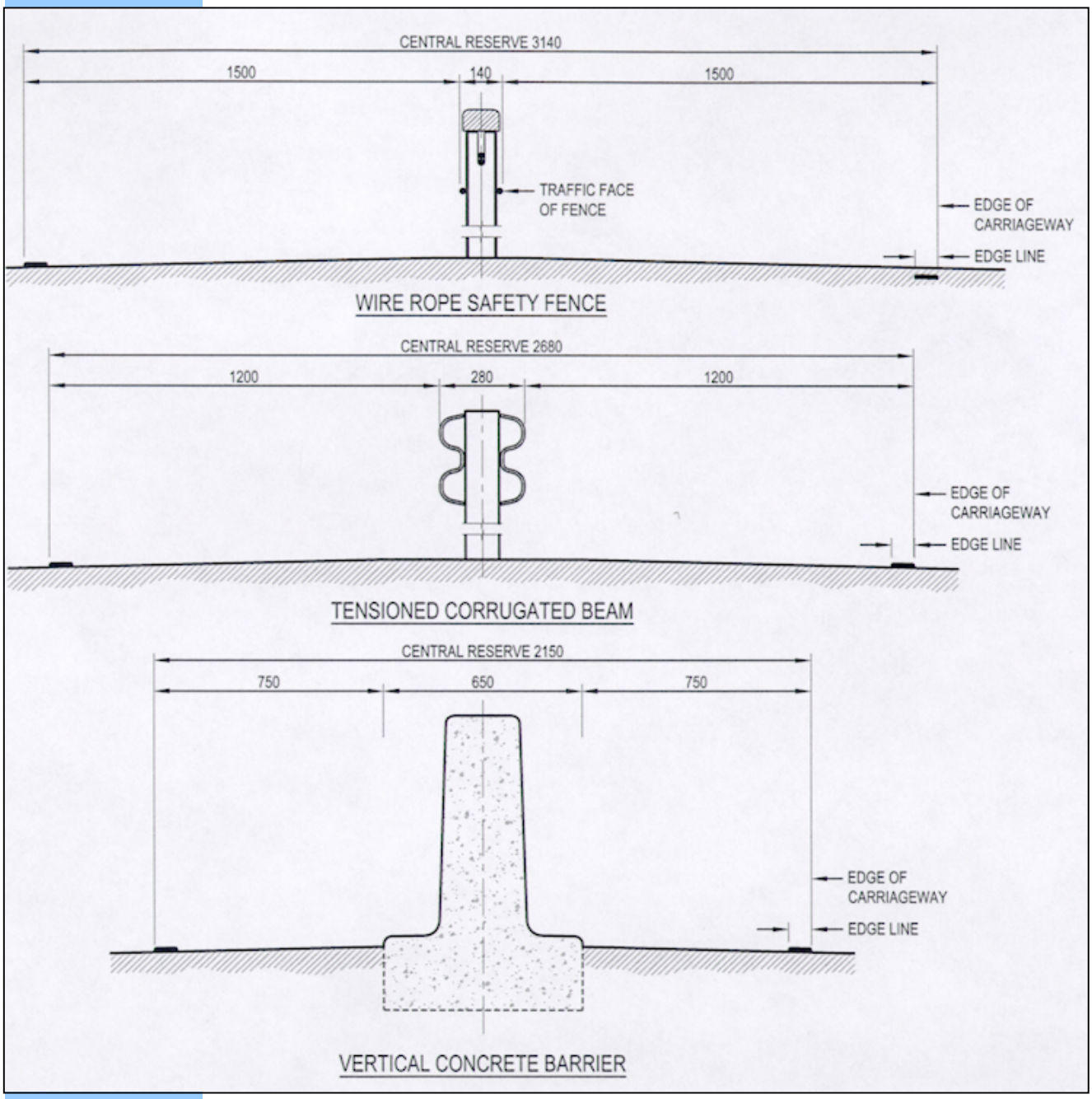
The standard 800mm high barrier is suitable for use for all typical applications where a standard metal or wire rope might otherwise be used. The higher 1400mm barrier is suitable for high contaminant situations such as to protect bridge piers and other structures.

"1400mm Higher Concrete Barrier"



Whilst standard steel and wire rope safety fences require a “deflection zone” on either side, this is not required for the vertical concrete safety barrier.

The diagrams below illustrate the deflection zones required for the different types of highway safety face. The central reserve width is greatly reduced for the vertical concrete barrier.



As illustrated above, the central reserve width and therefore the overall land-take width can be greatly reduced by using a concrete barrier. This is not only beneficial for new highway schemes, but also for existing highways that require widening.

Technical Guidance Sheet S2 “Special Vertical Concrete Barriers” [4] provides details of a variety of barriers for special circumstances.

Specification

The following specification requirements are aimed at providing a uniform and acceptable product nationwide:

- *Tolerance on height:*
  ± 20mm.

- *Regularity of top surface:*
  ± 10mm over 3m straightedge.

- *Tolerance on other profile dimensions:*
  This should not be negative, but should allow up to + 10% for swelling/slump effects.

- *Tolerance on position:*
  ± 13mm.

- *Concrete Specification:*
  Concrete shall be C35 with air entrainment, and shall be compliant with BS 5328.

- *Fibres:*
  The concrete shall incorporate synthetic fibres, which have BBA accreditation, and shall be used in accordance with the manufacturers instructions.

- *Reinforcement:*
  Longitudinal reinforcement shall be provided as shown on the cross sections illustrated. Any lap in the reinforcement shall not be less than 20 times the bar diameter. Laps shall be welded with a minimum of two 75mm long, 3mm continuous fillet welds on one side.

- *Joints:*
  Cracks cannot be eliminated, but shall be controlled by the introduction of induced joints. The induced joints shall be formed by partial depth sawcutting and shall not be wet formed. The sawcutting shall be carried out a soon as is practicable, before random shrinkage cracking occurs. The sawcut shall be 3mm wide between 30 and 50mm deep and shall be formed to all exposed faces and surfaces. Joints shall be sealed, with a cold poured polysulphide sealant, preferably of a colour to match the concrete.

- *Surface Finish:*
  No hand-finishing shall be applied where the extruded dimensions and tolerances are achieved. When hand finishing is required for corrective purposes, floats shall be long enough to ensure that the alignment on all faces is maintained. Individual surface holes and blemishes of less than 13mm diameter will not generally require corrective action.

- *Remedial Work to Finished Concrete:*
  Where the alignment / regularity requirements are not achieved, then the surface may be ground to achieve the requisite tolerance provided that the overall dimensions of the barrier are not reduced below the minimum specified dimensions.

Practical Guidance

- Vertical concrete barriers should ideally be placed on a cement bound or equivalent bound material. However, a properly compacted granular Type 1 material, with a closed surface and treated with a bituminous spray to produce uniform friction under the barrier, may be an acceptable alternative.

- Consistent concrete with a slump of between 10mm and 25mm, incorporating crushed rock course aggregates should be used for barrier construction.

- Continuous progression of the slipforming machine will avoid “stepping”.

  Production of the 800mm barrier would normally be limited to 200 to 250m per shift. Production of the 1400mm high barrier would normally be limited to 80 to 100m per shift.

General

Vertical concrete barrier (VCB) is usually marginally more expensive to build than the standard metal and wire rope alternatives. However, the maintenance costs are significantly reduced and there are additional safety and other benefits in using the VCB.

It should be noted that the European Standard EN1317 is being finalised. This code identifies "containment levels" for different situations and matches these with suitable types of safety fence. The code also considers "Accident Severity Index" (ASI) which measures the degree of damage to various vehicles impacting safety fences. The code has been prepared by authorities familiar with the more traditional steel and wire rope safety fences. Consideration for VCB has been limited. Britpave is currently seeking funding for an investigative project to establish how the VCB will perform against these criteria.

References

(1) Highways Agency. Manual of contract documents for highway works, Volume 3, Highway construction details.

(2) Highways Agency. Manual of contract documents for highway works, Volume 1, Specification for Highway Works.

(3) Highways Agency. Manual of contract documents for highway works, Volume 2, Notes for Guidance on the Specification for Highway Works.

(4) Britpave, Technical Guidance Sheet S2, Special Vertical Concrete Barriers.

Acknowledgements

Guidance Sheet S1 is one of a series of guidance notes prepared for use by Britpave members.

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