8.0

Other Options

8.1 Armco Bridges

Armco bridges are an alternative to conventional re-inforced concrete bridges and are somewhat cheaper than the concrete structure. They were originally developed in the USA in 1896 and first used in the UK in 1913 and approved by the Department of Transport in 1954[167]; many such structures are now in use.

The bridge is formed from corrugated steel plates that are shaped to form a circular or elliptical tube around the railway, over which the road can be built. Other shapes are also possible. The steel plates are galvanised and usually coated with bitumen as well. The manufacturers claim a similar design life of 120 years. Critical to the success of such structures is the surrounding fill material and quality of construction as the fill material acts as part of the load bearing structure.

Construction of the bridge requires the removal of the railway track over the length of the structure which would usually require a 54 hour possession. On removal of the track, the ground underneath the structure position is removed and two layers of bedding material are deposited. The lower layer of material is well graded fill material of class 6K; natural gravel, sand, crushed rock, gravel or concrete or well burnt colliery spoil, or any combination thereof, with a particle size of <20mm. The depth of this material is one tenth of the span laid in 150mm layers and compacted to meet the requirements of BS1377. This layer includes removal of any soft spots in the underlying surface. The upper layer of material class 6L is uncompacted sand to a depth of 50mm to allow bedding in of the corrugated structure. The width of these layers is 800mm wider than the span on both sides.

The fill material on either side of the structure has to be class 6M; natural gravel, sand, crushed rock, gravel or concrete or well burnt colliery spoil, or any combination thereof, with a particle size of <75mm. This fill material has to be compacted in layers of 150mm to a width equal to the span on each side of the structure and to a depth of one fifth of the span over the top of the structure.

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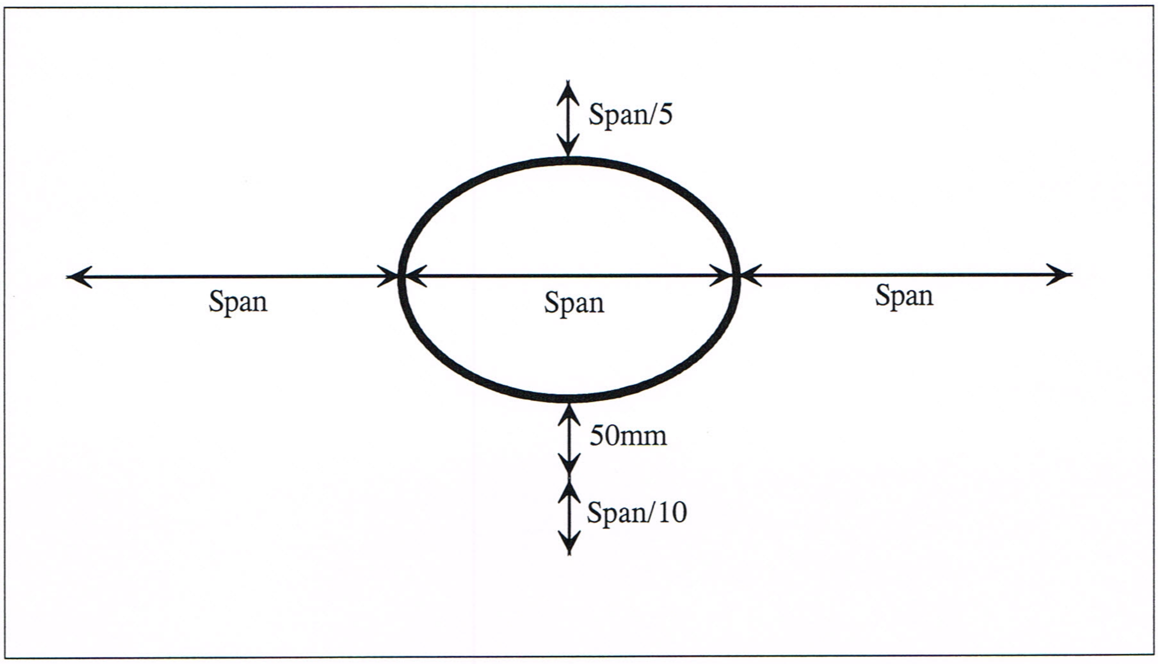
167 Asset International Ltd, UK Manufacturer, Design Package, date unknown.

Figure 8.1

Sketch showing the extent of various fill material around structure



With reference to Chapter 7; if one assumes the larger bridge requirements, an Armco bridge with a 10.376m span will cost approximately £10k less than a similar sized concrete bridge. The Armco bridge requires more earthworks to get the depth over the top of the steel plates and consequently requires a longer approach, if the one in ten approach is to be maintained. This in turn leads to a slightly greater land take and widening of the side slopes, again to maintain the slope at the same ratio of 1:1.5. Road length is also increased slightly as a result.

Land clearance, nominal:		£500
Excavation of topsoil:	£0.44 x 756	£333
Imported selected graded fill material:	£11.95 x 7020	£83889
Compaction of fill (90%):	£0.26 x 6318	£1642
Compaction of fill (10%):	£0.43 x 702	£301
Testing of compaction:	nominal	£1500
Replacement of topsoil:	£0.42 x 756	£317
Seeding:	£0.48 x 2076	£996

Total earthworks cost £89578

The steel structure cost is approximately £2700 per metre including construction; the length required will be 13.25 metres, thus 13.25 x £2700 = £35775.

Land take increases to 1.075 acres at £3700 per acre, thus £3977.

Roadworks require 215 metres of highway at £845 per, metre, therefore £845 x 215 = £181675.

Table 8.A

Construction cost of Armco bridge with 6.1m road

	6.1 metre road
Landtake	£3977
Bridgeworks	£35775
Earthworks	£89582
Roadworks	£181675
Other costs	£155045
Total	£466513

Figure 8.2

The ARMCO bridge at Holywood NIR, under construction;

the steel corrugated plate elliptical 'tube' is in place, the earthworks around have yet to commence.

Photo: Reproduced by kind permission of Asset International Ltd.

Figure 8.3 (top)

The ARMCO bridge at Holywood NIR, under construction; a different view of construction.

Photo: Reproduced by kind permission of Asset International Ltd.

Figure 8.4 (bottom)

The ARMCO bridge at Holywood NIR, in use.

Figure 8.5

The ARMCO bridge at Glenlough, NIR; from road (top) and rail (bottom).

Note how unobtrusive the bridge is.

The £10k saving is minimal, however, these bridges have one excellent advantage over a concrete structure in that they are more pleasing to the eye and this could be a benefit in sensitive country areas, as will be seen in figures 8.4, 8.5 and 11.1.

8.2 Electric Gate Locks

During the course of studying level crossings the author came across the level crossings at Bellasize[168] and Gilberdyke in East Yorkshire. These two level crossings are UWG with an electrically released gate lock, which the local signalman releases, railway traffic permitting, on demand from the road user, who uses a telephone located at the level crossing for that purpose. The gate release is interlocked with the appropriate signals. Wicket gates are provided for pedestrians. The road use is minimal as the roads are cul de sacs giving access to a small number of properties. Whilst the equipment on site is life expired semaphore signalling, the principle of operation could easily be adapted for modern use at sites such as the LC at Myroe in Co. Londonderry (See Chapter 9, page

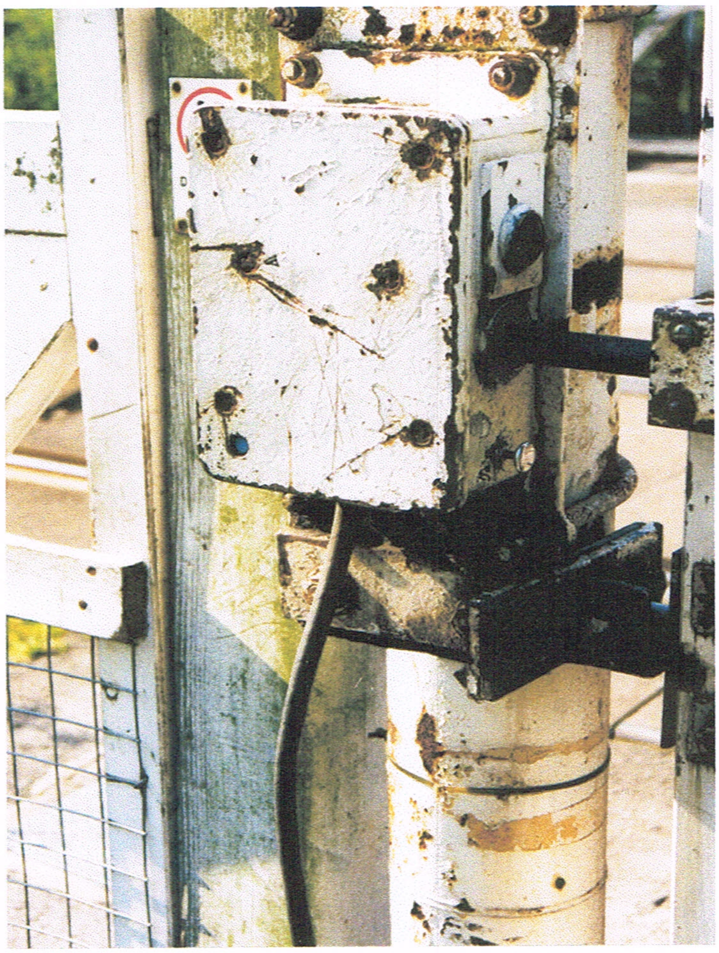


Figure 8.6
The electric gate lock at Bellasize UWGRbS LC (left) and user notice (top); The light mentioned is the small grey/blue circular indicator in the bottom lh corner. The stud is on the bottom rh side of unit, just below the bolt seen in the locked position.

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[168] Railtrack circuitry for Bellasize LC kindly supplied to the author by John Maw, LC Engineer, RT LNE Zone.

9.10) where usage by road users is exceptionally small. The lock position is indicated to the signalman.

A modernised version of such electrically released gates may be the solution at such crossings. The HMRI guidance[169] on level crossings does not necessarily require interlocking with the signalling and, provided the user was made aware that they must still, 'stop, look and listen' for trains, such gate locks would offer a slightly more secure gate than nothing at all and, more to the point, reduce the need, and costs of an AHB at such remote locations. The operation of such gates could be enhanced by the signalman making a note of registration numbers of vehicles using the level crossing and logging the same in the train register; the last recorded user being prosecuted if the gates were left open. The lock indication to the signalman would enable him to caution trains if required. The regular user would soon become aware of the method of operation and the casual user would possibly be deterred from using the level crossing, thus minimising its use.

8.3 Constant Warning Time, Grade Predictors and Motion Detectors

Constant warning time devices are the American standard of level crossing device either with or without barriers. As a result of the high numbers of grade crossings in the USA this equipment is effectively 'off the shelf' and, consequently, costs are far lower. It has not been possible to establish American costs, although the Australian and New Zealand railways have generally standardised on such equipment. Australian and Tasmanian railways recently installed a number of such crossings based on Harmon and Safetrans equipment at a cost of circa \$(A)42k per crossing; open level crossings without barriers; circa £18000. Barriered crossings are estimated to cost around \$(A)80k[170]. These costs are for single track lines. Motion detectors work on the principle of a tuned loop formed by the two running rails and a short circuit bond at the crossing and the extreme end of the loop. As train wheels enter the tuned area the first wheelset acts as a moving short

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169 Railway Safety Principles and Guidance, Part 2, Section E, Guidance on Level Crossings, HMRI/HSE, 1996, ISBN 0 7176 0952 9.

170 The Application of LC Processors on the Newport to Ararat line, T.Deveney, & Installation of Grade Crossing Predictors on AN Tasrail, C.J. Edwards, Institution of Railway Signal Engineers, Australasian Section, Technical Meeting, Launceston, Tasmania, November 1996.

circuit loop altering the characteristics of the tuned loop and the detection equipment is able to derive the speed of the train and thus it's arrival time at the crossing accordingly. At the appropriate time this operates the flashing lights and barriers, if fitted. Harmon equipment of this type has recently been installed on the Cromer branch line in Norfolk, although this is currently being soak tested in parallel with existing equipment, in connection with the approval and safety case process. These level crossings have had to use UK barriers mechanisms and road traffic signals. Costs are not known.

Some North American research papers seem to suggest that such predictors are unreliable[171]. They are also not interlocked, or proved within the signalling system and the only protection is the road signals. If these fail, the safety of the railway is degraded. Such equipment fitted will reduce the installation costs but none of the other annual costs of maintenance, accidents and delays. Experience by others[172], suggests such detectors are not used in sub-tropical and tropical areas as rust build up can prevent operation. Other Engineers[173] have reported that such equipment cannot cope with high acceleration rates and is best suited to railways with consistent stock types and speed profiles.

8.4 Teknis Safe Cross[174]

Teknis Safe Cross is an Australian product that works in a similar manner to grade predictors in determining the speed of the approaching train. The difference is that the speed and direction of the approaching train is measured by doppler radar located at outstations at the appropriate strike in point. These outstations then transmit the information to the master station located at the level crossing which processes the information and then operates the equipment to a pre-determined cycle. The train must pass through the section or a failure condition is logged. This system is priced at

[171] Flashing lights and bells at level crossings; present problems and directions for the future, E. Hauer, Toronto University, 1984.

[172] Personal discussion with Mr R.S. Wyatt, Technical Director, S&T, Halcrow-Transmark.

[173] Personal communication, Mr B. Talbot, LC Testing Engineer, AMEC Rail, referring to Australian experience.

[174] Radar Based Level Crossing Control, S. Lechowicz, Institution of Railway Signal Engineers, Australasian Section, Technical Meeting, Launceston, Tasmania, November 1996.

$(A)32k excluding gates and signals, but can only be used on single track railways as trains on double track railways would cause masking of the sensors.

8.5 Westrace

Westrace is a programmable logic controller based interlocking system using ladder logic as the programming language. The system is manufactured by Westinghouse Signals Ltd. and a level crossing controller based on Westrace has just received generic safety approval. Two UK level crossings have had such a system installed; Frating AHB on the Clacton branch and Jacob's Gutter AHB on the Fawley branch. The PLC has inputs from track circuits in the same manner as a conventional relay based system, and then produces outputs to road signals and barrier machines etc. The barrier machines require additional contactors due to the current loads. Westinghouse claim[175] reduced whole life installation and maintenance costs. Although the design costs are likely to be lower, the maintenance costs are not likely to be lower, and the electronic nature of the product will probably mean a shorter life when compared to the 25 years of a relay based system. Smaller location cases will also reduce costs somewhat.

8.6 Road Traffic Light systems

Road traffic light systems could be adapted to a railway environment. Most modern system are based on a personal computer running with a Windows type program. Modern systems meet Department of Transport regulations. Similar systems are installed

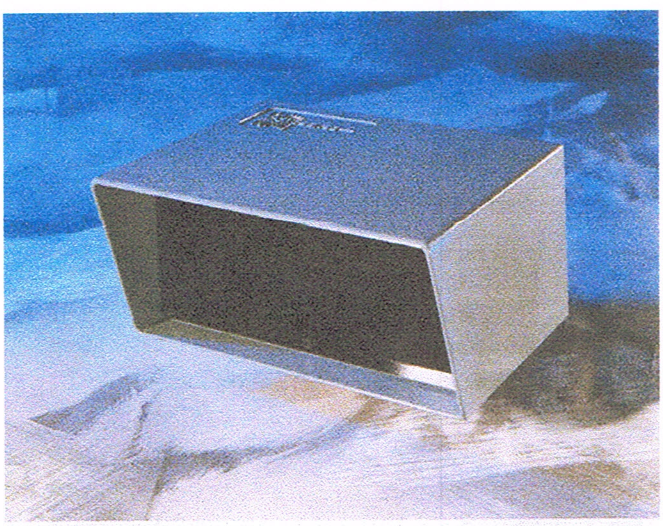

Figure 8.7
Typical road traffic signalling infra-red vehicle detector.
Photo: Reproduced by kind permission of Microsense Ltd.

[175] Westrace Level Crossing Controller, Westinghouse Signals Ltd, Trade brochure 1999.

for fire and ambulance stations, low flying aircraft approaches, lifting bridges and other unusual hazards. Such systems have built in means of detecting wrong side failures, e.g., two conflicting greens in a set of traffic lights; and are designed to shut down in such an instance. Various means of traffic detection are currently used, including tuned loops buried in the road, infra red and microwave detectors placed facing oncoming traffic. Such systems work well with trains throughout Europe.

There is no reason why similar detectors could not be used in a railway application although the infra red and microwave detectors may have to be limited to single line railways for the same reasons as the Teknis system. Tuned loops could be used and possibly mounted outside of the track at the side of the train. Alternatively, track circuits could be maintained to offer the required inputs to the computer. Barrier contactors would also be required. The road signal industry already produce light emitting diode signals which have a longer life than conventional quartz halogen lamps currently used. Space savings would also be substantial when compared with a railway based, relay system. According to Spon's Civil Engineering guide a set of traffic lights cost around £35k (see figure 8.7).

8.7 Conclusion

Armco bridges offer a more aesthetic solution in sensitive areas and, in the application described, are slightly cheaper than a re-inforced concrete structure.

Electrically released gates offer the advantage of a secure gate controlled by a signalman or other railway official, possibly ideal in a remote location with minimal use, such as the locations on NIR discussed in Chapter 9. The downside is that if interlocked with signals, an open gate will cause delay; if not interlocked, an open gate will increase the risks to the railway and public.

Modern electronic systems are likely to become more commonplace and probably cheaper as software can be mass produced in generic forms; the downside with any electronic system is the pace of development and thus early retirement in the electronics industry, probably giving some of these systems a 10-12 year maximum life. Additionally, such systems do not readily reduce the maintenance, accident or delays at all which form a large part of level crossing finances. Most modern electronic systems have the benefit of continuous data logging facilities.