Improved appearance of bridge parapets

Advice to designers on best practice for the appearance of bridge parapets
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IMPROVED APPEARANCE OF BRIDGE PARAPETS

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1.0 Introduction

1.1 Preamble

The purpose of a bridge parapet is to contain errant vehicles or pedestrians using a bridge. To fulfil this function the parapet is situated at the edge of the deck, a position where it has a great impact on the appearance of the bridge. The Department of Transport’s Standard for The Design of Highway Bridge Parapets (BD52/93) states in the design requirements that: “The aesthetic effects of the parapet construction including its details should be considered at the initial stage of the design of the structure.” This requirement is recognised by those responsible for designing bridges but is often not reflected in finished structures.

Parapet forms have not evolved at the same pace as bridges. Standard designs are still based on styles that were developed during the expansion of the motorway system forty years ago. The development of new vehicle parapets, particularly in metal, is made difficult by the Codes of Practice that govern design. The prescriptive rules which govern the placement, size and shape of the parapet elements limit the possibilities open to the designer who is made to work hard to create anything out of the ordinary.

1.2 Historical Influence

Parapets were an early enhancement of bridge structures, introduced to give confidence to the user or as a necessity on some suspended structures. The earliest vehicle parapets were purely functional, relying on their mass to prevent anything leaving the bridge.

As bridge builders became more confident parapets became more of a feature of the bridge often being adorned with decoration and artwork. This philosophy continued with the development of new materials and types of bridge. Of particular note was the development of iron bridges where parapets could be made lighter to demonstrate the relative strength of the new material and elaborate castings could be used to decorate the parapet.

This document is intended to be used in two ways; to provide information on the types of parapet available for use in particular situations; to give examples of good parapet design and detailing and general advice on improving parapet appearance. Some of the suggestions contained within this report may require the Codes of Practice to be interpreted in an unconventional manner. It is important to stress the role played by the Technical Approval Authority (TAA) for a bridge. Their understanding and support is essential if significant advances are to be made in the appearance of parapets.
and the associated increase in bridge population. Designed to emphasise the speed and dynamism of the new highways whilst using material efficiently, the familiar standard parapets are still widely used today.

**1.3 Design Perspectives**

The two perspectives of a bridge that are generally experienced are; on the bridge when travelling over it; off the bridge when viewed remotely in elevation. In the former situation the parapet will often be the only visually discernible element of the bridge. In the latter situation the parapet can have an enormous influence on the perception of the bridge and its proportions. The designer striving to create an attractive bridge must duly consider both perspectives.

In designing for the view when crossing a bridge the principal concern should be the bridge’s setting. In an urban setting where the view is of little interest, the bridge parapet can enhance and add interest to the roadside environment with the clever use of colours, shapes and textures.

Alternatively if a bridge is set in an environment which the bridge user may wish to appreciate, the parapet is considered an obstruction. In this situation the designer faces the challenge of making the parapet unobtrusive as well as aesthetically pleasing.

A bridge design will most often be conceptualised and evaluated with regard to its side elevation. This view of the structure is usually the most expressive and it is from this viewpoint that the structural principle of the bridge is most obvious. When a designer strives to make an elegant or striking bridge, it will be this elevation that they are judging.

The parapets’ effect on the bridge elevation depends very much on the type and scale of the bridge; on a large suspension bridge, always viewed from a distance, the parapet may be barely discernible; on a small footbridge the parapet will contribute greatly to the impression of the structure.

The criteria used to judge a bridge by remote viewers and bridge users are therefore very different and it is only by considering both these viewpoints that the design of aesthetically pleasing parapets can be achieved.

**1.4 Design Presentation**

If a bridge is to succeed visually the parapet must be designed with the bridge, as opposed to being thought of and added later. Whilst the different parts of the bridge, such as the deck, the pier and the abutments, may be in harmony, many bridges fail to succeed visually due to the lack of any clear relationship between the structure and the parapet. To encourage successful design it is important that all drawings right from the concept stage reflect the scale and appearance of the parapet. The impact of the parapet on the bridge proportions can readily be appreciated in this manner.

3. The parapet of this bridge has been designed as its most striking feature
2.0 Parapet Analysis and Design

2.1 Parapet Safety

The design criteria for parapets depend on which bridge users they are required to contain. Pedestrian parapets are designed for the static loads it is anticipated may act on the barrier in a crowd situation. The design of a structure to withstand these loads is within the capability of a competent engineer.

Highway parapets are designed for the containment of vehicles. This is achieved by absorbing some of the impact energy and deflecting the vehicle away from the edge. There are three levels of vehicle containment provided by highway parapets:

i) Low containment parapets are designed for urban environments where speeds are restricted to less than 80km/hr.

ii) Normal containment parapets are developed and tested to resist certain vehicles travelling at up to 113 km/hr. These are used on the motorway system.

iii) High and very high level containment parapets are used in particularly sensitive locations where any parapet failure would have severe consequences.

With regard to the appearance of the parapet and the bridge overall, it is generally in the designer’s interest to use the lowest containment level acceptable. Gaining approval for the use of a lower containment level will usually require co-operation from the TAA with justification in the form of a detailed risk assessment.

During a collision a parapet may need to withstand extremely high peak loads. The collision normally results in permanent deformation and damage to part of the parapet system. The dynamic nature of the vehicle/parapet response has historically been very difficult to accurately analyse. The exception is very stiff concrete parapets, which can be considered to behave as rigid bodies. Conventional structural analysis is not concerned with post failure behaviour, which is often critical in parapet performance. Full scale testing of parapet designs is therefore required to verify a particular design.

2.2 Current Design Codes

At present there are three current design codes available for use in the design of parapets in the UK, these are:

i) BD 52/93: The Design of Highway Bridge Parapets.

ii) BS 6779: Highway Parapets for Bridges and Other Structures.

iii) BS EN 1317: Road Restraint Systems.

2.3 Other forms of Vehicle Restraint

Not all vehicle restraint systems are classed as parapets, although the distinction may sometimes seem unclear to the layperson.

The difference between crash barriers and parapets is the extent of deformation they permit; crash barriers deflect to a greater extent. The wheel penetration may be up to 2.0m on a crash barrier. If used on a bridge the deck width may need to be increased to allow for this.
Other forms of restraint such as kerbs, crash cushions and bollards may be variously employed. These elements will be required to conform to particular design codes and are beyond the scope of this report. Their use in conjunction with parapets can be beneficial by reducing the containment requirement of the parapet, (eg; an anti-mount kerb may reduce impact speed by around 15kph).

5. An anti mount kerb is used to protect an historic parapet

2.4 Road Safety Issues

Detailed information on road traffic accidents is sparse. The Department of Transport publishes default figures for accident rates, accident costs and accident casualties for use in road network analysis models. This information does not give an indication of the part played by parapets in road safety.

Although parapets are universally required on road bridges, there is little published on how frequently parapets are brought into use. This would influence the risk assessments carried out to decide the appropriate containment level. Anecdotal evidence was sought for the Avonmouth Bridge on the M5 near Bristol (no actual records exist). This suggested an average of 2 parapet hits a year over the last 20 years – only on one occasion was the parapet breached. The road alignment is straight but, considering the traffic flow (over 100,000 vehicles per day), speed of traffic and the length of the bridge (over 1400m) this is a very low accident rate.

The relationship between the view afforded to drivers using a bridge and road safety is the subject of conjecture. Whilst a stunning view from a bridge may distract a driver momentarily from the road ahead, it may be arguable that on long bridges or on scenic roads the mean traffic speed are reduced and hence accident rates are lower. Further research would be required to correlate accident rates against parapet design.

One area where parapets may be able to demonstrably improve road safety is in providing guidance to motorists. The use of bright colours, reflective coatings or electric lighting could possibly assist motorists at complicated road interchanges and have a positive effect on accident rates.

Preventing glare from the headlamps of oncoming vehicles may help to improve road safety at night. Panels or vanes fixed to the top of vehicle restraints, particularly in the central reservations of dual carriageway roads are quite common. Obscuring barriers such as these may also help to prevent ‘rubber-necking,’ which is a cause of some accidents.

6. The Hume Bridge in Manchester has bollards as secondary protection

7. Vanes protect the adjacent properties from glare.
3.0 Construction and Appearance of Currently Accepted Parapets

3.1 Metal

The standard steel or aluminium parapets developed in the 1950’s are made up of horizontal rails spanning between vertical posts. An alternative, available for low containment, is a parapet made up of panels of vertical infill members at close centres. This is frequently seen in urban environments.

If a metal parapet is specified, the choice between steel and aluminium will be governed by whole life costs of the parapet. The greater material cost of aluminium is weighed against its lower maintenance costs.

The rigorous testing procedure required for normal and higher levels of containment before a new all metal parapet can be introduced has restricted the number of these parapets which are available.

3.2 Concrete

The use of reinforced concrete for full height parapets tends to be restricted to high containment. Its rigidity makes it ideal for this application. There are some very good examples of its use in normal containment situations where it has given the concrete bridge an homogenous finish, however weight often precludes use on light bridges.

Concrete parapets are typically constructed as pre-cast units because of economic factors and the higher quality finish available. It is possible to introduce patterning on the outer face of the parapet.
3.3 Combined Concrete/Steel

This form of construction gives the designer the most freedom. A concrete plinth can be combined with metal posts and rails to form a parapet. There is no testing requirement of the steel, which allows the designer scope to develop a parapet of their own, so long as strength stipulations are met. The plinth is required to be 400mm-800mm tall depending on the code used and the containment level required.

This form of parapet has not been widely exploited in this country as yet, with the exception of some of the early motorway bridges and some elevated urban motorways. It is more common on the Continent where it has been used on many landmark structures.

3.4 Masonry

The use of masonry as a parapet material has a long history. In many environments, the appearance of brick or stone offers a more publicly acceptable alternative to concrete where a solid parapet is required. Recent developments using masonry working compositely with a concrete core make it possible to design low and medium containment parapets in brick or stone.
3.5 **Timber**

A relatively recent development in parapet design has been the introduction of a low containment highway parapet of timber construction. Timber has a long history as a bridge component, has environmental benefits and is one of the few materials with an appearance that is almost universally favoured. Interestingly, the problem encountered with this type of parapet is designing it to not damage the bridge superstructure when failure occurs. Timber parapets and crash barriers are used more extensively in the U.S.A., to very good effect, where they are accepted by most approving authorities.

The use of timber for footbridge construction is becoming more common as longer spans and more exciting profiles are possible with glued and laminated beams. Timber is a familiar material that generally meets with public approval.

3.6 **Glass**

The range of laminated and toughened glass now available is increasing the possibilities for the use this material in pedestrian parapets. Commonly used for enclosed footbridges such as link bridges between buildings, it presents an aesthetically pleasing form of screen especially where full protection of this kind is desired.

Issues to be addressed when specifying glass include maintenance (scratched and dirty glass is far more noticeable than scratched and dirty steel) and the prevention of glare in highway applications. Glass technology is advancing at such a rate that these issues are now manageable.

3.7 **Composite Materials**

At present the use of composite materials for parapets has been restricted to footbridges, although there are advances being made in some European countries which extend the possibilities. This family of materials has great potential for future use in parapets.
4.0 Improving Standard Parapets

4.1 Provision of Secondary Safety Barriers

In producing an out-of-the-ordinary scheme the designer will need to go beyond “off the shelf” parapets. The greatest freedom of expression is possible in pedestrian parapets for which destructive testing is not required to gain approval. However, in order to have this option on a highway bridge, it is necessary to build a traffic containment barrier in addition to the parapet. This solution is also widely employed to protect existing parapets which are considered to be under strength. The crash barrier then provides vehicle restraint and the parapet contains pedestrians only.

20. Crash barrier does not trap pedestrians

The design of the bridge can also benefit from the introduction of a secondary barrier since load on the footpath will be reduced. Vehicles are prevented from mounting the footway. The only loading to be considered in this area is pedestrian live load. The less onerous loading on the footpath results in a lighter structure at the edge of the bridge, although extra width may be required to accommodate the additional barrier.

Before adopting a crash barrier/parapet combination it is necessary to consider the perception of the pedestrian using the bridge. The presence of a continuous crash barrier deters pedestrians from crossing the road, this may be desirable in many urban design situations where efforts are made to control “jay walking”, but may also intimidate pedestrians. The length of the bridge as well as its location will have a bearing on whether the pedestrian feels trapped in an alleyway. This problem can be overcome by the imaginative design of the crash barrier, (eg; a concrete barrier can be disguised as a bench or a planter to reduce its visual impact). It is also possible to use a discontinuous crash barrier or bollards to alleviate the feeling of entrapment. The solution may require the assistance of the TAA.

19. Crash barrier protects parapet and cable stays
4.2 Detailing of the parapet

Within the prescriptions of the Codes of Practice it is possible to improve the visual effectiveness of parapets without altering their structural performance. These improvements must be justifiable in terms of cost. As one important aspect of appearance is the longevity and durability of the finishes, the ease and cost of maintainability becomes paramount. Many existing parapets have deteriorated visually because their long term appearance was not adequately considered at the design stage.

4.2.1 Proportions

Good bridge design will ensure that any particular element or relationship between elements does not spoil the aesthetics of the bridge as a whole. It is essential that the size and scale of the parapet construction is appropriate to the bridge. Rules of thumb exist for successful bridge design in terms of correct proportioning of the bridge elements such as the piers, deck edge and cantilevers. These principles need to be extended to the choice of parapet design particularly with regard to the number and spacing of posts, the height of plinths and the slenderness of rails. Non structural additions such as dummy rails or relief patterns can be considered to give the required effect of scale to the parapet/bridge combination. The use of shading and edge beams can also be effective in altering the apparent size and proportion of parapets to suit those of the bridge.

4.2.2 Bridge/Parapet Interaction

On bridges viewed from the side, the bridge structure and the parapet can sometimes appear to be very distinct which can spoil the aesthetics of the bridge. This can be overcome by applying cladding panels to the edge of the bridge structure that mask the parapet. This solution removes the delineation between bridge and parapet and therefore gives the bridge an overall streamlined, uncluttered appearance. Perforations in the portion of the panels extending above the bridge deck provide transparency and afford some views to those using the bridge.

21. Edge beam reduces the impact of the parapet

22. Interface between bridge and parapet is blurred

By reflecting the pitch of the parapet posts with patterning on the edge of the bridge at similar centres, the bridge and parapet are united. There are examples where this has been effectively achieved by creating a faceted surface on the side of the deck. The faceted surface creates shadowing effects lending depth to the patterned elements.
23. Edge detail complements parapet posts

4.2.3 Mesh/Sheeting

Given the widespread use of mesh panelling on existing parapets, there is a need to develop and introduce more attractive and easily maintainable panel types. The unattractive sight of rusting panels can be avoided completely if aluminium or stainless steel is used. Sheets of these materials punched or sheared to the solidity desired by the designer are a viable alternative to wire mesh if whole life costs are considered.

24. Plastic coated mesh after the coating is breached

Vertical vanes oriented perpendicularly to the roadway can be effective in enhancing the outer face of the parapet whilst retaining visibility for bridge users. Since views are most often glimpsed by motorists to their side, the orientation of these louvres does not unduly obscure these sideways views, particularly from a vehicle travelling at speed. The louvres are often made from composite material such as G.R.P. that can be brightly coloured and has very low maintenance requirements. The open louvre arrangement does not attract unnecessary wind load to the parapet and also reduces some of the noise and light pollution emanating from the roadway.

25. Plastic panels provide an alternative screen

4.2.4 Texturing of Concrete Parapets

Unless carefully detailed and well finished, concrete can be bland and uninteresting. Decoration of the outside face of the parapet and indeed the bridge structure in the form of relief patterns can give interesting effects. The traffic faces of parapets are not usually provided with relief decoration for safety reasons. The design codes dictate that the traffic face of the parapet must be free of projections above 20mm.

A further benefit to a textured concrete finish is in maintenance, a relief pattern is effective in reducing the incidence of graffiti. Textured concrete also tends to weather more attractively, staining actually exaggerates the surface patterns, rather than spoiling a smooth surface of concrete.

A design method that may allow relief patterns to be detailed on the traffic face of concrete parapets is the addition of a metal main longitudinal member to the parapet at the height that collision occurs. This metal member will prevent any snagging and therefore allows the traffic face to be textured.

26. Textured internal face of concrete parapet
4.2.5 Colouring of Parapets

The use of colour on bridges can help the designer achieve a range of desirable effects. Some colours can be used to lend individuality to bridges or families of bridges, others tend to camouflage and understate bridge elements. The particular desired effect can be achieved through careful consideration and consultation. The use of bold colours also helps to orientate motorists and can make bridges and interchanges into landmarks.

27. Its colour makes this bridge stand out

**Coloured concrete** may be appropriate and desirable in many circumstances. Colour can be introduced by careful sourcing of coloured aggregates or by the addition of dye admixtures. Concrete is prone to staining as it ages which can have a very unattractive appearance. Careful detailing and specification of surface finish and concrete mix constituents can reduce the severity of staining.

**Painting** has been the traditional method of surface decoration, a wide range of colours and finishes are available. Both aluminium and steel can be satisfactorily coated, cost savings through factory application are possible although handling of painted components then becomes more important. Modern paints offer good adhesion and resistance to weathering and abrasion. If the component is not galvanised steel or aluminium, then corrosion will occur once the paint film is fully breached. Paint cannot be recommended for components such as mesh, which cannot be painted quickly or effectively. The possibility of applying paint completely on site lends it to rejuvenating existing parapets of all materials.

**Vitreous Enamel** coating of mild steel and aluminium parapet components can be used to give a pleasing appearance. The porcelain coating is factory applied and results in a surface that is resistant to weather, abrasion and light. The coating provides corrosion protection until it is breached, most commonly by heavy impacts. The treatment is not suitable for components with sharp edges but rails and posts could be suitably designed for ceramic coating. The coating can achieve a life of up to fifty years, however repairs to the coating may not achieve the durability or colour match of the original.

28. Strong colours extend to the mesh.

**Anodising** of aluminium components is a very suitable and appropriate method of improving their appearance. Although the appearance of untreated aluminium is often acceptable, anodising can impart a range of colours permanently. The electrolysis process forms an artificially thick coat of aluminium oxide that can be given lasting colour through the use of inorganic or metallic pigments. The surface is attractive, light resistant, very hard and durable. The range of colours is large, but depends upon the particular alloy in use.

29. Coloured parapet set back behind crash barrier.

4.2.6 Decoration

Adorning bridge structures with artwork both adds interest to the motorway environment and gives bridge structures identity. This can be particularly well exploited in a regional sense by using artwork to make statements to motorists about the district through which they are travelling. Regional Bodies, other than the owners of the structure may be willing to fund such improvements. Possibly the most appropriate medium for decoration is ceramic tiles which benefit from vivid colours and low maintenance whilst also deterring graffiti.
30. **Tiling conveys regional identity**

Tiling is most often applied to other elements of the bridge structure such as piers and abutments but there is no reason that it could not be used to decorate both faces of concrete parapets provided secure attachment of the tiles is ensured. The possibility of loose or shattered tiles falling onto passing traffic following a collision must be reduced to the satisfaction of the TAA.

4.2.7 **Vegetation**

There has been a move in recent years to promote green bridges (that is bridges on which plants are grown), particularly in urban environments. It has been widely recognised that careful planting can be used to improve the appearance of bridge abutments. A natural progression from this is to cultivate plants around the parapet using the parapet as a framework or trellis. Careful selection of plants could lead to different effects ranging from well maintained and manicured to wild and unkempt (in appearance – not practice). This would undoubtedly make bridges more interesting.

4.2.8 **Lighting Columns**

The interaction of lighting columns and parapets can be difficult. If the lighting column is positioned outside the line of the parapet it can break up the lines of the structure, inside the parapet it is an obstruction and a litter trap. The best solution is therefore to incorporate lighting columns into the line of the parapet, either built off the top of the parapet or incorporated into the structural lines of it.
5.0 Best Practice in Parapet Design

5.1 Suspension Bridges

The sheer magnitude of these structures often causes the parapet to pass unnoticed. This should not diminish the designers responsibility, these grand structures deserve carefully considered parapets. If the walkway is positioned outside the cable line a secondary barrier will normally have been used. The designer therefore has the freedom to design the outer pedestrian parapet in a form appropriate to the bridge, maximising the views from the bridge.

35. The crash barrier and parapet on Humber Bridge

5.2 Cable-Stayed Bridges

These landmark structures often require the use of a crash barrier to protect the cables from vehicle strikes. The outer parapet may then be designed for pedestrian restraint only, enabling it to be detailed in sympathy with the location and architecture of the bridge. An area which requires particular consideration on cable stayed bridges is the interaction of the sloping cables with the lines of the parapet members. Orienting the vertical members to reflect the angle of the stays is an effective way of reducing the visual clutter.

36. Parapet stanchions angled to suit cables

5.3 Motorway Over Bridges

The standard metal traffic parapets were developed as part of the massive expansion of the motorway system in the 1960’s. The arrangement of horizontal members was designed to emphasise the speed and dynamism of the then new highways. The use of these parapets is still valid on motorway bridges, in the context for which they were designed. Some improvements can be made to the finishing of the parapets in order to improve their appearance.

37. A brightly coloured overbridge

When a bridge parapet is painted, or coloured by anodising or other techniques mentioned earlier, it can stand out dramatically. Colour can be used to give a regional identity or coordinate with other street furniture. This has the benefit of giving the driver a sense of location in what may otherwise be a bland corridor.

Very careful consideration should be given when infill is required on the traffic face. The use of stainless steel or aluminium perforated panels provides a better more enduring appearance than mesh. The maintenance of mesh has been a problem in the past with regular replacement the most viable solution.
As an alternative to the standard parapets the use of combined metal and concrete parapets is recommended, they can give reasonable visibility for bridge users and lend uncluttered, clean lines to the elevation. These parapets also give the designer greater freedom of expression.

5.4 Motorway Underbridges

In general motorway environments are both bland and sterile, those using the roads are detached from the landscape that they are travelling through. Bridges offer views that break the monotony of embankments and roadside furniture. Designers should attempt to enhance the motorist’s journey by maximising the sights from the road. The parapet can be used to emphasise the presence of the bridge by drawing one’s attention to it. Colour can be used to distinguish the parapet from the standard grey colour of a crash barrier.

Often the only indication that a river is being crossed is a small signpost at the start of the bridge and these are easily missed. An approach that can be borrowed from historical bridge builders is to emphasise the ends of the bridge and the start of the parapet with a feature or standard. This can be achieved without contravening the parapet design regulations.

5.5 Major Highway Footbridges

Footbridges over large roads and motorways can be generally divided into two sections. Firstly, typical beam bridges, where the parapet sits on top of the superstructure and is all the persons crossing the bridge will experience. The second type of footbridge often seen in this situation is the through truss.

Both of these bridge types are basic structures that have clear structural expression if done well.

The beam bridge is a very simple structure which benefits from a simple, plain parapet. A parapet made up of small members such as a vertical railing is more in context than a horizontal rail parapet whose members seem disproportionately large. A fine vertical railing usually avoids the need for mesh, which is a further advantage.

Through truss footbridges are striking because of their magnitude. It is not possible to understate this structure and so it may as well be emphasised. The parapet top will often be around the mid-height of the truss, a position where it will confuse the viewer from the clean lines of the truss. A truss that has full height mesh or railings without a discernible handrail looks far more attractive than one that is complicated by a standard parapet within the truss structure. Solid panel infill to the truss openings can work well for bridges over railway lines.
5.6 Link Bridges

Another common form of footbridge more in evidence in recent years is the link bridge joining buildings. These are normally fully enclosed to act as a continuation of the buildings they link. The use of glass parapets in this situation is appropriate and attractive. Glass protects the bridge user from the elements and its transparency alleviates feelings of claustrophobia. Where a link bridge is clad with glass or panels, the joints must coincide with any visual elements of the structure to avoid a disjointed appearance.

5.7 Bridges in Urban Environments

Generally an urban bridge will have a speed limit below 80km/h and hence require only a low containment parapet. This has the effect of minimising the structural weight of the parapet. The use of a combined metal and concrete parapet allows the designer to introduce elements of individuality into the parapet, possibly to reflect the environment of the bridge.

The use of secondary protection to reduce parapet requirements should be investigated with the TAA. A pedestrian standard requirement gives the designer absolute freedom to develop the parapet.

Urban bridge parapets must be detailed to reduce the risks of vandalism. Enhancing bridges through the use of colours or ceramic artwork should be considered.

5.8 Bridges in Rural Environments

An appropriate material for a rural bridge is timber. An earlier section described how low containment bridge parapets have been developed in hardwood. In America the use of timber for parapets and crash barriers is widespread. The TAAs in the United Kingdom are gradually accepting it as a material in highway bridge construction.

Although unlikely to be financially competitive, locally won materials such as stone or rock can be attractive. There exist fine examples of modern road bridges clad in stone.

Footbridges in a rural environment should similarly not look out of place. There are a number of timber kit bridges available for short and medium spans that provide a very natural solution with parapets in the same material as the structure.
5.9 Railway Overbridges

Railway parapets are the subject of the most strict stipulations in the codes of practice. At present the design codes require these parapets to be solid. This requirement is for two purposes, to prevent vandals from aiming missiles at a train easily, and to prevent the train driver from confusing car brake lights with red signal lights. The restrictions are most stringent for high speed lines with overhead electrification equipment.

In Continental Europe, the railway and associated electric equipment are sometimes protected by means of a shelf cantilevering outwards from the bridge above the sensitive areas. If the parapet has the required containment level, this much less imposing solution may be feasible in some situations.

Some recent metal railway parapets have gained approval for the use of perforated sheeting, this may represent a rationalisation of parapet design by the approving authorities.

5.10 Canal Bridges

Many regions are now realising the potential of the canal system of the country which has lain redundant for many years. Use of the waterways, primarily for recreation, is on the increase and cities and towns are seeing the banks of canals redeveloped as desirable areas to live.

Canals are generally considered peaceful, tranquil places removed from the bustle of everyday life. The design of the parapet should reflect this, emphasising vertical members as opposed to the horizontal lines on motorway overbridges. The short span and steep vertical curve of these structures lends itself to this type of parapet.

5.11 Equestrian & Cycle Bridges

The vertical height required for these parapets is greater than that for an equivalent pedestrian bridge. Unfortunately this is often achieved by adding a disparate structure on top of a standard parapet design. The height of these parapets can be emphasised using vertical members to create a more uniform finish.
6.0 Future Developments

The standard parapets which have been available since the 1950’s are still widely used on new bridges today. In the right context, such as motorway overbridges, these designs are still valid and do not appear incongruous. The harmonisation of European Standards should have the effect of widening the market and increasing the choice available to the specifier.

What this report has aimed to emphasise are the alternatives which are available within the current codes of practice, which may not be immediately obvious. The largest area of freedom to design is with parapets of combined concrete and steel, a parapet type which has not been fully exploited in recent years.

An area where additional investigation would be of benefit is the development of parapets from currently non-standard materials such as timber and composite materials. The use of timber, as both a popular material aesthetically as well as environmentally sustainable is one which should be more widely practised. The development of standard parapets would undoubtedly increase the use of these materials and should not be too onerous following work done in a number of other countries. The new arrangement of structural design Eurocodes should simplify this process.

Composite materials offer a colourful, low maintenance future for parapets. Previous uses of these materials has tended to mimic what has been previously done in steel, there is great potential for using this easily formed material to create exciting new forms of parapet.

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