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Bridge Aesthetics

L'esthétique des ponts

Brückenästhetik

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SUMMARY
The importance of space control in the design of bridges is considered with some aesthetic problems and suggested solutions.

RESUME
L'importance du contrôle de l'espace dans le projet des ponts est examinée. Quelques problèmes esthétiques et leurs solutions sont présentés.

ZUSAMMENFASSUNG
Der Einfluss des räumlichen Erfassens beim Entwurf einer Brücke wird diskutiert. Es werden Probleme der Aesthetik und Vorschläge zu deren Lösung aufgezeigt.

When considering the aesthetics of a bridge design it is normally the form and detailing of the structural elements that are discussed. The spatial proportions and patterns are either overlooked, or ignored entirely. This may be due to a lack of perception in these matters, but more often an awareness of the background of limiting factors which render complete freedom in design impracticable. Deck levels will be fixed by the Highway Engineer, pier positions limited by ground conditions under the guidance of the Soils Engineer and choice of structural form influenced by practical and economic parameters. However, it is rare to encounter a set of conditions permitting only one possible solution and experience shows that often a more satisfying aesthetic solution, at very small extra cost and labour, can be obtained by small adjustments in span arrangement and structural detailing. It is a fact that more often than not the essential character of a bridge is determined by its voidal shapes and proportions.

To digress briefly, in the architecture of Buildings, the prime purpose of the Architect is to provide "enclosed spaces" for functional enjoyment by the Client. Unfortunately, only a few modern Architects appreciate the aesthetic importance of these "space boxes". Space boxes (halls, rooms etc.) are defined by boundaries - floors, walls and ceilings - and are usually "open-ended" in part by fenestration. It may be noted that the surface treatment of these planes can contribute slight apparent variations in the essential spatial proportions. For example vertical patterns on walls give an apparent increase in height, horizontal patterns on walls give apparent increase in length, ceilings may appear higher by careful choice of colour and texture. In good design there must be a delicate balance between the voids and masses accompanied by sympathetic detailing. We cannot simply ignore the spatial forms, in which, as someone has said, we live, move and have our being.

Bridges do not, as a rule, enclose space. They organise and regulate spatial flow. The voidal shapes which they produce, often quite complex, may be pleasing to the eye and may often be in sympathy with the landscape. But just as one sometimes finds badly proportioned rooms - in which one cannot relax with ease - there are to be found ugly and even aggressive voidal forms in bridges, and too often voidal forms entirely at variance with the environment. I am not aware of any Rules which one can apply for visual aesthetic enjoyment - Engineers must exercise individual perception and develop individual awareness of aesthetic form. A few examples will reveal the importance of good spatial proportion.

1. Bridges in relation to the landscape. Good manners in Architecture require due consideration for neighbours - in this case the environment. Bridges which by reason of unsympathetic form, materials or detailing are seen to be in harsh contrast with their surroundings will provoke dissatisfaction - leading even to aggressive feelings towards the structure.

A gently rolling pastureland cannot withstand the impact of a monumental structure. Its peace will be destroyed by the focal drama of the intrusion. There will be a conflict between horizontal and vertical forms. The environment requires the maintenance of the quality we call "repose". On the other hand an extensive river estuary may be relieved of monotony by the intrusion of a focal point - such as a large suspension, or stayed girder bridge.

A high embankment crossing a river valley will inevitably tend to bisect the valley spatially. A massive viaduct may have a similar effect, but if a viaduct of suitable scale and proportion is substituted, it is possible that the essential spatial character of the valley will be hardly disturbed.

As well as dignity, lightness and delicacy are essential qualities in Bridge Architecture and voidal patterns contribute greatly to these qualities.

2. Bridges with multiple approach spans. As the number of spans increases, individual span proportion and detail are absorbed into the overall pattern and texture. Large central spans, if provided, reduce the risk of monotony by contributing a dominant element to the composition. It often occurs that these larger spans require somewhat differing structural forms from the side spans. This presents no aesthetic problems if dealt with sympathetically. The horizontal deck lines, including soffit structural members, should flow easily, without punctuation, from one form of construction to the other, and any change in material should be carefully detailed in texture and colour to avoid any suggestion of fragmentation. One of the first principles in Architecture is Unity of Composition. The technique of proportionally reducing the span ratio towards each abutment can give a useful improvement in perspective, provided deck lines and ground converge. The key to success lies in the formation of similarly proportioned trapezoidal voids. Where ground and deck lines are nearly parallel it is better to preserve the rhythm of equal spans right up to the abutments.

In townscapes, where building skylines break up the ground lines destroying the void pattern, it seems better also to maintain equal span rhythm.

3. Bridges on the Motorways. The sense of spatial flow becomes very obvious where high speed traffic is involved. Where a motorway runs in a cutting the continuity of the bank slope is an important spatial element. Massive abutments to overbridges constitute unpleasant "stops" to the flow pattern. It is much better to permit the bank slope to flow under the bridge by providing additional side spans. It may be observed that there is also a flow pattern across the overbridge, i.e. across the motorway. Massive abutments will also prevent the easy flow of deck lines into the ground. This integration of flow lines into the environment is an important element in good design. Nature is diverse in character and does not easily accept the simple geometrical land shapes created by the economics of highway engineering. Careful attention to additional land shaping, supplemented by tree and shrub planting will help to restore harmony with natural forms and should always be considered essential to the completion of the motorway contract. The character of space is defined by its boundaries.

4. Arch Rib Bridge Forms. These structures pose some interesting spatial problems which are only rarely solved in a pleasing manner.

The void under the arch provides an observer at ground level with an almost ideal "frame" for a vista. The curved soffit of the arch is infinitely more relaxing to the eye than a comparable rectangular form provided by beam and pier constructions. The actual shape of the curve is of some interest. Modern structural analysis often requires a parabolic form, but the limits of peripheral vision prefer a shape more approaching the elliptical. Probably the best compromise would be segmental. Another visual defect of the parabola is in the acute perspective view - when a bridge is viewed from a position near an abutment the curve of the parabola tends towards the monumental - containing two straight lines and a segmental crown.

Interesting problems in form occur between the straight lines of the deck and the arch curves and these are greatly influenced by acute angled triangular voids in the spandrels. Feelings of tension and aggression can be reduced by spandrel struts which increase the dominance of the central void. The three dimensional aspect of space must be remembered and large slab wall struts here will have a disastrous effect on the composition.

Finally, as an example of the strength of the void in aesthetics we may examine the effect of duality in bridge design.

Briefly, duality is simply the intrusion of two identical focal shapes which

cause the interested observer to compare each with the other, back and forth, endlessly until the observer suffers fatigue from irritation and distraction. It is the anti-thesis of Unity in composition and the defect is well known to Artists and Architects alike.

A two-span bridge whose voids are both identical may generate duality. Even a powerful motif on the central pier will not prevent this. It is possible that the two voids enclose dual vistas - be that as it may, it is not possible for the central pier to hold the composition together. On the other hand, a three-span bridge, though it has two piers, is devoid of this defect, particularly when the side spans exhibit smaller voids than the central span. In these instances it will be seen that the voids dominate the masses. The phenomenon would seem to apply less to motorway bridges however where the alternate traffic flow coupled with the effects of traffic speed reduce the distraction noted above. Nevertheless, in the Author's view, three span motorway bridges are more pleasing than two span types.