Cheshire County Council

Proposed Second Runcorn-Widnes Bridge

Initial Feasibility Report

February 1978

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1. INTRODUCTION

1.1 This report describes the requirements of, and possible solutions for, a second road bridge between Runcorn and Widnes. It also summarises the situation with regard to possible objectors to the scheme.

1.2 History

Your letter of 16th December 1970 requested an estimate for a new crossing of the river Mersey in the Runcorn - Widnes gap and we provided this, along with some general comments on the proposed bridge, in January 1971.

On 19th November 1971 you asked us to proceed with an investigation to establish the feasibility and acceptability of a new bridge between the existing bridges. Our preliminary opinions on this were given in our letter of 16th June 1972.

It was subsequently agreed informally that as both a widened existing bridge and a new bridge would ultimately be required, it would be better to initiate the widening before completing our report on the second bridge. In the meantime we would continue discussions with possible objectors in order to try and reach agreement on an acceptable scheme.

1.3 Scope of the Report

This report details the requirements which have been considered for the bridge together with the development of the basic geometry of the structure. Drawings are included of outline designs which have been prepared in order to compare the aesthetic aspects. No detailed structural design has been carried out.

A summary is included of the discussions and tests which have been carried out in order to try and reach agreement with those authorities which might object to the scheme.
2. LOCATION

2.1 General

The configuration of the Runcorn Expressway (Section 9) Junction makes it highly convenient to place the second road bridge between the existing road and rail bridges. This location means that there will be no flyovers or underpasses crossing the existing approach viaduct, thus saving land and reducing visual intrusion.

On the northern side of the river, the widened approach roads will accommodate traffic from the second road bridge; again without need for flyovers or underpasses.

The amount of land and property required by this location will be a minimum, and that which will be required is already in shadow areas from the existing road and rail bridges.

2.2 Alignment

The two existing bridges converge in plan towards the north bank of the river before diverging as the railway turns to the north east. At their closest point there remains sufficient space for the second road bridge and we recommend that it should be sited on a centre line 21.5m from, and parallel to, the existing road bridge centre line. This alignment will place the new bridge mid-way between the existing bridges at the north main piers.

2.3 Spans and Pier Positions

For reasons which will be explained in Section 4, the possible pier positions at this site are severely limited. It is essential to keep the south pier on the south bank of the Manchester Ship Canal and, in a northerly direction, the next available position is opposite the northernmost of the two central piers of the railway bridge. In a northerly direction again, the next position occurs between the side-span sections of each bridge.

The main span is thus determined as 210m with a north span in the range 130 - 180m. The south span has no serious restraints on its length.

2.4 Facilities on the Bridge

The carriageway will be of 3 lanes plus a hard shoulder giving a width between kerbs of 14m. Provision will be made for marginal strips/emergency walkways which will extend the overall width to 15.9m.

Vehicle parapets and street lighting will be provided to current standards.
3. POSSIBLE TYPES OF BRIDGE

3.1 General

The type of bridge which is most suitable for any particular crossing is normally determined by the length of its main span in conjunction with the vertical profile and the method of construction that might be used. The main span of this particular crossing is such that steel girder, cable-stayed or prestressed concrete structures would be suitable.

3.2 Profile

The vertical profile must be such that the gradient does not exceed 4% on any section of the carriageway. This is particularly relevant to the Runcorn approach where it is necessary for the underside of the superstructure to provide a clearance level of 28.8m as it crosses the Ship Canal. A 4% gradient from the existing approach viaduct to the north of Egerton Street will result in a construction depth of about 8m being available at the south main pier.

3.3 Type

A depth of 8m is too small for the pier section of a prestressed concrete structure built by a balanced cantilever method and the choice is therefore restricted to a cable-stayed or steel girder bridge. Cable-stayed structures of this span can be both economic and elegant when situated so that they are not in visual competition with adjacent structures. However, at this particular site both the existing bridges have visually prominent superstructures and it would be almost impossible to arrange the towers and cables of a cable-stayed bridge so as to have an acceptable appearance when seen through the existing structures.

These objections necessitate the bridge taking the form of a steel girder which would present the most inconspicuous type of structure. Within this general description come box girders, plate girders, trusses and space frames. The exact type of structure will ultimately depend on the economic situation at the time of tendering but we do not envisage that the overall dimensions will be greatly affected by the exact choice of type.

3.4 Bridge Details

Under the present situation we consider that steel truss construction is likely to be the most economic due to the reduced fabrication costs as compared with box or plate girder work. It will undoubtedly be possible to develop a bridge deck which will act compositely with the truss and thus produce a further saving in weight and cost. Such a deck would be constructed of either stiffened steel plate or prestressed concrete. We have not, at this stage, attempted to develop the design in any detail.

3.5 Aerodynamics

On a span of this length there is always a possibility of aerodynamic oscillations occurring, particularly when the weight has been reduced to a minimum. The likelihood of this is reduced in a truss scheme due to the reduced obstruction offered to air passing the structure. Aerodynamic tests which were carried out at the National Physical Laboratory for the existing road bridge indicated that buffetting effects caused as a result of air flowing through the railway bridge,
could be induced in a structure to leeward of the railway bridge. However, these effects were reduced when the new structure was placed closer to the railway bridge.

We have had preliminary discussions with the National Physical Laboratory and their opinion was that, depending on the final form of the new bridge, some form of wind tunnel testing would be advisable. This would, in fact, involve testing a unique situation - that of three long span bridges in close proximity. At this stage we do not anticipate that there will be any major problem in designing a structure to withstand aerodynamic excitation particularly if a truss is used.

3.6 Piers

Due to the presence of the I.C.I. cold water intake downstream of the site at West Bank Power Station it has, in the past, been necessary to create the minimum obstruction in the river in order to avoid the possibility of siltation at the intake.

To this end the new piers in the river will be placed in line with existing piers and will be made as narrow as possible. During construction it will be necessary to construct the temporary cofferdams in the river so that they form extensions of the railway bridge piers.

3.7 Summary

Although structural considerations must always be of paramount importance we believe that in this particular location it will be essential to provide a bridge which is visually unobtrusive to the road user. To this end we consider that a truss supporting a deck at upper chord level satisfies both the structural and visual requirements of the bridge.
4. POSSIBLE OBJECTORS TO THE SCHEME

4.1 General

Part of our brief has been to identify those authorities which might be expected to object to the construction of a second bridge, to discuss the proposals with them in general terms, and try to reach agreement on an acceptable scheme.

Our discussions were held during the period 1972 - 74 and the following comments are relevant to the situation at that time. Since then the existing road bridge has been widened and the West Bank Power Station has been demolished.

The authorities which objected to the Parliamentary Bill for the existing road bridge, and the other authorities which we have consulted, are:

(a) I.C.I. Limited
(b) The Manchester Ship Canal Company
(c) The Upper Mersey Navigation Commissioners
(d) Department of Trade and Industry
(e) British Rail
(f) Mersey and Weaver River Authority

All authorities except (c) were approached by us and the conclusions reached are now summarised individually.

4.2 I.C.I. Limited

This company, which is the major industrial employer in Runcorn-Widnes area, generated power until recently for its local industrial plants at West Bank Power Station. This occupied a site immediately downstream of the railway bridge and extended along the north bank of the river for a distance of 270m. At the extreme downstream end of this site there is a cold water intake pipe through which cooling water is drawn from the river.

The level of this intake is very close to the river bed and at normal low tide it is only just covered. An abnormally low tide exposes part of the intake. I.C.I.'s concern is that any change in, or addition to, existing features in the river introduces a risk of the intake becoming silted up and rendered useless.

This was their concern when the piers for the existing road bridge were proposed but measurements of the river bed level taken for the ten years following construction of the piers indicated no appreciable change. Similar concern was expressed by I.C.I. when we put forward the proposal for the mid-river pier of the second road bridge. In order to try and resolve the problem and to provide some definite information on river flow it was decided to ask the Hydraulics Research Station to carry out a float tracking survey during all stages of the tide.

The survey was carried out under the supervision of Mrs Mary Kendrick, a Principal Scientific Officer at the Station, who is well known for her previous work on siltation in the Mersey estuary. When the results had been plotted they were examined in order to see if the introduction of the new pier would be likely to alter the direction of flow in any part of the river. The conclusion reached by H.R.S. in their report was: “From the evidence of the float tracking......... there is nothing to suggest that a significant change in bed configuration is likely to occur as a result of the construction of an additional pier in line with the existing centre railway bridge pier”.
Although I.C.I. have not accepted the above view unconditionally, they have indicated that they could probably reach an agreement if adequate safeguards were to be provided during the construction stage, when the temporary cofferdam would be in the river.

The tests described were carried out in June 1973 and since that date the Power Station has been completely demolished.

There is, therefore, reason to believe that if a Parliamentary Bill promoted for a second road bridge then a satisfactory undertaking could be agreed with I.C.I before the Bill is deposited.

4.3 The Manchester Ship Canal Company

The Company are interested in maintaining clearances for shipping in the canal and in ensuring that no damage occurs to the canal wall.

The first item can be satisfied by a bridge which gives vertical and horizontal clearances not less than those provided by existing bridges. The canal wall is susceptible to scour on the riverward side and if this is allowed to increase in any way there might be a danger of the wall being seriously undermined. If a new bridge pier is placed close to the wall, the river current velocity between the wall and the pier could be increased to a dangerous amount and so increase the likelihood of scour occurring.

We have made proposals to the Company for both the clearances and the pier positions and we have their written acceptance of these as being satisfactory to them.

4.4 The Upper Mersey Navigation Commissioners

The Commissioners were responsible for navigation in the river until March, 1973 when they were disbanded due to the virtual cessation of commercial traffic in the river. In view of this no approach was made to them.

4.5 Mersey Conservancy — (Department of the Environment)

The outline scheme was submitted to the Acting Conservator of the River Mersey who expressed his provisional agreement with it.

4.6 British Rail

The existing railway bridge is founded on the sandstone rock of the river bed, and British Rail's main interest is to ensure that loading on the rock due to existing and proposed foundations does not become excessive. They indicated verbally that with the proposed scheme the loading would be acceptable but were unwilling to comment formally until a more detailed scheme for the piers could be provided.

Other minor problems may arise due to the need for shielding road lighting and vehicle headlights so as to avoid glare to train drivers. We do not envisage that there will be any great problem in satisfying British Rail on these items.
4.7 Mersey and Weaver River Authority

This Authority shared I.C.I.'s concern about the possible effects on river bed siltation during the construction of the new river piers. Otherwise, they have had no comment to make.

4.8 Other interested Authorities

The Acting Conservator has suggested that the Mersey Docks and Harbour Company should also be kept informed.

4.9 Summary

There is good reason to believe that the requirements of the interested authorities we have approached could be satisfied before a Parliamentary Bill is promoted. Apart from the problem of maintaining smooth flow around the new piers in the river during construction, there appear to be no other items which present major difficulties.
5. COSTS

We have not attempted to make any detailed cost estimates or to compare the costs of various types of superstructure.

Our original estimate given to you in January, 1971, has been updated and we have compared this with other major bridge schemes which we are studying at present.

The conclusion we have arrived at is that the total cost for the main spans and the approaches would be of the order of £12 million at present day prices. This figure applies to a length of structure between abutments of 770m.
6. PARLIAMENTARY PROCEDURE AND TIMING OF THE PROJECT

A private bill is normally deposited in November, and the various stages of its consideration take place in the following months so that, if successful, the bill receives the Royal Assent in July or a little earlier.

Various documents have to be prepared prior to the bill being deposited. These include the Parliamentary Plans, the Book of Reference, and a draft of the actual bill which contains any undertakings given to potential opponents of the bill.

In order to allow sufficient time for the preparation of all the necessary documents, a decision to promote a bill and instruct Parliamentary Agents should be taken not later than March in the year concerned. Allowing for the Parliamentary processes, detailed design of the bridge and the tendering period, construction could probably start two and a half years after having decided to proceed. Construction would probably take three to three and a half years so that a decision to proceed and seek Parliamentary power should be taken approximately six years before the bridge is required to be in use.
7. CONCLUSIONS

Although we have not been requested to carry out any detailed design work on possible bridge types, we are satisfied that a bridge on the selected alignment is feasible. Objections from river users and other parties can, we believe, be satisfied by adopting the measures outlined in this report. The remaining problems are all of an engineering nature and we have every confidence that sound solutions can be found at the detail design stage.

In the section on Parliamentary Procedure and Timing, we have indicated that instructions to proceed should be given some six years prior to the required opening date. Our experience with the promotion of Parliamentary Bills is such that we would recommend a generous amount of time to be left for this phase, and that careful assessment of the likely date by which the bridge will be required should be made as early as possible.

The widening of the existing road bridge has now been completed and due account has been taken of the aspects covered in this report in the design of several important features. This is particularly so on the Runcorn approach where the road alignment has been determined by the new slip road spur, and sufficient width has been provided to accommodate future northbound traffic intending to use the second bridge in addition to southbound traffic on the existing bridge.
8. REFERENCE DRAWINGS

The following drawings indicate the main features of the additional bridge:

359/001A  Steel Truss Alternatives
359/002  Cable Stayed Alternatives
359/004  Alternative Bridges — Cross Sections
359/005  Setting Out