ITEM No 5

Forth Estuary Transport Authority

First Internal Inspection of Main Cable – Interim Report

25 November 2005

1 Purpose

1.1 To give members an update on the main cable inspection and analysis, and to seek approval to appoint engineering consultants for further studies.

2 Background

2.1 Intrusive inspection of the cables is now complete following site work during 2004 and 2005. Laboratory testing of wire samples extracted is also complete. Analysis and checking of cable loads due to the latest bridge specific live load has been carried out and checks are being made of the dead load of the suspended structure. The consolidated report from consultants FaberMaunsell and Weidlinger has not yet been submitted but I am able to provide an interim report on the critical issue of cable strength.

2.2 It is now clear, based on analysis of the worst section of cable found during the inspection that there has already been some reduction in cable strength.

2.3 Work done to date indicates that there are no immediate safety concerns and the bridge can comfortably carry the existing traffic loads with an acceptable factor of safety.

2.4 However, it is essential that measures are taken as soon as possible to halt the corrosion or at least slow down the rate of deterioration.

2.5 The universally favoured method of doing so is to install a system of Dehumidification. This involves pumping dried air into the cable at various points having first wrapped it in an airtight neoprene membrane.

2.6 Dehumidification is a well-tried system of preventing corrosion of galvanised steel; we already use it in the anchor chambers. However, its application to main cables of suspension bridges is relatively new. Such systems are being fitted to new bridges to protect them from corrosion and retrofitted to older bridges in Japan, Sweden and Denmark where corrosion has been uncovered. Whilst there is good reason to have confidence that dehumidification can slow down or halt corrosion there is no body of evidence yet available to allow an assurance to be given that this will work on Forth.

2.7 In the event that the dehumidification is unsuccessful and the corrosion in the cables cannot be halted, then consideration will have to be given to reducing traffic loading on the bridge at some point in the future. This is predicted to occur in about 9 years time and the necessary reduction in loading would require restricting the maximum gross vehicle weight to 3500 kg. If the corrosion continues, the predicted loss of strength in around 14 years time will be such that consideration will have to be given to complete closure of the bridge.

3 Main Report - Way Ahead

3.1 The Authority has already decided to fit both cables with acoustic monitoring equipment and this work is programmed to commence on site in March 2006 with commissioning planned for the end of July 2006.

3.2 Monitoring for a period of 8 months or so will provide information to boost confidence that the limited intrusive inspection had indeed uncovered the worst affected section of cable.

3.3 Following a positive outcome of this initial period of acoustic monitoring, installation of the dehumidification equipment to the cables could commence in April 2007. This work could take up to two years to complete and a detailed feasibility study will be required to examine the specific technical difficulties involved in fitting a dehumidification system to this bridge. The estimated cost of fitting dehumidification to the cables is £12m.

3.4 Following a period of 5 years or so a further intrusive examination will be carried out to determine the effectiveness of the dehumidification system and re-evaluate cable strength.

3.5 Risks

- Only 4% of the cable has been opened up for inspection. The current calculated strength and predicted future strength of the cable have been determined from the worst section found from the inspection. As the sample size is relatively small there is a possibility that the worse section of cable has not been uncovered.

- During the initial period of acoustic monitoring, if results indicate that numerous wire breaks are occurring in a particular section of cable that has not been inspected, an immediate intrusive inspection will be required to determine the condition of the cable at that section.

- There may be specific technical difficulties that prevent the installation of dehumidification equipment on the Forth Road Bridge.

- Following a period of 5 years or so it may be found that the corrosion has not been halted or that its progress has not been sufficiently reduced.

3.6 Replacement or Augmentation of the Main Cables

Should it become necessary in the future for this Authority to give consideration to replacing or augmenting the main cables, several significant engineering difficulties require to be overcome e.g.

- the main towers, including existing cable saddles, have already been strengthened and new load paths require to be identified at the tower tops.
- new anchorages will be required.
- the existing truss is overstressed and will require to be strengthened.

A critical question is the extent of the carriageway restrictions that will be required to carry out replacement or augmentation of the main cables.
Given the above, it is recommended that a feasibility study be carried out. This study is likely to cost between £1M and £1.5M and could take up to 18 months to procure and complete.

3.7 Traffic Restrictions

- Some traffic restriction will be required to fit the acoustic monitoring during spring and early summer 2006. It is hoped that these will be limited to a small number of partial weekend restrictions.
- Resurfacing of the northbound carriageway is programmed for 2007. During these restrictions it may be possible to equip the west cable with dehumidification.
- Fitting out the east cable will require restrictions during 2008.

4 Conclusion

4.1 Significant corrosion has been found within the main cables on the bridge and a system of dehumidification will be fitted as soon as possible with the aim of providing an environment within the cables that will prevent further deterioration occurring. If successful, and traffic load increases do not rise significantly, then in the long term the bridge will continue to operate without restriction. If no action is taken or the dehumidification does not arrest the deterioration then within 9 years the Authority will be faced with restricting the weight of vehicles using the bridge and within 14 years having to consider closing the bridge to all vehicles.

5 Financial Implication

5.1 Clearly, the findings of the investigation work take priority over other schemes previously identified in the long term capital plan. Feasibility studies and remedial work can be accommodated by adjustment of the capital plan e.g. by delaying the painting of the suspended truss.

6 Recommendation

6.1 It is recommended that members:

(a) agree to commence the procurement of suitably qualified consultants to:-

- carry out a feasibility study, and prepare and supervise a scheme for dehumidifying the main cables at an estimated cost of £1.2M.
- carry out a feasibility study into replacement/augmentation of the main cables at an estimated cost of between £1M and £1.5 M.

(b) note that I will submit a tender report to a further meeting

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Appendices

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Background Papers Technical data from consultants