FORTH ROAD BRIDGE

Meeting of Forth Estuary Transport Authority

30 October 2009

Capital Plan to 2023/2024

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1. Purpose of report

1.1 To provide members with a brief update of bridge schemes included in the long term Capital Plan to 20023/2024.

2. Main Report

2.1 The bridge schemes listed in the long term Capital Plan are those schemes that are considered to be essential for the maintenance and safe operation of the bridge.

2.2 The Capital Plan sets out as far as possible to identify the major improvement and strengthening works that will be required on the bridge over the next 15 years. Many of the schemes are unique and some have yet to be fully determined in nature and extent and this makes estimating project costs difficult. Optimism Bias has not been included in the Capital Plan estimates and all are at 2008/9 costs.

2.3 The Plan has been developed on the assumption that there will be no replacement of the main expansion joints until 2016.

In addition, no allowance has been made in the Plan for the possible replacement/augmentation of the main cables or any work on the main cable anchorages apart from the investigation into their long term structural integrity.

2.4 As reported to the Board in February 2009, the announcement of a firm commitment by the Scottish Government to a definite programme for the construction of the Forth Replacement Crossing, has allowed for a review of the Authority's capital plan to be carried out. This review is ongoing, and its purpose is to examine whether or not schemes that cause major traffic disruption can be deferred and, given the proposed change in use of the existing bridge after 2016, will also allow a re–appraisal of certain schemes that are required as a direct result of traffic loading effects. The replacement of the expansion joints was the first of these schemes to be reviewed.

2.5 Carriageway or lane closures will be required to carry out many of the planned works and each carriageway or lane closure will be fully utilised to minimise

the impact of disruption. Most of these carriageway or lane closures will be carried out overnight. However, weekend restrictions would be required to carry out waterproofing and resurfacing works and some of the expansion joint inspections.

Intermittent closures of the footway/cycletracks would also be required to carry out some of these schemes. However, one footway/cycletrack will remain open at all times.

3. Significant Schemes

The following describes some of the more significant schemes included in the Capital Plan

3.1 Main Cable Acoustic Monitoring and Inspection

Commissioning of the system was completed in August 2006 and both main cables are being continuously monitored for wire breaks and 47 wire breaks have now been confirmed to date. Some down time on parts of the system has been experienced due to the necessity of installing the dehumidification system. Work on reinstating those parts of the system affected is starting on site shortly.

3.2 Main Cable Dehumidification

Both cables have now been wrapped and the three access platforms have been removed from the bridge. All three dehumidification plant enclosures have been placed in the gap between the carriageway and footpath under the west cable. Installation of the monitoring sensors to establish the exhaust relative humidity levels has now been completed. Dehumidification of the west cable which started in March 2008 is producing the expected slow and steady fall in the relative humidity within the cable. Substantial completion of the project, including commencing the dehumidification of the east cable is still on programme to be the end of October 2009.

As has been previously reported to Members, dehumidification is a well-tried system of preventing corrosion of steel and is already in use in the anchorage chambers of the bridge. 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 existing bridges in Japan, Sweden and Denmark where corrosion has been uncovered but at an earlier stage than on Forth. 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 unconditional assurance to be given that this will prevent a further reduction in strength loss in the main cables at Forth.

3.3 Main Cable Internal Inspection

Three panels on the east cable were opened in early 2008 (two of which were opened previously in 2004) and, as reported to Members, whilst the main cable was found to have suffered further strength loss due to corrosion, the rate of loss of strength was not as great as had been predicted in 2004.

Further internal inspections have been allowed for in the Capital Plan, the first of these is programmed for 2011/12 and work will be starting soon to engage the consulting engineer to take forward this work. However, it should be noted that should the relative humidity within the cables fall more slowly than expected then this inspection date may have to be delayed.

As reported, the 2011/12 internal inspection of the main cable will allow another point to be plotted on the cable strength loss versus time graph and be the first indication of the effectiveness of the dehumidification system.

Unfortunately, there seems to be some expectation that the 2011/12 inspection will produce significantly better data than we currently have in predicting the strength of the cable. This is not the case. As stated, we will have another point on the strength loss versus time graph but it will be another indicator only. Of course, it will be important and will give more confidence but should not be described as significantly better data. Further points in the future, post 2011/12, will need to be obtained to further increase confidence levels in the capacity of the cables. It is almost certainly the case that some degree of uncertainty concerning the magnitude of future strength loss of the main cables will remain and the cables will require to be continually monitored, and be subject to a regime of internal inspections and strength evaluations, for the remainder of the service life of the bridge.

3.4 Anchorages Investigation

Work on the tender documents for this investigation is continuing but further work on the statistical approach is being developed. In addition, a Peer Review Panel has been appointed to carry out a high level overview of the project. It is now likely that work will not start on site until 2012/13.

3.5 Tower Impact Strengthening

The background to this scheme is that is has been recognised that there is a risk that the main towers could suffer an impact from an errant HGV resulting in structural damage. Recent work carried out by the Highways Agency in England has re-evaluated the loads that can be applied by an errant HGV impacting on highway structures, recommending that they be doubled in specific instances. The existing barriers at the towers are the original construction and would be ineffective in protecting the towers against the new impact loadings. However, it should be noted that as far as can be ascertained these new loads have not yet been incorporated in technical memorandum.

It must be stressed that the risk of this type of collision occurring has a low probability and no reports of this type of incident occurring at towers on other bridges in the UK or elsewhere in the world have been uncovered. Flint and Neil, consulting engineers, have been engaged to carry out a study to look at the possibility of strengthening the towers locally and upgrading the existing barrier. From the initial evaluation it appears that due to the geometry, and the capacity of the towers and adjacent deck, only a limited amount of additional protection to the towers could be installed.

Given the above, this scheme is being reviewed and a further report will be brought to the Board in the near future.

3.6 Localised Wind Barriers at Main Towers

This scheme is also still at feasibility stage. A check is being carried out on the effects of the barriers on the lateral thrust bearings and wind bracing at the main towers. Once these checks have been completed a report will be brought to Members early in 2010. If the checks are favourable it is hoped to start on site in 2011.

3.7 Parapet and Barrier Replacement

Following the success of the testing programme on the suspended span parapets and barriers, work is continuing to determine whether or not some minor insitu modification need to be made to the parapets and barriers.

Preparation of the testing programme to determine whether or not the viaduct parapets will need to be replaced has now started and updated reports will be brought before Members as testing work develops.

3.8 Replacement of Main Expansion Deck Joints

Tenders have been submitted for fabrication of the failsafe devices and the replacement springs, bolts and other ancillary components have been purchased. Installation will be carried out during the next 18 months by the maintenance team.

The Underdeck Access Platform tenders have been returned and the tender will be awarded shortly. It is expected that the platform will be fabricated and erected by the end of 2010.

3.9 Replacement of Viaduct Bearings

Tender documents were issued on 5 October to six contractors and tender return and evaluation is expected to be completed to present for approval at the December 2009 Board Meeting. Works on site are programmed to start in April 2010 and take three years to complete.

3.10 Resurface Viaducts and Approaches

Following a tendering exercise, W A Fairhurst have been appointed as consulting engineers to design and supervise these works on site. As a first stage a study and trials will take place to determine the most suitable system of waterproofing and surfacing to apply to the viaducts. The resurfacing work on the viaducts is currently scheduled to take place in 2012/13. However, following the trials a decision will have to be taken, given the future use of the bridge, on the most suitable course of action. A full waterproofing and resurfacing scheme would involve weekend carriageway closures.

The resurfacing of the north rock cut will have to take cognisance of the Forth Replacement Crossing tie in and is likely to be limited to overnight wearing course removal and reinstatement.

3.11 Resurfacing Main and Side Spans

An allowance has been included to resurface the main span Southbound in 2013/14 and similarly on the Northbound in 2016/2017.

3.12 Main Tower Painting

Painting of the south tower was completed in 2008 and work on site to erect the dropped object canopy at the north tower is underway using overnight carriageway closures. Full bridge closures will also be required although these will be both limited in number and duration. Erection of the dropped object canopy, and the modifications and independent check on the tower painting platform, are all expected to be complete to allow painting of the north tower above deck to be carried out in 2010.

The dropped object canopy will be dismantled upon the completion of the of the north tower painting above deck and this will also be the last stage of the main tower painting project.

3.13 Suspended Span Painting

The scheme to replace the protective coating system on the stiffening truss has been put back until there is confirmation on the outcome of the de-humidification scheme. Should it become necessary to replace or augment the main cable it is likely that significant structural modification would be required to the truss.

3.14 Suspended Span Truss Assessment

The assessment work has now been completed and an independent check is nearing completion. Possible strengthening work on the truss has also been put back until there is confirmation on the outcome of the de-humidification scheme.

3.15 Truss End Links

The assessment work has now been completed and an independent check is being carried out. Upon completion of the independent check, procurement of the consulting engineer to design the scheme will be followed by procurement of a contractor to carry out the work. The programmed start date for work on site is now 2011/12.

3.16 Cable Band Bolts

The investigation work into the cracking of the cable band bolt nuts being carried out by consulting engineers, Aecom, has been delayed partly due to the discovery of another cracked nut in June 2009 bringing the total found to ten. Further laboratory testing is underway which will be complete by the end

of October 2009. It is now expected that a report will be brought to the December 2009 Board meeting.

3.17 Improvements to deck half joints

The existing half joint detail causes significant maintenance problems as well as increased loads on the deck and poor ride quality for users. There have been several attempts in the past to try to reduce the problem within the traffic management constraints of minimising delays to users. These past efforts have helped but have not eliminated the underlying problem. Following work carried out between consulting engineers Fairhurst and FRB's own staff a new detail has been identified and a prototype design has been prepared by Fairhurst which is now programmed to be installed in 2011/12. Once installed the prototype will be monitored and if successful will allow a decision to be taken on whether or not to proceed with replacement of the detail on all of the 192 half joints as part of the truss strengthening/ painting scheme.

3.18 High mast Lights

The lighting in the plaza area is provided by four high mast lights and ancillary peripheral lighting columns. The high mast lights were erected in 1977 to serve the newly widened toll plaza. These lights are now proving difficult to maintain and consulting engineers, Atkins, have been appointed to carry out a structural assessment of the masts and a lighting survey to determine whether to retain the existing layout or replace it a new system. Included in this survey will be an environmental assessment.

3.19 Replace weigh in Motion System

The primary function of the weigh in motion system is to help establish a Bridge Specific Loading for the bridge. Under national technical standards, long span bridges such as Forth can use a Bridge Specific Loading rather than adopt the usually more onerous national assessment standard load. However, its use is governed by the need to check the loading every two years.

The weigh in motion system works by dynamically weighing each and every vehicle that crosses the bridge in both directions. The system can also used to classify and count vehicles to in order to provide traffic statistics

The existing system was installed in 2000 in the north rock cut, set within both northbound and southbound carriageways. Similar systems were installed on the M74, Erskine Bridge, Tamar and Tay Road Bridges. All these systems were based on dynamic weigh pads installed in the carriageway. Unfortunately, these plates have proved to have a short service life and have had to be replaced or reinstated in both carriageways. The resulting downtime of the system has caused significant problems in both establishing the bridge specific loading and traffic counting.

3.20 Cathodic Protection to Pier Defences

Over the past few years inspection and monitoring of the cathodic protection to the main tower pier defences has highlighted that some of the components

making up the system have broken down. A scheme to repair and refurbish the system is now being prepared and is programmed to commence in 2009/10.

3.21 Suspended Spans Underdeck Access Study

The walkways and access system to the underside of the suspended span decks and steelwork located just below deck level was installed in 1983. This system allowed effective safe access for inspection and maintenance, especially painting. The access system is made up of aluminium boards which span across, and are supported by, the main structural members of the walkways. These boards are moved from one location to another on the bridge by a combination of manual handling and lifting equipment. Improvements in the procedure over the last few years have made inroads into reducing the manual handling element of the work but it is still significant and in some areas it has to be done in less than ideal conditions.

The boards are deteriorating with age and require more maintenance as they get older. In addition, the capacity of the boards and supports have been recently assessed resulting in some operational restrictions having had to be imposed.

Given the manual handling issues, the age and limits on the capacity of the system the study will look at options for replacement or refurbishment.

4. Recommendation

4.1 It is recommended that members note this update on the capital programme.

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Appendices

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Background Papers