

Forth Replacement Crossing

Main Crossing (Bridge) Scheme Assessment Report Development of D2M Alternatives

**Report on Scheme Development
October to November 2008**

No part of this report may be copied or reproduced by any means without prior written permission from Jacobs Arup – Jacobs UK Limited and Ove Arup & Partners International Limited Consortium. If you have received this report in error, please destroy all copies in your possession or control and notify Jacobs Arup.

This report has been prepared for the exclusive use of the commissioning party and unless otherwise agreed in writing by Jacobs Arup, no other party may use, make use of or rely on the contents of this report. No liability is accepted by Jacobs Arup for any use of this report, other than for the purposes for which it was originally prepared and provided.

Opinions and information provided in the report are on the basis of Jacobs Arup using due skill, care and diligence in the preparation of the same and no warranty is provided as to their accuracy.

It should be noted and it is expressly stated that no independent verification of any of the documents or information supplied to Jacobs Arup has been made.

Contents

Bibliography and Workstream Timeline	1	6	Assessment of Tower Options	23
1 Introduction	2	6.1	General	23
1.1 Background to D2M Option	2	6.2	Mono-Tower	23
1.2 Multi-Modal Base Case	2	6.3	H-Shape Tower	26
1.3 Dual 2 Lane Configurations Studied	2	6.4	Diamond Tower	27
1.4 Development of Scheme Options	3	6.5	A-Shape Tower	28
2 Description of D2M Options	4	6.6	Assessment of Options	28
2.1 General Arrangement	4	7	Assessment of Options for Approach Spans	31
2.2 Functional Cross Section	4	7.1	Deck	31
2.3 Deck Type	4	7.2	Piers	31
2.4 Tower Forms	5	7.3	Assessment of Options	32
2.5 Approach Bridge Type	6	7.4	Conclusion	33
2.6 Foundations	6	8	Construction Methods and Programme	34
3 Key Issues and Assumptions	8	8.1	Construction Methods	34
3.1 Crossing Stays	8	8.2	Construction Programme	34
3.2 Consideration of longer main spans	8	9	Durability, Inspection and Maintenance	35
3.3 Live Load	8	9.1	Durability	35
3.4 Ship Impact	8	9.2	Inspection & Maintenance	35
3.5 Other Issues	9	9.3	Lane closures for stay replacement	35
4 Assessment of Functional Cross Section Options	11	9.4	WASHMS	35
4.1 General	11	10	Preliminary Consideration of Anticipated Departures From Standard	36
4.2 Alternative Functional Cross Section Arrangements	11	10.1	Use of Eurocodes	36
4.3 Assessment of options	11	10.2	Post-tensioned grouted ducts	36
5 Assessment of Deck Type Options	12	10.3	Orthotropic deck stiffness	36
5.1 Single Box Girder	12	10.4	Ship Impact	37
5.2 Twin Box Girder	17	11	Conclusions and Recommendations	38
5.3 Ladder Beam	19	11.1	Assessment of Scheme Options	38

11.2 Recommended Options for Further Development	42
Appendix A - Multi-Modal Base Case Drawings	43
Appendix B - D2M Feasibility Studies	44
Appendix C - Architectural Figures	45
Appendix D - D2M Scheme Assessment Drawings	61
Appendix E - Construction Programmes	63

Bibliography and Workstream Timeline

As highlighted below, this is the seventh of a series of reports which cover the project development work carried out during 2008, following completion of the Forth Replacement Crossing Study during 2007.

Ref	Report Title and Work Period	Report synopsis
1.	<i>Forth Replacement Crossing Study Report 5: Final Report</i> <i>Work pre-June 2007.</i>	Report on work undertaken by Jacobs and Faber Maunsell to June 2007 to assess the options for a replacement crossing which recommended that a cable stayed bridge in 'Corridor D' – a crossing point immediately upstream of the Forth Road Bridge - be taken forward as the best overall performing option.
2.	<i>Forth Replacement Crossing Route Corridor Options Review:</i> <i>Work carried out by Jacobs Arup, January to May 2008.</i>	Report to assess 9 mainline connecting road corridors: three in the Northern Study Area and six in the Southern Study Area. It recommended that two of the northern and two of the southern corridor options be taken forward for further assessment.
3.	<i>Forth Replacement Crossing DMRB Stage 2 Corridor Report:</i> <i>Work carried out by Jacobs Arup, May to August 2008.</i>	Report on the assessment of the shortlisted corridor options and a supplementary assessment of a variant version of a connecting road corridor in the Southern Study Area. The report recommended that work continue to identify in detail the optimum road improvement within Corridor Option 1 North and Corridor Option 1 South.
4.	<i>Forth Replacement Crossing, Main Crossing (Bridge) Scheme Assessment Report, Development of Options:</i> <i>Work carried out by Jacobs Arup, January to August 2008.</i>	Report on the assessment of options for the outline design of the replacement crossing.
5.	<i>Forth Road Bridge – Feasibility of Multi-Modal Corridor:</i> <i>Work carried out by Jacobs Arup, August to October 2008.</i>	Report on the feasibility of utilising the existing Forth Road Bridge for non motorised and public transport/light road traffic, including for a potential future guided bus/tram/ light rail facility. The report concluded that this would be a feasible option.

6.	<i>Forth Road Bridge - Audit of Feasibility of Future Multi-Modal Use - Summary Report</i> <i>Work carried out by Faber Maunsell to November 2008</i>	Independent summary of review on the Jacobs-Arup assessment of the feasibility of utilising the existing Forth Road Bridge for non motorised and public transport/light road traffic, including for a potential future guided bus/tram/ light rail facility. The report concluded that the Forth Road Bridge could, in principle, be adapted for future LRT
7.	<i>Forth Replacement Crossing, Main Crossing (Bridge) Scheme Assessment Report, Development of D2M Alternatives:</i> <i>Work carried out by Jacobs Arup, October to November 2008.</i>	Report on the assessment of options for a narrower replacement crossing to carry a dual carriageway road with hard shoulders.
8.	<i>Forth Replacement Crossing, Scheme Definition Report.</i> <i>Work carried out by Jacobs Arup, July to November 2008</i>	The final report on the project planning work carried out during 2008 which provides recommendations of the road connections and the incorporation of the Forth Road Bridge as an integral element of the proposals for use by pedestrians, cyclists, public transport and any future multi-modal facility.