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PS/ *Secretary of State for Industry*

13 November 1981

Miss Caroline Stephens
Private Secretary to the
Prime Minister
10 Downing Street
London SW1

Dear Caroline

PRIME MINISTER'S MEETING ON THE CHANNEL TUNNEL

The Department of Transport are providing briefing for this meeting to which we have contributed. Since preparing our briefing we have seen - as a result of your kind intervention - a copy of the note for the meeting prepared by BSC. The Prime Minister may find it helpful to have some comments on the note prepared by Department of Industry officials.

2 The Annex to the BSC paper, describing EuroRoute's effects on the UK steel industry, is satisfactory as far as it goes and confirms that the implications of the scheme for employment and profitability at BSC would not be dramatic. The Annex, however, contains not a word about the alternatives to EuroRoute. Any steel-intensive scheme, whether EuroRoute or one of the two bridges, would bring some benefit to BSC. As sponsors of EuroRoute, the Corporation have no interest in drawing attention to the point but it is one which the Prime Minister will wish to have in mind during the discussion with Mr MacGregor.

3 There is one new point in BSC's paper worth noting. The Introduction records that British Shipbuilders (BS) are amongst the "financial subscribers" now associated with the scheme. Officials do not know the precise nature of BS's involvement but the reason for the link is that EuroRoute would involve work at shipyards. BSC themselves estimate that:

SECRETARY OF STATE FOR INDUSTRY

a assembly of deck units would employ 100 men for 4 years at each of 6-8 sites, some of them shipyards;

b a further 6-8 sites would be required for assembly of tunnel units, each of which would employ 150 men and would almost certainly be based on existing shipyards with launching slipways;

c if the tunnel sections of EuroRoute were built of steel tubes rather than reinforced concrete, assembly of the tubes would put still more work to the shipyards.

(a) and (b) alone could entail firm employment in shipyards for between 1,000 and 2,000 men over 4 years, although the extent to which these jobs would be additional is not at present clear.

Yours sincerely

Ian Ellison

IAN ELLISON
Private Secretary

DEPARTMENT OF TRANSPORT
2 MARSHAM STREET LONDON SW1P 3EB

B/F 16/11/81

Miss C M Stephens
Private Secretary to
the Prime Minister
10 Downing Street
LONDON
SW1

12 November 1981

Dear Caroline,

Thank you for your letter of 24 September about the Prime Minister's meeting with Mr MacGregor and Sir John Howard on 17 November to discuss the fixed Channel link. I attach two copies of a brief for the Prime Minister.

I confirm that Mr Howell will be attending the meeting. I am sending a copy of this letter and enclosure to Ian Ellison and David Wright.

Yours,
Anthony Mayer

R A J MAYER
Private Secretary

EUROROUTE: BRIEF FOR PRIME MINISTER'S MEETING WITH MR MACGREGOR BSC. 17 NOVEMBER 1981

BACKGROUND

EuroRoute

1. EuroRoute is a Group set up by Redpath Dorman Long (a BSC subsidiary) and Sir Robert McAlpine & Sons Ltd. It is advised by Lazard Brothers (on finance) Mott, Hay & Anderson (on engineering) and Coopers & Lybrand (on traffic and revenue). Mr MacGregor, Chairman of BSC, originated the EuroRoute scheme for a fixed Channel link. His interest stems largely from involvement in the Chesapeake Bay crossing, a similar scheme built in the USA. He discussed it with the Secretary of State (Mr Fowler) on 11 February. A note on BSC's involvement is at Annex A. Sir John Howard is an engineer who has also shown a keen interest in the proposal.

The Scheme

2. The EuroRoute project (March 1981) is one of eight schemes submitted, and proposes a combined viaduct bridge and immersed tube for road and rail. Twin viaducts from the English and French coasts span inshore shipping lanes carrying roadways to artificial islands (where frontier controls would be located) at the edges of the main shipping lanes (8 - 10 km out). The roadways then continue in immersed tubes alongside a railway which is in immersed tube throughout. The railway is an essential part of the ventilation for the road. Three ventilation islands are needed as well as the two main islands.

Cost

3. EuroRoute estimates that the link, including road infrastructure at portals would cost about £3,800M at mid 1980 prices (nearly £4,000M at Jan 1981 prices). This estimate excludes the cost of rail facilities at portals, rolling stock, and inland road and rail infrastructure which could add more than £500M to the total cost (Jan 1981 prices).

Traffic

4. The proposed link would cater for all types of road and rail traffic, for which EuroRoute gives the following estimates for traffic in 2000:

rail passengers (m. crossings)	10
passengers with cars (m. crossings)	9.1
rail freight (m. tonnes)	4.2
road freight (m. tonnes)	8.6

Finance

5. The promoters are confident of their ability to raise private finance, including provision for overruns but have not specified likely sources. The amount of equity would be small, though some loan finance might involve a degree of participation in profits. Government indemnities covering political cancellation, delay in provision of public sector infrastructure, interference in commercial operation and changes in the tax laws would be required.

Current Position

6. ~~Mr Fowler~~ Earlier in the year it was hoped that a decision in principle on a fixed Channel link might be reached by the end of 1981, but initial discussions with French officials suggest that the French Government may need a little longer. Some provisional conclusions should be reached in early 1982 but it is not yet possible to be certain how detailed these will be. Mr Howell's minute of 27 October (at Annex B) gives the background.

Provisional DTp View of Scheme

7. The proposal is very ambitious, but well thought out and presented. EuroRoute's financial and engineering consultants are amongst the best in the world, and much detailed planning has gone into the scheme. However, the scheme combines the practical problems of bridges with those of immersed tubes in difficult location; bored tunnels would avoid these difficulties but could not provide for direct road transit.

There would be serious navigational problems. The Channel is the world's busiest international waterway. During construction, the laying rigs for the tubes would be stationary and huge prefabricated sections would be on tow in the Channel. Once completed, the inshore viaducts (which could not economically be proofed against every type of collision damage) and artificial/ventilation islands would pose a serious permanent hazard to shipping, Reaching an international agreement on the placing of obstructions in the Channel would involve lengthy and complex negotiations. There are no precedents for dredging and laying tube sections at such depths and in such weather conditions. No equipment capable of doing this work exists. The scheme is costly and there is a high risk of time overrun, caused by the need to develop special equipment, carry out extensive geological surveys and undertake complex negotiations (within the Inter-Governmental Maritime Consultative Organisation). There is a significant risk of a shipping incident during construction. Should the structure be abandoned before completion, or damaged thereafter, obstructions in the Channel would have to be removed which might cost as much as had been spent up to that time. Since the company might not be able to pay for removal or repair, or arrange insurance, liability could well fall on the two Governments.

8. Much of the inspiration for this scheme comes from the Chesapeake Bay crossing in the USA. While it is of similar scale, there are several important differences between this crossing and the proposed Channel Link. Chesapeake Bay is within US national waters, it is relatively shallow and lightly trafficked, mostly by US Navy ships. (It has, nevertheless, been hit 5 times since being opened.) The Chesapeake Bay crossing is not thought to operate profitably.

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we are checking

Views of the Department of Industry

9. Annex A sets out Department of Industry's views as BSC sponsor. In summary three of the schemes under consideration are steel intensive -

EuroRoute itself, and two bridge schemes. The remaining options, mostly bored tunnels, would use much less steel but would provide some welcome business to BSC. In every case we must assume that at least half the steel would come from France. The relative shares of UK orders taken by BSC and by private steel makers depends on the types of steel required, but BSC would expect to gain 80-95 per cent of the orders for EuroRoute (but rather less for either of the bridges).

10. All three schemes would help to safeguard jobs and improve profitability in BSC and, to a lesser extent, in the private sector. But the effects would not be dramatic. If BSC gained the maximum share of steel orders for EuroRoute, that might safeguard about 400 jobs over 5 years in BSC (but not create new ones) and might add upt to £5M a year to the Corporation's profits. These results would be proportionately reduced for the less steel-intensive schemes.

11. The effect on Redpath Dorman Long, BSC's constructional steelwork subsidiary, would be welcome. It is a prime candidate for privatisation, and the prospects of a major flow of new work would improve the likelihood of privatisation if current negotiations for a merger with Trafalgar House fell through.

EuroRoute Publicity

12. EuroRoute has conducted a well managed publicity campaign, concentrated largely on the scheme's direct effect on the UK economy, and in particular, on employment. EuroRoute claims that about 100,000 jobs could be created for 4 or 5 years in the UK alone, largely in depressed areas where the structure might be prefabricated. EuroRoute has done some fairly intensive lobbying in Parliament and maintained contact with officials (including French officials).

LINE TO TAKE

13. EuroRoute should not be offered any direct encouragement in view of the British doubts as to practicability and cost and the French Government's need to consider further.

14. Hence, the Prime Minister is recommended to give Mr MacGregor's presentation a full hearing and to assure him that bilateral discussions with the French will consider all available options, including EuroRoute, and in particular, none of the schemes submitted to the Secretary of State will be excluded from the joint study.

15. As to timing, Mr MacGregor might be reassured that HMG and the French are pressing on with the fastest practicable timetable, but that we might need a little longer than the rest of 1981 in which to reach some decisions of principle.

POINTS TO MAKE

16. Technology: This is a very ambitious scheme, some elements of which stretch the limits of existing technology (dredging and laying tubes at these depths and in such exposed and busy waters). Why is such an option considered preferable to one of the simpler options such as either a bored tunnel or a straightforward bridge?

17. Employment: EuroRoute claims that 100,000 jobs would be created in the UK alone. Would a further 100,000 jobs be created in France? Can we be sure that the prefabricated tunnel and viaduct sections will be made in the UK? What longer term employment gains and losses have been estimated following completion?

18. Capital Costs: What is the likelihood of serious time and cost overruns? How does the possibility of cost overrun affect the raising of finance?

19. Timetable: Discussions with the French have recently begun and a final decision will therefore take rather longer than originally expected. How does this fit in with EuroRoute's timetable for developing the scheme and raising the finance?

20. Monopoly: Unlike some smaller scale options (particularly the single track rail 6 metre tunnel), this form of link might establish a dominant position in the short sea market. Any disruption of services through the link would thus have very serious consequences. Why should the two Governments put all their eggs in one basket? Has EuroRoute any detailed thoughts on the degree of Government pricing control that might be necessary in the link's operation?

21. France: How strong is support in France? What benefits would accrue there?

CONCLUDING REMARKS

22. Mr MacGregor and Sir John Howard might be thanked for their presentation and reassured that a decision will be taken by the two Governments as soon as practically possible. They should also be reminded that both Governments will have to contemplate the likely consequences of a fixed link (or of no fixed link) very carefully before that decision is reached.

ANNEX A

IMPLICATIONS FOR THE UK STEEL INDUSTRY OF EUROROUTE AND THE MAIN ALTERNATIVE SCHEMES.

A. Tonnages of steel required

1. EuroRoute and the main alternative schemes would take about 5 years to construct. Steel usage would be spread fairly evenly over the period. French producers would be likely to supply up to half the steel required. On this basis, the schemes compare as follows:

TONNES OF FINISHED STEEL

SCHEME:	Euroroute	Bridge A— "Eurobridge"	Bridge B— "Link into Europe"	Twin 7 metre rail tunnel	Single 6 metre rail tunnel
PROJECT LEADERS:	BSC/Redpath Dorman Long	Pell Frieschman/ Sir Frederick Snow	Freeman Fox and Partners	"Channel Tunnel Developments 1981" Consortium— Wimpey/Tarmac	British Rail/ SNCF
TONNAGES.					
Total tonnage	900,000	900,000	550,000	70,000	35,000
Total UK share	500,000	450,000	275,000	35,000	17,500
Annual UK share	100,000	90,000	55,000	7,000	3,500

B. EuroRoute: type and source of steel required

2. There are three possible ways of building EuroRoute. The bridge viaducts for carrying road traffic to and from the off-shore islands would be a constant factor, requiring 35,000 tonnes of steel plate a year from BSC (the UK private sector steel producers make virtually no plate).

3. But the submerged sections - the 36 kilometre rail tunnel, and the twin road tunnels running for 19 kilometres between the offshore islands - could be built either of:

(a) concrete reinforced with steel; or

(b) tubes made from steel plate; or

(c) a mixture of the two.

4. While the choice would not markedly affect the total tonnage of steel required for the scheme, it would dictate the relative use made of reinforcing steel and steel plate. And, because the UK private sector steel makers (principally Sheerness Steel, Manchester Steel, and Allied Steel and Wire) are involved in producing the former but not the latter, it would in turn affect their potential share in the project. The estimated effect is as follows (all figures approximate):

TONNES OF FINISHED STEEL PER YEAR

Type of steel	Scheme (a) (Reinforced concrete)		Scheme (b) (Steel tubes)		Scheme (c) (Mixture)	
	BSC share	Private Sector	BSC share	Private Sector	BSC share	Private Sector
Plates - viaduct bridges:	35,000	-	35,000	-	35,000	-
Plates - steel tubes:	-	-	38,000	-	8,000	-
Reinforcing steel:	32,500	17,500	7,800	4,200	27,300	14,700
Other (share unallocated):	15,000		15,000		15,000	
Total:	100,000		100,000		100,000	

Scheme (a) (Reinforced concrete)		Scheme (b) (Steel tubes)		Scheme (c) (Mixture)	
BSC share	Private Sector	BSC share	Private Sector	BSC share	Private Sector

PERCENTAGE OF SUPPLIES*

79%	21%	95%	5%	83%	17%

* Excluding quantity under "Other (share unallocated)".

5. Comparable estimates for the other main schemes are not available. But the basic amount of BSC-supplied steel plate required for viaduct bridges in all three variants of EuroRoute (35,000 tonnes per annum) would be more or less matched by the tonnage needed for towers and bridge decks in either of the Bridge schemes (at about 30,000 tonnes per annum). In addition, the two Bridge schemes would require, respectively, 60,000 and 25,000 tonnes per annum of UK-produced steel wire. Private sector UK steel firms-in particular, GKN, Bridons, and Allied Steel and Wire - would stand to gain the bulk of the orders, with BSC benefitting as well through supplying the second and third of those firms with the necessary basic steel.

C. Effect of EuroRoute and alternative schemes on employment in the steel industry

6. The three variants of EuroRoute would provide firm employment in BSC for 300-400 men over the 5-year period. Of the alternative schemes, Bridge A would have much the same effect; Bridge B about half that; and the rail tunnels very little indeed. The effect of any of the schemes on employment in the private steel sector is difficult to estimate at present but would be less than for BSC.

7. The jobs involved in BSC (and in the private sector) would probably not be additional - the extra tonnage required would not warrant bringing on additional plant or shifts. Depending on the plant loading position, the tonnage might simply replace less profitable export orders.

D. Effect on BSC's plants

8. For EuroRoute scheme (a), based on reinforced concrete tunnels, the extra throughput of steel plate would benefit Scunthorpe, Hartlepool and the Scottish plate mills. It would represent about 5% of BSC's annual capacity to produce plate. In reinforcing steel, the throughput would represent about 3% of Scunthorpe's annual production of the billets from which reinforcement steel is made.

E. Effect on BSC's profitability

9. The effect would depend on whether the steel required for EuroRoute (or for one of the other steel-intensive schemes) represented additional production by BSC or was used as a substitute for less profitable export orders. The former would maximise the benefits, though either would help to improve profitability by guaranteeing a firm level of orders over 5 years. But the effect should not be exaggerated. Even if BSC were assumed to supply all the steel required for the two most steel intensive projects (EuroRoute and Bridge A) - and, as noted above, the UK private sector would in fact take a share - then increased profits in the range £10-£50 per tonne of steel supplied would increase BSC's profitability by only about £1-£5 million per year. While a useful sum, such a range would not have a dramatic effect on BSC's overall results.

F. Effect on Redpath Dorman Long Ltd (RDL)

10. RDL is BSC's constructional engineering subsidiary and the joint leader, with BSC itself, in the EuroRoute consortium. It lost £7 million in 1980/81 on a turnover of £83 million. As one of BSC's peripheral businesses, it is a prime candidate for privatisation.

11. Although its recent unprofitability coupled with the effects of the recession on its prospects have made a sale difficult, negotiations are now in progress for a merger with Trafalgar House (the details of which have yet to be completed). Construction of EuroRoute would involve RDL as a fabricator of steel for the viaduct bridges, as well as for the tunnel units to the extent that these were made from steel plate rather than reinforced concrete. In addition, RDL would stand to participate in the overall project management and to act as sub-contractor for civil engineering projects on and off the construction site. The capacity of the company would probably have to be increased to cope with the extra work. Intensive use of RDL's facilities, coupled with a regular and increased throughput of standardised construction work, would do much to restore RDL to profitability.

Iron and Steel Division
Department of Industry
10 November 1981

ANNEX B

Prime Minister

CHANNEL LINK

The purpose of this minute is to inform you of developments since your meeting with President Mitterand on 10-11 September and to indicate how I see matters developing.

Contact with French officials, including a senior member of M Fiterman's "cabinet", was established very quickly. They have been friendly and constructive - even enthusiastic. But they are not inclined to rush matters. They emphasise - and here they are reflecting the general philosophy of the new administration - the need for a thorough study of regional, employment and other social effects in full "concertation" with local interests. They have made it clear that is is not possible given their late start to reach a decision in principle by the end of the year as my predecessor had hoped. They suggest that, by February of next year, it should be possible to narrow down the options for detailed study but no more.

This would make it difficult to have legislation - probably a rather complex hybrid bill - ready for the 1982/83 session. We shall have a clearer view at official level, of the French position on 28 October. I shall be meeting M Fiterman at dinner the same evening and will pursue this with him further.

Meanwhile on our side we are pressing ahead with our studies on a timescale which would enable us to hold to that objective. I expect to receive a report from Sir Alec Cairncross, my special adviser, in the next few weeks. Complementary studies by my own officials will be completed around the same time. I intend, very shortly

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thereafter, to concentrate my own thinking on a very short list of schemes - at least for a first phase in the development of cross-channel links: the French are putting emphasis on the need to build potential for development into any modest beginning.

French ideas on finance for their half of the project are limited at the moment to the public sector, although not to central government. There could be problems here in arranging a proper balance of powers and rights with an exclusively private consortium on this side of the Channel. The prospects of financing the UK half of the project without any risk whatsoever to Government funds remain, both for this and other reasons, less clear than I would like and it will be important to avoid commitment until the issues on this are clarified. Concentrating the thought - and competition - of promoters on a narrower range of schemes should help with this problem.

I will keep you informed of developments and as the next step will let you know the outcome of my conversation with M Fiterman on 28 October.

I am copying this minute to the Chancellor of the Exchequer, the Foreign and Commonwealth Secretary and to the Secretaries of State for Trade and the Environment.

DH

D H

27 October 1981

EuroRoute

Road and Rail Channel Crossing

Proposal in brief

May 1981

EUROROUTE

PROPOSAL IN BRIEF

CONTENTS

1. INTRODUCTION

The EuroRoute Proposal for a combined road and rail fixed Channel crossing is put forward by a consortium at present led by the British Steel Corporation and Redpath Dorman Long Limited. A Joint Venture of firms is at present being formed.

The advisers to the Group, who have been involved in the preparation of the Proposal, are:

Finance	-	Lazard Brothers & Co., Limited
Engineering Studies	-	Mott, Hay & Anderson
Traffic & Revenue	-	Coopers & Lybrand Associates, Limited

The EuroRoute crossing will be of major and practical benefit to the U.K. and her European partners. The design is the single most effective combination of road and rail facilities. It is planned to meet the current and future needs of business and leisure travel and freight transport between Britain and Europe - the country's largest and fastest growing market. By providing both a road and rail crossing, maximum flexibility of this international asset will be ensured to cater both for future needs and for changes in the relative costs of different methods of transport.

The EuroRoute design has been developed after intensive research and satisfies the various technical problems raised by a fixed cross-Channel link. Built within the scope of available technology, the prefabricated structure will allow work to be spread over a number of locations and then assembled on site, maximising employment opportunities and reducing to a minimum the risks of increased costs and production delays. These factors should assist in the obtaining of private financing and thus contribute to reducing difficult decisions about public expenditure. The EuroRoute offers social and economic advantages without cost to the public purse or to the environment.

At all stages security has been a prime consideration. Security of design, security of financing, protection of the user, safety of shipping and the use of standard construction techniques have contributed to this aim. The provision of road and rail alternatives enables management to be split into two separate entities, preventing problems of monopoly control.

The positive benefits of a Channel crossing are potentially enormous, but to realise them it is essential that any cross-Channel link should provide the most effective access to all users and meet in full the needs of the present and the future. The EuroRoute is the most effective answer to those needs.

The project is described in detail in the document entitled "EuroRoute - Proposal for Road and Rail Channel Crossing", submitted to the Department of Transport in March 1981. The following pages describe the proposal in brief.

2. DESCRIPTION OF SCHEME

The EuroRoute crossing is designed to provide a fixed Channel link for both road and rail traffic.

The crossing incorporates two 2-lane carriageways and two rail tracks. The railway is carried in submerged tube tunnel throughout the crossing. The road carriageways are carried on twin viaducts across the inshore shipping zones of the Channel, and in a common submerged tube tunnel structure with the railway beneath the main shipping lanes. The transition for road traffic from viaduct to tunnel takes place within offshore artificial islands constructed at the boundary of the main shipping lanes.

The overall length of the crossing, excluding onshore approaches, is approximately 36km. The central tunnel section beneath the main shipping lanes is approximately 19km long.

Viaducts rather than tunnels are employed to carry the road across the inshore zones so as to minimise the length in tunnel. This will keep the tunnel section within known limits for driver reaction and allow a sufficiently rapid response time for emergency services.

The twin viaducts will be approximately 1km apart and will each carry one carriageway of the road. This arrangement will ensure that the crossing can be kept open to traffic even in the unlikely event of a ship colliding with one viaduct. Inshore shipping will be served by special navigation openings, at which increased spans and clearances will be provided.

In addition to the main offshore islands at the boundaries of the shipping lanes, three intermediate islands will be constructed to carry ventilation shafts down to the central section of the tunnel. Two of these ventilation islands will be in line with existing sandbanks in the Channel.

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KEY:

- SEPARATION ZONES
- ROADS (SURFACE)
- ROADS (TUNNEL)
- RAILWAY (SURFACE)
- RAILWAY (TUNNEL)
- COMBINED

Km 0 1 2 3 4 5

EUROROUTE

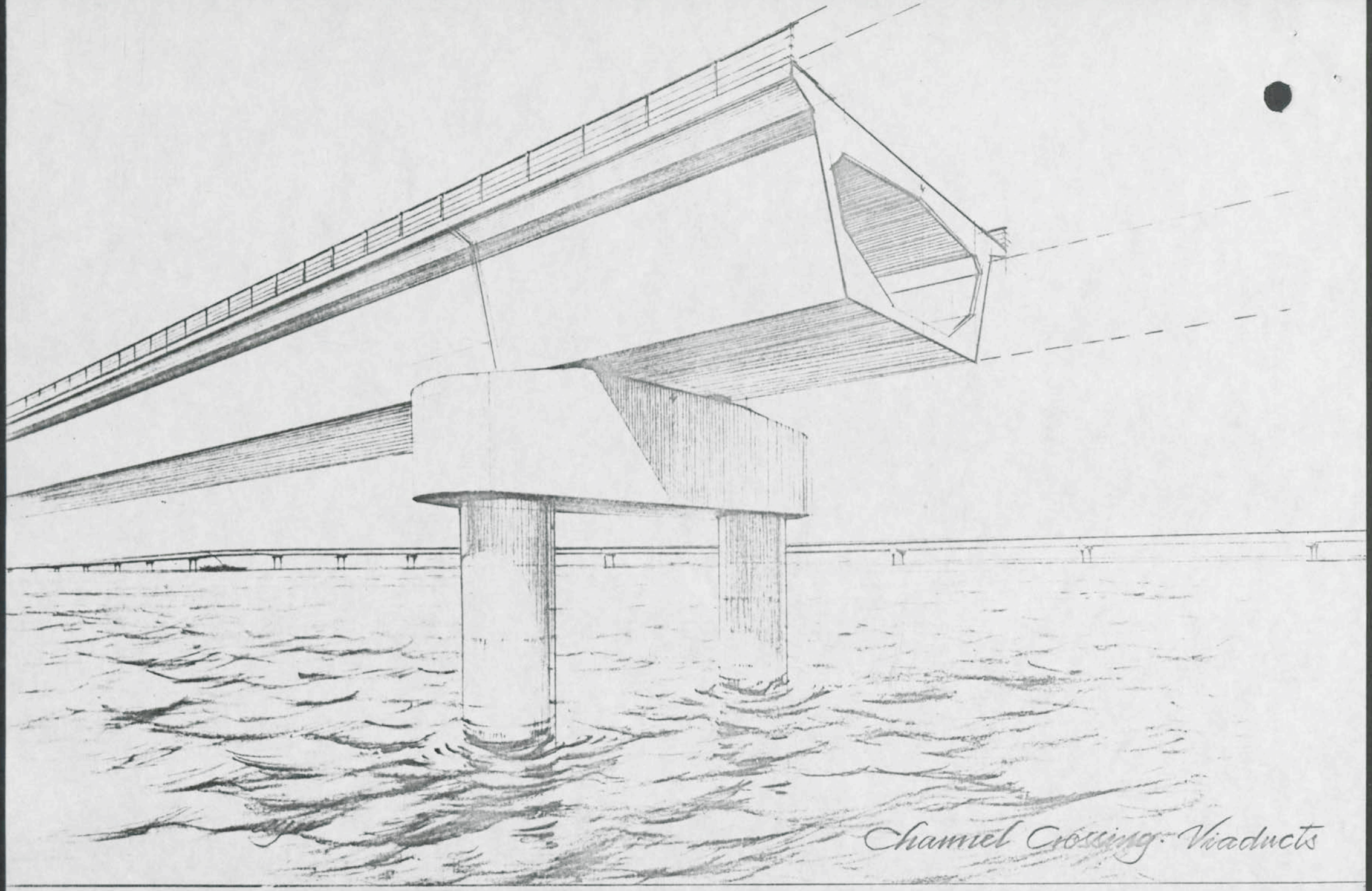
ROAD AND RAIL CHANNEL CROSSING

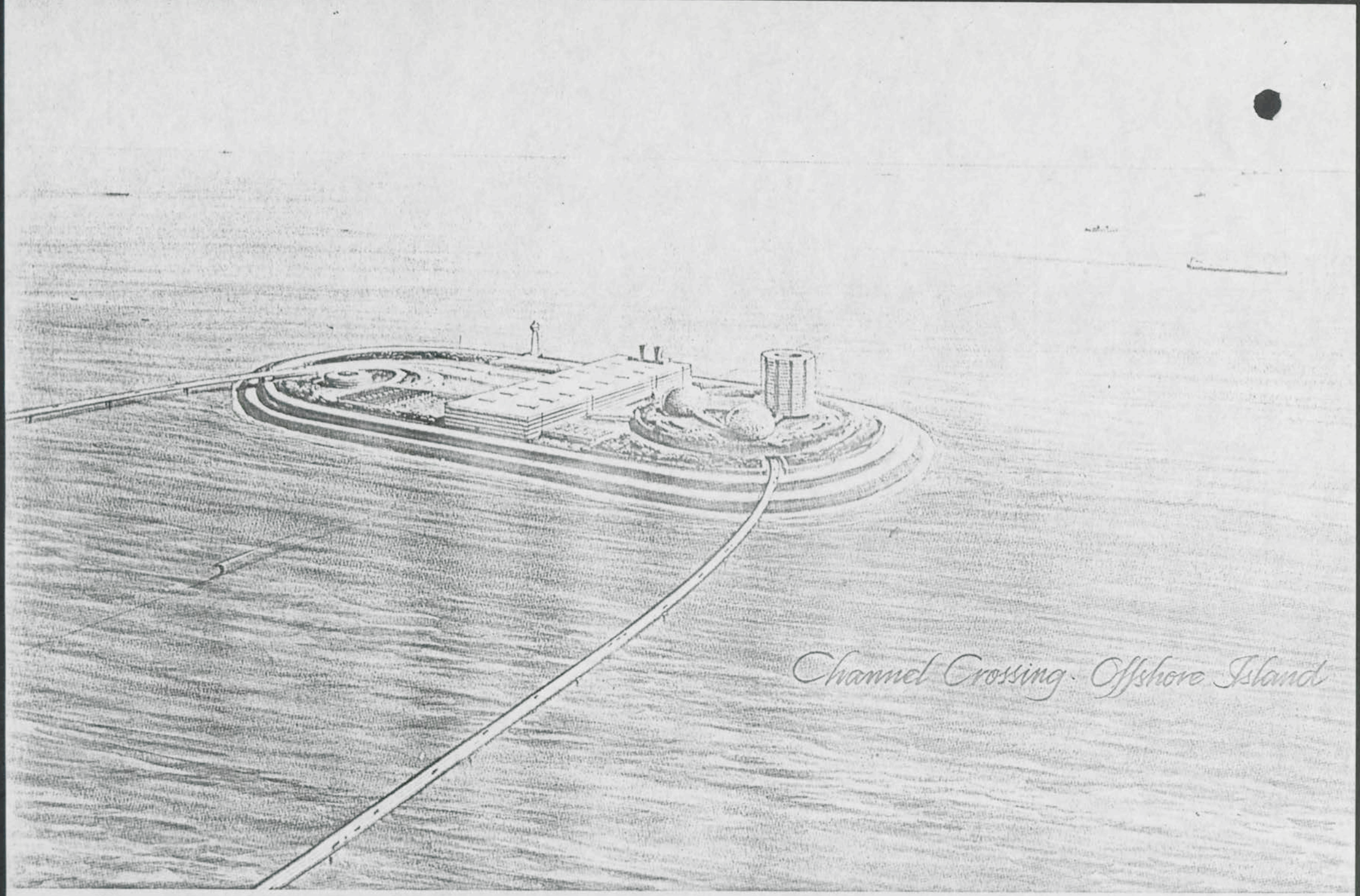
KEY PLAN

Mott, Hay & Anderson
Consultants, London

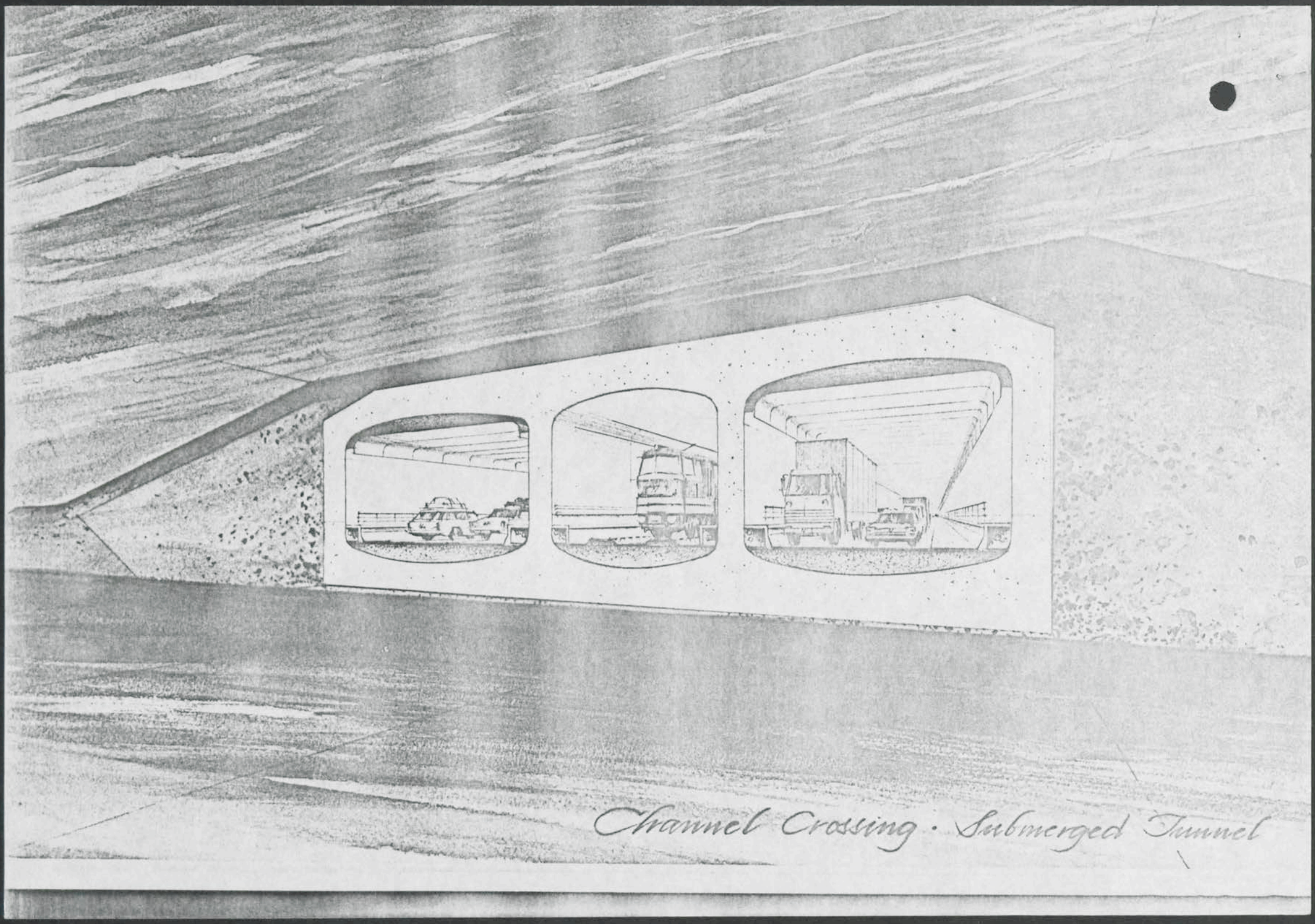
Drawing no. 1

Channel Crossing · Viaducts at English Coast.


Channel Crossing: Viaducts



Channel Crossing - Offshore Island



Channel Crossing · Submerged Tunnel

The alignment has been fixed in principle to give the most suitable connections with existing and planned motorways and railways in England and France, while providing feasible conditions for construction in the Channel (see Drawing No 1).

Proposals at the English coast and inland are designed to have virtually no effect on the environment of Kent. The inshore viaducts reach the coast at low level at Abbot's Cliff, and the road is then carried inland in tunnel as far as the Alkham Valley, where it joins the proposed A20 improvement road between Folkestone and Dover. The A20 will link directly to the M20, and thence to the M25 orbital motorway around London. The railway is carried from the coast to Holywell, just north of Folkestone, in tunnel and will then follow the route envisaged for a rail-only Channel crossing as far as the existing main line between London and Dover.

In England, no major surface roadworks beyond those proposed in the Government's 1980 White Paper on roads will be needed as a result of the crossing.

The present study has not investigated in detail the planning of road and rail links in France, but it is envisaged that no serious difficulties in locating suitable routes to conform with planning and environmental requirements will arise.

The combined road and rail crossing will provide adequate capacity for the foreseeable future as well as considerable operational flexibility.

3. FORM OF CONSTRUCTION

The greatest possible use will be made of prefabricated modular construction. The major benefits of this will be firstly in allowing fabrication to be spread widely over various locations in the U.K. and continental Europe, including existing yards and dry dock facilities (c.f. Fig. 11.1), and secondly in giving a substantially reduced period of construction by allowing work to be carried out simultaneously at many different points.

Modular construction is proposed for the viaducts, submerged tunnels and structural cores of the artificial islands. The large prefabricated units will be brought to the site of the crossing from the fabrication areas by sea.

Road Viaducts

The viaducts consist of a series of simply supported spans, each 125 m long. Piers are formed from large diameter steel or concrete cylindrical piles, driven or drilled into the sea-bed. The piles are connected by a cross-head above water level, which supports the bridge deck units. These units consist of prefabricated steel boxes, with orthotropic plate decks carrying the roadway.

The 125m long bridge deck units will be prefabricated complete at coastal sites or shipyards before being launched, and towed by sea to site. They will then be lifted out of the water, cleaned and painted, and carried by barge to be placed in their final position by floating crane.

The level of the viaducts will be such that the soffits are well clear of the highest predicted wave. The soffit level is currently planned to be 15m above mean high water, subject to detailed consideration of shipping and safety requirements. At the navigation openings for inshore shipping, special spans will be provided. The viaducts will rise locally to give at least 35m clearance above mean high water at these spans.

Submerged Tunnels

Both the rail-only submerged tunnel across the inshore zones of the Channel and the combined road and rail submerged tunnel across the central zone will be formed from 125m long concrete elements, cast individually in special basins. The elements are designed to be buoyant, and are floated on completion by flooding the casting basins. They are then towed to the site of the tunnel by sea.

At the site, the elements are sunk onto a prepared bed and joined to form a continuous tunnel structure. They will be located either on the seabed or in trench below the seabed, depending upon local conditions.

The tunnels will be heavily protected and armoured to ensure that damage from any cause cannot occur.

This form of construction technique has already been adopted in other parts of the world to give an economic method for building sub-aqueous tunnels.

Offshore Islands

Following the considerable experience gained by British contractors with the placing of very large structures in the North Sea, it is proposed that the two main offshore islands and the three

intermediate ventilation islands should be constructed by placing a large central concrete element, forming the island's core, on the seabed. This will then be surrounded with rock and hydraulic fill to form sloping protective flanks to the islands. The flanks will be heavily armoured. In the case of the main offshore islands, these units will be built up from large sub-assemblies, and will contain the spiral ramps carrying the roads between viaduct and tunnel levels. The British main offshore island will be extended by the placing of additional hydraulic fill to give a surface area sufficient for the location of frontier and toll facilities on the island (this will avoid the environmental disadvantages of locating these facilities on the mainland in Kent).

Feasibility of Construction

Initial discussions with the Hydraulics Research Station at Wallingford indicate that hydraulic effects arising from construction of the artificial islands, tunnels and other works in the Channel should not be unduly difficult to deal with, although detailed model testing will be necessary to confirm this.

The plant and equipment required for construction in the Channel are within available technology, and, where not already in commission, may be designed and built in the periods of time allowed in the project programme.

Tunnel Ventilation

The tunnel ventilation system for road traffic will be designed to cope safely with the worst conditions created by exhaust fumes with the crossing operating at full capacity. The scheme proposes the use of the railway tunnel in the central section as a fresh air inlet duct: preliminary calculations indicate that this concept, which reduces capital costs appreciably, is feasible. Fresh air will be introduced and exhaust air expelled at the three intermediate ventilation islands and the main islands.

Additional ventilation to deal with railway requirements, including emergency conditions, will be provided.

4. CONSTRUCTION PROGRAMME

A four phase programme is proposed for development and construction of the project. Phase I will cover detailed studies to

confirm the feasibility and cost of the project, and legislative documents will be drawn up. In Phase II, legislative powers will be obtained and detailed design and preparatory work will be carried out. The preparatory work will include the construction of accesses, working sites and casting basins and the ordering of long lead items. Phase III will cover the main construction of the crossing up to the opening of the first road carriageway to traffic. Provided that all necessary preparatory work is carried out in Phase II, Phase III may be completed in the very short period of 4 years. During Phase IV, the railway and the second road carriageway will be constructed and opened to traffic.

On the assumption of the deposit of a Bill in Parliament in late 1982, with Royal Assent following in August 1983, it is estimated that the first roadway could be opened to traffic in early 1989.

5. SHIPPING AND NAVIGATION

The Dover Strait is one of the busiest waterways in the world, with up to 500 shipping movements per day. Shipping is regulated by a traffic separation scheme, requiring through traffic to keep within defined lanes. The present scheme is contravened frequently, and shipping accidents occur, although their frequency has been reduced markedly since the introduction of the separation scheme.

The EuroRoute crossing is designed to meet the requirements of the Inter-Governmental Maritime Consultative Organisation (IMCO), and particularly to facilitate enforcement of the traffic separation scheme. In particular, the artificial islands are located in such a way as to delineate the lane boundaries in the central section of the Channel. In addition, lane discipline will be imposed on all but the smallest shipping in the inshore zones. These measures will reduce very considerably the possibility of contravening the separation scheme, and will lead to an increase in safety. The reduction of cross-Channel ferry movements resulting from construction of the scheme will also have a major effect in reducing collision risks.

Navigation and monitoring aids will be located at the artificial islands and elsewhere to assist ships on passage and to give

warning of the presence of the crossing. Emergency craft will also be stationed at or near the crossing to give assistance to vessels in difficulty.

6. ENVIRONMENT

The EuroRoute scheme has been planned specifically to minimise environmental impact, and it is expected that the overall result of the scheme will be to improve rather than worsen the effects of traffic on the environment in the general area of the approaches to the crossing. In particular, it may be noted that, in England, all the roads necessary to carry traffic to the crossing are already planned or under construction, and the scheme will tend to concentrate traffic on motorways properly designed with adequate capacities and reduce traffic on overloaded local roads. In addition, the most difficult facilities to locate in England because of land requirements, namely the toll and frontier facilities, are planned to be at the British main offshore island. In France, the combined road and rail crossing is expected to bring important benefits to the depressed regions of Pas de Calais and beyond.

The most sensitive area affected by the crossing is the rural landscape at the English coast, designated as an area of outstanding natural beauty. This area will be traversed by the road and rail approaches mainly in tunnel, and environmental intrusion as a result of the scheme will be kept to a small level. At Abbot's Cliff, where the crossing meets the coast, the viaducts will be as low as possible to minimise their visual effect in comparison with the great scale of the cliffs: at this point the cliffs are approximately 140m high, whereas the height of the top of the viaducts will be about 15m above sea level.

Rail facilities onshore will require similar land areas as for rail-only Channel crossing schemes. No new rail links to the crossing are envisaged in England.

7. OPERATION AND CONTROL

The road and rail sections of the crossing will be operated entirely independently for normal running. Road traffic will be controlled from a main control centre at which traffic conditions, equipment status and alarm systems will be monitored. This centre will be in contact with the police and other authorities, and will be able to initiate action in an emergency.

The railway will be operated from two control centres, one in England and one in France. In certain types of emergency, in which common operation of the road and rail facilities was required, overall control would revert to the main control centre.

Emergency personnel and equipment will be available to deal with fire, accident or breakdown. Evacuation of the rail or road tunnels can be carried out in safety. The ventilation system and other facilities will be designed to provide safe conditions in all emergencies.

Crossovers will be provided at either coast and at the main offshore islands to allow traffic to change from one carriageway to another, or to be directed back to the coast if a section of the crossing had to be closed in an emergency.

Various precautions, including the installation of internal and external surveillance devices, will be taken to minimise the risk of sabotage. The various structural elements will be designed specifically to maintain their integrity in an attack.

8. COST ESTIMATES

The capital cost of construction of the crossing at mid-1980 prices is estimated to be £3,800 million. Expenditure up to the completion of Phase III and the opening of the first roadway to traffic is estimated to be £2,850 million.

The cost attributable to the rail-only elements of the crossing is estimated to be £650 million.

The proposed scheme is capable of modification and reduction in scale to accommodate a single rail track only. In this case, the total estimated cost of the crossing is £3,600 million.

9. TRAFFIC AND REVENUES

Traffic forecasts for the EuroRoute crossing have been made by Coopers & Lybrand Associates, based partly on work completed in 1979 for the European Commission and partly on new work commissioned for this proposal. Forecasts take account of alternative growth rates for the UK and continental Europe, changes in relative pricing between road and rail transport, changes in journey characteristics and other relevant factors, and give a relationship between external economic factors and demand for travel and freight haulage. Projected traffic on the EuroRoute crossing in the year 2000 is, for the central (low growth) case, 19.1m passengers and 12.9m tonnes of freight. For the high growth case, the projections for the year 2000 are 27.5m passengers and 19.6m tonnes of freight.

On the central case hypotheses, the road capacity of the crossing is reached in about the year 2025. At this time rail capacity is not expected to be fully used, and further rail growth could take place.

On the basis of the revenue forecasts derived from the central case traffic projections, the internal rate of return of the scheme in real terms (i.e. after allowing for inflation) is estimated to be 7%. Sensitivity calculations show that this rate of return is robust to variations in revenues, costs and construction over-runs.

10. FINANCE

Lazards are financial advisers to the EuroRoute Group and to the Proposal and have exceptionally wide international connections and experience with major capital projects.

This Proposal is bigger but simpler than its competitors. It can be built more quickly, with work spread to many locations and employs simple, well proven techniques with minimum risks - these factors will be attractive to providers of finance.

It must be a matter of judgement what balance to strike between reduced risks, greater costs, shorter construction and other factors. A three-stage building programme in which the over-

whelming proportion of the finance is committed just prior to the second stage (Phase III) while an initial commitment of some full risk money is made prior to completion of legislative, Treaty and other formalities, will dramatically advance the date when the facility can be brought into service.

Equipment and supplies could be sourced almost throughout Europe and may easily be directed to and generate employment in distressed areas in England and France.

The advanced but simple technical solutions incorporated in the Proposal, and its considerable capacity to accept growing and changing traffic patterns, assure the cash flow required.

The main national and international potential sources of money have been reviewed. It is suggested that Governments are unlikely to be willing to give the concessionaires unlimited rights indefinitely to exploit a de-facto monopoly, and that, consequently, conventional distinctions between "debt" and "equity" may be blurred.

While the attitude of the French and British Governments will be of paramount importance, the support of the EEC and of others will also be crucial. At least an Anglo-French Treaty will be necessary, in addition to the domestic enabling legislation.

An Owning Entity need not necessarily be owned by the Governments, nor by the contractors nor by the Managers. Nor need ownership and control run together. It is too soon to anticipate the final commercial, legal and financial structure, but provided that the political decisions in London, Paris and Brussels are sufficient, it is considered that the EuroRoute Proposal could be financed without any necessary recourse to public funds.

11. EMPLOYMENT AND RESOURCES

Total employment in the construction, shipbuilding and construction-related industries is estimated to be over 260,000 man-years. Overall employment, including subsidiary

employment generated as a result of the project's construction, is estimated to give a total employment figure for the full construction period of over 500,000 man-years. Average employment will reach over 100,000 per annum.

The modular form of construction and phasing sequence proposed mean that major employment will be generated very rapidly after final commitment to the project.

As a result of the major distribution of work over a wide range of locations made possible by the large element of prefabrication, employment during construction at the British and French coastal sites will be comparatively small. The combined workforce at these sites is estimated to be no greater than 12,000 per annum at the peak.

Some of the possible sites for fabrication and quarrying in the UK are shown in Figure 11.1.

SOME OF THE POSSIBLE SITES FOR FABRICATION & QUARRYING IN THE U.K.

Figure 11.1