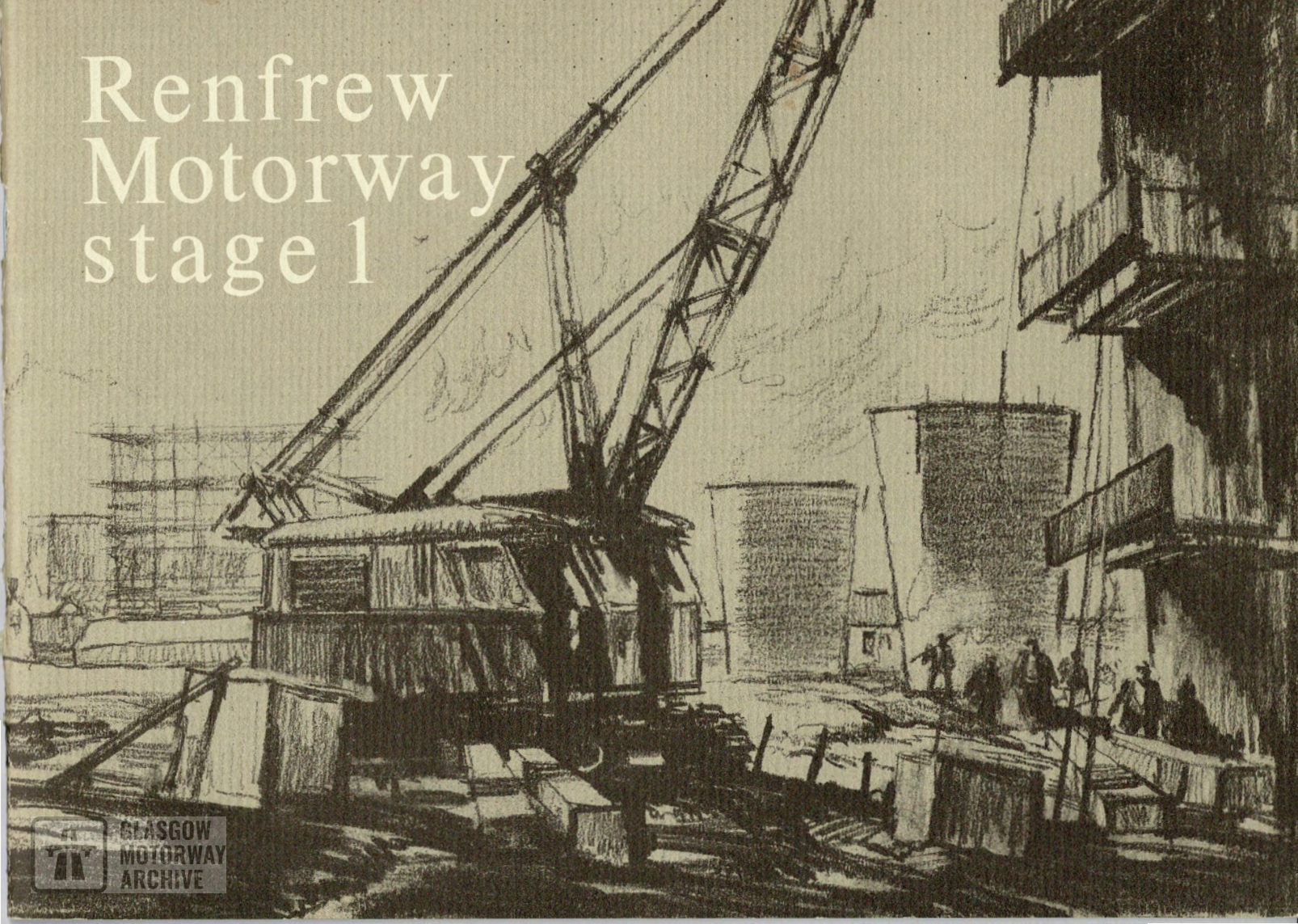
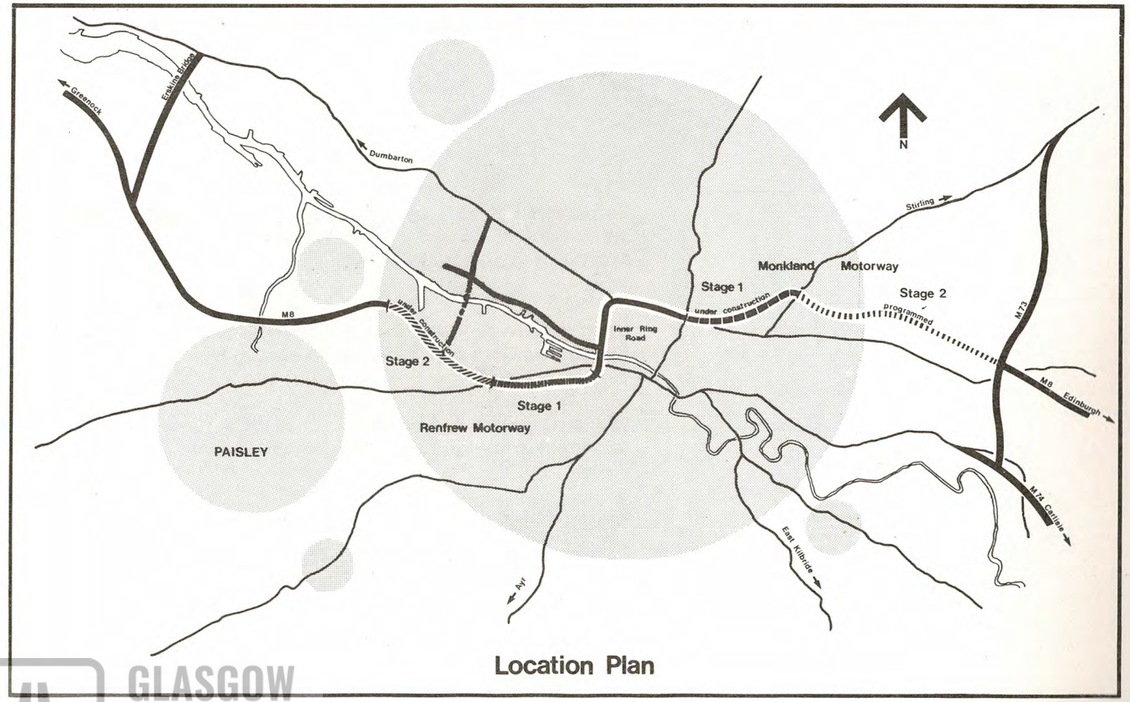
# Renfrew Motorway stage 1



## RENFREW MOTORWAY STAGE 1

| | |
|---|---|
| **CLIENT:** | Corporation of the City of Glasgow<br>John Armour, CEng FICE FIMunE FRTPI<br>Master of Works and City Engineer |
| **ENGINEER:** | Scott Wilson Kirkpatrick & Company (Scotland)<br>Consulting Civil and Structural Engineers |
| **ARCHITECT:** | William Holford & Associates (Glasgow)<br>Architect and Planning Consultants |
| **CONTRACTOR:** | Balfour Beatty Construction (Scotland) Limited |




Location Plan

## BACKGROUND TO THE PROJECT

In 1960 Scott Wilson Kirkpatrick & Partners were appointed by the Corporation of the City of Glasgow to review the City roads and traffic strategy. The result of this appointment was first an interim report on an Inner Ring Road followed in 1965 by a comprehensive report entitled "A Highway Plan for Glasgow" which proposed a system of radial motorways and expressways.

During the early 1960s the Corporation Planning Department were developing a planning strategy for the City which included the designation of 29 areas of the City as Comprehensive Development Areas. The opportunity was taken as far as possible to plan the City highways to pass through these CDA's, thus reducing the impact of the projected roads on the urban fabric.

The Renfrew Motorway Stage I forms part of a motorway crossing Glasgow in an east-west direction which will connect with existing motorways on both sides of the City. This east-west motorway is the first major stage of the comprehensive highway system proposed for Glasgow.

The motorway construction started in 1965 with the Townhead Interchange on the North Flank of the Inner Ring Road. The first phase will finish with the completion of the second stage of the Monkland Motorway programmed for completion in 1977, giving 13 miles of continuous urban motorway. Within this framework is the Renfrew Motorway Stage I project started in 1973 and due for completion in 1976.

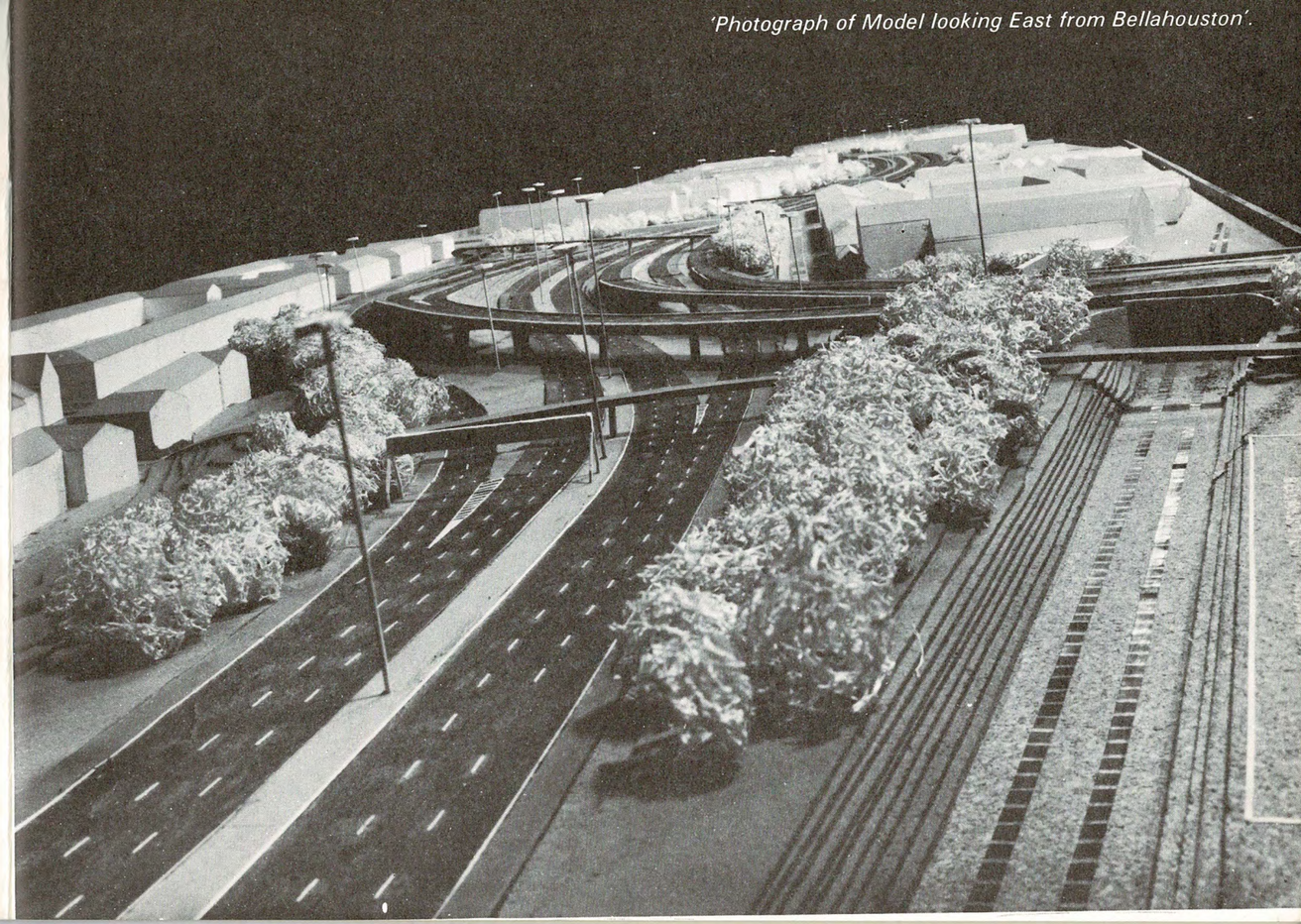
## PROJECT DATA

| | | |
|---|---|---|
| Tender Cost | (£) | 13,510,917 |
| Length of Motorway | (Km) | 3.3 |
| Length of New Surface Streets | (Km) | 2.3 |
| Earthworks Excavation | ($m^3$) | 450,000 |
| Number of Bridges | | 13 |

## GEOMETRIC DESIGN CRITERIA

| | | Motorway | Ramps |
|---|---|---|---|
| Design Speed | (Km/h) | 100 | 60 |
| Radius (minimum) | (m) | 650 | 240 |
| Radius (absolute minimum) | (m) | 350 | 130 |
| Maximum Gradient | (%) | 5 | 5 |
| Sight Distance | (m) | 210 | 90 |
| Maximum Superelevation | (%) | 7 | 7 |



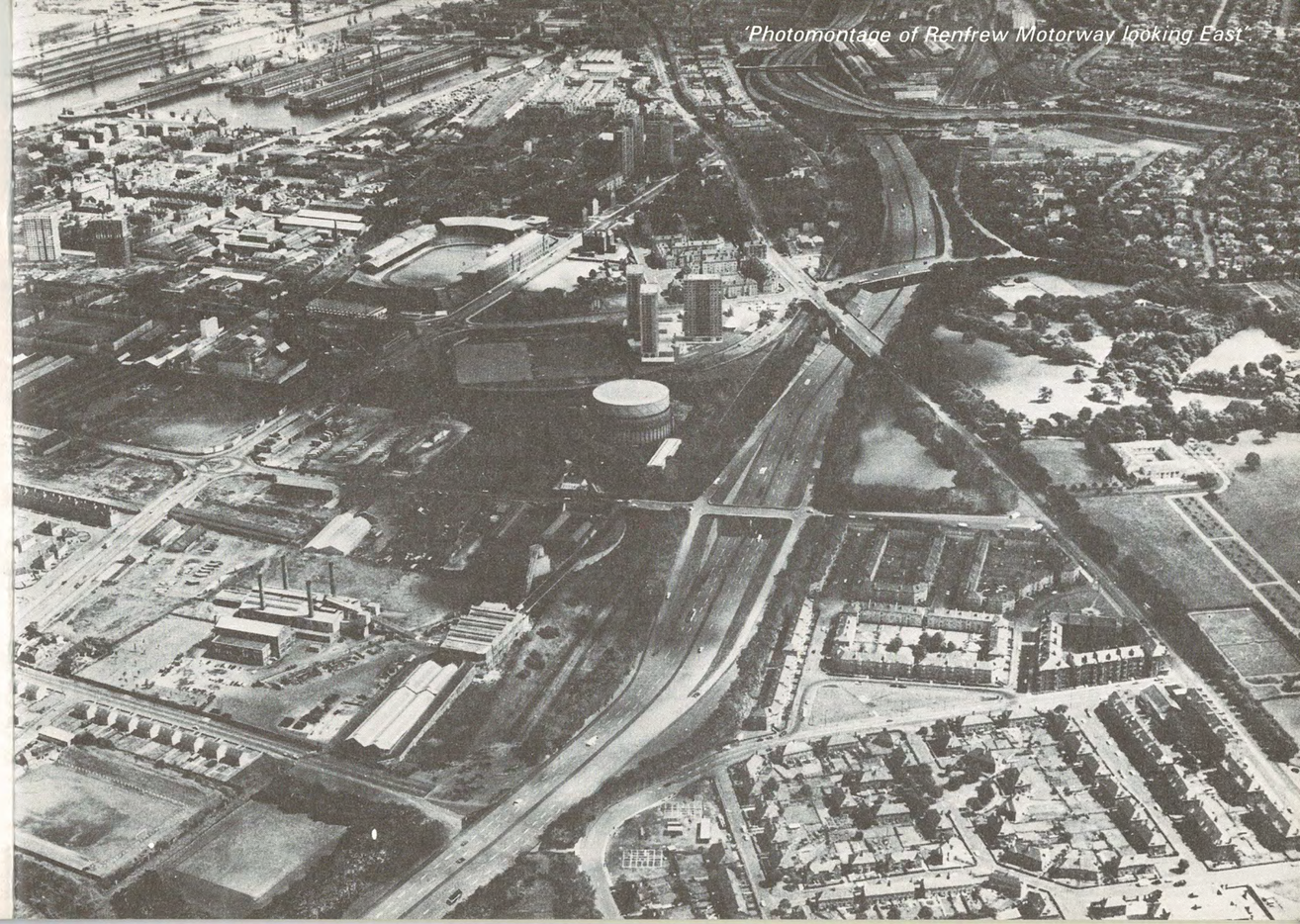


*'Photograph of Model looking East from Bellahouston'.*

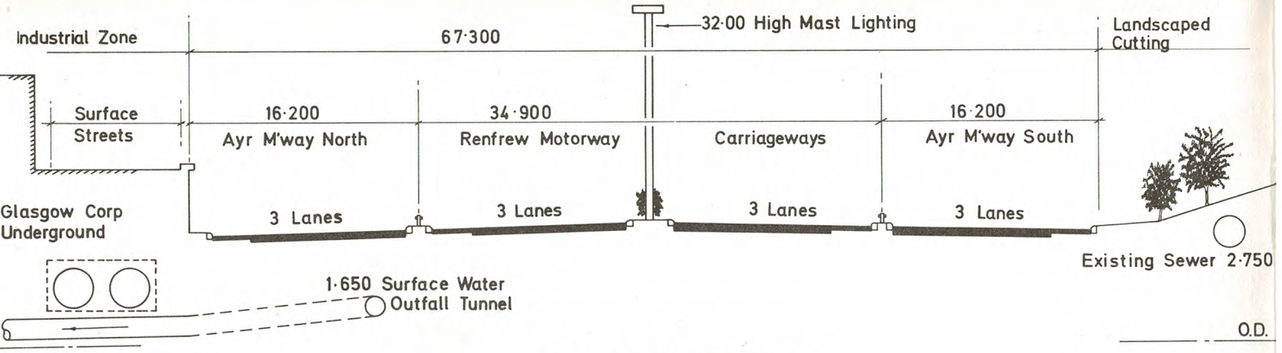
## THE PROJECT

The Renfrew Motorway Stage I project runs parallel to the River Clyde from the Kingston Bridge in the East to Helen Street in the West where it links with the Stage II project.
There are 3.3 Km of motorway to be constructed. The eastern section (1.9 Km long) between the Kingston Bridge and the Ayr Motorway Interchange has four three-lane carriageways. The western sector (1.4 Km) has two three-lane and four-lane carriageways.
There are in addition to the motorway new surface streets totalling 2.3 Km in length. A new 1.65 meter diameter surface water sewer extends for a distance of 1.75 Km to outfall at the River Clyde.
The project includes a section where unusually large traffic volumes are anticipated between the merging of two radial motorways (Renfrew Motorway and Ayr Motorway) and divergence into the two flanks of the Inner Ring Road. These large volumes, coupled with the high proportion of weaving traffic, led to the "braided" design that has been adopted. With this configuration no weaving of traffic occurs since a separate route is provided for every movement between the two flanks of the Inner Ring Road to the east and the two motorways to the west.
To minimise severance the motorway follows closely the Glasgow-Paisley railway along the western section and the edge of existing industrial development along the remainder.

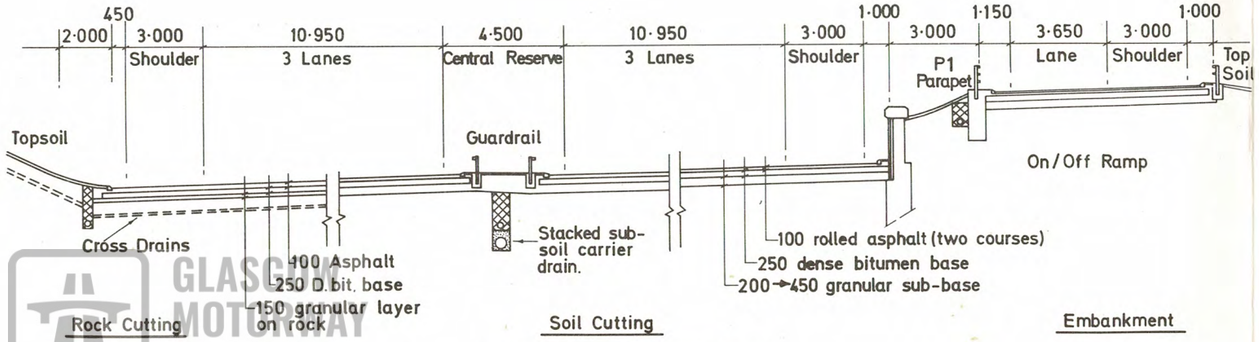




*'Photomontage of Renfrew Motorway looking East'*




BRAIDED CARRIAGEWAYS




CARRIAGEWAY CONSTRUCTION



## ROADWORKS

### Ground Conditions

There are different conditions east and west of Bellahouston Bridge where the motorway crosses the main railway. To the west the soils are diverse but generally boulder clay (10 metres deep) overlies shale, coal and sandstone. Also in the western section old mine workings form undesirable voids beneath the motorway and it has been necessary to fill these by cement grouting.

On the east of Bellahouston Bridge, the soils are generally loose silty sands, with an existing water table at only about 2 metres below ground level overlying boulder clay and sandstone at a depth of 20 to 30 metres. This high water table, combined with the loose sands required special design consideration to avoid settlement of the motorway. The adopted solution has been to lower the water table during construction, excavating to a depth of 1.3 metres below formation level and replacing the material suitably compacted.

**ROADWORKS (Contd)**

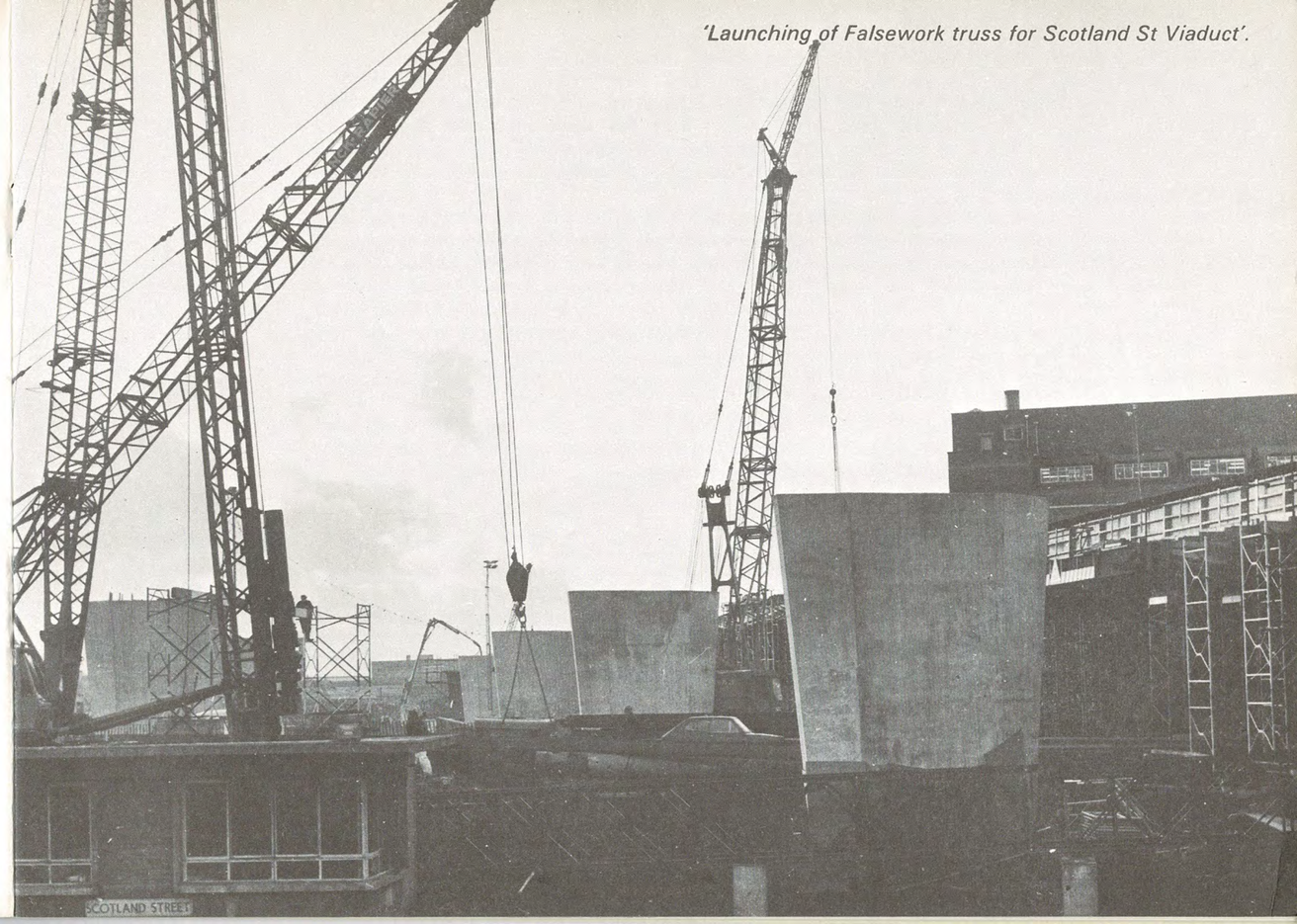
**Drainage and Services**

Providing surface water drainage for urban motorways is normally difficult and expensive because of the lack of suitable outfalls. The problem on this motorway has been accentuated because two sections have depressed profiles and since the water table in the alluvial soils is relatively high. The solution has been to provide a new outfall sewer discharging to the River Clyde and a new trunk sewer extending nearly the full length of the motorway and which will also drain other connecting sections of motorway not yet constructed.
The outfall section of 1.65 metres diameter, carried out under an advanced contract, was constructed in tunnel with compressed air and deep open cut. Other sections of the trunk sewer are being constructed using well-pointing. Extensive sub-soil drainage is being provided to deal with the high water table and for slope drainage.
Since the motorway route occupies a congested urban area, the existing services — water, gas, sewers, electricity, post office, transport cables — had to be diverted to fit motorway plan. The planning and co-ordination of these diversions has been intricate. Many of the diversions had to be carried out before it was possible to start major works.

**Pavement Construction**

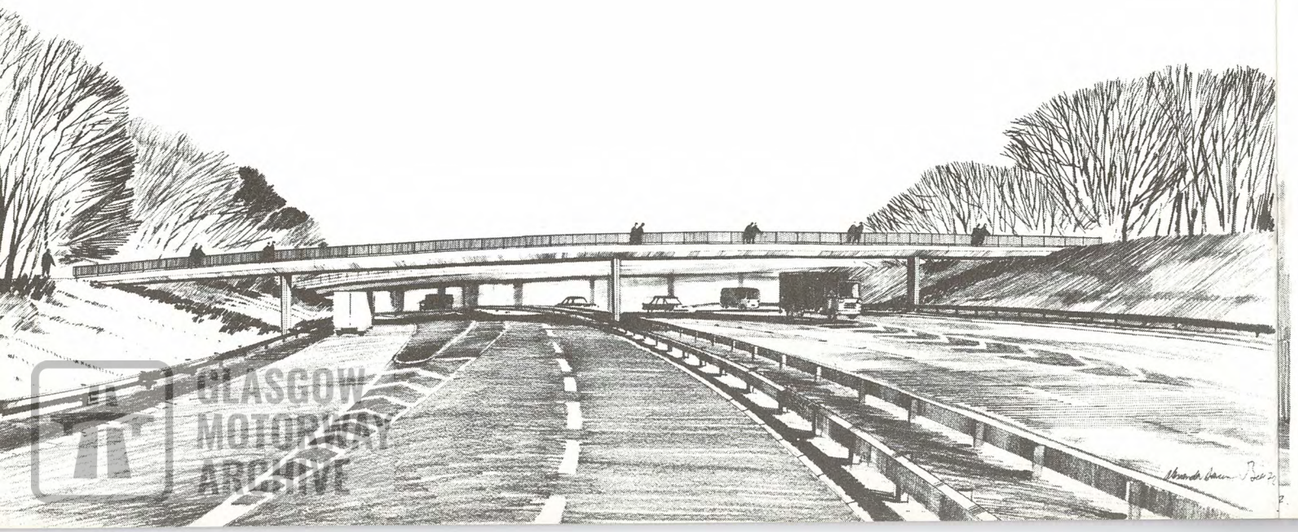
A flexible pavement construction has been adopted as best suited to the ground conditions and the varying cross sections of an urban road.
The Type 1 sub-base material varies from 200 mm to 450 mm, depending on the sub-grade conditions.
The road base will be dense bitumen macadam. The 250 mm thickness of this layer is due to the high numbers of heavy vehicles anticipated on this section of road.
Surfacing will be hot rolled asphalt.






*'Launching of Falsework truss for Scotland St Viaduct'.*

*Artists impression of Footbridge*





**ROADWORKS (Contd)**

**Landscaping**

Since the inception of the motorway construction in Glasgow, the relationship of the roads with their surroundings has been given detailed consideration. William Holford and Associates have assisted in the design of all the projects by advising on aesthetic consideration, pedestrian routes and landscaping.

The closely-knit urban character of the area through which the Renfrew Motorway passes precludes the possibility of large areas of landscaping on its periphery. However, it has been possible to maintain a continuous belt of landscaping along the road from Bellahouston Park in the West to the Kingston Bridge in the East.

Existing trees are retained where possible, and to supplement them, large areas of trees and shrubs are to be planted throughout the motorway corridor.

Side slopes will be generally at 1 in 3, or flatter, to ease maintenance although in some cases site conditions have dictated steeper slopes at 1 in 2. All the landscaping work is carried out in association with the City Parks Department.

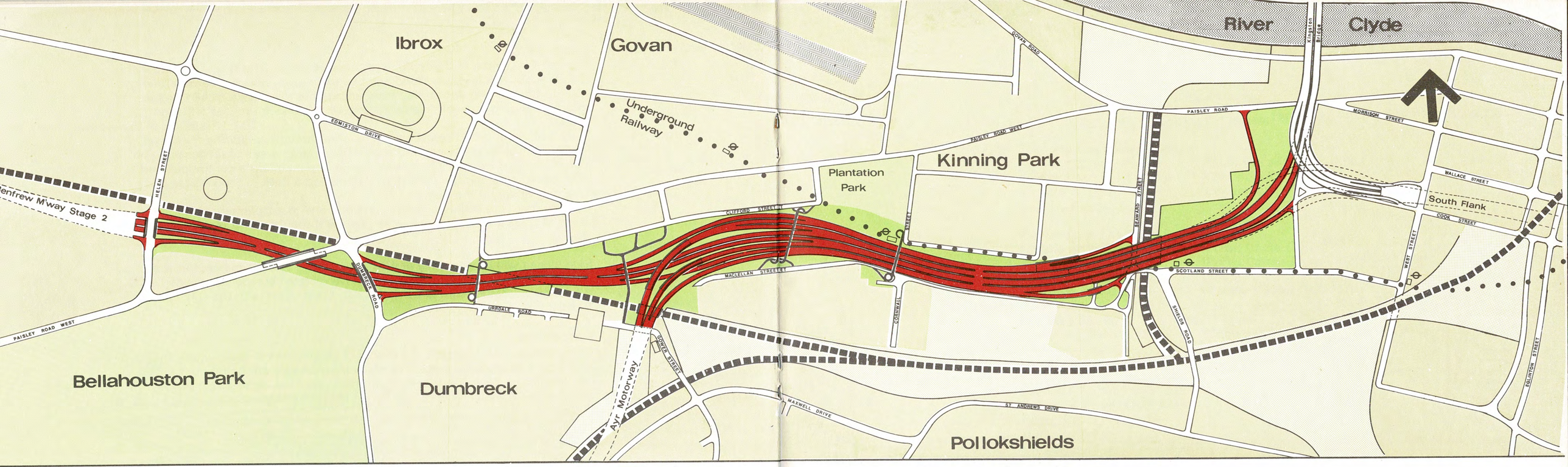
**Pedestrians**

In the design of the project the wishes of pedestrians to walk where they want have been recognised. Five pedestrian bridges are being built across the motorway. Over the length of the motorway the north-south pedestrian bridges will coincide with long established pedestrian routes.

**Lighting and Signing**

Lighting has been designed by the City Lighting Engineer. The motorway carriageways are being lit by high pressure sodium lighting mounted on 24, 30 and 36 metre high steel masts sited both in the central reservation and at the motorway edges.

Advance and confirmatory direction signing is by messages carried on internally lit gantry signs which are designed to incorporate, in the future, the remotely controlled motorway signal system.




SCOTT WILSON KIRKPATRICK & COMPANY (Scotland)
Consulting Civil and Structural Engineers
6, Park Circus, Glasgow

| | |
|---|---|
| Multi-lane Motorway | 3·3 km |
| Surface Roads | 2·3 km |
| Bridgeworks | 33,600 sq.m |
| Contract Price | £13·5 million |

Motorway
Motorway Landscaping
Railway Property
Open Space

SCALE Metres 0 50 100 200 300 400 500

THE CORPORATION OF GLASGOW

# RENFREW MOTORWAY STAGE 1.

*Artists impression of Scotland St Viaduct*



**STRUCTURES**

There are four distinct bridge types on the project, as follows:

1. Concrete Box Girder Bridges:
   - Scotland Street Viaduct (Table Top with suspended spans)
   - Paisley Road West Bridge (Continuous)
   - Ramp A Bridge (Continuous)
   - Ramp C Bridge (Continuous)

2. Pre-tensioned M Beam Bridges:
   - Bellahouston Bridge (Portal Construction)
   - Gower Street Bridge (Portal Construction)
   - Helen Street Bridge (Simply Supported)
   - British Rail Bridge 10 (Simply Supported)

3. Flat Slab Reinforced Concrete Bridges:
   - Dumbreck Road Bridge (Continuous)

4. Footbridges:
   - Beech Avenue Footbridge
   - Cornwall Street Footbridge
   - Kirkwood Street Footbridge
   - Percy Street Footbridge
   - Hazlewood Road Footbridge

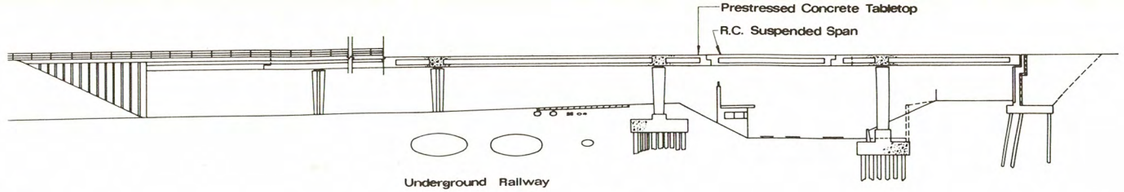
**STRUCTURES (Contd)**

All bridges are of constant depth and follow the vertical geometry of the road they carry.

Foundation conditions vary considerably throughout the length of the site. The structures in the eastern half are founded on steel 'H' piles and those to the west on large and small diameter bored cast insitu piles and pad footings.

In addition to the bridges there are nine reinforced concrete cantilever retaining walls and one steel sheet piled wall totalling 1.8 Km in length. In the alignment of retaining walls consideration was given to land use, land form and relationship with adjacent structures. An unusual feature of the walls is the use of vertical precast concrete facing units which also serve as a front shutter.



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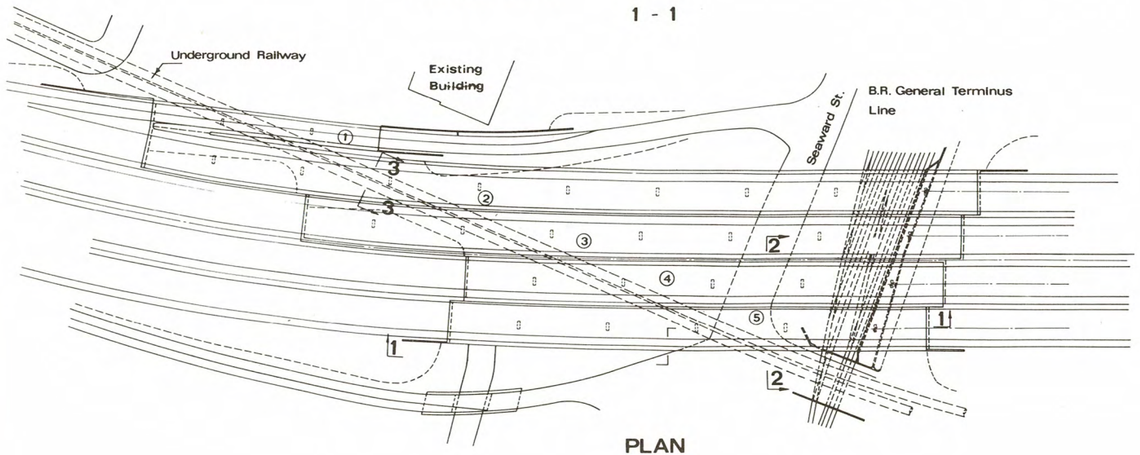


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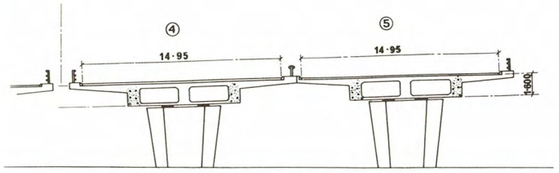


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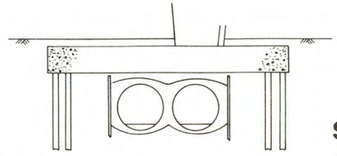
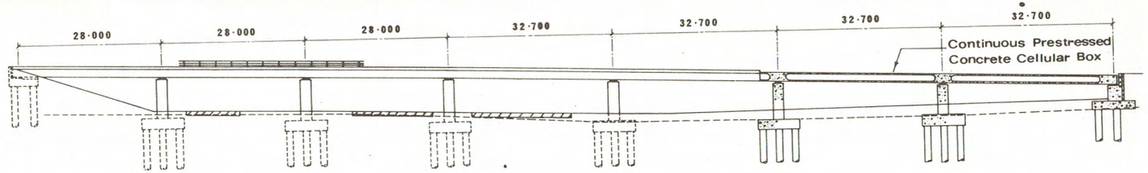
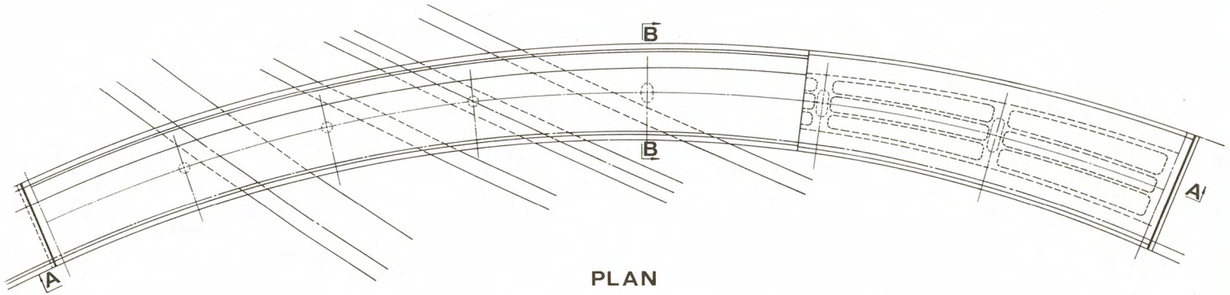


3 - 3

SCOTLAND STREET VIADUCT




A - A

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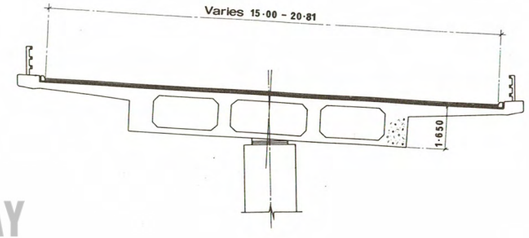
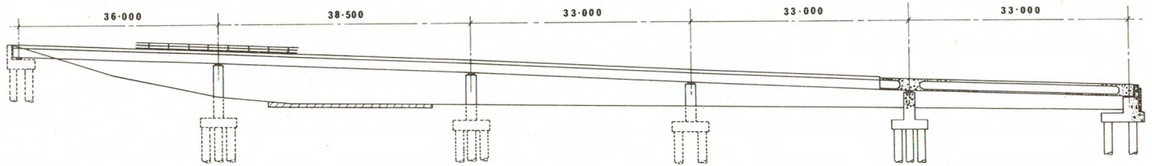



B - B

RAMP A
BRIDGE

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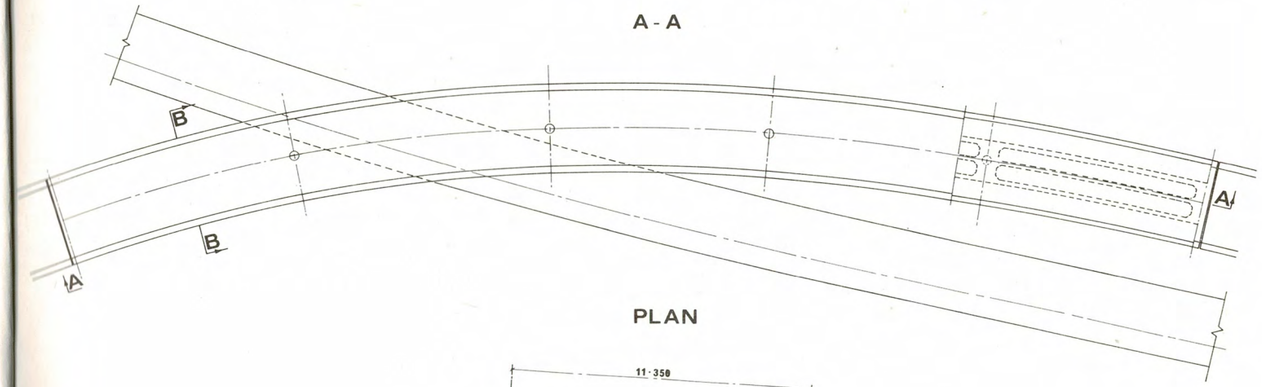


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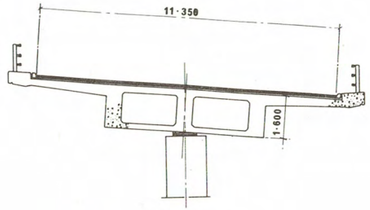
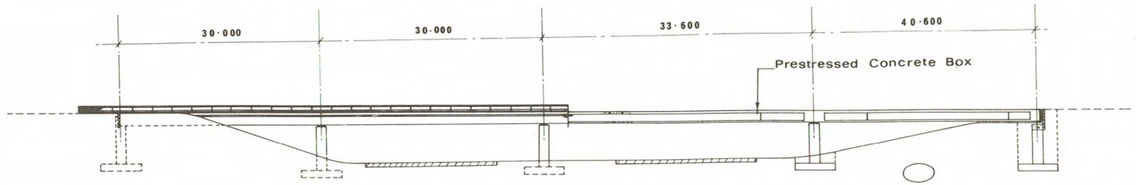



B - B

RAMP C
BRIDGE

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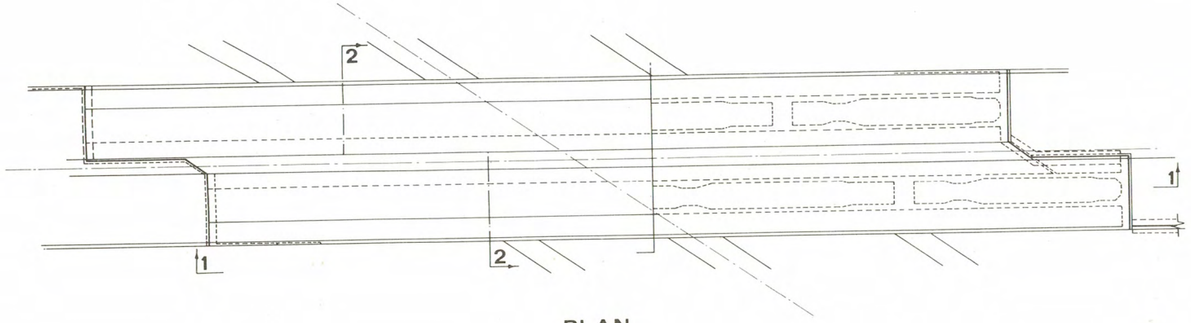


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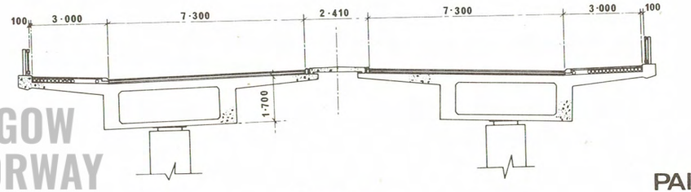
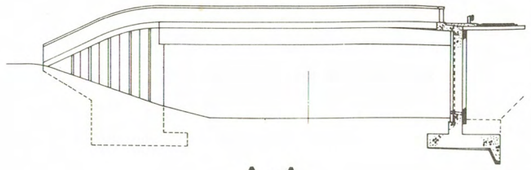



2 - 2

PAISLEY ROAD WEST
BRIDGE





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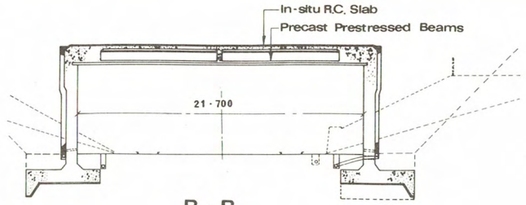


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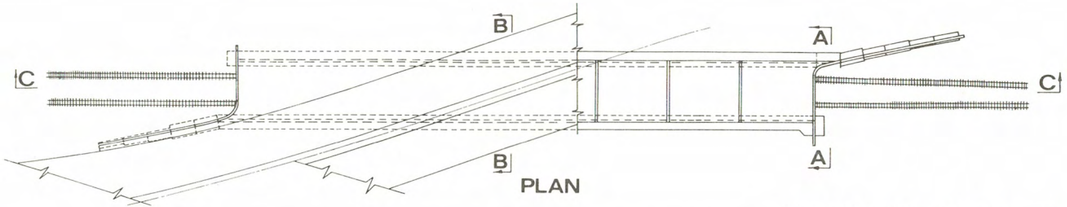


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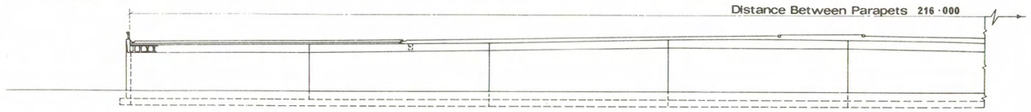
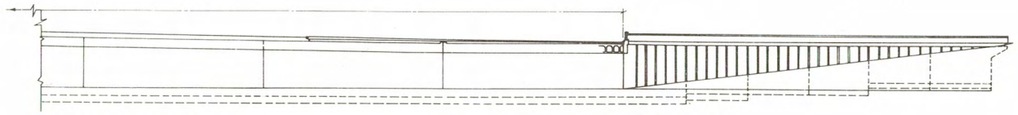
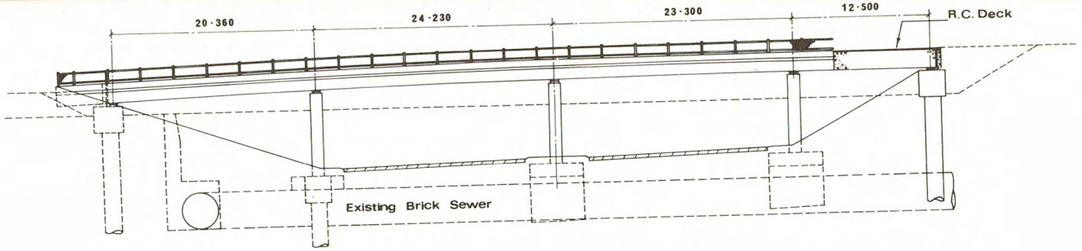


C - C

BELLAHOUSTON
BRIDGE

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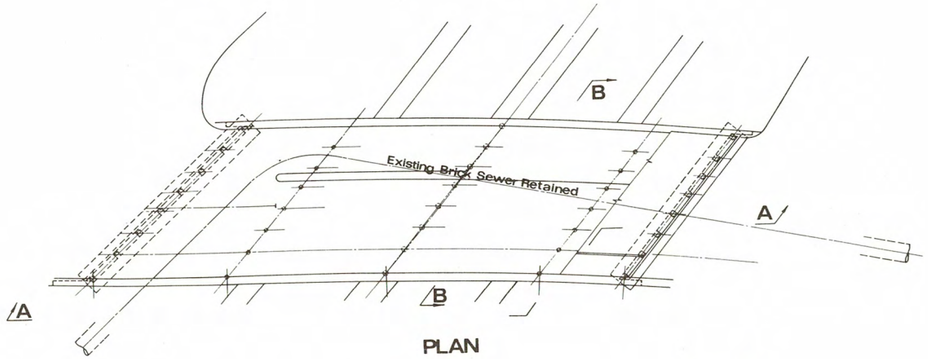


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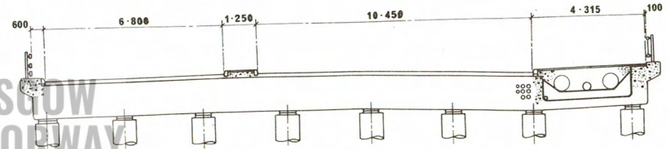
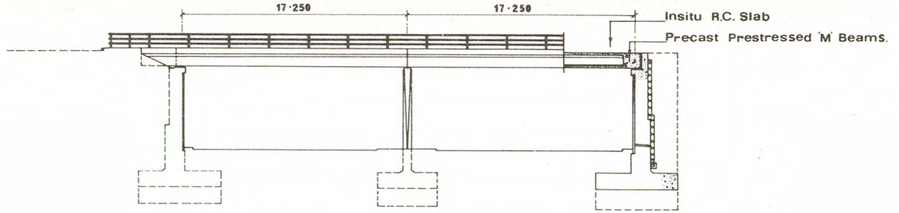



B - B

DUMBRECK ROAD
BRIDGE

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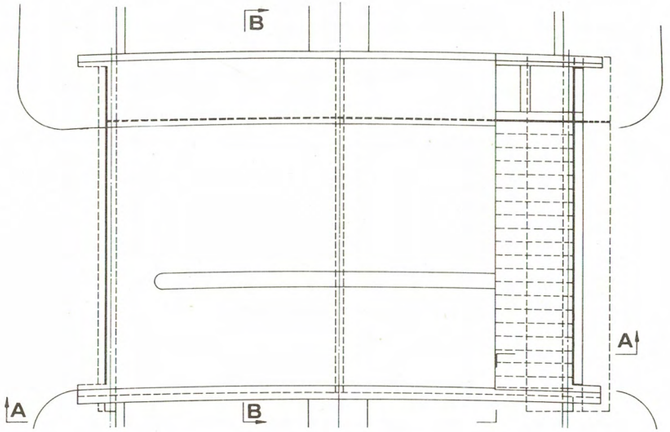


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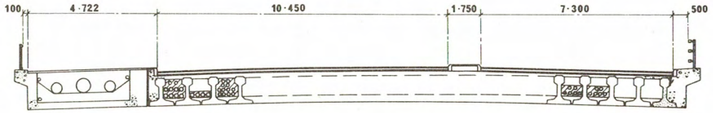
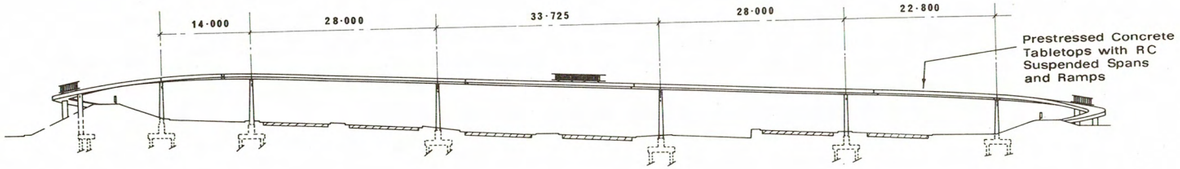
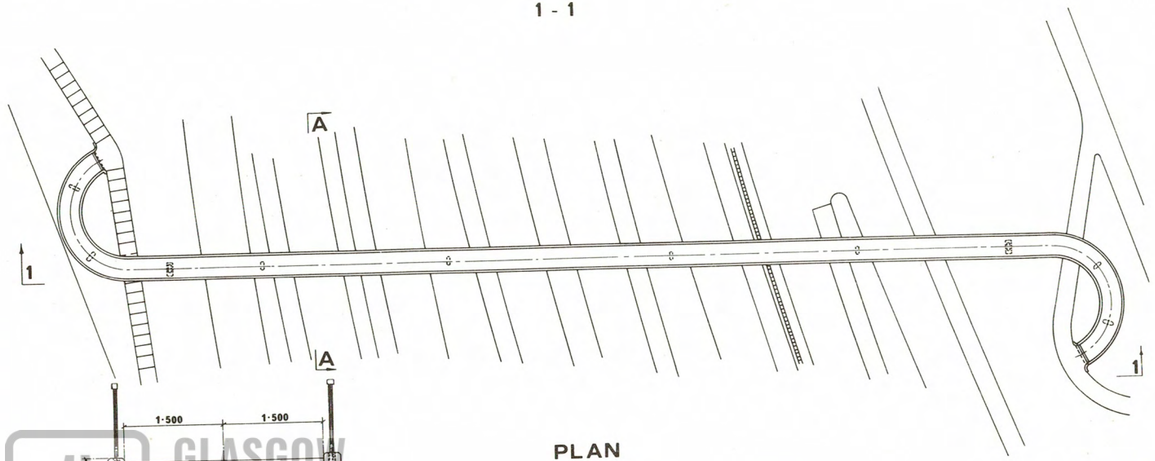



B - B

HELEN STREET
BRIDGE




1 - 1




PLAN

A - A

PERCY STREET
FOOTBRIDGE



| | |
|---|---|
| CHIEF RESIDENT ENGINEER: | N.M. McKay, CEng. BSc FICE MIWE |
| RESIDENT CONTRACTS MANAGER: | D.E. Wild |
| MATERIALS TESTING CONSULTANTS: | Sandberg<br>Solus Schall Limited |
| ELECTRICAL ENGINEERING CONSULTANTS: | Strain & Robertson |
| MINING CONSULTANTS: | J.W.H. Ross & Company |
| COVER ILLUSTRATION | Ernest B. Hood |