RENFREW BYPASS

RENFREW BYPASS
MOTORWAY M8

Client :-

THE SCOTTISH DEVELOPMENT DEPARTMENT
(ROADS DIVISION)
EDINBURGH

Consulting Engineers :-

CROUCH & HOGG
18 WOODSIDE CRESCENT
GLASGOW

The Motorway M.8 is designed for traffic using the south bank of the River Clyde westward of the City of Glasgow and serves the Counties of Renfrew and (North) Ayrshire.

The Motorway is referred to as the Renfrew Bypass as it is located within the County and by-passes the Royal and Ancient town which gives its name to the County. Much of the route is elevated above the surrounding countryside and users of the road, especially when travelling westward, will enjoy unrestricted vistas to the semi-circle of hills and distant mountains of the Counties of Stirling, Dunbarton, Argyll and Bute.

The immediate purpose of this section of Motorway, now at an advanced stage of construction, is to provide a fast route to the new Glasgow Airport at Abbotsinch and the industrial developments at Linwood and also to improve communication between the Burgh of Paisley and the City of Glasgow. The Motorway is designed for a speed of 70 m.p.h.

M.8 replaces that part of A.8 commencing on Renfrew Road at the boundary of the City of Glasgow and the County of Renfrew and rejoins A.8 just east of Bishopton.

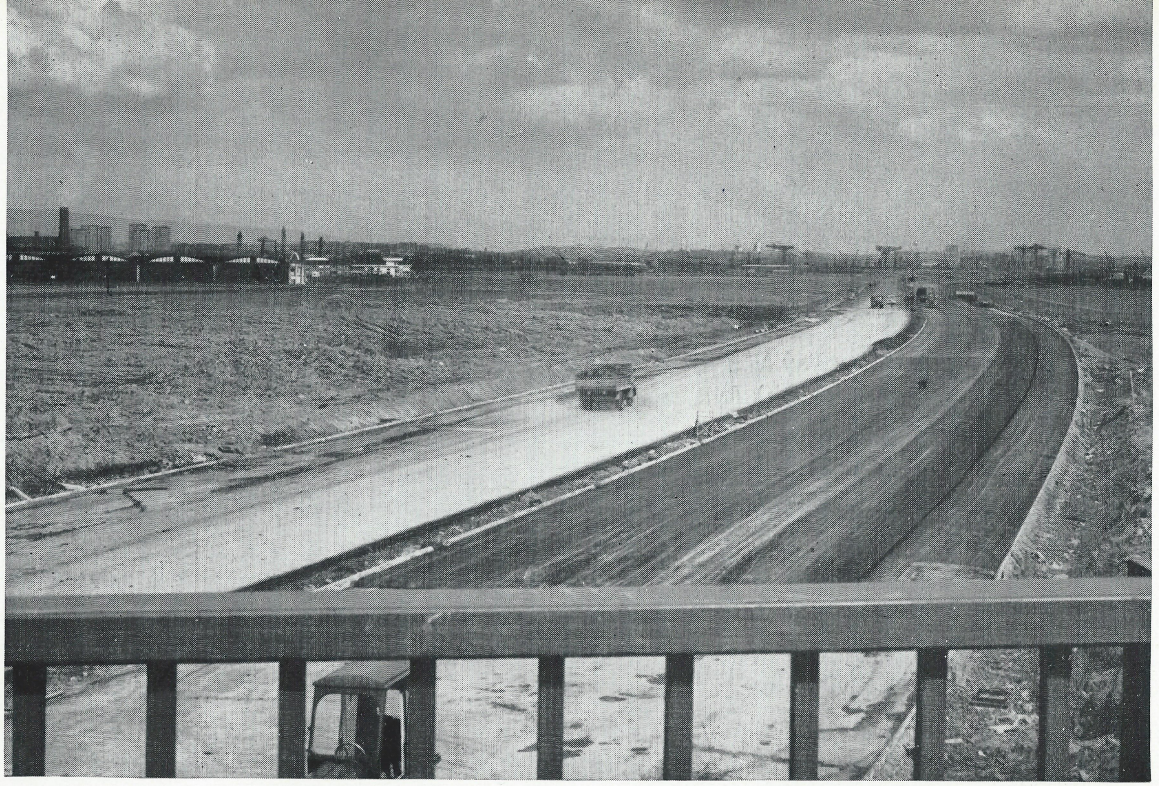
Earlier investigations for a bypass of Renfrew were concerned with a route to the north of the Burgh as the presence of Renfrew Airport and Hillington Industrial Estate restricted any diversion to the south. However, the decision to close Renfrew Airport and transfer to Abbotsinch removed this restriction and at the same time made more urgent the need for rapid access between Glasgow and the new Airport.

Two factors had an important bearing on the choice of route and profile of the bypass. Firstly, the requirements of flight clearances and the possible runway extensions at Glasgow Airport dictated the limits of the land available, and secondly, the existence of Paisley Harbour and a ship-building yard on the White Cart Water required the new road to cross the river at high level to allow ships to reach Paisley and to give clearance for the superstructures of the special craft which are built in the shipyard and will be launched under the viaduct.

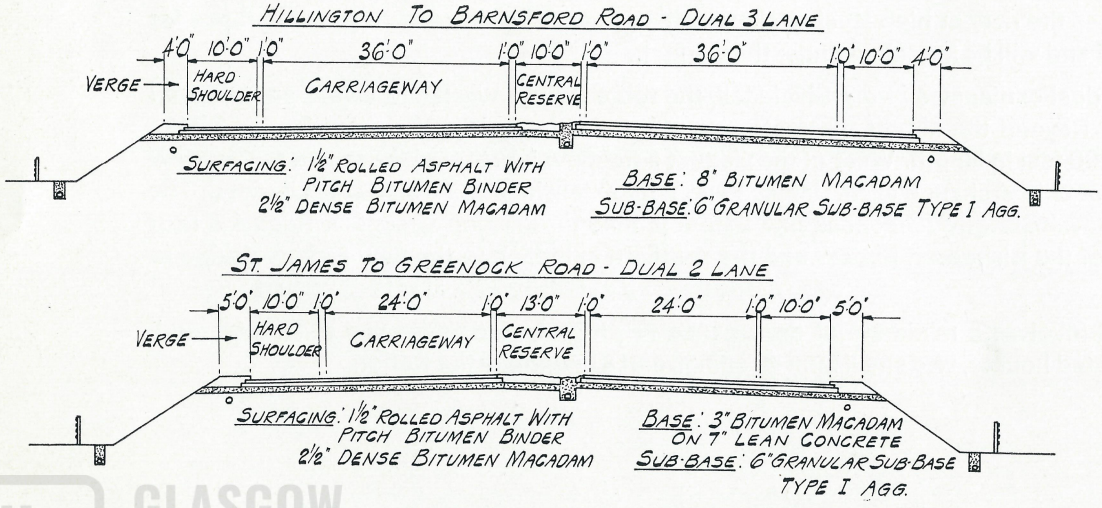
Commencing at the City of Glasgow boundary on the existing dual carriageway from Shieldhall, the route swings westward across an improved Hillington Road (B.770) and through the former Renfrew Airport. Beyond the airport the motorway passes under Paisley/Renfrew Road (A.741) before rising to cross the White Cart Water by means of a viaduct 2,700 feet in length. West of the viaduct a freeflow junction gives access to Glasgow Airport while the main route continues across Barnsford Road to a new Interchange at St. James Park, with extensions to Paisley and Linwood. The bypass then swings northwards running parallel with British Railways' Glasgow/Greenock line before joining the existing Greenock Road A.8 near Bishopton, by means of a temporary junction, pending completion of the Bishopton Bypass and the southern approach to the new Erskine Bridge to be built over the River Clyde.

The route selected for the motorway extends to $6\frac{1}{2}$ miles and involves a minimum of disturbance to property and severance of farming land. Demolition of properties has been confined to an Inn, three prefabricated houses, two small farm steadings and a temporary fire station.

The alluvial deposits in this part of the Clyde valley extend to considerable depths over a wide area and a variety of sub-strata was encountered. Over most of the site these consisted of silts and clays of high plasticity extending to depths up to over 120 feet, and with one exception, all bridges are on piled foundations. At the west end of the viaduct in Abbotsinch the greatest depth of silts and clays coincides with the greatest height of embankment and to allow for consolidation of the subsoil below the bank in advance of road construction a preliminary contract was let for the construction of this embankment using pulverised fuel ash (P.F.Ash) as fill material. This material compacts to a density of 90 lb./cu. ft. and sets hard as a result of pozzolanic action in the ash. Gauges located below the bank have recorded a total settlement of 21 inches under the bank at its greatest height of 26 feet and settlement has now almost ceased.



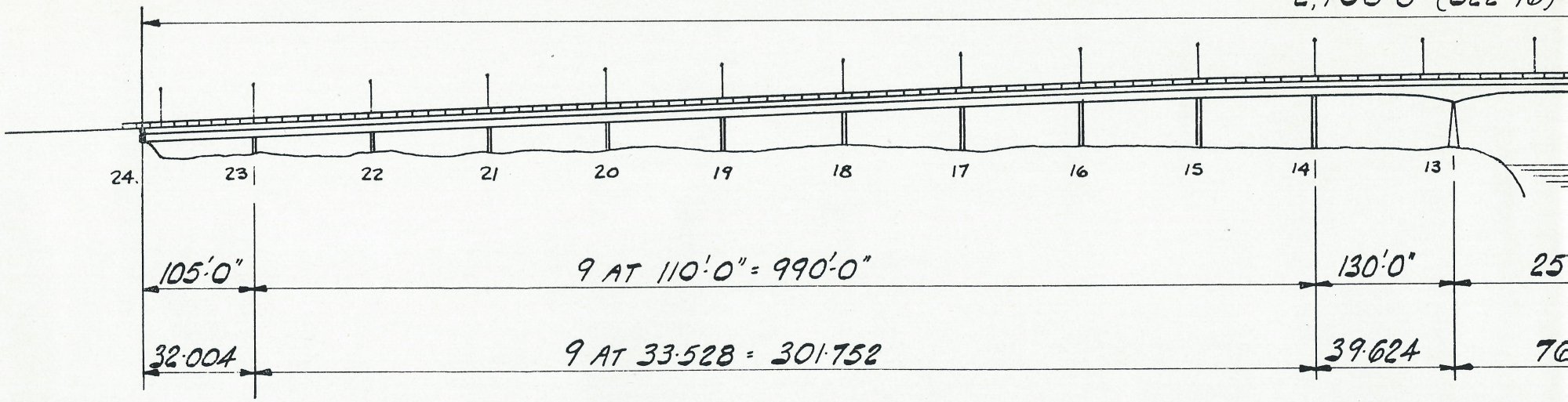
The Motorway under construction through the former Renfrew Airport

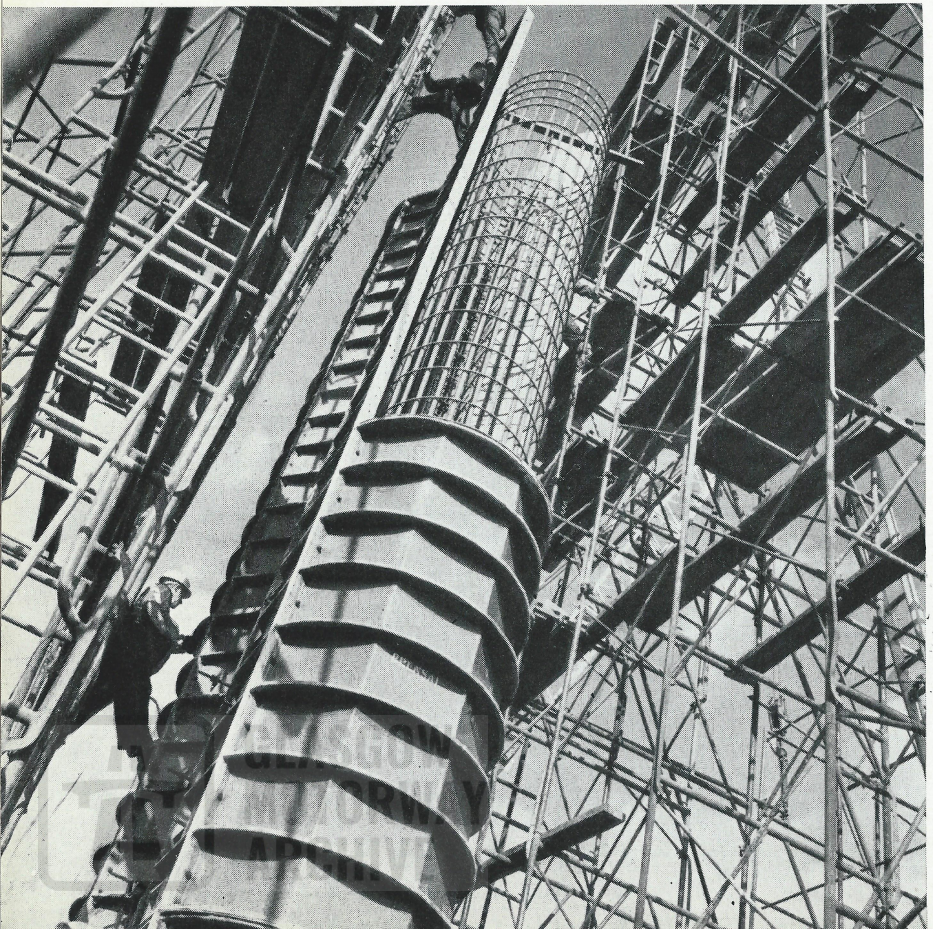


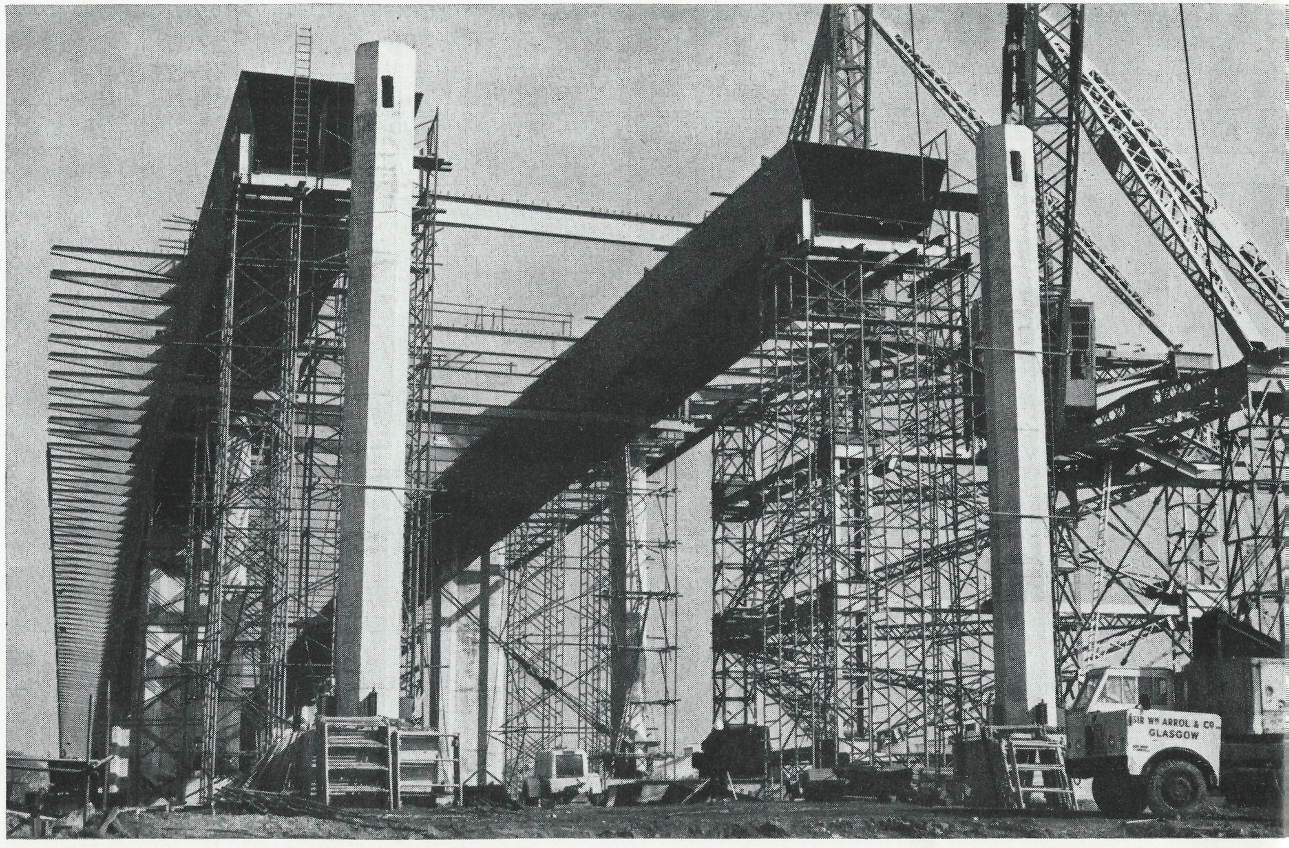
TYPICAL CROSS SECTIONS

From the City boundary to St. James Interchange, urban motorway standards apply and dual three-lane carriageways are provided with 10 feet wide hard shoulders except over the viaduct and its immediate approaches where these are omitted. West and North of St. James the construction is dual two-lane carriageways with hard shoulders and the wider central reserve and verges of a rural motorway.

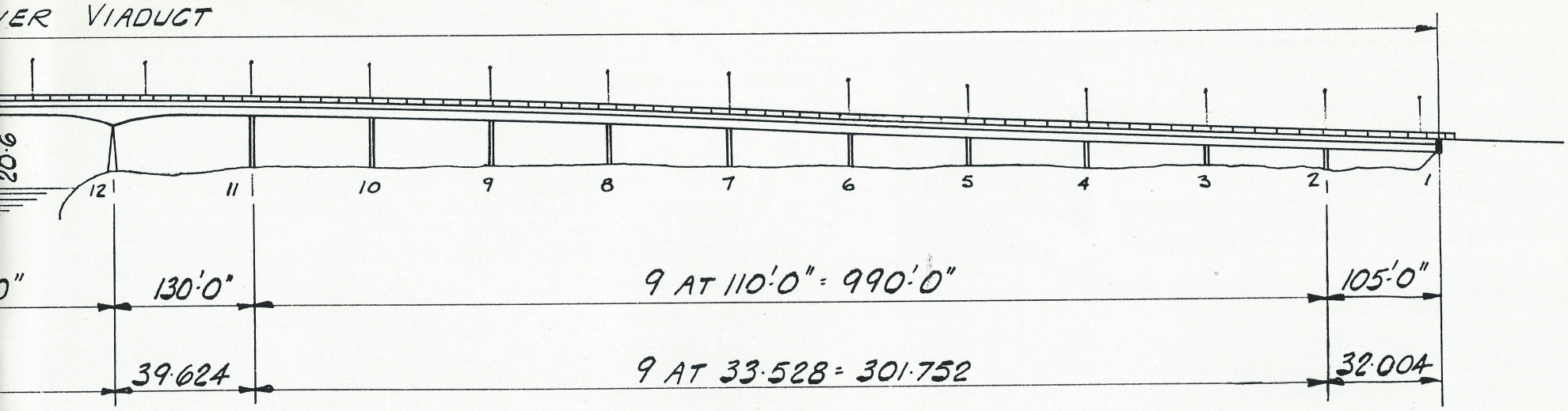
In each motorway contract alternative quotations were obtained for three composite and three wholly flexible forms of pavement construction. In the first contract the road base consists of 8" bitumen-bound base and in the second a composite base consisting of 7" of lean concrete topped with 3" of bitumen macadam is used. Throughout the roadways the surfacing comprises a $1\frac{1}{2}$" wearing course of rolled asphalt with pitch bitumen binder on a $2\frac{1}{2}$" base-course of dense bitumen macadam. Hard shoulders are surfaced with dense tarmacadam and surface dressed with red stone chippings.







LEFT — Fibre glass shutters being fixed around dumbell pier reinforcement
ABOVE — Steelwork erection approaching pier 11 East side

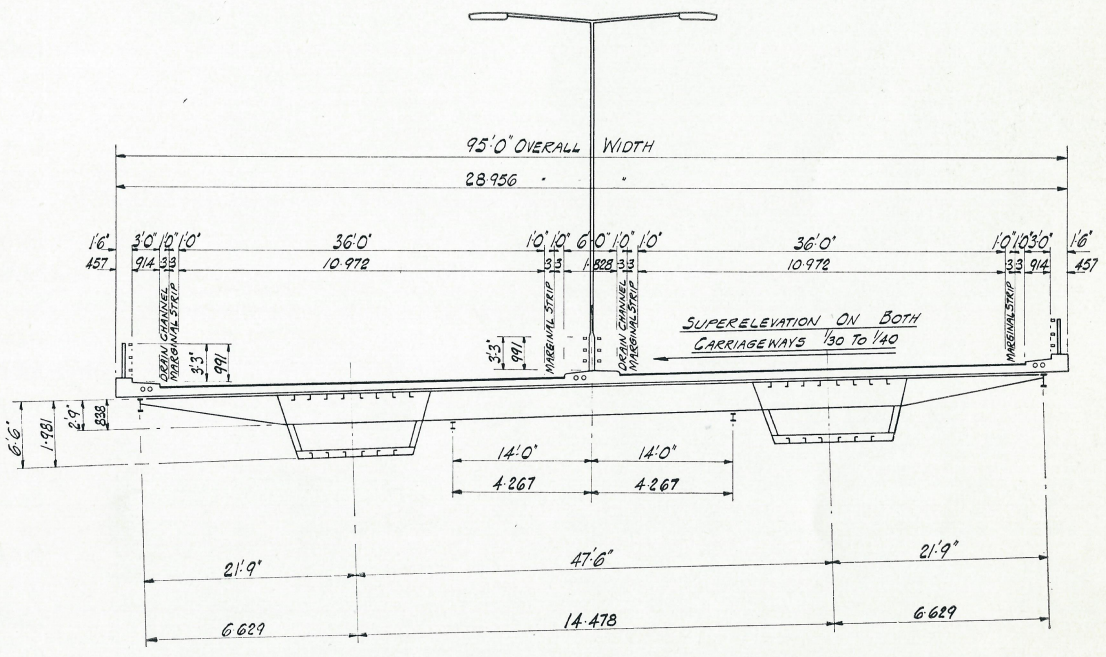


The White Cart Viaduct is curved to a horizontal radius of 4,167 feet and comprises a river span of 250 feet, anchor spans of 130 feet, 18 approach spans of 110 feet and 2 end spans of 105 feet, making 2,700 feet in all. It is 95 feet wide and provides three traffic lanes on dual carriageways with approach gradients of 1 in 30 and rises 80 feet over the White Cart Water.

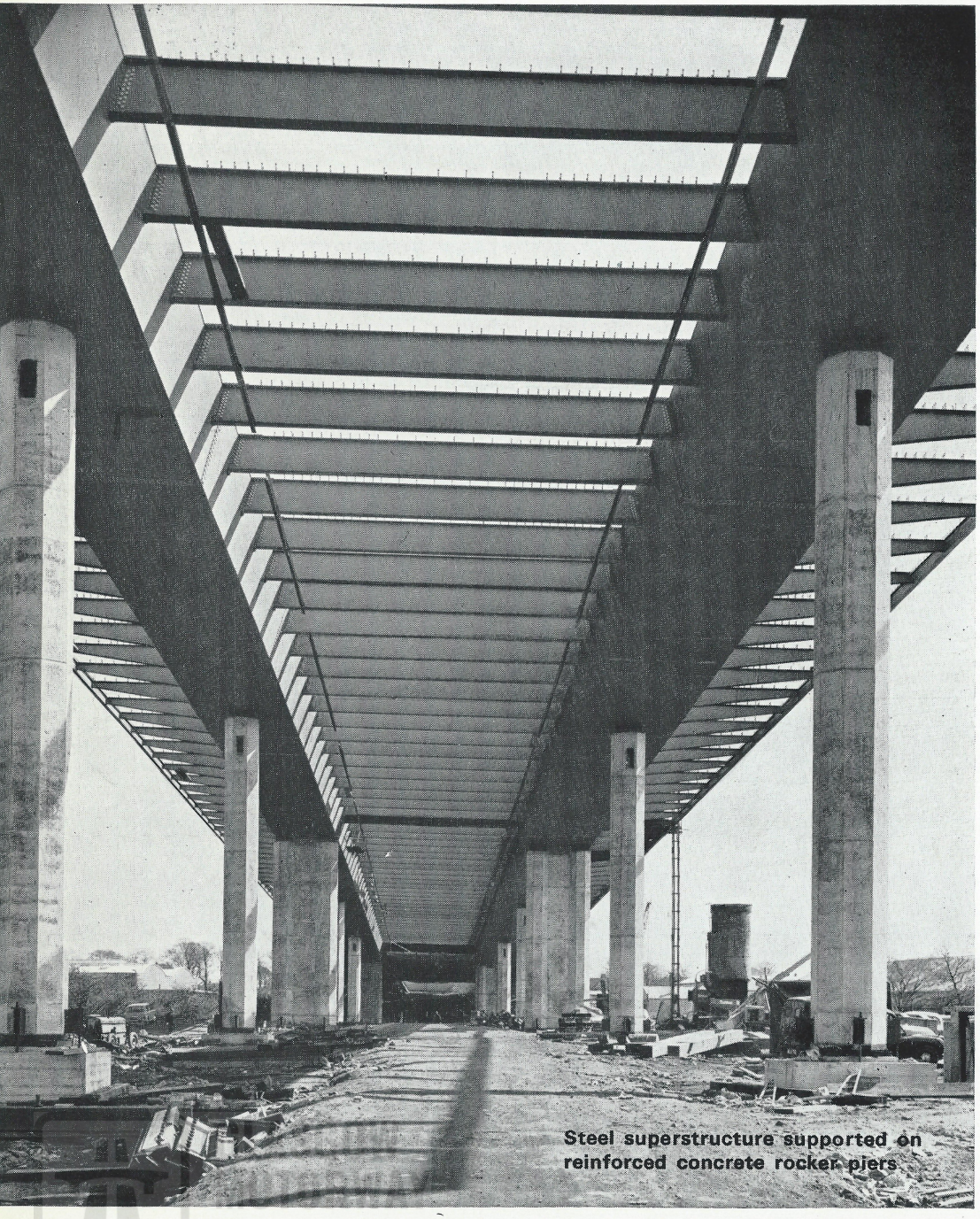
One important feature of the viaduct is the articulation of the reinforced concrete approach piers which behave as full height rockers. Longitudinal stability is achieved at the main river piers and the 8 in. range in expansion is accommodated by an open comb roadway joint at each abutment. This arrangement enables an uninterrupted running surface to be provided for the motorist and will reduce overall maintenance costs.

FOUNDATIONS Borehole investigation revealed sandstone at the east end of the site at a depth of 60 feet, overlaid with glacier boulder clay and alluvial silts. At the west end of the site, 150 feet maximum depth of silt overlies shales and sandstone. The shales are shattered for a depth of 700 feet and form a 500 feet wide band known as the Paisley Ruck which crosses the west line of the viaduct.

Carefully instrumented piles were put down to rock in the poorest region of the site and were tested both vertically and horizontally. The results enabled safe working loads to be established for the 12 in. × 12 in. × 90 lb. Universal Bearing Piles of 95 tons for vertical loads and 3 tons maximum for horizontal loads. 60,000 linear feet of piles were driven to a minimum set of 60 blows for the last 3 inches. All joints between pile sections were full strength butt welded and 20 per cent were ultrasonically examined.



TYPICAL CROSS SECTION



Steel superstructure supported on reinforced concrete rocker piers

Cathodic protection will be installed to prohibit corrosion of the steel piles. An impressed current will be delivered to permanent graphite anodes which will be arranged in horizontal beds and vertical tubes between foundations.

PIERS Each of the reinforced concrete piers of octagon section were poured continuously within fibre glass shutters which were stripped after a minimum of 24 hours. Concrete was delivered by skip to the top of each pier and was dropped through trunking a maximum height of 50 feet.

Mild steel rocker bearings, fabricated to suit the shape of the piers, have the bearing surfaces treated with 2 coats epoxy paint.

SUPERSTRUCTURE Design of the superstructure was aided by computer analyses and at an early stage wind tunnel tests were carried out by the Aeronautics Department of Glasgow University. The results emphasised the streamlined nature of the superstructure and to complete the programme full scale wind testing of the approach spans is proceeding. Pressure sensing points will be installed around the cross section leading to manometer tubes inside the box girder where automatically triggered cine cameras will record pressures.

The superstructure has been designed to carry 180 ton vehicles and to withstand winds in excess of 100 m.p.h.

Twin mild steel trapezoidal box girders form a continuous spine, each girder being $6\frac{1}{2}$ feet deep and 15 feet wide. Shop welded units 55 feet long and weighing 35 tons are delivered to site by road and are lifted into position on the east side by two 20 ton derrick cranes. A 40 ton tower crane is used on the west side with a 15 ton mobile assisting. On the river span the box girders increase in depth to 15 feet with the webs in the same plane throughout.

The 110 tons suspended river spans are assembled in a Clyde shipyard, lifted into the water and then towed to site. Special traversing rigs, mounted on the end of the main cantilevers, hoist the spans into position.

The varying curvature of the viaduct both in plan and elevation is achieved by having skew ends to the boxes requiring extremely accurate calculation prior to fabrication. All site joints are made with cadmium plated friction grip bolts. All steelwork is shot blasted and etch primed after fabrication and is given two coats of lead primer and one coat of micaceous iron oxide before leaving the works. After erection a final coat of micaceous iron oxide is applied from the permanent maintenance painting gantries running on continuous rails below deck level.

DECK The 8 in. thick doubly reinforced deck slab acts compositely with the steelwork for live load only and is held down by studs welded to the steelwork top flanges. Alternate 20 feet long 95 feet wide deck panels are formed in single 65 cu. yd. pours including the upstanding edge beams. All main reinforcement is high tensile. Prior to laying the $1\frac{1}{2}$ in. thick hot rolled asphalt running surface a rubber bitumen waterproof layer will be applied to the surface of the concrete deck.

Interchange giving Access to Glasgow Airport with the St. James Interchange at top of photograph.

INTERCHANGES

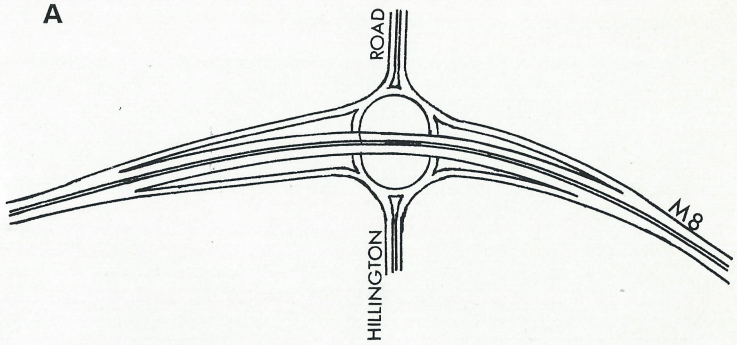
The Hillington Interchange consists of a flyover roundabout, where slip roads from the motorway give access to a roundabout constructed at ground level on Hillington Road which will be improved to dual carriageway standard. Traffic for Renfrew and Hillington leaves the motorway at this point.

At Renfrew Road the motorway passes below the existing A.741 from Paisley to Renfrew. Slip roads link the east bound carriageway with Arkleston Road and the west bound carriageway with Renfrew Road.

Access to the new Glasgow Airport at Abbotsinch is provided by a free flow junction of the single trumpet type where four slip roads connect to the Airport roads system at the point selected by the Airport designers.

The St. James Interchange consists of an elevated roundabout above the motorway with a direct dual carriageway link into Paisley, a link westward to Linwood (which is being carried out by Renfrew County Council) and a link to Barnsford Road for local traffic from Inchinnan or Houston.

A



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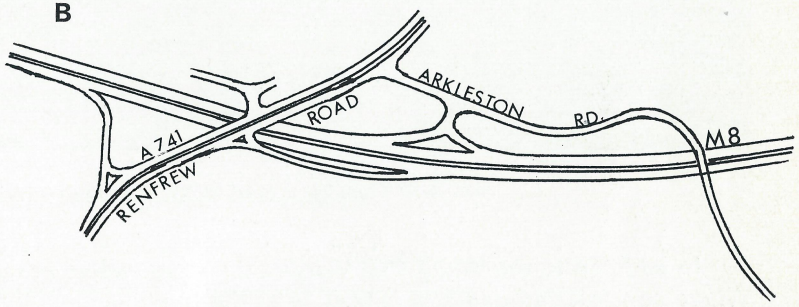

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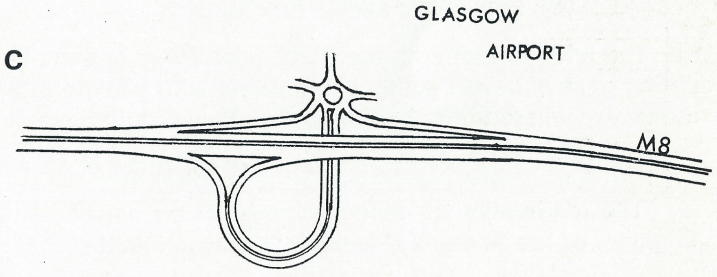

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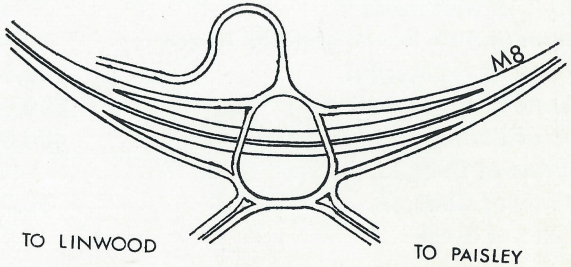

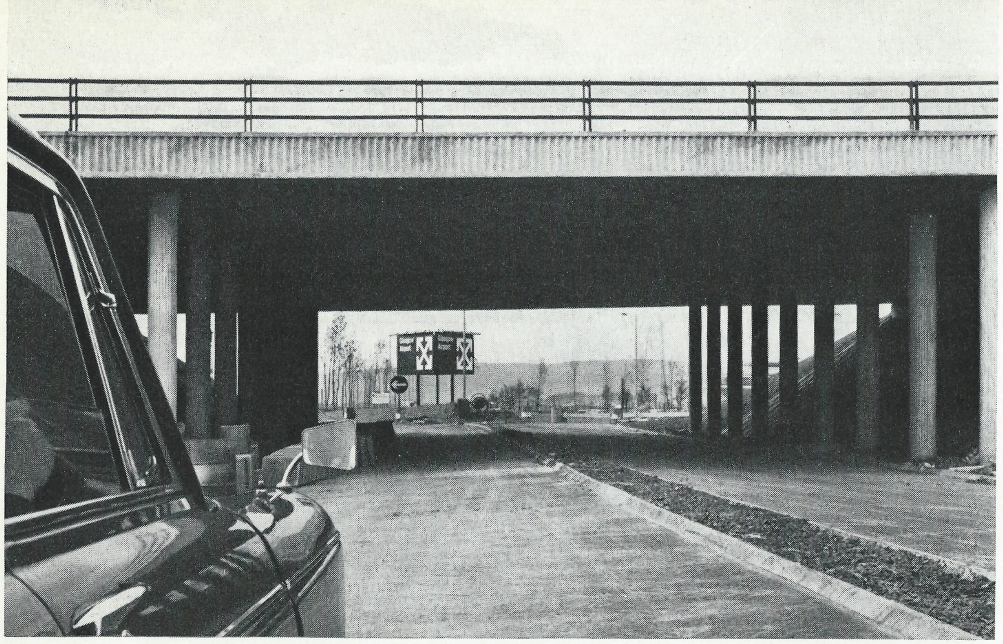

Access to Glasgow Airport below the motorway,

Bridge over the Black Cart Water

In addition to the White Cart Viaduct there are twelve bridges on the bypass and design has been standardised as far as possible to two main types to reduce costs. Where construction depth is critical as at the Interchanges, three and four span bridges consist of reinforced concrete slab decks continuous over their supports on 21 in. diameter precast concrete columns, hinged top and bottom. Column capping beams are within the depth of the slab and similar column and edge treatments on all six bridges of this type give a simple functional appearance.

The bridges spanning the Black Cart Water and the River Gryfe, where headroom is not critical but where shuttering could be difficult, have simply supported spans consisting of steel beams acting compositely with a reinforced concrete deck slab. This composite construction is also used for two bridges carrying existing roads over the motorway where traffic had to be maintained during construction and a variety of services accommodated.

The cost of the works involved is of the order of £5 millions and completion is expected early in 1968.

The roadworks are being carried out on behalf of the Secretary of State for Scotland under the direction of J. S. McNeil Esq., C.B.E., B.Sc., M.I.C.E., Chief Road Engineer of the Scottish Development Department.

The new link road from St. James Park to Linwood is for the County Council of Renfrew and their County Surveyor is W. A. Paterson Esq., M.I.Mun.E., F.Inst.H.E.

Length of Motorway	6.5	miles
Length of Side Roads and Slip Roads	4.2	miles
Volume of Excavation	303,000	cu. yds.
Volume of Imported Filling	896,000	cu. yds.
Area of Carriageway Surfaces	404,000	sq. yds.
Number of Bridges	12	
Volume of Concrete	16,000	cu. yds.
Weight of Steel	1,500	tons

Viaduct :—

Length	2,700	feet
Concrete in Piers	1,710	cu. yds.
Structural Steelwork	5,000	tons
Concrete in Deck	7,500	cu. yds.
H. Section Steel Piles	2,410	tons
	(60,000 lin. ft.)	

Consulting Engineers :-

CROUCH & HOGG
GLASGOW

Contractors :-

HILLINGTON TO BARNSFORD ROAD - - - - - -	PETER LIND & CO. LTD., LONDON & CANNOCK
BARNSFORD ROAD - ST. JAMES - GREENOCK ROAD -	MARPLES RIDGWAY, LTD., LONDON
WHITE CART VIADUCT - SUPERSTRUCTURE - - - -	SIR WILLIAM ARROL & CO. LTD., GLASGOW
WHITE CART VIADUCT - FOUNDATIONS - - - - -	MURDOCH MACKENZIE, LTD., MOTHERWELL
P. F. ASH EMBANKMENT AT ABBOTSINCH - - - -	JOHN DRYSDALE & CO. LTD., GLASGOW

Printed by Maclure, Macdonald & Co., Glasgow