Scott Wilson Scotland: A History

Volume 3 [Rev 1]

The Glasgow Motorways 1963 to 1976

JP McCafferty

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Scott Wilson Scotland: A History

The Glasgow Motorways 1963 to 1976

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1. The Highway Plan and the Appointment of Consultants

[Highway Plan; Glasgow Inner Ring Road; Cullen; Grace; Townhead 1, Woodside 1 & 2 (North Flank); Kingston Bridge, Charing Cross (West Flank); Clydeside Expressway]

Scott and Wilson, Kirkpatrick & Partners' traffic studies for the Highway Plan predicted traffic flows of around 100,000 vehicles per day for the design year of 1990 requiring up to four, lanes of motorway in both directions on the Glasgow Inner Ring Road. John Cullen, in 'Glasgow Motorways a history', noted that, "In Glasgow, with a low car ownership in UK terms and with only a few short sections of existing streets with traffic flows of more than 20,000vpd, this was mind-boggling. Indeed, at this time I would say that not one person in a hundred, maybe in a thousand, thought that this would really happen but was just another of those post-war, pie-in-the-sky paper exercises that would soon be forgotten". Indeed, Henry Grace, senior partner, delighted to tell about the time he attended a conversazionne at the Institution of Civil Engineers where a model of the proposed Townhead Interchange was on display, attracting considerable interest with its loops and flyovers. He observed one elderly engineer studying the model from all angles and eventually depart saying "it will never be built"! Of course, nothing of this type had ever been envisaged, far less built, in any British City!

Anxious to see work commencing on the ground as quickly as possible, The Corporation of the City of Glasgow and the Scottish Development Department, who contributed 50%-75% of the cost of major new roads, appointed consultants for the detailed design in 1963 as follows:-

SWK: Townhead Interchange Stage 1, Woodside 1and 2 (The North Flank).
WA Fairhurst & Partners: Kingston Bridge, Charing Cross (The West Flank).
Sir William Halcrow & Partners: The Clydeside Expressway.

To facilitate this end, SWK were asked to postpone publication of 'A Highway Plan for Glasgow' and transfer all resources to the design process. When asked how SWK intended to carry out the detailed design work, Henry Grace explained that drainage, roadworks and the like, would be done in Glasgow while the more technically complex work such as bridges would be done in London. Finding that this was not quite what the City of Glasgow had in mind, Grace quickly changed tack to the effect that everything would be done in Glasgow! And so, it is to this event that the establishment of an independent Glasgow business, rather than a 'branch office', can be traced.

2. The North Flank of the Glasgow Inner Ring Road

[6 Park Circus; 1964: key staff: Hodgen, Moncrief; Breakey; McKenna; Munro; Cullen et al]

The growth in staff required for the detailed design necessitated a further move, this time to 6 Park Circus, Glasgow, in the summer of 1963. The four-storey town house, in one of the most architecturally significant areas of Glasgow, was occupied, in part, by a firm of technical writers whose business was gradually ebbing away. This proved fortunate because, as they downsized and eventually faded away, SWK was able to expand and eventually fill the whole building.

By 1964, the key members of the permanent staff were:-

Roy Hodgen, [recently promoted to Associate] with overall responsibility and control, reporting to Partner, Henry Grace [in London];
David Moncrief, responsible for Road design, geometry, etc., supported by Willard Dougal [Feb 1964], Hamish Taylor, Billy Holmes[Jan 1961] and Hamzatt Ijaiya [seconded from SW Nigeria];
JM (Don) Breakey, responsible for Drainage [1963];
Brian McKenna, responsible for Bridges and Structures [who transferred from SWK London 1963], supported by Peter Innes [who joined from Freeman Fox in 1963], plus Gavin Walker, Bill Malcolm, Dr Stan Porter;
Angus Munro, responsible for traffic matters, and
John Cullen, who remained Roy Hodgen's 'understudy', with responsibility for Highway Planning, supported by Andy Davies, Jack Wood, John Stamper and tracers [X?] and Dawn Hogg.

During the detailed design, the appointed consultants reported to John Armour, the City Engineer, who was responsible for implementation, rather than to the Planning Department as had previously been the case.

While SWK had already set down the overall plan for the Glasgow Inner Ring Road and had defined the important geometric standards, they, in conjunction with William Holford & Associates, now set about making liaison with W.A. Fairhurst and Partners to agree and define all other design standards. As there were no defined or accepted national standards for urban motorways in 1963, appropriate new standards had to be defined, many of them based on American experience. Here again, 'new ground' had to be 'broken'! The input from Holford & Associates, who acted as architectural advisers and Landscape Architects, was invaluable in ensuring that, aesthetic matters were given their rightful place and that, a coherent and consistently high standard of design and townscape was achieved.

For those used to the massive computing capability now available on laptop computers, it comes as a surprise that the complex vertical and horizontal geometry, combining the straights, circles, spirals and superelevation required for an urban motorway was carried out 'by hand', with only the assistance of a mechanical calculator, about the size of a suitcase, that could add, subtract, multiply and divide [all slowly] and produce the answer on a paper 'tally roll that was then stapled onto the calculation sheet. Logarithms and trigonometric functions, interpolated to one second of arc, were obtained from 'Peters Tables'! An excellent understanding of geometry was required!

Aerial surveys were commissioned to provide accurate mapping and all horizontal geometry was plotted [by hand] on 1:500 plans, laid out on a large 'table tennis'-type table, to ensure that critical control points such as corners of buildings etc. were 'cleared' by the required margin. Critical clearances between carriageways and overhead bridge decks were checked and re-checked!

All drawings were prepared by the younger engineers, draughtsmen and tracers [usually women, almost everyone else, apart from the admin staff being male].

Brian McKenna played the pivotal role in defining structural types and leading the design process for the bridges, retaining walls and other structures on the North Flank. Brian graduated from Imperial College in 1953, was awarded an SWK Scholarship to Illinois University, USA, for studies in structures, soil mechanics and foundations, gaining an MSc in 1961, and had extensive experience in the design of bridges and structures. The complex horizontal and vertical geometry resulted in reinforced and prestressed concrete being the preferred material for bridge decks as this could be moulded to the complex shapes resulting from variations in curvature, superelevation and skewed supports more readily than could steel. Furthermore, reinforced and prestressed concrete, properly designed and constructed, were thought to require less maintenance and be more durable than steel. SWK used prestressed concrete where appropriate, had a rigorous and scientific approach to reinforcement 'cover', introduced air entrained concrete, specified 'designed' high strength concrete and required all concrete bridge decks to be waterproofed; none of these approaches was in common

use at the time. Continuous rather than simply supported construction was preferred as was constant-depth construction following road geometry, to provide simple elegant structures. An important development for the quality control of the 'specified strength' structural concrete was that it was all produced and tested on-site, rather than transported to site from external suppliers, more used to the production of lower grade 'specified mix' concrete for buildings and other less critical structures.

Unusual, or highly skewed bridge decks, were analysed using ICT Grillage programme C5 357 or IBM programme 'Stress'. This was an unusual, advanced and sophisticated technique in the 1960s!

Intermediate Bridge supports were either reinforced concrete circular columns or rectangular piers, with, pad foundations resting on rock, or reinforced concrete pile caps and bored, cast-in-place piles, socketed into rock.

Retaining walls and vertical faced bridge abutments on the North Flank were normally reinforced concrete cantilever types founded on stiff boulder clay, or shale, limestone or sandstone of the Carboniferous Limestone Series. Where rock was deep, bored, cast-in-place reinforced concrete piles were used to transfer loads to underlying rock where necessary. All walls and abutments had waterproofing applied to the retaining surfaces and positive piped drainage systems and weep pipes to minimise water pressures.

Where aggressive ground conditions existed, buried concrete was coated with bituminous paint [where possible] and sulphate resistant cement was specified. This was a particular problem in the Townhead area where aggressive ground conditions remained on the site of Charles Tennant's Bleach and Chemical Works, reputed to be the World's oldest.

3. Townhead Interchange, Stage 1

[Opened April 1968; Armour; Vaughan]

Townhead Interchange Stage 1 was opened by The Secretary of State for Scotland The Right Hon William Ross, MBE, MP, on 5th April 1968. In his speech, Willie Ross remarked that "Scott, Wilson, Kirkpatrick would make a first class half-back line in any team", from which, it can probably be deduced that SWK had done a jolly good job!

The commemorative brochure lists, Scott Wilson Kirkpatrick & Partners, Consulting Engineers; Wm. Holford Associates, Consulting Architects; Master of Works & City Engineer, John Armour and Contractor, Marples Ridgeway. Tom Vaughan was the Resident Engineer.

Target 1 of the Highway Plan envisaged the completion of a motorway link across the city, from northwest to south east, including the North and West Flanks of the Glasgow Inner Ring Road. Townhead Interchange, at the north west corner of the proposed ring road, was designed to provide multi-directional connections between the North Flank of the Inner Ring Road and the proposed Monkland Motorway (the east-west route) and also with the proposed Springburn Expressway and the proposed East Flank of the Inner Ring Road (the north-south route), together with connections to the remaining surface streets in the Townhead area. It was envisaged that the Interchange would be completed in three stages as the overall plan unfolded.

Townhead Interchange Stage 1 was, therefore, designed to provide the initial east-west route carrying the heavy traffic from the existing Parliamentary Road-Alexandra Parade route over the very heavily congested Springburn Road-Castle Street-High Street north-south route, thus providing welcome relief to this very heavily trafficked and congested area. To achieve this, and to facilitate the envisaged future construction, a number of 'stub ends' were constructed which would ultimately be required to make the connections to the proposed East Flank of the Inner Ring Road and the Springburn Expressway. In addition, temporary connections to surface streets were constructed, as

were those bridges and retaining walls that would have been difficult to construct at later stages. This 'staging' of construction was complex!

As the alignment of the proposed North Flank of the Inner Ring Road and Monkland Motorway followed the line of the relict Monkland Canal, which had been closed to traffic, a 'pre-construction contract was commissioned to maintain the water flow (which was utilised by local industry, a brewery in particular,) between Millburn Street and Speirs Wharf, in two 24 inch (600mm) diameter pipes.

To take advantage of a lower than expected tender sum for Townhead 1, an extension to the contract was negotiated for the construction of Woodside 1. This included additional retaining walls for ramps to and from realigned Craighall Road, Bridges 8A and 8B over the connection between Dobbie's Loan and Craighall Road including a complicated junction (Dougal's Folly!), realigned Dobbie's Loan and the connection with Garscube Road including two open span pedestrian underpasses.

The construction of the Inner Ring road required a high concentration of Bridges and other structures; Townhead 1 was no exception. Including Woodside 1, there were ten bridges, six pedestrian underpasses and thirteen retaining walls. Reinforced or prestressed concrete was adopted throughout because of its adaptability to the complex road geometry.

Four bridges (Baird Street, K Central and J&K East) had heavy skews of 35 to 70 degrees. The longest, at 820ft (250m) with 7 spans and 627ft (191m) with 5 spans, respectively, were J&K East (skewed 40 degrees anticlockwise at the west and 70 degrees clockwise at the east!). These bridges were of continuous, prestressed, post-tensioned, concrete box beam construction, cast span-by span, with continuity achieved by overlapping the tendons over the piers. Connecting deck slabs and side cantilevers were constructed following completion of post-tensioning. These were sophisticated and advanced bridges for their era and may well be the first use of continuous, prestressed, post-tensioned concrete box beam construction in Scotland.

Three bridges (Royston Road and J&K Central), having smaller skews and spans, were of continuous, reinforced concrete, voided slab, construction, and two (8A and 8B), were of continuous, reinforced concrete, construction.

North Wallace Street footbridge was of continuous, prestressed, post-tensioned concrete, construction over the motorway with reinforced concrete side spans.

Bridge abutments and retaining walls were, generally, of reinforced concrete, cantilever construction, faced with red sandstone, uncoursed random rubble facing. The source of the red sandstone remains a matter of discussion; some still believe it came from demolished tenements (which may indeed have been the original inspiration) but it is now generally accepted that the material was imported from Dumfriesshire "being red sandstone of which the buildings in much of the City have been built"!

The design speed for the Inner Ring Road was 50mph limited to 40mph on ramps. Geometric standards based on these speeds and US experience were derived and adopted. Pavement construction was 4 in. (100mm) hot rolled asphalt surfacing, over 10 in. (250mm) bitumen-bound roadbase and a minimum of 12in (300mm) sub base. Extensive alterations were required to the drainage and public services which were altered to accommodate not only the various phases of the road construction but also the radical redevelopment of the adjoining areas.

At the date of opening [5 April, 1968], the estimated cost of construction, including the Woodside 1 extension, was £3.1M. Work commenced on 1 November, 1965; the Woodside 1 extension commenced 3 April, 1967 and two sections of the Works were opened to traffic during 1967. The Contract included about 5,000ft (1.5km), of dual carriageway motorway, together with other works.

4. Woodside Section 2

[Maryhill Motorway; St George's Cross Interchange; Charing Cross Section; N & W Flanks Opened 4 Feb 1972; Balfour Beatty; CDAs]

The Woodside Section of the Inner Ring Road completed the North Flank between Townhead Interchange Stage 1 and St Georges Cross. Almost all of the construction took place within the Cowcaddens and Woodside Comprehensive Development Areas and part of the eastern section of the Woodside Section, Woodside 1, had been included in the Townhead 1 contract.

As was the case at Townhead, the design of the Woodside Section was significantly influenced by the need to accommodate interchange connections to planned future motorway development, in this case the Maryhill Motorway, which was to head north along the Forth & Clyde Canal Glasgow Branch, from the Inner Ring Road near Speir's Wharf. This interchange required the eastbound carriageway of the Inner Ring Road to cross a future ramp leading north (Bridge 9) and 'stub ends' on Bridges 11 and 12 to accommodate future connections north, to the proposed Maryhill Motorway. Bridge 12, carrying the westbound carriageway of the Inner Ring Road, also needed to be widened to accommodate 'weaving' traffic between the Maryhill Motorway and St George's Cross Interchange to the west and be significantly higher than the adjacent Bridge 11, to provide clearance over the eastbound carriageway of the Inner Ring Road for the proposed ramp connecting to the Maryhill Motorway. These arrangements proved ultimately to be unnecessary as enthusiasm for more motorways waned. There was to be no Maryhill Motorway!

No abortive 'stub ends' were required at the St George's Cross Interchange because it made full connection to the adjacent Charing Cross Section of the West Flank which was completed about 9 months after Woodside 2, on 4 February 1972.

Much of Woodside 2 is carried on bridges or viaducts or supported by retaining walls. There were five bridges, two viaducts, two footbridges, two pedestrian underpasses and eleven retaining walls.

Bridges 11, 1,200ft (365m) long and Bridge 12, 1,500ft (460m) long, were the most significant structures. These long viaducts were required to carry the Inner Ring Road from higher ground at the east to lower ground at St Georges Cross, over the heavily trafficked New City and Garscube Roads. Viaducts also minimised 'severance' of the existing urban fabric and provided visual connection at ground level. To facilitate speedy construction and deal with the large and varying widths of carriageway, simply supported, precast, prestressed, post-tensioned concrete beams with reinforced concrete deck slabs were considered to offer a more economical form of construction than the cast in-situ box beams favoured at Townhead. All internal beams were straight, while the U-shaped edge beams were curved to follow the horizontal alignment of the carriageways.

The beams were simply supported on inverted, T-shaped, reinforced concrete, pierheads, each supported on two 6ft (1.82m) diameter multi-faceted reinforced concrete columns. To provide constant depth construction following the road geometry, beams and pierheads were constructed with 'half joints', the beams being supported on elastomeric bearings. Each deck was fixed at one end and free at the other. There were extensive reinforced concrete cantilever abutments and walls at the west, and reinforced concrete, 'buried' abutments at the east end.

A total of 224 beams were constructed on site at a production rate of one beam per day. Production and storage of beams took place while foundations and piers were being constructed, allowing fast deck construction thereafter.

A notable feature of the production of beams on site was the decision to carry out full scale load tests on several half joints with different arrangements of reinforcement. Half joints in prestressed concrete beams of this scale were, at the time, novel. The test joints were restrained by anchors grouted into rock and the test loads applied by hydraulic jack (not quite to failure but near enough to cause everyone concerned to act ‘gingerly’ while checking strain gauges and taking measurements of crack widths and the like!]. The results proved that the designs were sound and enabled the simplest arrangements of reinforcement to be adopted.

Another interesting course of events arose from the decision to cut up the defunct half joint test pieces and at least one ‘condemned’ beam, for disposal in landscaped earth bunds. The safety of such an operation generated much debate on site. Thermal lances, rather frightening pieces of equipment, produced scenes akin to Dante’s Inferno, with the lone operator engulfed in clouds of dust, the thermal lance burning white hot and molten concrete flowing onto the ground, while everyone else crouched behind barriers of railway sleepers at a safe distance! The result was a ‘damp squib’ confirming that properly grouted prestressing tendons and anchorages do not fly out of the ends of beams when severed!

Bridge 9, carrying the eastbound carriageway of the Inner Ring Road over a ‘stub end’ of Ramp H, which would have connected to the, subsequently abandoned, Maryhill Motorway, was of reinforced concrete beam and slab construction with a high, reinforced concrete, cantilever abutment at the fixed east end an intermediate row of, small diameter, multi-faceted, reinforced concrete, columns and a piled, reinforced concrete, ‘bank-seat’ abutment at the top of a side slope at the west end. The geometry was complex, with varying superelevation, horizontal spirals, a vertical curve, and varying skews, 60 degrees at the east, 45 degrees at the column line, and 30 degrees at the west! A complex grillage analysis (using IBM programme ‘Stress’) was required for the deck. Equally complex reinforcement was required to cope with the constantly varying geometry and the interaction of shear, torsion and bending effects. Metal bearings were used throughout.

The bridges at the St George’s Cross Interchange were less complex.

Bridge 13, carrying the curved Ramp B, was of continuous, reinforced concrete, single solid box construction, with modest side cantilevers.
Bridge 14, carrying the Gt Western Rd Connection, was of continuous reinforced concrete, solid box construction, the four box ‘spines’, being connected by a reinforced concrete top slab.
Bridge 15, carrying Gt Western Rd Connection over St George’s Road in a single span, was of prestressed, post-tensioned U beam construction, the beams being connected by a reinforced concrete top slab.

Bridge 15, had reinforced concrete, cantilever, abutments and, Bridges 13 and 14, had tapered reinforced concrete intermediate supports and piled, reinforced concrete, ‘bank seat’ abutments.

Bridge foundations were reinforced concrete pads, founded on rock or supported on bored, cast in-situ, reinforced concrete piles socketed into rock.

Reinforced concrete, cantilever, retaining walls and bridge abutments were generally adopted. The red sandstone facing adopted for the Townhead 1 and Woodside 1, walls and abutments was not universally admired. It was thought, by some to be an inappropriate, rustic and expensive sham! Consequently, SWK and Holford Associates devised an aesthetically pleasing, modernist, precast, reinforced concrete, facing panel with ‘wally blue’, exposed flint aggregate that could also be used as a front shutter during the Woodside 2 construction. These precast panels were subsequently adopted for walls and abutments on the remaining contracts for the Glasgow Motorway system, although some consultants chose to attach the panels to the walls rather than use them as front shutters!

Work commenced on 1st September1968 and the estimated construction cost, at the date of opening, May1971, was £[unknown]. The Contract included about 4,000ft (1.2km) of dual carriageway motorway and about 3,500ft (1.1km) of surface streets together with significant drainage, landscaping, and other works, the aforementioned bridges and structures, and reconstruction of the entrance and reception area for the St George's Cross Underground station. The Main Contractor was Balfour Beatty.

The completion of the adjacent Charing Cross Contract of the West Flank, in January 1972, triggered the Official Opening of the North and West Flanks of the Inner Ring Road by The Rt. Hon. Gordon Campbell, M.C., M.P., Secretary of State for Scotland on 4 February, 1972.

WA Fairhurst, were the Consulting Engineers for the Charing Cross Section, with Whatlings Ltd as Contractor. WA Fairhurst, were also consultants for the Kingston Bridge and approaches which were opened in June 1970 by Her Majesty the Queen Mother; the Contractors were the Logan Marples Ridgeway JV. W Holford Associates were Consulting Landscape Architects throughout.

Construction of the North and West Flanks of the Inner Ring Road from Townhead, to just south of the Kingston Bridge, took just over six years and just over ten years from conception of the plan to completion; a remarkable achievement!

The total length of the North and West Flanks was about 2.5 miles (4km) and the cost of construction, at February 1972, was estimated to be £21.3M. Fees, disbursements, land costs and contractual claims not yet agreed, were in addition to this figure.

The majority of the work took place within the pre-established, Townhead, Woodside, Cowcaddens and Anderston Comprehensive Development Areas.

5. People and Events

[Cullen; Munro; Dougal; Breakey; Holmes; Innes; Port]

John M Cullen left SWK in 1967 to become a Research Fellow at the University of Strathclyde on 'containerisation' and later moved to the Department of Highways in Ontario. John thought Roy Hodgen was a brilliant Engineer but that he, perhaps, lacked appropriate social skills and lost key staff as a result.

Hamish Munro and others had also departed by 1967 leaving Willard Dougal responsible for Roads under JM Breakey. Billy Holmes transferred to 'Swinging London', also in 1967, for a six week secondment helping John Swift on the Lagos Apapa Road in Nigeria and stayed for five years! Peter Innes left the Bridges Section for SWK London and Dr Stan Port, and others in Bridges, had also gone by mid-1967.

Late summer 1967 saw the influx of some eager new recruits!

[McGowan; Toal; McKittrick; McCafferty; McDougall]

Bob McGowan joined the Bridges Section from a firm in Vancouver, Canada, and found himself in Gavin Walker's team in Room 5 as a replacement for David Sergeant working on the St George's Cross Bridges with John (Jack) Bruce, Graham McDonald (who shortly after emigrated to New Zealand), John Toal (fresh from a post-graduation, voluntary work, 'gap year' in South America, and brand new graduate, Bob McKittrick. Bob McGowan recalled that, as most of the deck design for the St Georges Cross Bridges was complete, he worked on substructure and assisting Gavin Walker on the development of the new precast concrete facing units for retaining walls.

Jim McCafferty and Stuart McDougall, also brand new graduates, joined the Bridges Section in August 1967 where they were assigned to the Room 6 Team overlooking Park Circus. Jim [who's introduction to the Scott Wilson world of consulting engineering must have been broadly similar to that of the other new graduates of the era] recalls that, after a day or so 'breaking in', he was despatched to the Woodside 1 Site where the large diameter, Pinkston sewer, had been discovered during the excavation for a major retaining wall under construction near Bridges 8A and 8B. The order of the day was to design, as fast as possible, a new length of the wall, with a lower footing and a stiffened-up stem with a large hole, through which the fragile sewer could be connected to the downstream network! Some analytical work for the piers of Bridges 11 and 12 followed and then he was given responsibility for Bridge 9, the highly skewed bridge described earlier. PABI, later discovered to be Peter Innes, had prepared and loaded a grillage analysis of the deck. Jim found himself with an outline sketch of Bridge 9, a large pile of computer output, and no text books and few design guides to keep him on the right track; a daunting challenge! David Coutts and David Smith, relatively new recruits themselves, the chartered engineers responsible for the design of Bridges 11 and 12 were able to give general support and guidance, as did Brian McKenna, but the standing order appeared to be 'just get on with it'! So that's what Jim had to do, and, in due course, the design, calculations, drawings (all done in pen and ink by hand) and the Bill of Quantities were produced, having been inspected or checked occasionally by David Coutts or Brian McKenna during the process. On completion of Bridge 9, Jim designed, and drew up, the abutment and retaining wall complex at the west end of Bridges 11 and 12.

Around August 1968, Roy Hodgen transferred to SWK London to start the new Traffic Section. In conversation with Jim McCafferty in 2012, Roy's wife, Pat, confirmed that, as Roy had ambitions to be an SWK Partner he should have made that his requirement before making the move! Roy disliked living and working in London, much preferring the ambience of, and working style in, Glasgow. John Cullen, on a visit to Roy about this time, noted that "when Roy put his foot on the accelerator in SWK London, nothing happened. Whereas, in Glasgow, he and others would have made sure that things happened"!!

Mervyn Johnston, formerly a Partner in SWK Nyasaland took over from Roy Hodgen as Associate in charge of SWK Glasgow in 1968 [in those days, overseas staff, even Partners, dropped a grade on return to the UK!]. Mervyn, from N Ireland like Roy, was a nice but un-dynamic man completely out of tune with what was going on in Glasgow at the time; an inappropriate leader for the group of able and ambitious young engineers which had risen to the task in Glasgow.

Chris Ford transferred from SWK Kendal to Glasgow Bridges in September 1968, where he supported Brian McKenna [who had been promoted to Senior Engineer in 1965] on Woodside 2 Bridges, and later on the development of the Renfrew 1 Bridge concepts.

At the commencement of work on Woodside 2, Sep 1968, Bob McGowan transferred to Site as DRE Bridges with Bob McKittrick as his able, and only, assistant.

In November 1968, Jim McCafferty transferred from Bridges to Roads under Willard Dougal and Don Breakey. This was an altogether more light hearted experience with more opportunity for site visits, paid overtime and meeting people in the outside world! There were also frequent opportunities for games of Darts at lunchtime and after 5.15pm before the start of overtime! The Dart board was nailed to one of the doors in 'The Basement' where the roads men hung out. No-one, as far as is known, was injured trying to get through this door but it was a close run thing occasionally. Willard Dougal was hard to beat as he'd had a lot more practise than the others! Jim found himself engaged on setting out the main survey stations and finalising contract drawings for Woodside 2, preparing the 'graphic' layout drawings, plans and profiles for the Renfrew 1 Main Line and the complex 'Braided' interchange between Renfrew 1 and Ayr 1 [mostly done 'spread-eagled' on a low ping-pong sized

table], on the roads design, preliminary contract documents and ground investigation for Brandon Street Bypass, Motherwell.

In September 1969, Jim McCafferty transferred to Woodside 2 Site as ARE Bridges under Bob McGowan, where he found himself supervising the construction of Bridges 11, 12 and 9, an interesting and salutary experience, given his earlier involvement with the design! Bob McKittrick transferred to the Roads team about the same time and Bill Clarke soon joined the Bridges team from Argyll County Council. Bob McGowan's Sunbeam Rapier [or similar] parked outside the RE's Office complex had a novel window cleaning system, essential for dealing with the vagaries of the winter weather and the mud and dust on site. This system required that Bob should wind down his window, lean out and squirt a good dose of soapy water onto the windscreen from his 'Squeezie' washing-up container before switching on the wipers and lining the car up for an exit onto New City Road. Frequent re-applications of the soapy water were required before reaching home base in Uddingston! This nightly experience plus the offer of a job in the sun probably contributed to Bob's departure for SWK Nairobi in January 1970. **Gavin Walker took over as DRE Bridges** for the remainder of the project.

The Woodside 2 Site was too full of 'characters' on the RE and Contractors staff to mention more than a few!

[Davidson; Regdin Trophy; McTaggart; Vaughan]

Inspector of Works, Alec Davidson, had a good side-line going in the production of bird baths and similar garden ornaments which he created from concrete left over from the casting of 'control cubes' and moulds made from old bin lids and office lampshades. He was so successful at this that he was commissioned to make the 'Regdin Trophy' competed for regularly between the SWK and Holford Staff at Park Circus. Alec also carried a 'Blacktop' thermometer which he used regularly, much to the amazement of the Contractor's operatives, to pass or condemn everything from concrete to compacted fill! On the Contractor's side, Jock 'Horse-it-on' McTaggart, the Structures Foreman used all his talents to 'get things done' by most means fair or foul! On one occasion, Jock and his trusty crane driver decided to get a few more 40 ton beams onto Bridge 11 during the lunch hour. This resulted in a failure of one of the lifting 'hooks' and one end of the beam burying itself into the ground a few feet away from the workmen's bothy where they were having their sandwiches! Fortunately no harm was done but a closer eye was kept on Jock thereafter. Resident Engineer, Tom Vaughan 'The Shropshire Lad' indulged his interest in Tunnelling. towards the end of the job, by persuading someone at the Department of Mining at the University of Strathclyde to let him carry out research into aspects of stress changes in rock as a result of tunnelling. Tom was awarded his PhD as a result of his research and, it is understood, joined the Department of Mining at Strathclyde before finally retiring a few years later.

Following the opening of Woodside 2 in May 1971, the staff dispersed.

[McCafferty; McKittrick; McKenna; Ford; Holmes; WOW]

Jim McCafferty returned to the Glasgow Roads section to work mainly on the final roads design for Renfrew Motorway Stage I. Bob McKittrick returned to Glasgow Bridges working on Renfrew 1. Brian McKenna transferred to SWK London to work on various bridge projects leaving Chris Ford in charge of the Glasgow Bridge section. Billy Holmes returned from 'Swinging London' with an Afghan coat, long hair a droopy moustache and a long cigarette holder! Billy brought with him a Land Rover [thought to be from London Office and to which it was duly transferred after several weeks in Glasgow]. Attached to the back of the Land Rover was 'WOW', an Enterprise dinghy that Billy had mysteriously acquired from SWK Kendal on his way north! 'WOW' provided many years of excellent sailing on Loch Lomond for the SWK Glasgow enthusiasts. As for work, Billy quickly got to grips with

the computer programme required to define the complex horizontal geometry of the 'Braided' interchange on Renfrew 1.

1971 also saw the arrival of new graduate Hugh Blackwood who joined the Bridges Section and quickly found himself up to the ears in the design of Ramp C on Renfrew 1 and Bob McGowan re-joined Glasgow Bridges under Chris Ford, having transferred from SWK Nairobi around August 1971.

The most significant event of 1971 was, however, the creation of SWK & Co (Scotland) Ltd, the departure of Mervyn Johnston, and the return of Roy Hodgen as the Managing Director. This move recognised, at least in part, Roy Hodgen's aspiration to be a Partner, his desire to return to Glasgow and the growing recognition that the staff in Glasgow had aspirations to gain at least some control over their own destiny rather than be forever a 'Colonial outpost' of something bigger elsewhere!

April1972 saw Bob McKittrick leave SWK to seek his fortune with Balfour Beatty and Jim McCafferty transferring to Bridges after a period of 'double life' working on bridge design [Brandon Street Bypass Motherwell] in his lunch hours and in the evenings, and on roads design during normal hours. In 'Bridges', Jim was responsible for Scotland Street Viaduct, the most significant structure on Renfrew 1, moving on during 1973 with responsibility for all aspects [structures, roads etc] of Cathkin Relief Road, Rutherglen.

Having been persuaded by Roy Hodgen, **John Cullen returned from Canada to re-join SWKCSL** as a Senior Engineer [the same level as Don Breakey and Chris Ford] in September 1972.

On 23 October 1972, the Renfrew Motorway Sewer Outfall contract commenced with Stewart McNee as Resident Engineer.

The most dramatic of SWK Scotland's early years was 1973. And the most dramatic day in that year was 17 September. It was the official starting day for the 3 - year contract for Renfrew Motorway Stage 1, the biggest contract handled up to that time by SWKCSL. It was also the day when Chief Resident Engineer **Stewart McNee died suddenly** when leaving the office to go home in the evening, Stewart had joined SWK for the design of M6 in Westmorland in 1964 and then had a spell in the Ibadan office, Nigeria, in the early I970s before returning to UK as Resident Engineer on the Renfrew Sewer Outfall works, starting on 23 October 1972. He had been appointed Chief Resident Engineer for Renfrew Motorway Stage 1 with effect from 1 July 1973!

Apart from the personal tragedy, the drama of 17 September was heightened by events earlier in the year. Renfrew motorway was put out to tender on 29 March 1973 and within a month **Roy Hodgen had resigned as Managing Director of SWK Scotland** and left to become a partner of another firm taking Jack Wood with him. Following an urgent consultation with senior staff by Henry Grace and Charles Sang, **John Cullen succeeded as Managing Director** on 1 April 1973 and Don Breakey and Chris Ford joined the board. The latter was appointed director for the construction phase of Renfrew Motorway Stage 1. Henry Grace and Charles Sang, concerned that Roy Hodgen would attempt to take the City of Glasgow with him as a client, also met with John Armour, the City Engineer, to explain what steps were being taken to stabilise the situation and replace Roy Hodgen. To his credit, John Armour immediately re-assured them that Glasgow's contract was with SWK and not Roy Hodgen!

Chris Ford resigned on 1 September and left on 7 December 1973, to join Roy Hodgen. Thus the year ended with the replacement CRE not yet on site and an unexpected change in project director on the biggest job in the Scottish firm's history up to that time. Bob McGowan and Jim McCafferty discussed the situation by telephone on hearing that Chris Ford had resigned and concluded that

despite the shock of these events, **it was an ill wind that blew nobody any good and that opportunity suddenly lay ahead!**

Amidst these 'goings on', relatively minor events by comparison, still had their significance.

[McKittrick; Walters; McCafferty; Hunter; Baker; Robertson; Betsy Sinclair]

Having decided that the contracting life wasn't for him after all, Bob McKittrick returned to SWKCSL in March 1973, transferring to Renfrew Motorway Stage 1 as SARE Bridges under Tudor Walters in September 1973. In August 1973, Jim McCafferty was promoted to Senior Assistant Engineer [SAE] and new graduates, Ronnie Hunter and Alan Baker joined, as did Brian Robertson and the redoubtable senior secretary, Betsy Sinclair.

In those days, the number of recognisable steps in seniority was small, the standard route being Graduate Under Agreement [GUA], Assistant Engineer (Chartered, or not) [AE(C) or AE], Senior Engineer [SE]. Associates and Partners were on a different level altogether!

January 1974 saw the beginning of Britain's winter of discontent, with the miners' strike and the three-day week leading to the downfall of Ted Heath's Conservative Government. The three day week, introduced to save energy during the dark and bitterly cold January and February of 1974, was overcome by the ingenious introduction of Calor gas powered 'tilly' lamps and heaters which enabled, more or less normal, five day working, albeit in the rather strange atmosphere of underground shelter or gloomy campsite!

The arrival of Neil MacKay (ex M6 motorway and Mombasa water supply) on 8 January 1974, as project engineer for the supervision of construction was a significant step forward in overcoming the difficulties of that **desperate first winter on Renfrew Motorway Stage1**! By summer 1974, however, as it had become evident that the newly appointed CRE, who had replaced Stewart McNee, was not the man for the job, Neil McKay moved to site as CRE, signalling a change for the better in the relationship with Contractor Balfour Beatty and in the progress of the works.

From 1974 to 1976, work in the office included supervision-in-chief duties for Renfrew 1 and progress on other major roads projects as well as some adventures overseas!

[McGowan; McCafferty; Townhead 2; E & S Flanks GIRR; Clyderail-St John's Link; Renfrew 1; Ibadan Bypass; Baker; Hunter; Ayr Motorway; Mill St Rutherglen; Peterhead Housing; Baillie; Blackwood]

Under Bob McGowan, Jim McCafferty was responsible for the design of structures on Townhead Interchange Stage 2, including ground investigation, several major bridges including a multi-span steel railway bridge on 'live' track and several large retaining walls, including several hundred meters of contiguous bored pile wall anchored to rock; structural input to studies for the East and South Flanks of Glasgow Inner Ring Road, including a major crossing of the River Clyde at Glasgow Green; structural input for the feasibility study for rehabilitation of the Clyderail – St John's Link urban rail route in Glasgow as well as supervision-in-chief duties for Renfrew 1 and a brief spell in the Ibadan office of SWK Nigeria giving structural advice on the Ibadan Bypass.

Having joined as a graduate in September 1973, Alan Baker found himself involved in the structural design of Townhead 2 and in the revised design of abutments for Paisley Road Bridge on Renfrew 1 to suit conditions on site. Transferring to the Roads Section in February 1975, Alan became involved in studies for the East and South Flanks of GIRR and the geometric design of a motorway interchange for Lagos, Nigeria before moving on to Renfrew I Site as ARE Roads supervising construction of earthworks, roads, drainage, services and landscaping until December 1976.

From August to November 1973, the young Ronnie Hunter worked in Transportation Planning on Ayr Motorway and the East Flank of GIRR before transferring to work with George Baillie on Mill Street Extension, Rutherglen. Moving next door to 5 Park Circus in August 1974, Ronnie assisted Gavin Walker on the independent check of Ramp C Bridge on Renfrew 1 [about which more later!] followed by a brief spell on roads design for Peterhead housing sites, again under George Baillie. From June 1975 to May 1976, Ronnie was ARE Roads on the 'braided' interchange on Renfrew 1 before transferring to Peterhead as RE on the housing estate roads job until completion in December 1976.

Hugh Blackwood, who had transferred from Park Circus, was an ARE on the Ramp C area of Renfrew 1 Site until he transferred to SWK Ibadan, Nigeria in mid-1975.

6. 1975 proved to be another pivotal year in the fortunes of Scott Wilson in Scotland.

[M8 Monkland; Strathclyde Regional Council; 'Wind of Change'; Renfrew 1; McKittrick; McCafferty; McKay; Walters]

To the east of Townhead 1, Section 1 of the M8 Monkland Motorway designed by the City of Glasgow, opened in May and, later that month, the re-organisation of Scottish Local Government saw the absorption of the City of Glasgow into the newly created Strathclyde Regional Council. The disappearance of SWK Scotland's major and almost only client, the desire of the new SRC to undertake more design in-house, the slowing down of investment in major infrastructure and a gradual loss of appetite for major urban motorways in Glasgow signalled the start of a gentle and rather unsettling breeze through the corridors of 6 Park Circus. There was a major defection of staff to the new SRC and a growing realisation that the gentle breeze ruffling the papers on senior management desks would, during 1976, become a gusting 'wind of change'.

In October 1975, following some unpleasantness with the Renfrew 1 contractor, Bob McKittrick transferred back to Park Circus, becoming engaged on, among other things, water supply projects for SWK Kenya and Nigeria. About the same time, Jim McCafferty transferred to Renfrew 1 and shortly after became RE Bridges when Neil McKay returned to Park Circus as project engineer for the supervision of construction and Tudor Walters became CRE.

7. Renfrew Motorway Stage 1

Renfrew Motorway Stage1 (Consulting Engineer, Scott Wilson Kirkpatrick & Co (Scotland) Ltd; Contractor Balfour Beatty Construction (Scotland) Ltd) and the adjacent Renfrew Motorway Stage 2 (Consulting Engineer W A Fairhurst; Contractor Leonard Fairclough Ltd) (Helen Street to existing M8 near Glasgow Airport) were opened by the Rt. Hon. Bruce Millan M.P. Secretary of State for Scotland on 15 October 1976.
Together with Monkland Motorway Stage 1, which opened in May 1975, these sections of motorway provided another major step towards the completion of the motorway link across Glasgow, from Baillieston Interchange in the east to Glasgow Airport in the west, envisaged in SWK's Highway Plan for Glasgow.
The remaining link, Monkland Motorway Stage 2 was completed, in April 1980 (by Strathclyde Regional Council and contractors Whatlings [Monkland 2A] and French Keir [Monkland 2B]).

Renfrew Motorway Stage 1 runs parallel to the River Clyde, from the southern approaches to the Kingston Bridge in the east, to Helen Street at Ibrox in the west, a distance of 3.3km, where it links with Renfrew Motorway Stage 2.

The eastern section (1.9km long), between the Kingston Bridge and the Ayr Motorway Interchange at Dumbreck, has four 3-lane carriageways. The western sector (1.4km), from Dumbreck to Helen Street, has two 3-lane carriageways over part of this length and two 4-lane carriageways for the remainder.

There were, in addition to the motorway, new surface streets totalling 2.3km in length, and a new, 1.65m diameter, surface water sewer, 1.75km long, running to an outfall at the River Clyde.

One of the most significant changes facing the various design teams, when compared with the earlier work on the Glasgow Inner Ring Road, was the change from imperial to metric units for all calculations, dimensions and quantities. More powerful computing power was also available, particularly for the computation of the complex horizontal and vertical geometry of the roads and bridges. More powerful computing also enabled the analysis and design of the sometimes, quite daring, bridges on the project. The analysis of the complex box girder bridges, in particular, was aided by the use of the recently developed 'finite strip' computer programmes devised by Professor Cusens of Dundee University, which helped the understanding of shear-lag, torsional distortion and the like. The production of bills of quantities was also aided by the new, computerised, Civil Engineering Standard Method of Measurement [CESMM]. The Scottish Development Department [SDD] Roads directorate had also got to grips with the need for, and issue of, standardised design guidance notes and procedures, to fill the gap between existing Codes of Practice and British Standards, and the reality of current design and construction practice.

The project included a section where unusually large traffic volumes were anticipated between the merging of the two radial motorways (Renfrew Motorway and Ayr Motorway) and their divergence onto the West and proposed South Flanks of the Inner Ring Road. These large volumes, coupled with a high proportion of weaving traffic, led to the adoption of the 'braided', 4-carriageway design. With this configuration, no weaving of traffic occurs, since a separate route is provided for every movement between the West and proposed South Flanks of the Inner Ring Road to the east and the two motorways to the west. The 'Renfrew Motorway to South Flank' link was provided with a 'temporary' off-ramp to Paisley Road West, while the 'South Flank to Renfrew Motorway' link was provided with a 'temporary' on-ramp from West Street/Scotland Street. These 'temporary' ramps remained in place until the construction of the M74 Connection to the south end of the Kingston Bridge in 2011! The South Flank of the Inner Ring Road was not to be! However, the M74 Connection does now provide the last link in an eastwardly elongated 'Ring Road' bringing associated relief to the North and West Flanks which had become overloaded at peak hours.

The braided interchange connection to the Ayr Motorway was temporarily terminated at Gower Street in Dumbreck until the completion of Dumbreck Road Connection (M77 Ayr Motorway Stage1!) by SWK and contractor Whatlings, in August 1981.

To minimise 'severance' the motorway runs close to, the Glasgow-Paisley electrified railway along the western section and, the edge of existing industrial development along the remainder.

There are different ground conditions east and west of Bellahouston Bridge, where the motorway crosses the Glasgow-Paisley electrified railway. To the west, the soils are diverse but generally, boulder clay (up to10m deep) overlies shale, coal and sandstone. In addition, old mine workings forming undesirable voids beneath the motorway in this area, had to be stabilised by cement grouting.

To the east of Bellahouston Bridge, the soils are generally loose silty sands, with an existing water table at around 2m below ground level, overlying boulder clay, with sandstone at a depth of 20 to 30m. The high water table, combined with the loose sands, required special design considerations to avoid settlement of the motorway. The adopted solution was to lower the water table during construction using a 'well-pointing' system, excavate the loose silty sands to 1.3m below formation level and then replace the same material, suitably drained and compacted.

Providing surface water drainage for urban motorways is often difficult and expensive because of the lack of suitable outfalls. The problem on Renfrew Motorway Stage 1 was accentuated because two

sections have depressed profiles where the water table in the alluvial soils is relatively high. The solution was to provide a new 'outfall sewer' discharging to the River Clyde and a new 'trunk sewer', extending nearly the full length of the motorway, which will also drain other connecting sections of motorway not yet constructed. The 1.65m diameter 'outfall sewer' was constructed during an advance contract, in tunnel (using compressed air) or in deep open cut using 'well-pointing' to lower the water table temporarily where required. Extensive sub-soil drainage was also provided to deal with the high water table and for slope drainage.

As **the motorway passes through a congested urban area**, the existing services (water, gas, sewers, plus electricity, telephone and transport cables) had to be diverted to suit the motorway plan. The planning and co-ordination of these diversions was complex, requiring many of the diversions to be carried out before it was possible to start major works.

A flexible pavement construction was adopted to suit the ground conditions and the varying cross sections of urban road. Type 1 sub-base 200 to 450mm thick was adopted depending on the sub-grade conditions and dense bitumen macadam road base 250mm thick was provided to cope with the high numbers of heavy vehicles anticipated on this section of road. Hot rolled asphalt surfacing was provided.

As on the earlier, adjacent, Inner Ring Road, the relationship of the motorway with its surroundings was given detailed consideration, with William Holford and Associates advising on aesthetic matters, pedestrian routes and landscaping. The closely-knit urban character of the area through which the motorway passes precluded the inclusion of large areas of landscaping on its periphery. Nevertheless, it was possible to maintain a continuous belt of landscaping along from Bellahouston Park in the west to the Kingston Bridge in the east. Existing trees were retained where possible, supplemented with large areas of trees and shrubs planted throughout the motorway corridor. Side slopes were generally constructed at 1 on 3, or flatter, to ease maintenance, although in some cases, site conditions dictated steeper slopes at 1 on 2. All the landscaping work was carried out in association with the City Parks Department. The wishes of pedestrians were recognised by including five, north-south footbridges, coincident with long established pedestrian routes over the motorway.

High pressure sodium lighting mounted on 24, 30 and 36 metre high steel masts in the central reservation or at the motorway edges, was designed by the City Lighting Engineer, while advance and confirmatory direction signing is carried on internally lit gantry signs designed to incorporate a remotely controlled motorway signal system in the future.

There were four distinct bridge types on the project:

Prestressed, Post-tensioned, Concrete Box Girder Bridges:
Scotland Street Viaduct (Table tops and suspended spans);
Paisley Road West Bridge, Ramp A Bridge and Ramp C Bridge (All continuous).

Precast, Prestressed, Pre-tensioned, Concrete M Beam Bridges:
Bellahouston Bridge and Gower Street Bridge (Portal construction over railway);
British Rail Bridge 10 (Simply supported over railway);
Helen Street Bridge (Simply supported over motorway).

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

Footbridges:
Beech Avenue; Cornwall Street; Kirkwood Street and Percy Street Footbridges over the motorway.
Hazlewood Road Footbridge over the Glasgow-Paisley electrified railway.

All the bridges are of constant depth following the vertical geometry of the road or footway they carry.

Foundation conditions varied considerably, structures to the east being founded on steel 'H' piles and those to the west on large and small diameter bored cast in-situ piles or pad footings.

In addition to the bridges, there were nine reinforced concrete cantilever retaining walls and one steel sheet piled wall totalling 1.8km in length. The standard precast concrete facing units (serving also as a front shutter) developed for the Woodside 2 Section of the Inner Ring Road were adopted.

Scotland Street Viaduct was the largest and most complex structure with 33 spans of around 33.5m supporting a total length of 1.1km of carriageway! The viaduct crossed the multi tracked railway line to General Terminus Quay on the River Clyde (later abandoned), Seaward Street at the junction with Scotland Street and the Glasgow Underground Railway. Crossing the Underground at such an extreme skew, required large piled foundations that were major structures in their own right. Poor ground conditions (alluvial sands and silts overlying boulder clay) required steel H piles driven to rock. To minimise vibration damage to the Underground, nearby piles were driven within holes bored to below rail level and subsequently backfilled with concrete.
The viaduct decks were designed as prestressed, post-tensioned concrete, twin cell box girder 'Tabletops' with spans of 33.5m and reinforced concrete 'suspended spans' 20m long. Half joints provided between the 'Tabletops' and suspended spans were provided with elastomeric bearings and a movement joint at one end of each suspended span. This form of construction permitted work on several 'Tabletops' and later, several 'suspended spans' concurrently, enabling speedy construction. Reinforced concrete piers tapering slightly towards the base supported the decks on twin bearings.

Ramps A and C on the 'braided' interchange to Ayr Motorway were designed as continuous, prestressed, post tensioned concrete box girder decks, constructed 'span by span' with continuity of prestressing tendons achieved using live end-dead end connectors. Ramp A, seven spans and 215m long, varied in width and number of cells, while Ramp C, five spans and 174m long, had twin cells of constant width. Both decks had significant horizontal curvature following the road geometry. The decks were supported on twin bearings at both abutments, and on two of the wider piers on Ramp A, and on single bearings, allowing movement in all directions, at the four single column intermediate supports on Ramp C and at the remaining four single column intermediate supports on Ramp A. Lateral restraint was provided by horizontal 'pins' at the fixed abutments and by horizontally guided bearings at the free ends. During span by span construction, this arrangement required the contractor to provide temporary restraint at each leading bearing and/or other bearings.

A major incident occurred during the construction of Ramp C. [McGowan; McCafferty; Melville; Townsend; Dumbreck Road Link (M77 Ayr Motorway Stage 1]

Following the successful completion of four of the five spans, the contractor-designed temporary bearing restraint failed, allowing the deck to slew sideways and almost off the leading bearing but fortunately remaining supported on underlying falsework. The contractor quickly obtained and erected military trestling to stabilise the deck. After much intense and detailed deliberation by Bob McGowan, Jim McCafferty and others for SWK and John Melville, John Townsend and others for Balfour Beatty, the deck was lifted, rotated and moved horizontally back to its correct location and then lowered back on to the bearings, which had been taken apart, checked and provided with replacement 'ptfe' sliding material. The reason for the failure of the contractor designed temporary restraint was not entirely clear on first inspection. However, later detailed investigation proved that the cause was axial deck rotation resulting from unbalanced construction of the unstressed cast-in-situ concrete edge copes. The timing of the incident was probably due to a combination of a sudden drop in temperature during a rainstorm following a long period of hot weather. Further investigation revealed that the same defect was also present in the partially completed Ramp A but no slippage occurred. Construction of Ramps

A and C continued thereafter. However, following opening of the motorway to traffic in October 1976, work on both bridges continued for several years prior to the completion of the connection to Dumbreck Road Link (M77 Ayr Motorway Stage 1).

As one of those involved remarked at the time, “Sitting a bridge deck on a 'ptfe' sliding bearing was a bit like putting a pound of butter on a hot frying pan”!!

Paisley Road Bridge carrying Paisley Road over the motorway was of similar construction to Ramps A and C but it had straight, twin decks, with single cell boxes, each with four spans and 143m long.

The foundations for these bridges included reinforced pile caps and bored reinforced concrete piles socketed into rock.

Bellahouston (216m long) and Gower Street (63m long) Bridges over the electrified Glasgow-Paisley railway required ‘fail- safe’ working arrangements and other railway requirements but they were, otherwise, fairly standard ‘tunnel-like’ structures with a 21.7m span. The precast, prestressed, pre-tensioned concrete M beam decks were made continuous with the reinforced concrete abutments forming ‘portal frame’ structures providing some economy, reducing maintenance over the railway and providing additional stability. The reinforced concrete abutments were founded on firm boulder clay and underlying shallow mine workings were consolidated using cement grout.

Helen Street Bridge (simply supported, precast, prestressed, pre-tensioned M Beam deck) and **Dumbreck Road Bridge** (continuous reinforced concrete deck) were unremarkable, save for the need to carry major services, which dictated the form of construction.

Beech Avenue, Kirkwood Street, Percy Street and Cornwall Street Footbridges form an elegant group of bridges crossing, and best viewed from, the motorway. The decks were designed as a combination of prestressed, post tensioned concrete, box girder ‘Tabletops’ and ‘suspended spans’. Spans over the motorway varied from 24m to 34m approximately. Approach spans, where required, were helical, reinforced concrete slabs of gentle gradient rather than the more brutal stairs and angular ramps often used in such circumstances. The elegant appearance of these bridges was further enhanced by sympathetic soft and hard landscaping to provide a pleasant experience for pedestrians.

Hazelwood Road Footbridge, which adjoins Kirkwood Street Footbridge, crosses the Glasgow-Paisley electrified railway providing a pedestrian route to the nearby Bellahouston Academy. Restricted clearance over the railway and the requirement for high, solid, ‘unclimbable’ parapets resulted in a less elegant deck of simply supported prestressed, post-tensioned concrete beams with a connecting, reinforced concrete, bottom deck slab, forming a U-shaped construction.

The reinforced concrete Piers for the footbridges were founded on reinforced concrete footings resting on rock, or supported by bored, reinforced concrete, piles socketed into rock. At Beech Avenue Footbridge, two piers were supported on the deck of the underlying Bellahouston Bridge.

At the time of opening, the estimated cost of construction was £20.7M.

The Chief Resident Engineer, for most of the time, was Neil M McKay.

Construction commenced 17 September 1973 and the project was opened to traffic 15 October 1976.

Before the dust settled, the site staff had started to disperse. [McKay; Walters; McCafferty]

Neil McKay had returned to Park Circus to take up the role of project engineer but before long, he was off to the European Investment Bank in Luxembourg as RE; CRE Tudor Walters joined another firm and departed for Dubai; RE Bridges Jim McCafferty departed for SWK Hong Kong towards the end of November 1976, others stayed on to complete landscaping and measurement and some returned to Park Circus to carry on with work in hand or to seek-out the next projects.

The completion and opening of Renfrew Motorway Stage 1 was a great triumph. Major managerial and technical difficulties had been overcome and the end product was a very fine and beautiful example of urban motorway design and construction. Everyone involved on Renfrew 1, or on the earlier projects on the North Flank of the Glasgow Inner Ring Road or the production of the Highway Plan for Glasgow felt a great sense of achievement, that they had been involved in a 'great work'!

But it was the 'end of an era'. No-one was quite sure at the time but a year later everything was clear; nothing would be quite the same again!

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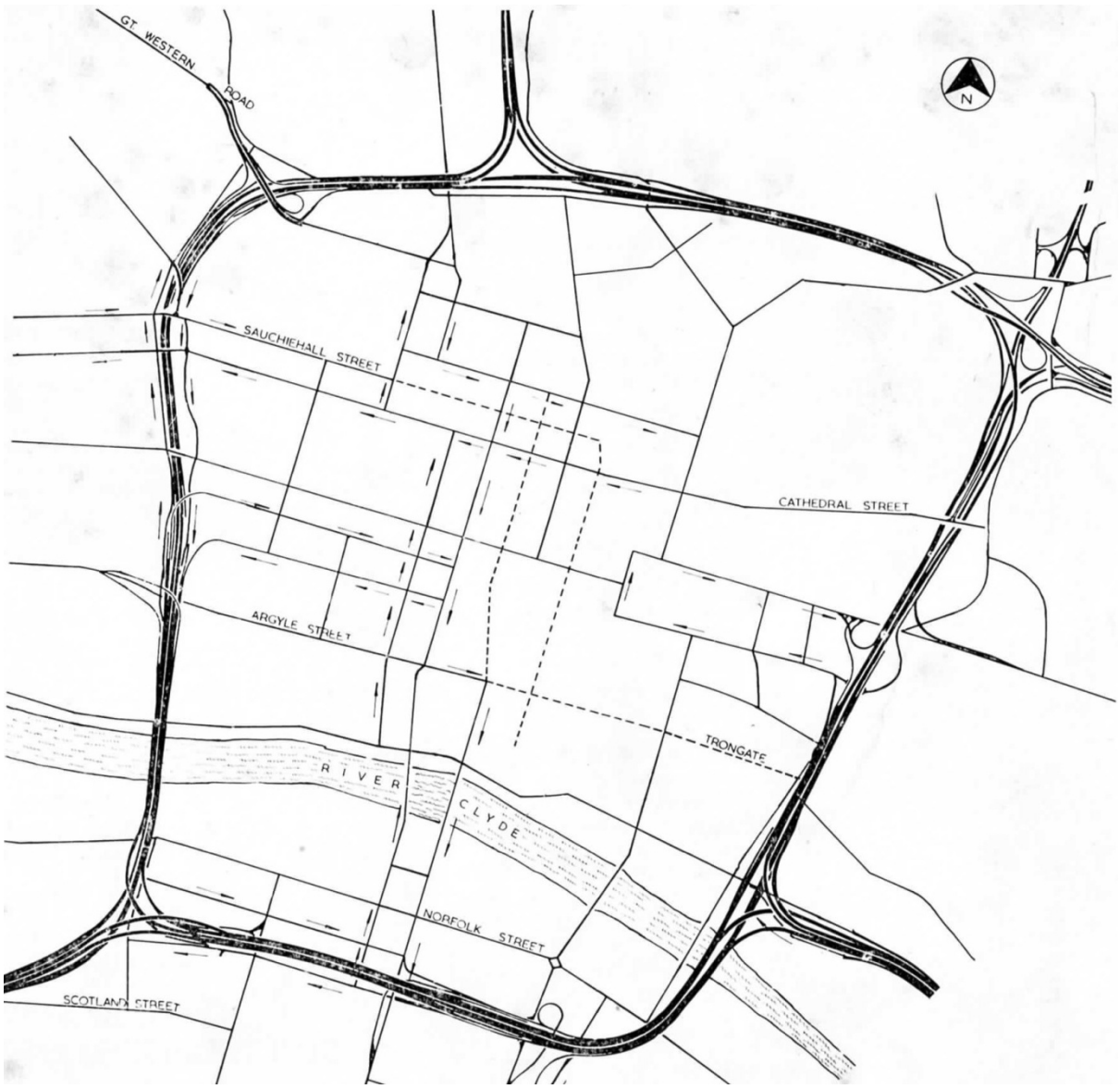
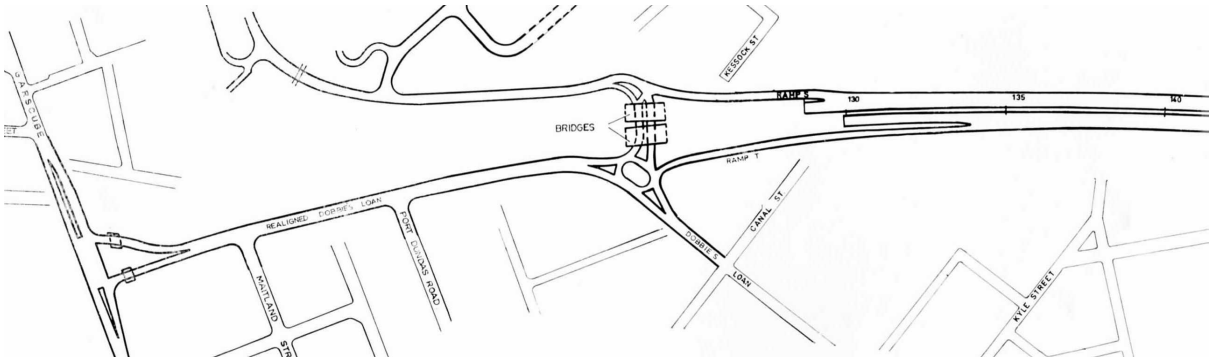
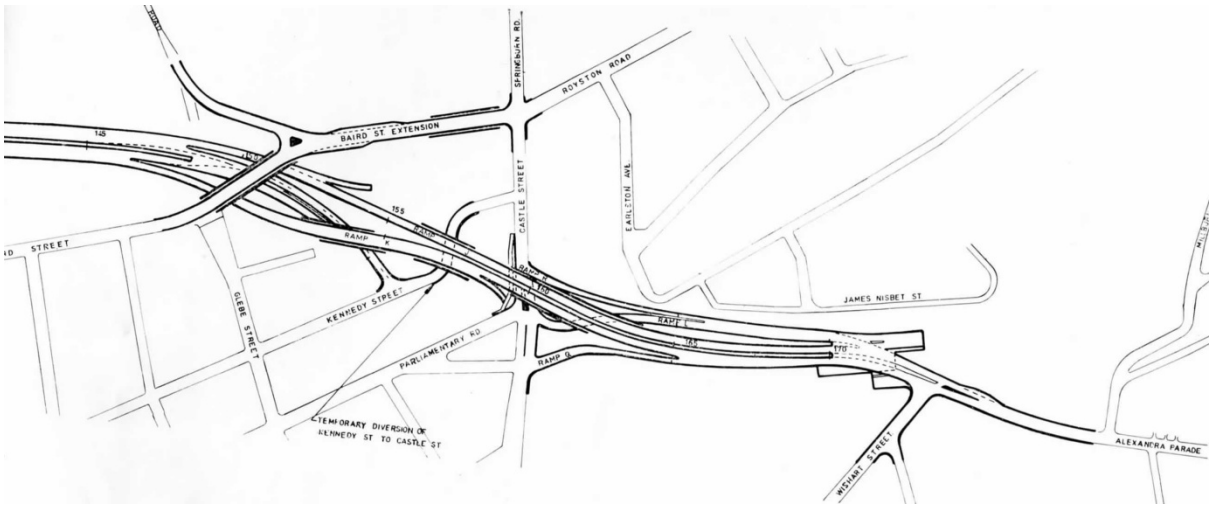


The Glasgow Inner Ring Road as proposed in 1964



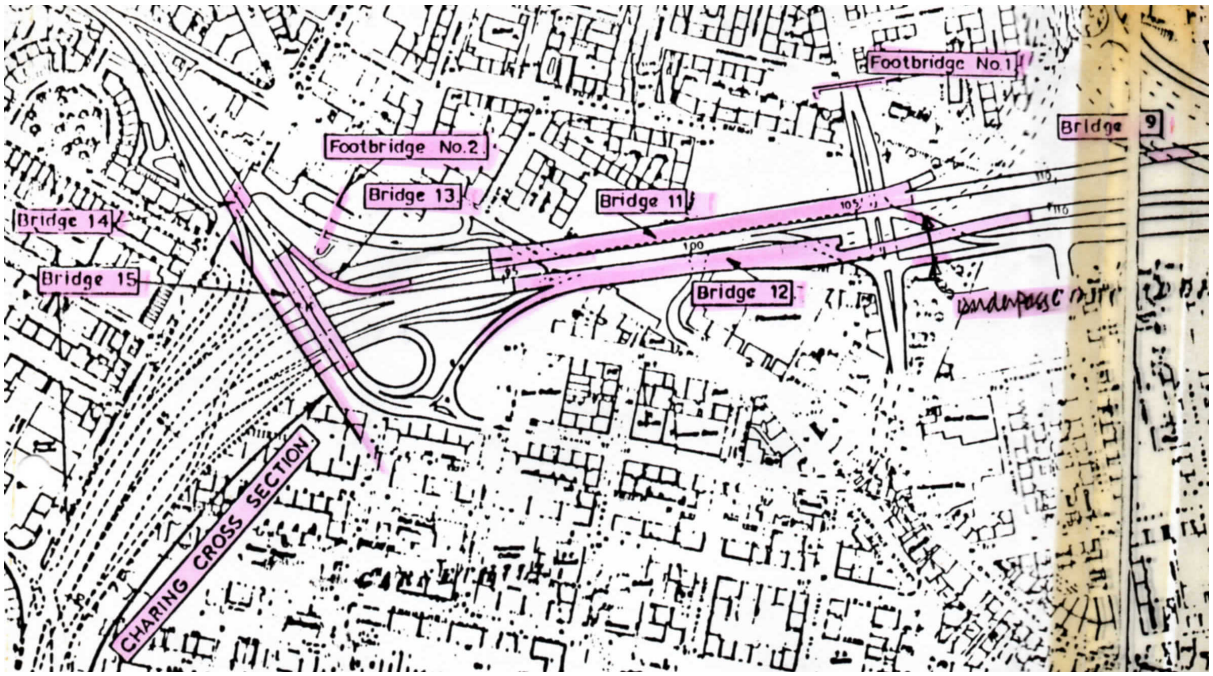
GIRR Woodside 1 was constructed as an extension to the Townhead 1 Contract [Bridges 8A &B in the middle]



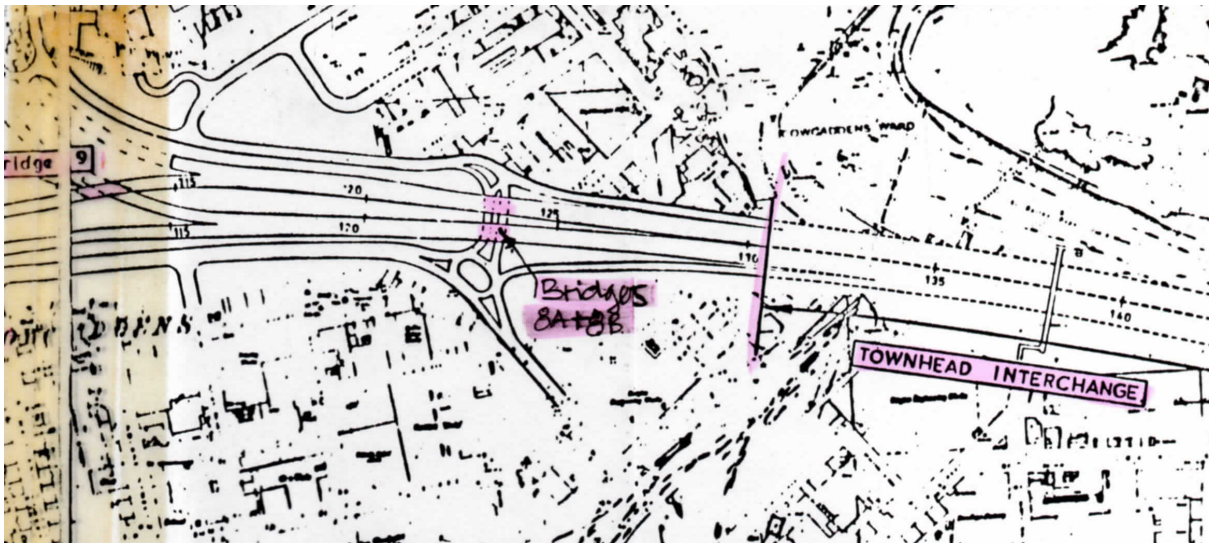
GIRR Townhead Interchange Stage 1

GIRR showing the proposed Comprehensive Redevelopment Areas [CDAs]

GIRR Townhead Interchange 1968 [Springburn Rd – Cathedral St right looking North]

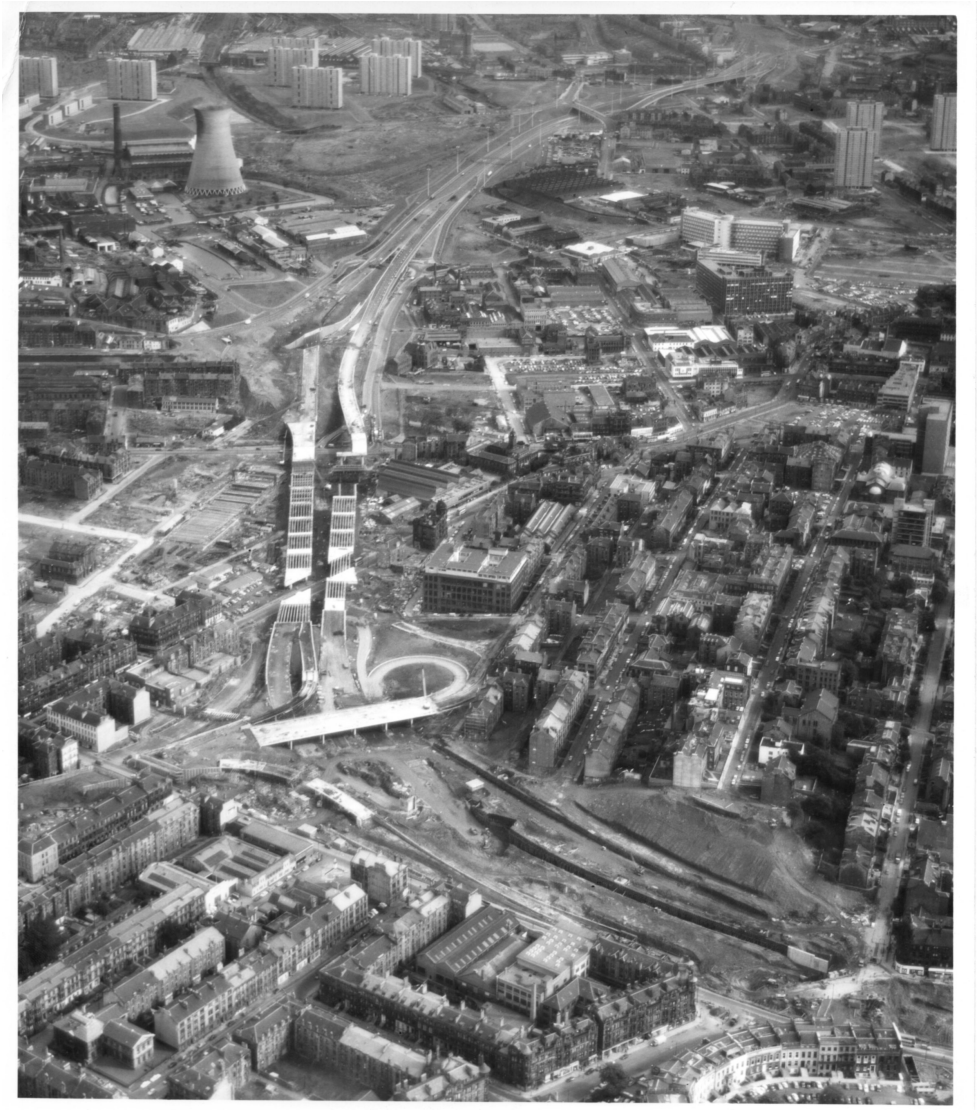


GIRR Woodside 2 St Georges Cross to Bridge 9



GIRR Woodside 2 Bridge 9 to Townhead Interchange Stage 1

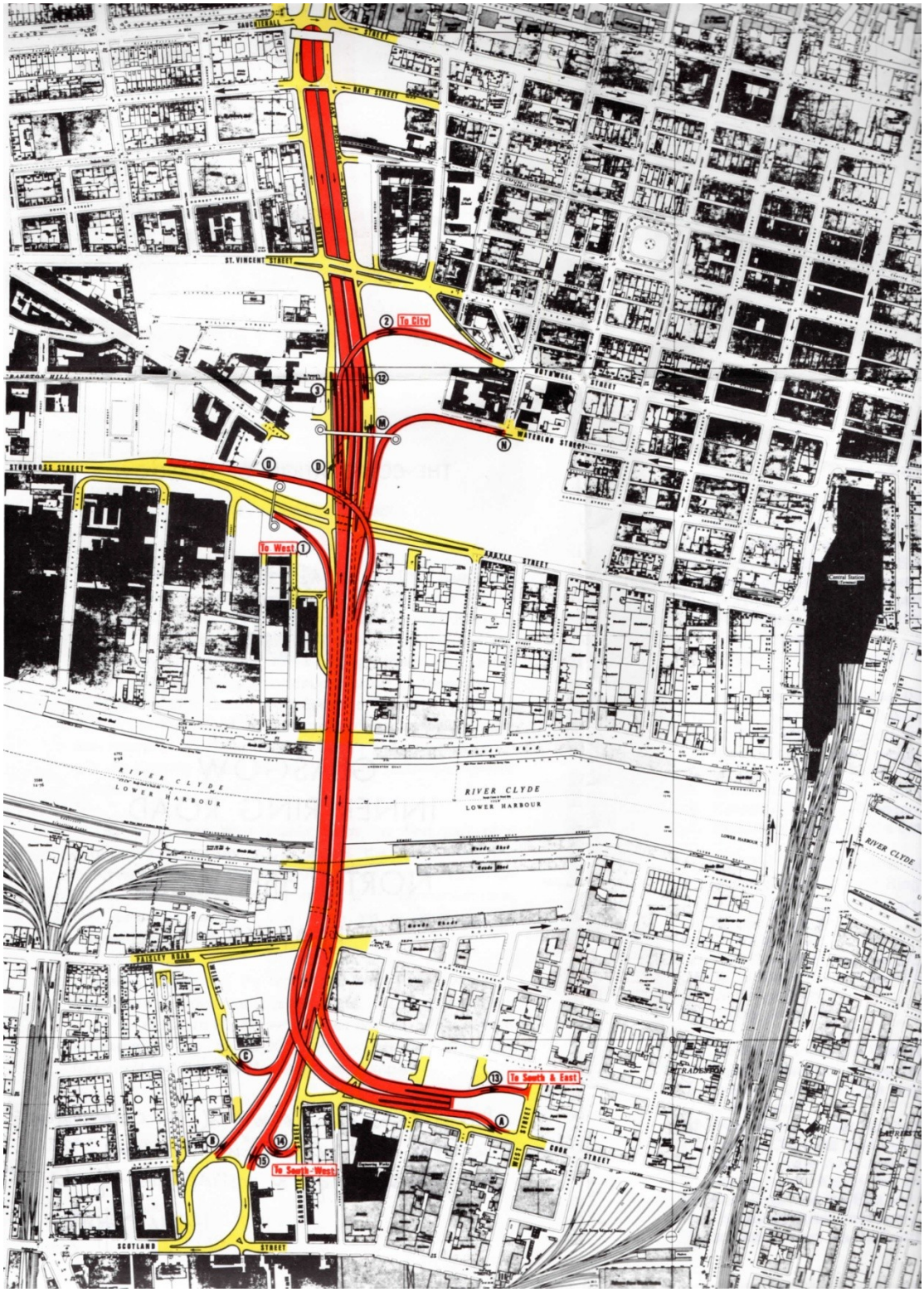
CORPORATION OF GLASGOW - WOODSIDE CONTRACT NO. 2.
Viaducts Nos. 11 and 12 Looking West 16/9/70



CORPORATION OF GLASGOW - WOODSIDE CONTRACT NO. 2.
North Flank Looking East 16/9/70

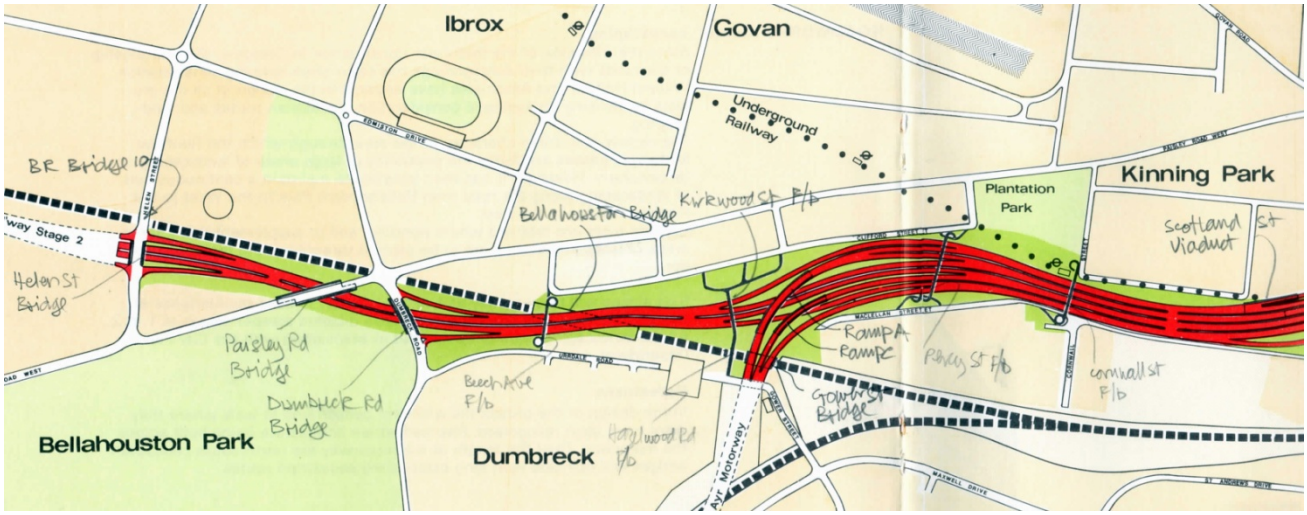
Woodside 2 Bridge 9 1971

This was Jim McCafferty's first bridge; he was also heavily involved on the design and supervision of the two major viaducts, Bridges 11 & 12.



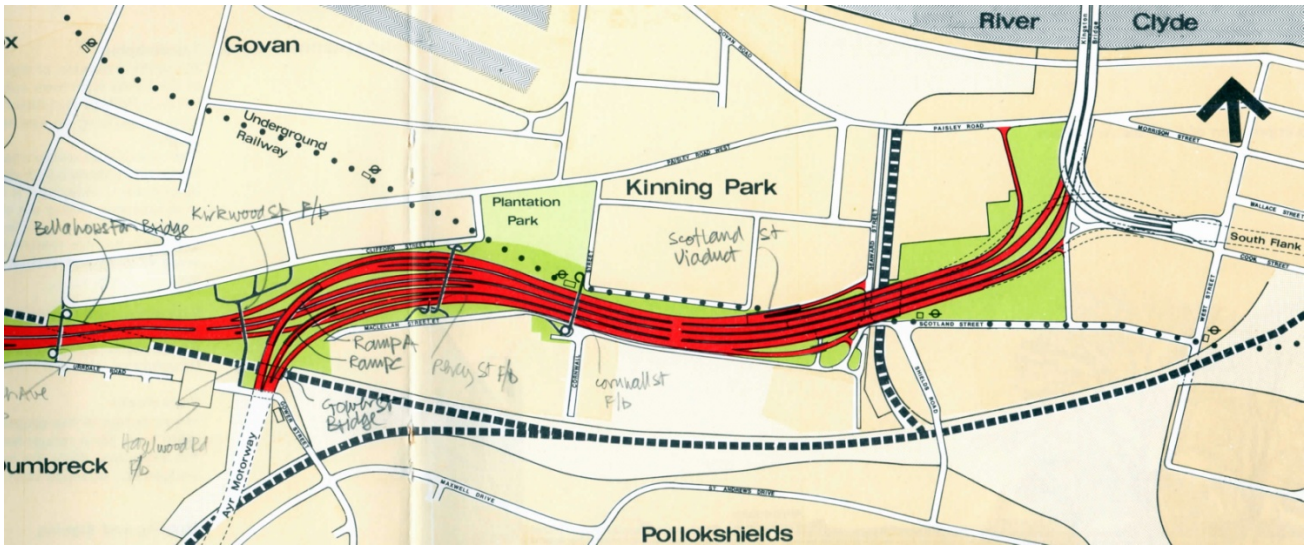
GIRR West Flank Kingston Bridge to Charing Cross

WA Fairhurst & Partners were Consulting Engineers for the West Flank of the GIRR [Kingston Bridge to St Georges Cross] plus Renfrew Motorway Stage 2.Scott Wilson Kirkpatrick & Partners were Consultants for planning the entire motorway system and for the North Flank of the GIRR [St Georges Cross to Townhead] plus Renfrew Motorway Stage 1.



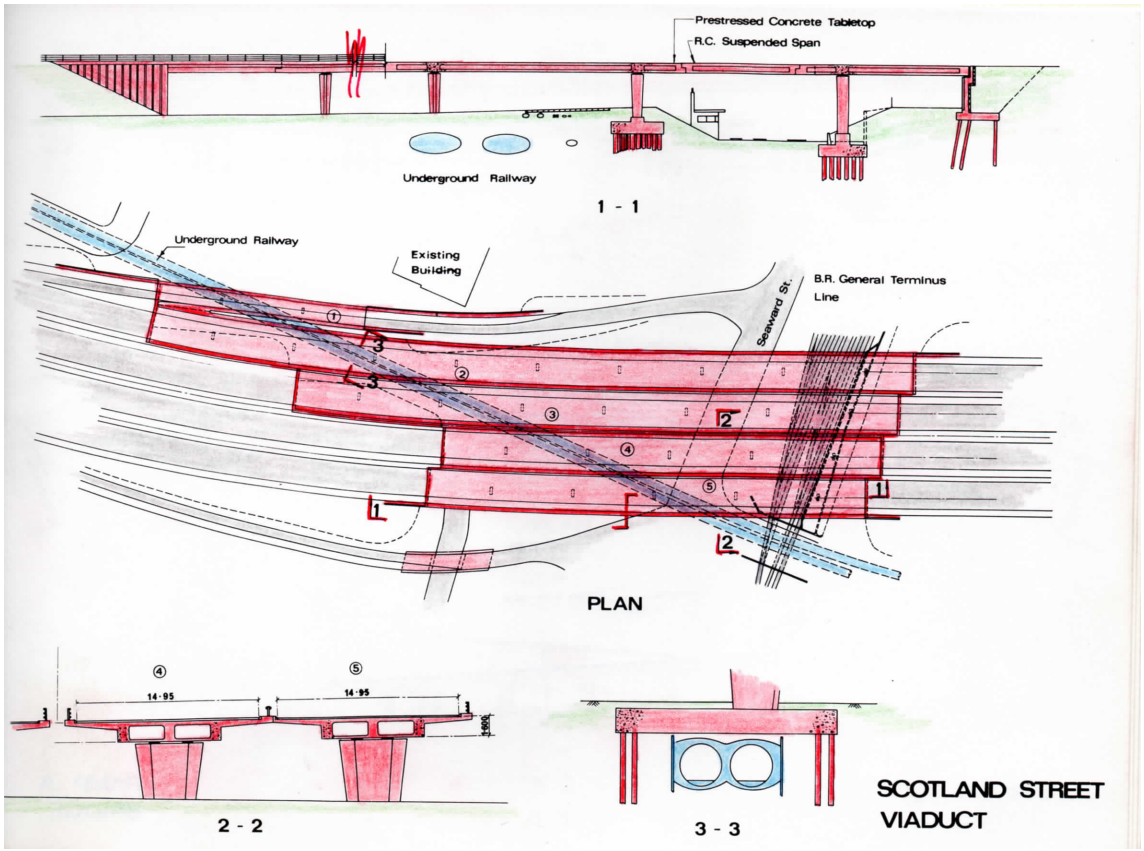
M8 Renfrew Motorway Stage 1 [Helen St to Kinning Park]

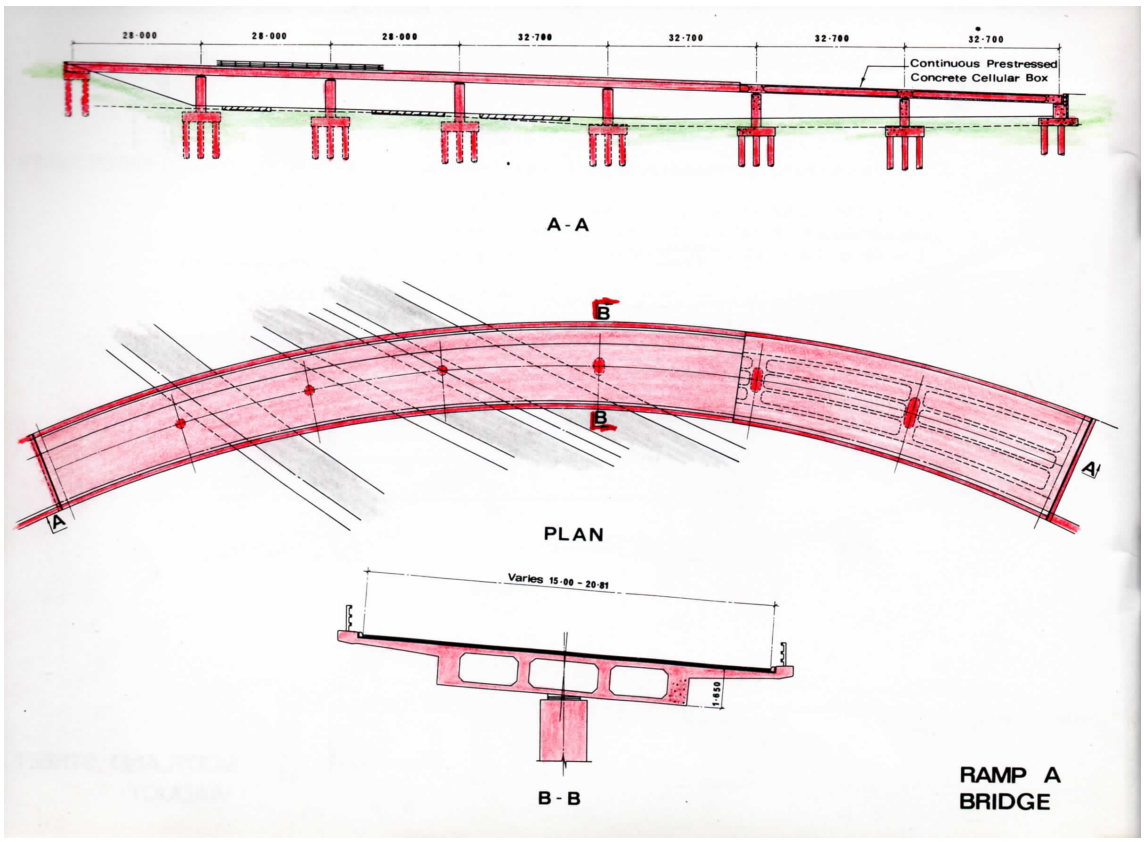
Identifying bridges

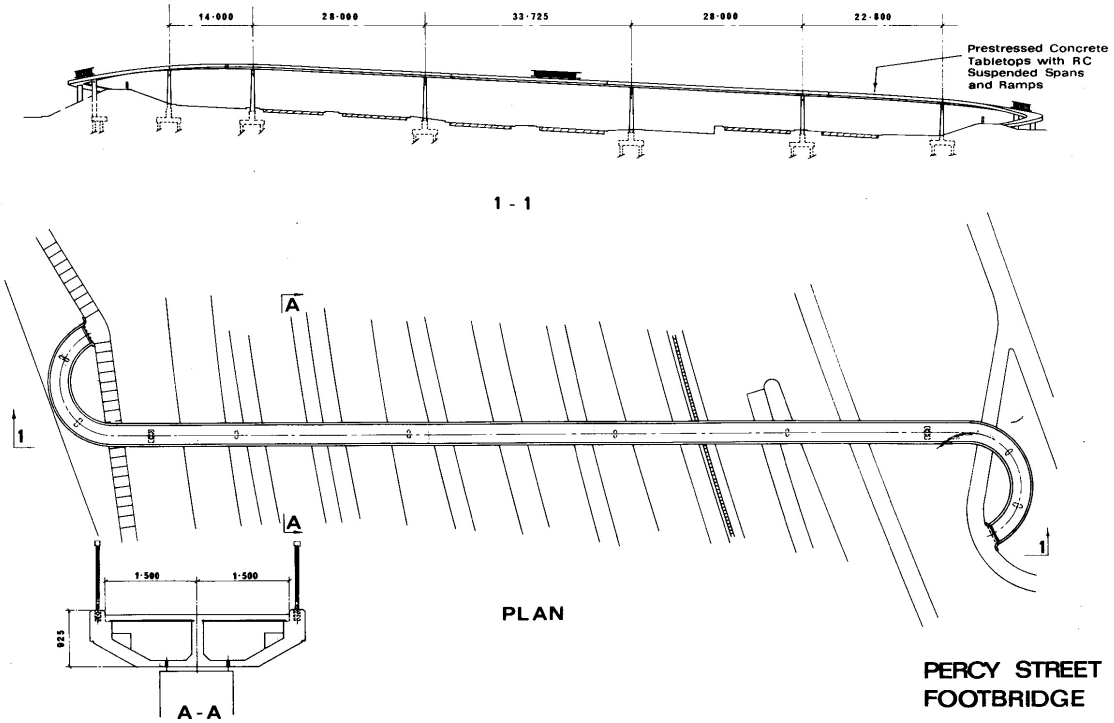


M8 Renfrew Motorway Stage 1 [Dumbreck to Kingston Bridge]

Identifying Bridges


Prestressed Concrete Tabletop
R.C. Suspended Span
Underground Railway
1 - 1
Underground Railway
Existing Building
B.R. General Terminus Line
Seaward St.
PLAN
14·95
14·95
2 - 2
3 - 3
SCOTLAND STREET VIADUCT


28·000
28·000
28·000
32·700
32·700
32·700
32·700
Continuous Prestressed Concrete Cellular Box
A - A
B
B
A
A
PLAN
Varies 15·00 - 20·81
1·650
B - B
RAMP A BRIDGE



Spiral Ramps were a feature of several of the long footbridges crossing the Braided Interchange between the M8 Renfrew 1 and the Dumbreck Road Connection M77.

Renfrew Motorway Stage 1 looking East from Helen St.

Kingston Bridge is on the top left.

The Braided Interchange connects the M8 with Dumbreck Road Connection [M77] near the centre crossing the railway.

Paisley Road West is the prominent road running diagonally from top left to bottom right.

Bellahouston Park is on the bottom right.

Dumbreck Rd Connection [M77] 2012

Dumbreck Rd Connection, opened in 1981, provided a motorway connection between the M8 Renfrew Motorway Stage 1 to Dumbreck Rd as a first step towards the construction of the M77 Ayr Road Route.

SW Glasgow Highway Planning Team 1964

L-R Andy Davies, ?, Jack Wood, John Cullen, ?, John Stamper.

SW Glasgow Roads Team 1964

L-R ?, David Moncrief, Willard Dougal, Hamish Taylor, Billy Holmes

SW Glasgow Bridges Team 1964

L-R Peter Innes, Brian McKenna, ?, Dr Stan Port, Gavin Walker, ?

The SW Glasgow Staff at 6 Park Circus 1971

L-R Harry Gibson, Len?, ?, ?, Bob McGowan, Hamish Leitch, ?, Raj Nayar, ?, John Cullen, Alan Baker, Maggie ?, Billy Holmes, Betsy Sinclair, Bob McKittrick, ?, Roger Anderson, ?, Dave Davidson, Salim Salmo, ?, Willard Dougal, ?, ?, Don Breakey, ?, Soldier?, George Baillie, ?, ?.