Glasgow Inner Ring Road: Woodside 2: Bridge 11 Beam Failure 1971

JP McCafferty

Introduction

Having graduated from Strathclyde, I joined the Bridges/structures section of SWK in Glasgow on 24 July, 1967 under Brian McKenna. The Bridges/structures section, based in rooms 5 and 6 on the first floor of 6 Park Circus, was, engaged on the design of the Glasgow Inner Ring Road [GIRR] Woodside 2 Section. I was assigned to Room 6, overlooking Park Circus Gardens, with Dave Coutts as my mentor. Stuart McDougall, who had graduated from Strathclyde at the same time, was also assigned to Room 6 with Dave Smith as his mentor. My main project was the design of Bridge 9, a two-span, highly skewed, reinforced concrete bridge, carrying the eastbound carriageway of the GIRR over a ramp which was to connect the westbound carriageway to the Maryhill Motorway heading north along the line of the Glasgow Branch of the Forth & Clyde Canal through Spiers Wharf. Bridge 9 turned out to be a bridge over a ramp 'to nowhere' as the Maryhill Motorway was never constructed. I also contributed to the design of the two main viaducts, Bridges 11 and 12 with responsibility for the West Abutments and retaining walls, and analysis of the 'portal frame' piers and pierheads. Dave Smith and Dave Coutts, with support from Stuart McDougall, were responsible for the design of the prestressed, post tensioned, beam and slab decks, the piers and pierheads, and the smaller East Abutments. From November 1968 to September 1969, I worked in the Roads section on various assignments with Don Breakey as my mentor, although I worked more closely with Willard Dougal.

The Woodside 2 Bridges and Structures Site Team

To complete my 'training under agreement', I transferred to the GIRR Woodside 2 Construction Site as an ARE [Bridges] under Bob McGowan, DRE [Bridges], supervising the construction of my own Bridge 9 and, among other things, various aspects of Bridges 11 and 12. As explained elsewhere in this 'history', I very much enjoyed being 'on-site', particularly the salutary experience of supervising the construction of Bridge 9 and the other structures I'd been responsible for in the office. DRE [Bridges], Bob McGowan, departed for SW Nairobi on 1 January 1970 and Bob McKittrick transferred from Bridges to Roads shortly thereafter; both had transferred from Bridges [Room 5 Park Circus] to Woodside 2 at commencement of construction in September 1968. Gavin Walker immediately took over as DRE [Bridges] and the two of us settled down to the supervision of construction until the arrival of Bill Clark a few months later.

The incident

Sometime in the spring of 1971, or thereabouts, I found myself sitting at my desk in the 'Bridges' office at the east end of the Engineer's Representative's Office complex finishing off my cheese and tomato sandwich and my polystyrene cup of vegetable soup, which was a favourite from Sloan's Dairies on the adjacent New City Road which traverses the site. Having eased my booted feet up onto my desk, I was gazing out of the widow towards the Balfour Beatty offices and the precast beam yard thinking that all was well with the world when there was an almighty thump followed by ground tremors and a strange rattling of what sounded like cables and metal thrashing together! After a short silence, all hell broke loose and I could see, and hear, people running past the offices in the direction of the 'thump'. I quickly followed to discover one of the 40 ton, 26m long, 1.6m deep internal beams for Bridge 11 embedded several feet into the hard packed site compound at one end and perched precariously on the pierhead and beams of the adjacent Bridge 11 at the other with the jib, control wires and lifting ropes swinging about and still vibrating with the shock of a failure of 'something'.

The Failure and the Reasons

It transpired that Structures Foreman Jock 'Horse-it-on' McTaggart had decided to 'horse things on' over lunchtime by lifting a 40t beam onto Bridge 11! The lifting arrangements had developed over a

period of months with Balfour Beatty preferring a single crane lift rather than the more controllable but more expensive two-crane lift [which was used for the 80t edge beams]. In addition, permission had been sought from the Engineer for lifting hooks made of prestressing strand in the form of 'bent hairpins' which were threaded into the complex reinforcement surrounding the beam half joints, end blocks and prestressing cables and ducts. These were fixed into position aligning with the inclination of the lifting cables from the single crane. This arrangement apparently worked until the fateful day of the failure of one of the prestressing strand lifting hooks! But why did it fail when the strength of the prestressing strand provided an adequate factor of safety? Investigation quickly demonstrated that the strand [made up of several individual smaller strands had failed at the point of contact with the crane lifting hook which provided a very tight radius over which the strand 'hook' bent and kinked thus raising the stresses locally to breaking point! As I was not personally involved in checking the original proposals or in supervising the lifting operations, I am not sure that a minimum radius of say 4 times the diameter of the strand had been agreed and subsequently ignored. No matter what the originally agreed lifting arrangements were, thereafter, the lifting arrangements were re-crafted and carefully scrutinised and supervised thereafter. The beam that had been dropped was set aside and later cut into several pieces and buried in landscape 'mounding on the north side of New City Road.

The Photographs

As can be seen from the attached and annotated photographs I took at the time, it was very fortunate that no one was killed or injured in this incident with the dropped end of the beam landing within feet of the workmen's bothy where they were all enjoying their lunchtime sandwiches. I noted that the large tea urn that stood outside the bothy was still boiling away within touching distance of the beam buried about four feet into the ground adjacent.

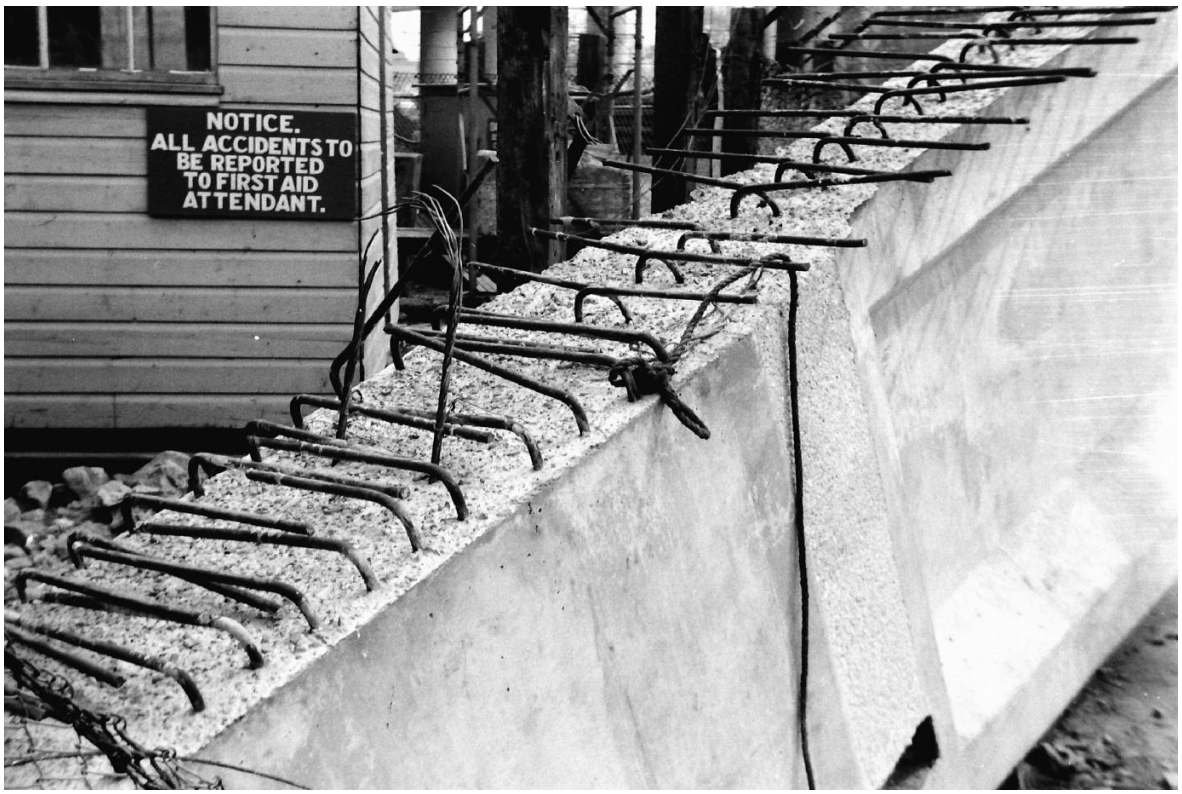
Jim McCafferty 2015

The beam, one end buried in the ground outside the Bothy, the other on the deck of Bridge 11.

Looking south, showing the dropped beam dangerously close to the Bothy and Site Offices.

The beam being lifted, using tackle threaded through the transverse reinforcement hole. Stuart McDougall and Roger Anderson [AREs Measurement] with Bob McKittrick [ARE Roads].

The 40t Beam buried in the ground at the Bothy and Site Offices; Stuart McDougall on the right.



The strand lifting hook showing where it failed over the small radius crane hook. Note the sign!!