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RESIDENT ROAD ENGINEER'S REPORT.

Some time ago the Hawera County Council were informed that the Waingongoro bridge was defective, and it was decided to get a report from the Resident Road Engineer. At the meeting on Saturday Mr G. T. Murray's report was read as follows:—

"General—The bridge is a segmental ferro-concrete arch of 70ft clear span, with a rise of 6ft and a width of 13ft inside guards and 16ft overall. Thickness of arch at crown, 1ft 10in to 2ft. It was built by contract at the latter end of 1907. Mr A. Buckland was the contractor, and Mr F. Basham (then county engineer, Hawera, but now county engineer, Eltham) being engineer in charge. Shortly after the removal of the centreing, the cracks began to appear, but I cannot ascertain if they have since increased in size. The reinforcing consists of seven longitudinal double rows of 53lb rails tied together transversely in four places at top by 2½in x 2½in x ⅜in angle irons. This reinforcement is on the same design as that of Maryborough bridge, Queensland. (See Transaction Inst. C.E., Vol. CLXI, page 246.) The design was not approved by any Government officer, but is, I consider, sufficiently strong.

"Concrete—The mixing of the concrete appears to have been rather dry and has been insufficiently rammed. This beneath the arch causes crevices and soakages in various places. The concreting was started in the centre of

the arch and work in 12in (or thereby) layers towards the end. The trucks carrying the concrete were (according to the contractor) run along the tops of the reinforcement rails and the concrete was filled in between the rails and up to a set of reinforcements, and when the work was resumed the concreting was started from the rails, thus leaving a rather weak joint at the rails. In these ways the actual workmanship was inferior.

"Cracks—There is one crack 5ft 8in on Hawera side of centre of bridge, which runs in an irregular and broken line right across the soffit of the arch. This crack is practically only a hair crack. The cracks in the wings are much larger, also the cracks between the parapet walls and the main body of the concrete on each side of the bridge. The wing and parapet cracks are unsightly, but do not materially affect the stability of the bridge.

"Design—The specified rise was 6ft, and actual levels show 5.98ft on the sea side and 6.05ft on the land side, so that the rise in centre, average 6.015, is practically exactly as specified. The points of contact between the abutments and arch at the four corners are practically on a dead level. The abutment walls are vertical and show no sign of having yielded. The material at the back of the abutments was in parts on each side rocky, but in parts only earth and clay, but the concrete was filled in right up to these backs. The design shows an absence of vertical reinforcing in the abutments, and the upper horizontal line of rails in the arch should have been connected with the curved line of rails by herring-bone bracing. The counterforts should also have been wider than 12 inches to be of any benefit. The rails were, so the contractor states, put in so as to break joint, but this cannot now be verified by inspection. The positions of the cracks are shown from actual measurements on the accompanying tracing.

"Conclusions—My conclusion is that notwithstanding the rise shows as specified, there has been a slight drop of

possibly half an inch at the centre, partly owing to settlement and partly owing to line of weakness running horizontally backwards from rise along the reinforcing rails of wings, and at the level of the part where the rails are bolted down on the abutments. This line of weakness would have been bettered by vertical reinforcing, which was omitted as already mentioned. The effect of the slight drop at the centre would account for the longitudinal crack below parapets, and also for the large oblique cracks in the parapets and wings. The sudden change in volume from 4ft 6in thickness in abutments to 12in thickness of wings would also tend to crack the wings in the directions in which the cracks actually are. I do not consider the bridge at present dangerous, but owing to inferior workmanship there is a leakage of water through the cracks. This is already affecting the rails as shown by iron rust.

"Recommendation—I would therefore recommend that the present tarred macadam be removed, that traffic be stopped for one day, that the whole top of arch between guards be coated with semi-liquid mortar of one cement to three of sand to a depth of one inch, and subsequently topped off with pure cement. This being done, traffic could be run over the bridge on temporary timbers resting on the guards, and, after allowing ten days for setting, the temporary bridge could be removed and the whole surface could be again covered with 6 inches of tarred macadam thoroughly rolled in. This would preserve the reinforcing from deterioration. The cracks along the sides should be filled up with similar mortar, as I do not think there will be any further settlement."

It was decided that the foreman (Mr Muggeridge) be instructed to carry out the recommendations during the month of July.