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NZ Transport Agency
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8 September 2009

Attention: Tommy Parker

Dear Tommy

AHB Cycleway - Holmes Submission

As requested we have briefly reviewed the above submission, in conjunction with Hyder (UK.) and have the following comments.

The proposal is based on the concept of transferring peak live loads in the main navigation span from the "overutilised" extension bridges to the "underutilised" truss bridge. To facilitate this redistribution of loading it is proposed that two large diaphragm beams be constructed between the east and west extension bridges, and passing beneath the truss bridge. The loads would be transferred to the truss bridge through a "dynamic smart system". This is understood to be an active control system which transfers peak loads away from the extension bridge to the truss bridge.

The feasibility of this proposal depends on a number of significant issues which are discussed below.

Firstly there needs to be sufficient reserve load capacity available in the truss bridge to cater for the additional loading proposed to be transferred from the extension bridges. A recent study[1] indicated that the truss bridge has sufficient reserve load capacity to cater for future traffic load growth for the next 10 to 20 years, and that further but limited strengthening of the bridge is possible. Given the timeframe noted above, this additional strengthening of the truss bridge would likely be required before the next harbour crossing is operational. It could be required earlier if legislation leading to higher vehicle mass and load intensity comes into force.

The truss bridge and box girder bridges will require significant local strengthening to allow the transfer of load from the box girders to the truss bridge. The two diaphragm beams are large structural members in their own right. The combined weight of the diaphragm beams, local strengthening of three bridges and the load transfer system itself will place significant additional load demand on the truss bridge, thus reducing its available capacity for live load.

Further strengthening is possible as noted above, but because this is limited then inevitably the future capacity available for long term traffic growth will be reduced. If as a result the truss bridge capacity is insufficient to sustain the maximum expected traffic load growth until the next harbour crossing is opened then this would be unacceptable. In principle a scheme which reduces the available future level of service of the strategic truss bridge asset is very undesirable.

Our assessment is that there is a significant risk the proposal will reduce the future load capacity of the truss bridge to a level which is strategically unacceptable to NZTA.

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[1] "Assessment of Effect of Future Traffic Load Growth on AHB", Beca, August 2009.

Secondly, the feasibility of the active control system needs to be established. Such a system will include computer controlled active systems including a variety of mechanical and electrical components. For such a system there are issues of reliability and a full failure mode and effect analysis would need to be undertaken to determine the attendant risks, warning systems and backup needed to ensure the bridge safety is never compromised. It can be expected that extensive monitoring and safety systems will be needed and in the event the failure mode analysis does not show a satisfactory solution is available, the system would not be feasible.

We are not aware of any similar systems on operational bridges and have asked Hyder (UK) to comment based on their experience. They are not aware of any directly equivalent system but noted two examples of simpler control systems. The most relevant example was a temporary propping system devised by Hyder for the Avonmouth Bridge to support the approach spans of the steel box girder bridge during the bridge strengthening. These could not be rigid as they would have attracted too much load, and hence each was supported on a hydraulic ram connected to a hydraulic accumulator, thus allowing the bridge to deflect under live load whilst providing a constant propping load. As the loads were transferred by props directly to the ground and were not varied it is very much simpler than the AHB scenarios proposed.

Finally, due to their required size the diaphragm beams will reduce the navigation clearance under the main navigation span and will clash with the utilities carried by the bridge. They will also have an effect on bridge aesthetics. These issues are however less significant than those noted above.

In summary, the proposed concept would reduce the future load capacity available from the truss bridge and would introduce a complex actively controlled load transfer system into an already complex structure. The long term impacts of the loss in truss bridge capacity, and the risks introduced by the active load control system, would both need to be evaluated to determine the feasibility of the proposal. The system would have a demanding maintenance and monitoring regime and any evaluation would need to consider both the short term and long term costs which are likely to be quite high.

Note that the additional costs of the proposed load transfer system would be additional to the costs already identified for the cycleway/walkway.

Should you require any further clarification, please contact the writer.

Yours sincerely

s 9(2)(a) [redacted]

on behalf of

Beca Infrastructure Ltd

s 9(2)(a) [redacted]