CITY OF VICTORIA

JOHNSON STREET BRIDGE

ELECTRICAL/MECHANICAL CONDITION REPORT

APPENDIX B

As a supplement to Robert Freundlich & Associates Ltd.'s mechanical investigations, we engaged the services of Crippen Consultants Ltd. (Mr. Dan Campbell, P.Eng.) to provide a supplementary overview of the bridge's mechanical systems. Mr. Campbell's experienced overview was most helpful in our evaluations. A copy of the Crippen report is included in this Appendix. We have the following comments on the recommendation items of the Crippen report:

5.1 We concur, and recommendations have been included in the main report. An exception to this is the loose bearing B12 on the highway bridge, as noted and discussed in the main report.

5.2 a. We agree that it would be "nice" to realign the entire drive system of each span. However, we found little evidence to suggest that this is required. Entire system realignment is a fairly major undertaking, and we suggest that other procedures recommended in our main report should eliminate this requirement. As noted in the main report, we do recommend repositioning/alignment of the south rail span motor and of shaft S1112/bearing B12. These are the only immediately obvious equipment items which are suffering from improper alignment.

b. We concur, and recommendation is included in the main report.

5.2 c. We concur with the concept of safety covers over all open gearing. However, we believe that this may be impractical from the point of view of physical on-going operational and maintenance requirements of the bridge. It would be difficult and costly to design effective full covers with inspection hatches or removable sections unless some form of automatic or remotely operated lubrication system was also incorporated into the design. The main Robert Freundlich & Associates report makes recommendations for some additional protective covers and for upgrading and additions to the existing personnel guards and railings. While we recognize that this is less than the most ideal condition, we believe that, when combined with formalized safety features and personnel awareness, the Robert Freundlich & Associates recommendations constitute a reasonable/realistic level of upgrading.

d. We concur, and recommendation is included in the main report.

e. This subject is discussed in the main report.

f. This subject is discussed in the main report.

g. This subject is discussed in the main report.

JOHNSON STREET BRIDGE MECHANICAL INSPECTION

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1. INTRODUCTION

The Johnson Street bridge comprises two independent side-by-side, 150 ft bascule bridges, one for the railroad and one for the highway traffic. The bridges were designed by the Strauss Bascule Bridge Company of Chicago in 1921 and constructed by the Canadian Bridge Company in 1921-22.

2. SCOPE OF WORK

The City of Victoria asked R. Freundlich and Associates to conduct a mechanical and electrical inspection of the bridges. Crippen Consultants was retained by R. Freundlich for the mechanical work. On 30 January 1990, Barry Wright of Freundlich and Dan Campbell of Crippen inspected the bridge, which resulted in the following notes:

3. INSPECTION

3.1 Rail Span

3.1.1 General

The storage of combustible maintenance materials and the auxiliary engine fuel tank in the machinery house coupled with the lubricant leakage and drips is a significant fire hazard. Leakage of those fluids could cause a water pollution problem.

The walkways and access ladders throughout the bridge do not meet current WCB regulations regarding handrails, safety cages and kickplates.

3.1.2 Drive Mechanism

The bridge was operated various times, both up and down. The mechanism was generally well lubricated and not excessively worn, however, there are the following items which require attention:

- None of the open gearing has guards to prevent men or material from accidentally getting caught in the mechanism.
- The open gear lubricant has caked on over time and is dirty. The gears should be completely cleaned and re-lubricated.
- Both motor brake and bridge brake assemblies are loose, sloppy and out of adjustment.
- The motor brake shock absorbers appear to be leaking oil.
- The south motor has excessive shaft endplay. The endplay vibration is transmitted through the gear trains and is visible as lateral oscillation of some of the bearings.
- The bull gears driven by the motor pinions appear to be out of round for both north and south drives. This may not be a problem if the motor pinion alignment to the bull gear is corrected.

- The south bull gear driven by the motor pinion makes excessive noise, probably caused by poor alignment to the motor pinion.

- The bridge upper limit switches are set such that the end stop on the rack is 111" from physically contacting the stop. If the limit switch were to fail, the bridge would raise until the end stop contacted, and in so doing would crush some of the platform handrail modifications made over the years.

- The large bearing beside the rack pinion is worn so that the slop of the pinion shaft in the bearing is felt as banging throughout the bridge during the last portion of the lowering stroke.

3.1.3 Structural Pins and Bearings

The exterior of the various trunnions and bearings in the structure were examined both in the static and operating modes (where possible) for signs of binding, slop and eccentric wear. Except for some external rust patches and mess due to the grease, there was no indication of roughness or excessive play. If the opportunity arises, at least one of the connections from the rack to the structure should be examined to see if the same bearing wear shown on the rack pinion bearing is apparent at the structure end of the rack.

3.1.4 End Locks

The end locks and rail signal lock were operated a number of times and appeared to work properly although the signal lock actuator arm is bent. The gears in the mechanism do not have guards.

The buffer stroke was 12" and took 40 sec to extend. During the bridge inspection, it appeared possible for the bridge operator to lower the bridge even if the buffer was not fully extended, ready for use.

3.2 Highway Span

3.2.1 General

- Again, the storage of combustible maintenance materials and the auxiliary engine fuel tank in the machinery house, coupled with the lubricant leakage and drips, is a significant fire hazard. Leakage of these fluids could cause a water pollution problem.

- The walkways and access ladders throughout the highway bridge are also in violation of WCB regulations regarding handrails, safety cages and kickplates.

3.2.2 Drive Mechanism

The bridge was only operated twice to minimize the disruption of road traffic. The mechanism was well lubricated and did not appear excessively worn, however, the following items require attention:

- The open gearing did not have guards to prevent men or material from accidently getting caught in the mechanism.
- The open gear lubricant has caked on over time and is dirty. The gears should be completely cleaned and re-lubricated.
- Both bridge brake assemblies are loose, sloppy and out of adjustment.
- The motor brake shock absorbers appear to be leaking some oil.
- The north and south line shaft outboard bearings are both loose on their mountings. The north bearing is particularly bad rising up close to 1/2" and the nuts are only finger tight.
- The mounting bolts for the north bridge brake are loose, allowing the entire brake to slop around on the support steel.
- The road bridge upper limit switches are also set so that the end stop on the rack is over 100" from physically contacting the stop. If the limit switch were to fail, the bridge would raise until the end stop contacted, and in so doing, crush some of the handrail modifications made over the years.
- The large bearing supporting the rack pinions are not as sloppy as the rail span, however, the operating strut guide alignments are not as good as the rail span. During some parts of the stroke, the guides appear to bind on the operating struts.

3.2.3 Structural Pins and Bearings

The exterior of the various trunnions and bearings in the structure were examined both in the static and operating modes (where possible) for signs of binding, slop and eccentric wear. Except for some external rust patches and mess due to the grease, there was no indication of roughness or excessive play.

One cover plate, over the south counterweight arm to link bearing, was missing, resulting in some debris accumulating inside the counterweight link.

3.2.4 End Locks

The end locks were operated several times and appeared to work properly. However, the rollers on the lock stand were grooved relative to the rail span, perhaps by wear over the years. The gears in the mechanism do not have guards.

The buffer stroke was 12" and took 12 sec to extend.

4. CONCLUSIONS

The most serious problem is the loose mounting of the highway bridge machinery. If the bearings' mountings are not tightened down, the torsion and bending in the shaft as the pinion rides up the bull gear could possible cause a failure in the shaft. The shaft is downstream of the bridge brakes therefore, the span would be uncontrolled and free to move as the counterweight directed.

The clunking noise and vibration during operation of the rail span can be corrected by overhauling the sloppy rack pinion bearings.

Most of the other problems with the bridges are to do with wear and alignment changes in the drives over the years. These can be corrected with a general mechanical overhaul of the equipment.

5. RECOMMENDATIONS

5.1 Urgent

Tighten all the loose bearing housings down immediately, installing new bolts as required.

5.2 Required

a. Realign the entire drive system of each span from the motors to the rack, overhauling the brakes and bearings at the same time.

b. Clean the old lubricants off the open gearing, inspect the gears and re-lubricate.

c. Fabricate and install proper solid or mesh safety covers over the open gearing. Install inspection hatches to allow inspection and lubrication.

d. Fabricate and install proper handrails and platforms throughout the structure to allow access and inspection of the bearings and lubrication points.

e. Move the end stops on the rack to be closer to the actual end limits and to protect the handrails.

f. The rollers on the road span lock stands should be inspected for wear. If they are worn, they should be replaced. Both the road and rail span lock stands should be re-shimmed to ensure tight engagement as specified on the original drawings.

g. Install a minimum level of fire detection in the machinery house, along with proper storage procedures.

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APPENDIX A

The following drawings are included for general information and clarification of equipment identification used within the report.

1. Highway Bridge Mechanical Equipment - #287.901-E1.
2. Railway Bridge Mechanical Equipment - #287.901-E2.