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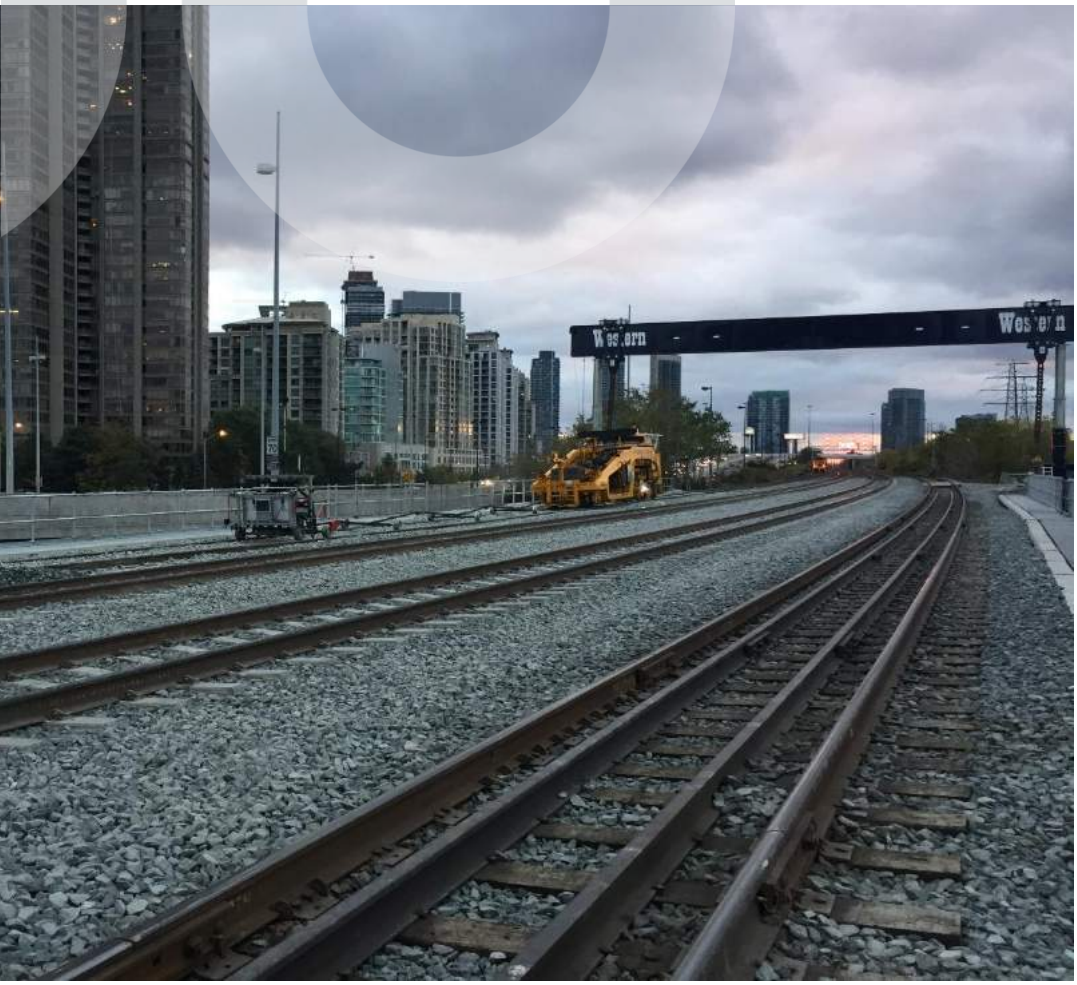

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1.0 Full Project Description

The Humber Bridge was built in 1911 on mile 5.02 of the Oakville Sub. and carries four tracks on eight spans over the Humber River under the jurisdiction of the Toronto Regional Conservation Authority. A full replacement of the superstructure and rehabilitation of the substructure was required, and Wood was retained to complete the design and contract administration. The bridge has now been replaced with design life of 100 years to accommodate increasing public transit.

1.1 Complexity

The existing Humber River Bridge was erected in 1911 in the Lakeshore West Rail Corridor over the Humber River. The bridge is 200 feet long and carries 4 railroad tracks over 8 ballasted deck plate girder spans. Due to a high level of settlement at the east abutment there was a constant need to add additional ballast to keep the vertical alignment correct. In 1946 a "helper pier" was constructed immediately adjacent to the east abutment to help mitigate any further settlement of the bridge. With the structure nearing the end of its structure lifecycle, the client decided that with increasing train service it was time replace the structure. The substructure was rehabilitated while keeping the original 1911 aesthetics in mind while the entire superstructure was replaced with new deck plate girder spans. This project was highly complex due to the nature of the Lakeshore West Corridor and existing site conditions. The corridor is used by multiple rail service providers such as GO Transit, VIA, Amtrak, CN and CP which means having a train pass over the structure every 15 minutes or less very common. This makes a rail corridor closure to replace full bridge spans very difficult to coordinate. With our extensive rail experience and past project within this corridor, we were able to work with the client to schedule 9 complete weekend closures to install and remove the gantry system and replace 8 spans and 8 approach slabs. It was determined that to achieve all of this work, 4 weekends would be used for span replacements, 2 weekends would be for approach slabs and 2 weekends would be for gantry installation and removal. To ensure that the contractor could completely replace 2 full bridge spans in the 50-hour closure, many scheduling workshops were held to break every activity down to the half-hour. Access was also a major concern for this project as there is no direct access to the rail corridor. Through coordination with the owner it was decided that large access ramps would be constructed on each side of the river to grant access to track level. These ramps were partially made of salvaged material and were left for maintenance access after completion. Additionally, the ramps needed to be properly secured to prevent trespassers from entering the rail corridor. All pier and abutment works were completed through temporary platforms constructed from a barge in the Humber River.

Figure 1: Cranes lifting half of the gantry truss system in to place on concrete corbels.

1.2 Meeting Client's Needs

The client's main project goals were to replace all spans of the Humber River Bridge with a new, 100-year service life structure while causing the least amount of impact to revenue train service. This goal was able to be met by utilizing 50-hour continuous work blocks during weekend closures of the rail corridor. This was possible through close schedule coordination with the client, contractor, CN and Via Rail which saw activities laid out in hourly intervals. A gantry system was used as opposed to a conventional crane for removal and installation of bridge spans due to the significant time savings involved in a fixed lifting apparatus. This allowed for the full removal and replacement of track, track bed, deck, girders and bearings for two bridge spans per 50-hour closure. The client also required that utility protection be implemented for rail signals, fire optic cables, and Bell 360. This was able to be met through close coordination with utility owners and a thorough work plan approval review process which provided a high level of detail as to how utilities would be located and protected. All client's needs and requests were able to be met ultimately due to our teams experience and understanding of work within this rail corridor

Figure 2: Humber River Bridge with all 8 spans replaced and open for service.

1.3 Environmental Benefits

The Humber River Bridge replacement took place under the jurisdiction of the Toronto Regional Conservation Authority (TRCA) who have stringent environmental requirements that must be met at every stage of a project. Before any work on this project began, we were required demonstrate to TRCA that our design did not impact any water courses or habitats within the project limits throughout construction or thereafter. Throughout the project, materials were reused where possible to help reduce the amount of waste being removed from site. An example of this is the existing ballast that was removed from the bridge decks. Two large access ramps were required to get materials and equipment to track level. The existing ballast being removed from the spans was removed and used in these ramps to reduce the amount of new granular material being imported. This ballast was also used for sloping of the corridor in areas where the erosion had taken away the existing slopes. The existing rail material to be removed was salvaged and used as the guard rails on the new track to reduce the amount of waste coming from the project. Where possible, the old rail was also used for transition rails and temporary rail before being salvaged in the client's storage yard. In line with environmental sustainability, this project involved tree protection zones that were to remain unimpacted by all construction activity. These zones consisted of physical barriers that set a perimeter around an area that is to be unimpacted by any activities.

Figure 3: Environmental protection installed around the center pier for concrete chipping.

1.4 Innovation

The Humber River Bridge replacement displays innovative engineering practices and techniques in every aspect of the project. Due to the requirement of not impacting revenue train service, the work had to be completed during weekend closures and it was crucial to ensure we were able to replace two spans per weekend. The weekend closures were carefully examined in hourly increments to ensure the amount of work required could be completed in time to open the rail corridor for Monday morning service. It was determined that tandem lifts with heavy cranes would involve too much set up and preparation time which would not allow for two spans to be replaced each weekend. Instead, a gantry system was utilized and was designed to operate on a non-tangent truss system and the existing abutments needed to be examined to determine if they could support the total load applied from the corbels, gantry system and bridge spans. The gantry system was designed specifically for this project but was also designed for reuse in other applications following completion. The time savings and safety benefits over a conventional crane lift are important factors that made this project a success.

Figure 4: A new span being lifted into position during of the 50-hour weekend closures.

1.5 Social and / or Economic Benefits

The increasing demand for public transit in the City of Toronto is pushing the client increase service to and from the downtown core resulting in a higher volume of train traffic through their rail corridors of one train in each direction every fifteen minutes. As such, the existing structures need to be rehabilitated or replaced in order to accommodate this increase in train traffic in terms of safety and reliability. In the case of the Humber River Bridge, the superstructure was completely replaced with eight new spans, and the substructure was rehabilitated to accommodate the span replacement. The existing structure required a high level of maintenance due to a settling abutment and deteriorating concrete and steel originally place in 1911. This replacement will eliminate the need for extensive maintenance which is paid for through the general public from tax dollars. The bridge has been designed with a 100-year life so there will be no need for any major replacement or rehabilitation works in the near-future which is imperative to ensure the client

can accommodate the ever-growing demand from public transportation to and from the City of Toronto and ensure the safety of all passengers and workers will using this service.

Figure 5: Humber River Bridge open for revenue service following a weekend work block.