NEW BRUNSWICK ROUTE # 126 (KOUCHIBOUGUAC RIVER BRIDGE NO. 5)
REALIGNMENT, RIGHT-OF-WAY AND STAGED CONSTRUCTION TECHNIQUES

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ABSTRACT

The desire to improve Canada’s roadways in the interest of safety is one of the prime focal points in highway and bridge design. Replacement of a bridge structure within a crowded right-of-way can pose interesting challenges for designers and for construction crews, when requirements of maintaining traffic and river flow are taken into consideration.

This paper will discuss the innovative approach the New Brunswick Department of Transportation (NBDOT) implemented on the road realignment construction project of Route #126 at the Kouchibouguac River located near Rogersville, New Brunswick. Improved vertical geometry associated with the new highway design for this section of Route #126 required the removal of an existing cast-in-place bridge, a significant increase in road grade elevation at the Kouchibouguac River, maintaining two lanes of traffic by means of three temporary detours over the existing and new bridge structures during the phases of construction, all within the confines of the narrow road right-of-way.

A 100 year design life criteria was required for this structure, therefore NBDOT specified a pre-cast concrete segmental arch for the new bridge and mechanically stabilized earth (MSE) for the retaining wall structures. The adjacent property, running parallel to Route # 126 for the length of contract is owned by New Brunswick East Coast Railway Company Inc. No impact on the railway bridge structure or the railway embankment was permitted, therefore an MSE wall with a pre-cast concrete traffic barrier was constructed to retain highway embankment slopes and to remain within the designated provincial right-of-way. The new bridge structure was spanning the Kouchibouguac River, which was environmentally sensitive. In-stream construction activity was strictly prohibited outside the June 1 to September 30 window and in an effort to protect fish habitat, work areas were isolated from the stream flow.

Finally, this paper will illustrate the various construction stages, erection technique of the TechSpan arch, detours implemented for road safety considerations and human factors involved in the successful completion of this project.
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1. INTRODUCTION

In the interest of public safety, New Brunswick Department of Transportation (NBDOT) strives to improve their roadway network by upgrading provincial highways to current standards and reducing the potential for vehicular accidents.

One section of two-lane highway on Route #126 near Rogersville, New Brunswick, which crosses over the Kouchibouguac River, was identified by NBDOT engineers in the 1990’s as an area which needed improved vertical roadway geometry. The existing highway alignment had shorter sight distances which increased the risk of accidents to local traffic, especially at the lowest elevation of the vertical curve, Bridge Number 5 crossing the river.

In 1997, NBDOT designers surveyed this section of Route #126 to plan for improved roadway geometry and possibly design for a new structure over the Kouchibouguac River. The proposed highway alignment significantly increased the road surface elevation at the location of the existing bridge. This structure was a 12.0 m span concrete rigid frame perched on rock foundation 2.5 m above streambed, which could not suitably accommodate loads associated with the improved vertical geometry. The river was environmentally sensitive, therefore in-stream work was strictly prohibited outside the June 1-September 30 window. The adjacent property running parallel to Route #126 for the length of the proposed roadway improvement was owned and operated by New Brunswick East Coast Railway Company Inc. (NBECR). No impact on the railway bridge structure, its embankments or right-of-way was permitted, therefore retaining walls containing highway fill and a buried arch were ideal structures for this project. A 100 year design life was required for this structure, therefore NBDOT engineers specified the buried arch to be pre-cast concrete.

NBDOT had to maintain two-lanes of traffic on Route#126 throughout the construction process. Due to the limitations at the existing bridge structure, staged construction became apparent. The following sections of this article will discuss several innovative methods of construction sequence, design materials used, environmental measures taken to protect fish habitat, and the final completion of the project, pertaining to the new river crossing structure and associated retaining walls.
2. EXISTING KOUCHIBOUGUAC RIVER BRIDGE NO.5 AND HIGHWAY ALIGNMENT

The existing two lane bridge located on Route #126 crossing the Kouchibouguac River near Rogersville, New Brunswick was a 12.0 m span concrete rigid frame structure perched on a rock foundation located 2.5 m above streambed. (see Figure 1a & b). The bridge was located at the lowest point of a vertical curve which was an area of great concern for local travellers. Due to sight distances, nearby intersections and speed of truck traffic, the bridge became a focal point of potential accidents. Through public input, NBDOT engineers reviewed the existing highway and river crossing and decided that an improved alignment was warranted.

The adjacent property running parallel to this section of Route #126 was owned and operated by NBECR. Through discussion with NBECR regarding the proposed new highway and bridge alignment, NBDOT engineers realized that complete isolation of their new structure and proposed highway embankment slopes had to be contained within the provincial right-of-way. No impact from the proposed highway alignment was permitted from NBECR. (see Figure 2)

3. ENVIRONMENTAL CONCERNS - KOUCHIBOUGUAC RIVER

Conditions of the Federal Fisheries Act and the provincial watercourse permit require any in-stream activities associated with construction only be carried out between June 1 to September 30 window. This aspect protects the spawning and fish habitat within watercourses of New Brunswick.

Route #126 crosses the Kouchibouguac River in its headwaters and it is noted to local anglers for its ideal fishing. The NBDOT were compelled to follow their guidelines to protect the river during the construction process. In-stream construction activity was strictly prohibited during the restricted months. The contractor, St.Isidore Asphalte Ltee, (SIAL) devised a environmental protection plan, acceptable to NBDOT, that would protect fish habitat and eliminate in-stream construction accordingly.
4. NEW HIGHWAY ALIGNMENT OF ROUTE #126

The new highway alignment for Route #126 near Rogersville, NB increased the existing road grade by approximately 7.0 m from the existing elevation. Due to the large increase in finished grade of the proposed highway, a buried arch spanning the river was chosen as the bridge structure. NBDOT specified a pre-cast concrete arch because a 100 year design life was required. With the restriction from NBECR on right-of-way infringement, NBDOT engineers incorporated a large retaining wall on the upstream end of the new arch to contain the highway embankment slopes. (see Figure 3)
To reduce the overall length of the buried arch and to contain the embankment slope on the downstream end, a smaller retaining wall was incorporated. (see Figure 4)

5. CONSTRUCTION MATERIALS, (ARCH, RETAINING WALLS, TRAFFIC BARRIER)

The NBDOT engineers specified a segmental pre-cast concrete arch to span the Kouchibouguac River on Route #126. The original span of the arch was 12.0 m, the same dimension as the existing rigid frame structure. Upon further survey of the rock foundation, where the new concrete arch was to be placed, it was determined that a larger 15.0 m span structure would be required so that the spread footings would not impact on the river for environmental concerns. The new concrete arch encloses the existing railway steel arch without impacting the plane of right-of-way as enforced by NBECR. (see Figure 5).
The segmental pre-cast concrete arch, TechSpan™ by Reinforced Earth Company Ltd. (RECO), was designed using a three hinged configuration; two at the base and one at the crown. The state-of-the-art design program developed by RECO uses a finite-element-method (FEM) to optimize the arch shape and minimize the bending moments. The final dimensions of the new concrete arch were 15.0 m span x 4.5 m rise x 28.3 m long. (see Figure 6)
The spread footings were designed to carry the vertical and horizontal loads imposed by the proposed concrete arch and associated backfill for the new highway alignment. (see Figure 7)

![Spread Footing Section Diagram](image)

Figure 7 SPREAD FOOTING SECTION

The NBDOT design for the river crossing structure required three separate retaining walls, two permanent concrete-faced mechanically stabilized earth (MSE) walls for the upstream and downstream ends of the arch (see Figure 8 & 9), and one temporary wire-faced MSE wall for staged construction. (see Figure 10)

![Upstream MSE Concrete Wall Elevation](image)

Figure 8 UPSTREAM MSE CONCRETE WALL ELEVATION
A permanent concrete traffic barrier, designed by RECO, was placed on the upstream MSE wall. (see Figure 11) The upstream wall had a vertical drop of 7.0 m to original ground, therefore a barrier was necessary to protect the travelling public.
6. STAGED CONSTRUCTION – KOUCHEBOUGUAC RIVER BRIDGE NO. 5

NBDOT’s requirement of maintaining two lanes of traffic at all times would pose a particular challenge at the existing and new bridge location. The construction of the new concrete arch had to be done in two stages. The construction sequence was as follows:

- Existing and Proposed Alignment of Route #126 (see Figure 12 a)
- Installed the arch to the upstream end of the existing bridge (see Figure 12 b)
- Installed the upstream permanent concrete-faced MSE wall together with the downstream temporary wire-faced MSE wall (see Figure 12 c)
- Traffic moved to Detour #1 location and remove existing bridge (see Figure 12 d)
- Install remainder of arch and downstream permanent concrete-faced MSE wall (see Figure 12 e)
- Traffic moved to Detour #2 location (see Figure 12 f)
- Install remainder of upstream MSE wall, install concrete traffic barrier, Traffic moved to Detour #3 location (see Figure 12 g)
- Finish downstream slopes and final grading (see Figure 12 h)
Figure 12(a) EXISTING & PROPOSED ALIGNMENT ROUTE #126 AT KOUCHIBOUGUAC RIVER

Figure 12(b) UPSTREAM CONCRETE ARCH INSTALLED
Figure 12(c) UPSTREAM MSE CONCRETE WALL & TEMPORARY MSE WIRE WALL INSTALLED

Figure 12(d) TRAFFIC MOVED TO DETOUR #1 & EXISTING BRIDGE REMOVED
Figure 12(e) REMAINDER OF CONCRETE ARCH AND DOWNSTREAM MSE CONCRETE WALL INSTALLED

Figure 12(f) TRAFFIC MOVED TO DETOUR #2
Figure 12(g) INSTALL REMAINDER OF UPSTREAM CONCRETE MSE WALL, INSTALL TRAFFIC BARRIER, MOVE TRAFFIC TO DETOUR #3

Figure 12(h) FINISH DOWNSTREAM SLOPES AND FINAL GRADING
7. CONCLUSIONS

The highway realignment project on Route #126 near Rogersville, New Brunswick for NBDOT was completed under budget and ahead of schedule. The innovative staged construction techniques to install the new pre-cast concrete arch structure, associated MSE retaining walls and pre-cast traffic barrier proved to be a success.

This section of Route #126 has been upgraded to the highest standards for this series highway for the Province of New Brunswick. The completed project has significantly improved the overall road geometry in the interest of public safety.

8. ACKNOWLEDGEMENTS

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9. BIBLIOGRAPHY

Reinforced Earth TechSpan Design Method

Reinforced Earth Design Method


