Delivery of CentrePort Canada Way

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Abstract

In October 2008, Manitoba passed the *CentrePort Canada Act* to establish CentrePort Canada as Manitoba's inland port in northwest Winnipeg and the Rural Municipality of Rosser to attract and coordinate business investment.

In April 2009, Manitoba and Canada announced a cost share agreement totalling $212M to fund the construction of CentrePort Canada Way (CCW), which is intended to be the road transportation backbone of the 20,000-acre CentrePort Canada development zone.

The concept for CCW called for a four lane expressway approximately 10km long between Winnipeg's Perimeter Highway and Brookside Boulevard including a major interchange and two rail grade separations on a route which had never been considered before. This is a greenfield project with all proposed roadways being new construction on new location. Construction was mandated to begin in 2010 with a 2013 completion date. This paper tracks the extraordinary measures Manitoba Infrastructure and Transportation (MIT) undertook to meet the fast track schedule and the required construction innovations. Significant aspects include:

- Accelerated conceptual, functional and detailed design with associated coordination challenges.
- Concurrent development of MIT's first ever design-build process.
- Design and construction of MIT's first mechanically stabilized earth walls.
- Design and construction of the largest overpass structures in the province.
- Design and construction of the largest box culverts in the province.
- Challenges in construction staging and traffic operations.
- Innovations in pavement rebar design and construction.
- Innovations in accelerated consolidation of embankments.

Introduction

CentrePort Canada (CC) is being developed as Manitoba's inland port. A contiguous parcel of 20,000 acres in the northwest quadrant of Winnipeg and Rural Municipality of Rosser has been identified as the development zone for this initiative. This zone is unique in that it is served by the Winnipeg James Armstrong Richardson International Airport, roadways that are part of the National Highway System, and three Class 1 railroads.

The vision for CC is to leverage its transportation advantages, its location relative to North American markets, and the competitive economics of the local economy to develop a world class logistics and manufacturing centre that fosters foreign trade.

The vision was established by the Province of Manitoba, local governments and business interests and formalized in the establishment of CentrePort Canada Inc. (CCI) by an act of the Government of Manitoba in October 2008. CCI is a non share capital corporation with the mandate to facilitate the development of the vision. It is not a development company as the lands within the development zone are largely in private hands.

In April of 2009, the Government of Manitoba and the Government of Canada jointly announced a $212M cost shared program for the central infrastructure associated with CC. That infrastructure is a new expressway intended to become the road transportation backbone of the development zone. It will connect Provincial Trunk Highway (PTH) 101 (part of Winnipeg's Perimeter Highway) with the intersection of Inkster Boulevard and Brookside Boulevard (located at the centre of Winnipeg's trucking industry). In between the two nodes, it traverses the width of the CentrePort Canada development zone.

Figure 1 illustrates the overall road works being constructed under the cost shared program. The coverage area of the drawings largely corresponds with the 20,000 acre development zone. The new expressway, at the heart of the illustrated road works, is what has now been named CentrePort Canada Way (CCW) and its development is the subject of this paper.

Conceptual Planning

Because Manitoba is one of many agencies in North America pursuing the establishment of inland ports, there is a competitive advantage in rapid development. To that end, the Government of Manitoba directed that construction work be initiated on CCW in 2010 for an opening no later than 2013.

The spring 2010 construction start meant that only one year existed to complete planning, design and initial contractor procurement. This timeframe was unprecedented in Manitoba Infrastructure and Transportation's (MIT) experience. As a result, a unique planning process was developed to meet the deadlines.

Since the concept for CC and CCW was entirely new, there was no pre-existing plan at any level. In particular, CC itself had no land use plan at its initiation. Traditional planning would have seen the land use defined, a conceptual transportation plan developed to fit the land use and then functional and detailed design. There was no time to undertake all of the planning steps sequentially which could nominally take three to five years.

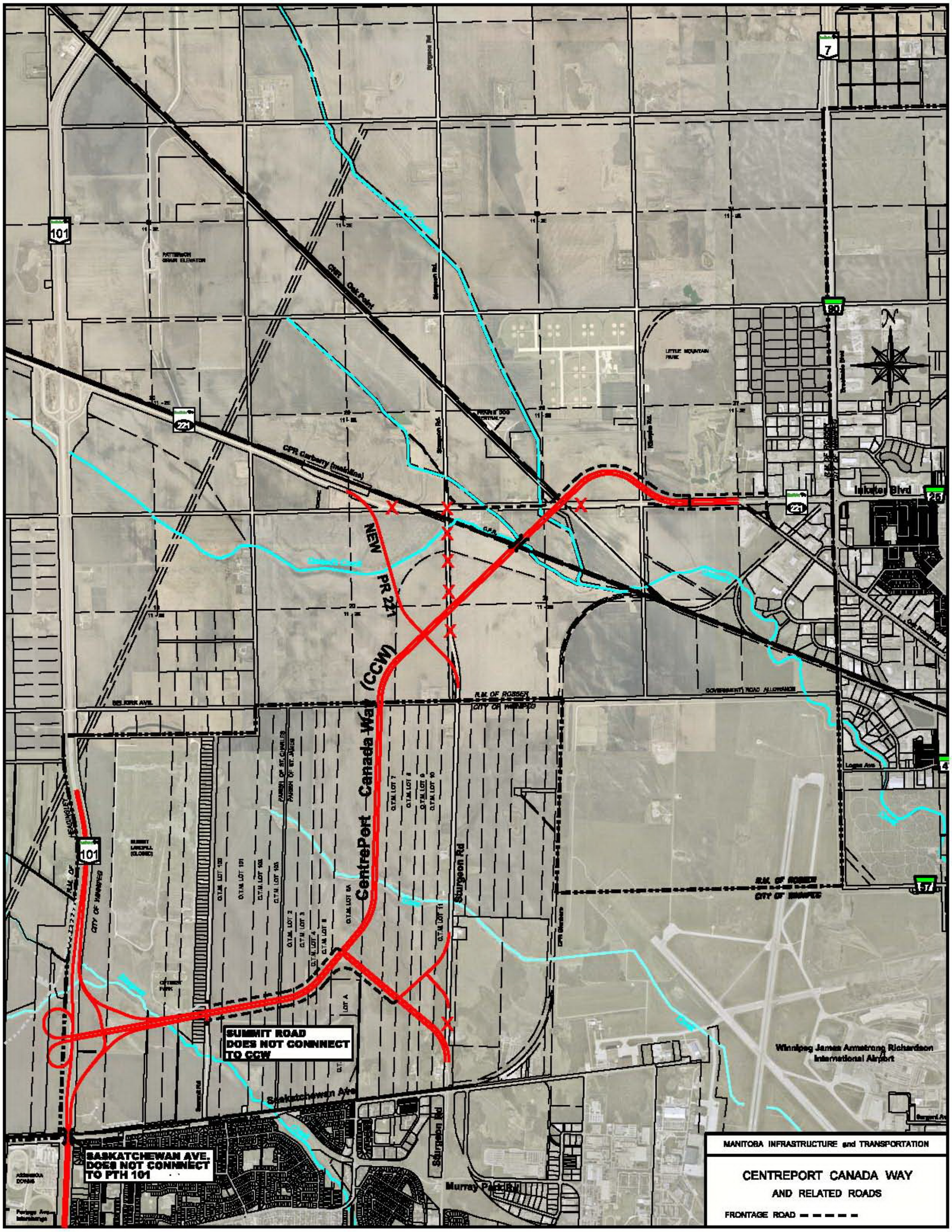

Figure 1 – CentrePort Canada Way Functional Plan

Instead, the project was broken down into a number of components that could be developed in parallel. Specifically, CCW became defined as three nodes with connecting roadway links. The first node was the western starting point of CCW which was envisaged as an interchange connecting with PTH 101. The second node was a grade separated crossing by CCW over CPR's mainline Carberry Subdivision. The third node was the eastern termination of CCW at the intersection of Inkster Boulevard and Brookside Boulevard in Winnipeg.

The nodes could be defined at the project start. The intersection of CCW with PTH 101 could only occur at one location due to the requirement of having it occur as southerly as possible on PTH 101 while avoiding existing development constraints. This requirement was to minimize travel times to the two most important connecting routes – the Trans Canada Highway, and PTH 75 connecting to the United States. The eastern node was a fixed pre-existing location and thus needed no study. Finally, it became readily apparent that the CPR crossing was also constrained to one location.

The constraints on the CPR crossing location were due to two pre-existing conditions. Glide path elevation restrictions for the proximate Winnipeg James Armstrong International Airport put an eastern limit on the crossing location. CPR required as much open trackage as possible west of the crossing to stage trains on multiple tracks. This pushed the location of the crossing back to the most easterly practical limit, resulting in only one option for the crossing.

With the nodes defined, work was initiated immediately on their development. The routing of the CCW road links was rolled into the land use planning study for designing and constructing at a later date. Since the complex design and construction elements were associated with the nodes (e.g. grade separations, an interchange and major water crossings), they were on the critical path. The links were significantly less complex and could be deferred and not affect the overall opening date.

This formed the definitions for what was termed Stage 1 and Stage 2 of design and construction. Stage 1 packaged the interchange of PTH 101 and CCW, a grade separation of PTH 101, Saskatchewan Avenue and CPR Gleboro, and a grade separation of CCW and CPR Carberry as one design and construction assignment. Stage 2 packaged all of the linking roadways as a second design and construction assignment.

Development of Stage 1

To expedite the development of Stage 1, MIT decided to develop its first ever design/build (DB) project. MIT sought the assistance of Alberta Transportation (AT), which had significant prior experience with DB works, and it was generously provided. AT granted copies of its DB documentation for contracts and specifications along with an outline of the processes they employed. These provided an excellent foundation for what would become MIT's process and documentation.

There are enough differences between any two agencies that the policies, practices, and documentation of one can never be directly applied to the other. This meant that a massive undertaking was required to adapt AT's DB process to MIT's environment. Over 1000 pages of contract and specification documents would have to be reviewed and edited to ensure conformity with Manitoba's requirements. In the end, every single page of the 1000+ pages provided by AT would require either revision or replacement.

To accomplish this MIT created a new section called the Major Initiatives Team to oversee the DB assignment. This team had four members whose role it was to define work activities and oversee their accomplishment by both internal and external resources. Given that this was MIT's first DB project, it was considered imperative to procure an Owner's Engineer (OE) with considerable DB experience. MMM Group was brought in by MIT to fulfill this role.

Within MIT, two overlapping workgroups were defined – the first dealing with the development of the contract documents and the second dealing with the development of a functional design for the DB infrastructure. MMM brought technical resources to the aid of both groups and took the lead in producing the functional design. Each internal group was comprised of approximately twenty members which were drawn from the senior levels of the partnering branches. For the group members, this work became additional to their normal duties so that they were not dedicated resources. Given this approach, the work produced and the timeframes under which it was done, were remarkable.

In less than six months, the overall contract document was in place including the functional design that formed the basis of the project. During this same time, a prequalification process was undertaken to establish a shortlist of three proponents to undertake the DB project. The next six months was then utilized to gain all necessary environmental approvals, select a contractor from the shortlist and assemble all of the necessary lands.

MMM took the lead in developing a comprehensive environmental assessment for the entire CCW project that had substantial input and coordination from MIT staff. A Canadian Environmental Assessment Act screening was undertaken as the major environmental task which was completed only one month before awarding the contract in April 2010. Environmental permitting was left as a responsibility of the DB contractor.

A lowest compliant bid process was used to select the DB contractor. Each proponent went through multiple submissions that were scrutinized in detail by internal staff and the OE for compliance with the contract requirements. Only when all of the proponents submissions were deemed compliant was a call made for a financial submission that priced the work. The proponent with the lowest overall price was awarded the work, which in this case was SNC Lavalin Constructors Pacific (SLCP).

The land acquisition proved more complex than anticipated. It was decided from the start that expropriation would be utilized for land assembly since negotiated purchases would take too long. Even at that, the land requirement had to be defined before the functional design was fully completed to allow sufficient time for expropriation. A risk assessment was performed to identify a property envelope that allowed for future design modifications that could occur as the functional design proceeded.

An unexpected twist occurred in a necessary land procurement from the CPR. The project required approximately 40 acres from a 900 acre CPR holding in the CC development zone to build CCW. As a federally chartered company, CPR cannot be expropriated and thus a negotiation was begun. However, CPR made a condition of their negotiation that MIT purchase the entire 900 acre holding and not just the 40 acres. This actually represented an opportunity for Manitoba in realizing the CC vision. It could result in the province owning a large parcel of developable lands, adjacent to a rail mainline in the heart of CC.

This much larger transaction brought significantly increased complexity to the negotiation as it involved new stakeholders and funding. Regardless, the negotiation was concluded to the satisfaction of all parties only two days before MIT was contractually obligated to provide access to construction lands to their contractor SLCP.

The conclusion of the procurement process saw a contract signed with SLCP on April 27, 2010 which was less than one year since project start as a clean sheet of paper initiative.

Stage 1 Design and Construction

Traffic Management

Stage 1 construction began in earnest in May 2010 with SLCP as the contractor and MMM Group retained as the OE for the duration of construction. The first challenge was traffic management and construction staging. SLCP's design for the one interchange in the project called for PTH 101 to cross over CCW. This was the opposite configuration as what was laid out in the original MIT functional design. For this to occur, approximately 1.5 km of PTH 101 would have to be elevated as much as 10m. PTH 101 is part of the four-lane Perimeter Highway around Winnipeg that has over 20,000 AADT in the project area. This traffic was contractually required to be uninterrupted for the duration of construction, originally anticipated to be three years.

MIT has never detoured four-lane traffic over long distances with anything less than a four-lane detour. There was no room to accommodate such a wide detour within the existing right-of-way and adjoining development meant that going outside of the right-of-way was not an option. The contract made provision for a two-lane detour, but special provisions were required for traffic operations and safety.

For one of the first times on an MIT roadway, a centreline rumble strip was incorporated over the length of the detour to reduce the risk of centreline cross-overs. Wide, paved 3m shoulders were provided over the entire length to provide emergency maneuvering space and space to hold stalled vehicles out of traffic. Illumination was provided at critical merge and access points.

The detour would also have to function as access to the work zone. The contractor was limited to five access points over the detour length (two to the east and three to the west) and left turns were prohibited for both entering and departing traffic. A comprehensive signing plan was developed along with substantive use of delineators to ensure safe traffic guidance and the contractor was required to have full time staff dedicated to signing and traffic management.

Figure 2 - Interchange of PTH 101 (diagonal from top left to bottom right) and CCW (horizontal left to right) with Detour Immediately Right of PTH 101

Unique Design and Construction Elements – Mechanically Stabilized Earth (MSE) Walls

The use of MSE walls on this project is a first for MIT, mostly because the acquisition of property along the sides of the embankment is not desirable and also because of sub-surface considerations. There are approximately 10,000 square metres of two stage MSE Structural Walls, approximately 230,000 m3 of MSE fill and 5,600 square metres of Sound Wall for the interchange of CCW and PTH 101 and the CCW overpass of CPR Carberry.

The MSE walls are constructed with piles and a transition slab below to:

- provide support to the MSE wall;
- reduce the active earth pressure from the MSE wall backfill acting on the pile caps; and
- mitigate the effects of potential differential settlement on the MSE wall.

Geotechnical considerations required the use of cast-in-place piles under the highest portions of the 9m maximum height MSE walls.

In a two-stage wall construction process, the wire wall is initially constructed and is not clad until target settlements are reached. Then, architectural precast panels are erected on a leveling pad, spaced off the wall face and attached by a system of adjustable hooks and turnbuckles. The void is then filled with granular material or grout. The prefabricated panels enable quick delivery and easy attachment. Electroplated turnbuckles with attached end hooks provide the anchoring system to fasten the precast face panels onto the wire mesh of the MSE wall. The coping, safety barrier, sound fence and road surface are added after installation of the facing panels.

Figure 3 – MSE Wall Construction

For noise mitigation from the vehicular traffic to surrounding areas, sound walls are installed above the MSE walls.

Settlement of MSE walls is typically monitored with the use of buried plates which are surveyed at regular intervals. Difficulties with this process include working around vertical access pipes, disturbance of the plates during compaction and also equipment covering up the access points. To mitigate these problems the DB team implemented a monitoring system that uses a pipe that is installed normal to the roadway near the base of the embankment. Continuous sensors within the pipe detect differential settlement across the embankment and can be accessed at any time.

Unique Design and Construction Elements – Overpass Structures

This project includes nine bridge structures with a total deck area of approximately 11,500 m2. Due to issued related to high till level and high groundwater levels, underpasses were not an option for this location. The bridge decks for the CCW interchange overpasses were made continuous to eliminate durability problems associated with deck joints over the piers. Precast, prestressed concrete NU girders, initially developed by Nebraska University's Construction Systems Technology Department, allow concrete bridge structures to have longer spans and shallower structural depth while optimizing weight and length with slender cross-sections. Concrete NU girders were used in Structures 1 and 4, enabling spans up to 42.2 metres to be achieved, minimizing the number of substructure units required, and therefore construction time, effort and materials. The CCW interchange at PTH 101 is the first in the Province of Manitoba to use concrete NU girders, and are the largest overpass structures constructed in Manitoba to date. Precast, prestressed, concrete box girders were used in Structure 5. All bridge structures and culverts are designed for a service life of 75 years. Transport of the long precast box and NU girders required careful route planning from the precast plant to the site and occurred only during low traffic periods. Each structure was constructed with fall arrest anchor points to provide added safety for bridge inspectors.

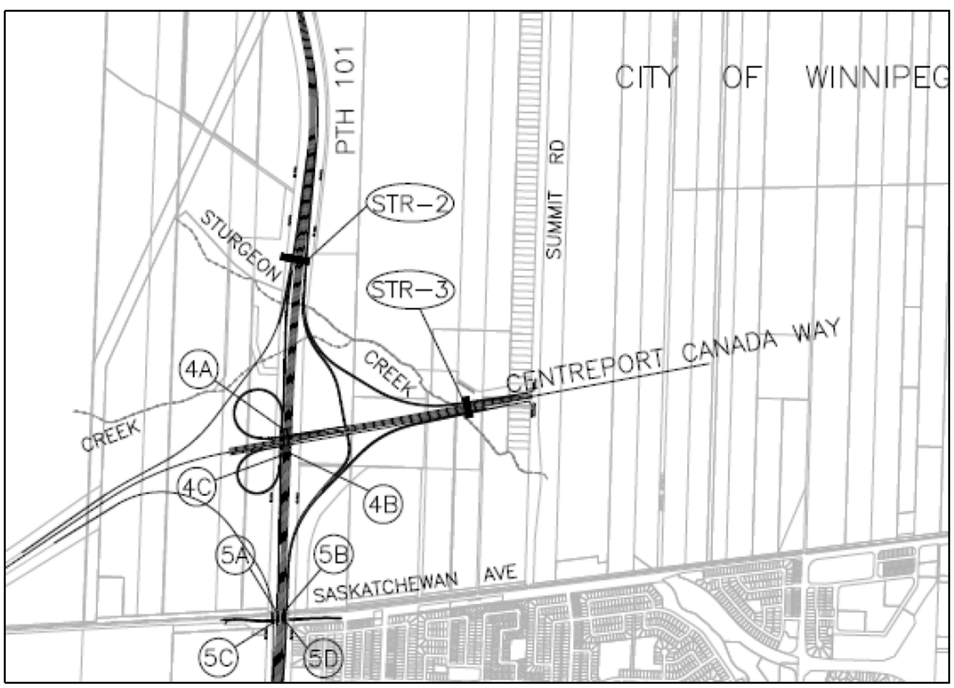

Figure 4 - Locations of Structures 2, 3, 4a, 4b, 4c, 5a, 5b, 5c, 5d (Structures 1a, 1b are outside of interchange area)

The construction of the interchange at CCW/PTH 101, the reconstruction of PTH 101 and the construction of CCW in the vicinity of the CCW/PTH 101 interchange includes:

- Construction of a paved four-lane divided arterial roadway providing for a future six lane roadway for CCW;
- All earthworks for approach fills and ramps for the First Stage and Ultimate Stage interchange works as defined in the functional design; and
- Widening of PTH 101 to account for a median widening, median pier requirements and the ramp connections.

The construction of the overpass of PTH 101 over the CPR Glenboro subdivision and Saskatchewan Avenue includes:

- Detour design for PTH 101 to maintain one lane of travel in each direction, including a temporary crossing of PTH 101 with CPR Glenboro with railway signals;
- A rail overpass structure with adequate structure widening on PTH 101 to provide for any ramp extensions providing for the CCW/PTH 101 interchange Ultimate Stage works;
- Raising of the PTH 101 profile to facilitate required clearance over the rail line; and
- Related excavation, retaining walls and noise attenuation.

The following is a quick summary of facts and figures for the overpass structures.

Structure 1A and 1B

Bridge over CPR Carberry and Omand's Creek on CCW Westbound/Eastbound Lanes:

- 103.95 m centre to centre of abutment bearings;
- Three span continuous precast, prestressed NU girders, 2 000 mm deep with cast-in-place deck and asphalt pavement overlay on a 25 degree skew;
- Two reinforced concrete conventional abutments and two reinforced concrete piers on steel H-piles with approaches on MSE walls;
- Initial 12.90 m clear roadway width with 16.6 m future widening;
- Approximately 1 452 m2 of deck area per structure; and
- Designed for AASHTO LRFD HL-93 Truck and Lane Load, AASHTO LRFD Tandem and Lane Load, and AASHTO MS 27 (HS 30) Lane Load.

Figure 5 – Structures 1A and 1B

Structure 4A , 4B and 4C

Bridge over CCW on PTH 101 Northbound Lanes, Southbound Lanes and C-D Road:

- 129.40 m centre to centre of abutment bearings;
- Four span continuous precast, prestressed NU girders, 2 000 mm deep with cast-in-place deck and asphalt pavement overlay on 13.2 degree skew;
- Two reinforced concrete conventional abutments and three reinforced concrete piers on steel H-piles;
- Initial 12.90 m clear roadway width with 16.6 m future widening;
- Approximately 1 808 m2 of deck area per structure; and
- Designed for AASHTO LRFD HL-93 Truck and Lane Load, AASHTO LRFD Tandem and Lane Load, and AASHTO MS 27 (HS 30) Lane Load

Figure 6 - Structures 4A, 4B, and 4C

Structure 5A, 5B, 5C and 5D

Bridge over Saskatchewan Avenue and CPR Glenboro on PTH 101 Northbound Lanes, Southbound Lanes and Interchange Ramps:

- 51.20 m centre to centre of abutment bearings;
- Two span continuous precast, prestressed box girders 1 200 mm wide x 1 100 mm deep laterally;
- post tensioned with cast-in-place deck and asphalt pavement overlay on 5.6 degree skew;
- Semi-integral abutments and piers on steel H-piles with approaches on MSE walls;
- Initial 12.90 m clear roadway width with 16.6 m future widening;
- Approximately 715 m2 of deck area per structure; and
- Designed for AASHTO LRFD HL-93 Truck and Lane Load, AASHTO LRFD Tandem and Lane Load, and AASHTO MS 27 (HS 30) Lane Load.

Figure 7 - Structures 5A, 5B, 5C, and 5D

Unique Design and Construction Elements – Box Culverts

Two new reinforced concrete cast-in-place box culverts were constructed at the redirected Sturgeon Creek crossings. Each box culvert is a single integrated three-barrel design (internal dimension: two - 6m wide x 4m high, one - 8m wide x 4m high). The PTH 101 box culvert (Structure 2) and CCW box culvert (Structure 3) are 140 m and 90 m long respectively. These culverts would be such that they could pass six school buses with room to spare. The size of the cells was generally governed by navigation requirements.

Design and construction of a new Sturgeon Creek Structure at CCW to accommodate the Ultimate Stage six lane CCW cross section was performed considering the hydrologic and storm water flow needs, Navigable Waters requirements, Fisheries (DFO) requirements and other applicable environmental requirements.

Removal and replacement of the existing Sturgeon Creek Structure at PTH 101, to accommodate the First Stage and the Ultimate Stage interchange works and the future median widening of PTH 101, was designed and constructed considering the hydrologic and storm-water flows, Navigable Waters requirements, Fisheries (DFO) requirements and other applicable environmental requirements.

The three-barrel culverts in Sturgeon Creek are the two largest box culverts in Manitoba. Their lengths necessitated intermediate skylight shafts and manholes to allow light into the tunnels for fish passage and also emergency escape for inspectors. One of the cells in each structure has riffles installed on the bottom to slow water flow as required for fish passage. The loads from soil and live vehicular surcharges on top of the culverts are carried by 700 mm thick roof and floor slabs and 450 mm thick exterior walls.

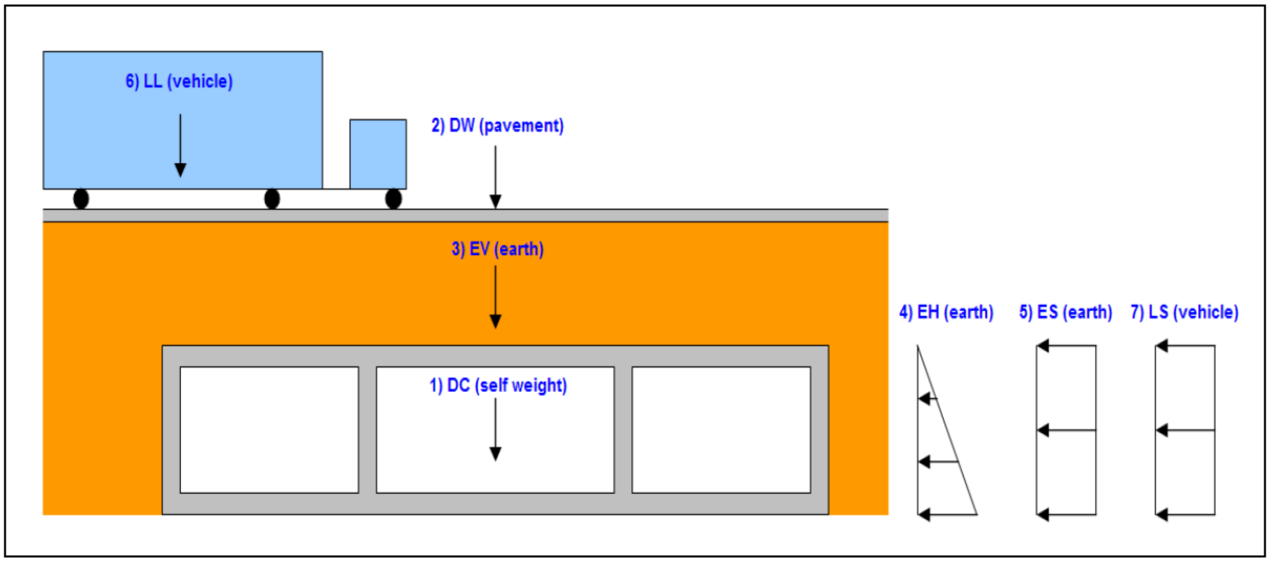

Figure 8 - Design Loads on Concrete Box Culverts

The following is a quick summary of facts and figures for the box culverts.

<u>Structure 2</u>

Reinforced Concrete Box Culvert in Sturgeon Creek on PTH 101:

- 3 barrels, two 4 000 x 6 000, one 4 000 x 8 000;
- Length 140 671 mm out to out of head wall, zero degree skew;
- 117 735 mm roadway width with shoulder and 4:1 side slope; and
- Designed for AASHTO LRFD HL-93 Truck and Lane Load, AASHTO LRFD Tandem and Lane Load, and AASHTO MS 27 (HS 30) Lane Load

Figure 9 – Structure 2

Structure 3

Reinforced Concrete Box Culvert in Sturgeon Creek on PTH 101:

- 3 barrels, two 4 000 x 6 000, one 4 000 x 8 000;
- Length 90 791 mm out to out of head wall, zero degree skew;
- 62 240 mm roadway width with shoulder and 4:1 side slope; and
- Designed for AASHTO LRFD HL-93 Truck and Lane Load, AASHTO LRFD Tandem and Lane Load, and AASHTO MS 27 (HS 30) Lane Load

Figure 10 -Structure 3 with Cast-in-Place Rip Rap in Exterior Cells for Fish Passage

Development of Stage 2

Land Use Plan and CCW Corridor Selection

Stage 2 involves the main line roadway for CCW, associated service roads and major at-grade intersections. Development of Stage 2 lagged Stage 1 by approximately one year due to the need to complete a land use study. While conducting land use studies is not normally a role performed by MIT, the Department was assigned the lead on the project due to the close coordination required for the road works.

The land use study proved a challenge due to the participation of numerous stakeholders and partners whose mandates were sometimes at odds with each other. A steering committee was responsible for direction of the study which and had representatives from provincial government departments, local governments, local industry and trade groups. There was little beyond a vision statement to guide the group in the development of a workable plan.

The plan was accomplished by developing a common understanding amongst all stakeholders as to the primary goals and objectives needed to achieve the CC vision. This was accomplished through workshops and comprehensive consultations. Once the goals and objectives were established, specific plan options were developed to meet them. These were analyzed and evaluated to result in the recommended plan. Included in this plan was a corridor selection for the second stage roadways as illustrated in Figure 11.

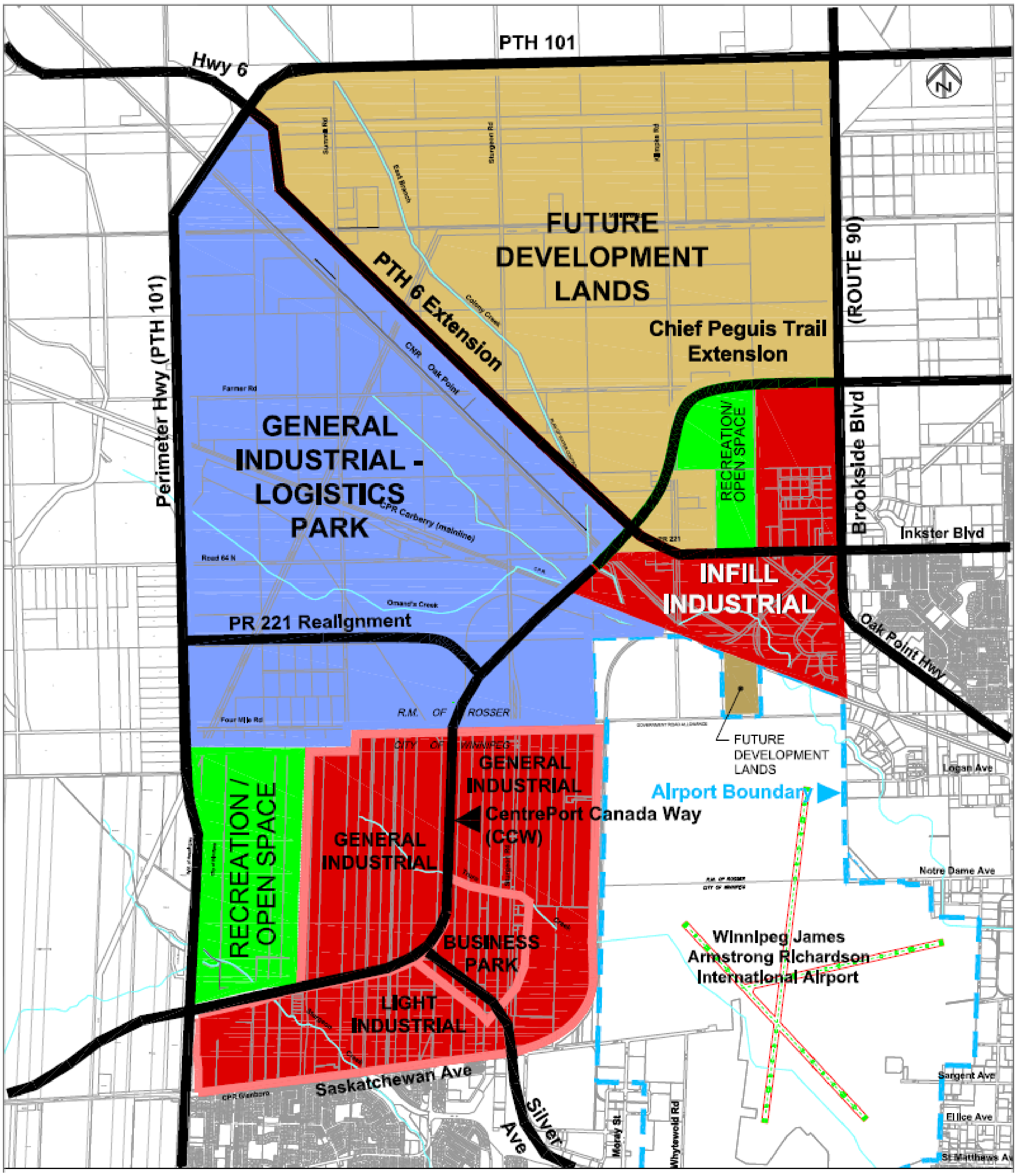

Figure 11 – CentrePort Canada Land Use Plan Illustrating CCW Corridor

(note: Only CCW is being built at this time with PR 221 Realignment, PTH 6 Extension, Chief Peguis Trail Extension and Silver Avenue Extension being long term planning objectives)

Development of Functional Design

Long Range Transportation Planning

The creation of CC in 2008 was a new concept to Manitoba Infrastructure and Transportation, and as such, it did not have long range highway plans in place to support its development. The Department did however have long range highway plans in place for the provincial highway system that supports growth in Winnipeg and surrounding area, and those plans needed to be modified to accommodate a concentration of business and industrial development in the NW corner of the City of Winnipeg. The two main highways that CentrePort Canada would connect would be PTH 101 and PTH 1W (Trans Canada Highway)

PTH 100/101

PTH 100/101 also known as the Perimeter Highway is a ring road around Winnipeg originally constructed in the 1950's and 60's intended to serve as a by-pass of the City for long distance travellers. The Perimeter Highway was constructed to what would be considered a suburban parkway standard with a fairly narrow raised curbed median 20 feet wide and at-grade intersections at many locations and interchanges at a few high volume locations.

The City of Winnipeg has grown substantially in the 60 years since the Perimeter Highway was constructed, and development has pushed outwards and in many areas it now butts up against it. In addition, significant ex-urban residential development has occurred and many people now live in bedroom communities within an easy commute of the City.

Because of this growth, the nature and volume of traffic on the Perimeter Highway has grown as well. While the by-pass component of the Perimeter Highway's function remains important, from a traffic volume perspective the inter/intra urban traffic functions of the Perimeter have become more important and its function is now mainly to distribute traffic between the rural highway system surrounding Winnipeg and its urban arterial street system. In recognition of this change in function, the Department now classifies the Perimeter Highway as an expressway that will become a freeway over time with all at-grade intersections to be eliminated and replaced with interchanges at strategic locations.

PTH 1W (Trans Canada Highway)

PTH 1W is both a Core National Highway under the National Highway Classification System classification and an expressway/ future freeway under Manitoba's highway classification system. Currently the high speed rural highway portion of PTH 1W ends approximately eight kilometres west of the Perimeter Highway where it changes to more of a low speed arterial street as it passes through Headingley, MB before connecting to the Perimeter Highway at a 1960's vintage cloverleaf interchange, approximately three kilometres south of the CentrePort Canada site. Prior to the creation of CentrePort Canada, MIT has had a long range plan in place that would by-pass Headingley to the north and bring PTH 1W to the Perimeter Highway as a high speed rural highway.

City of Winnipeg Inner Ring Road

In order to promote the efficient and effective movement of traffic within the City of Winnipeg, the City has a long range plan for an inner ring road that would parallel the Perimeter Highway, and separated from it by from 3 to 5 kilometres. Approximately 25% of the City's inner ring road has been constructed to date.

Land Uses

The 20,000 acre CentrePort Canada site will be developed primarily for business park and industrial type land uses with a rail facility at its heart. As a result, good accessibility for truck traffic is a key requirement for the development. Currently, northwest Winnipeg is home to a large industrial park and base for many truck companies.   The majority of the trucks accessing this area utilize Provincial Road (PR) 221 which passes through CentrePort Canada to connect to the Perimeter Highway and then destinations in Canada and the USA.

CentrePort Canada Way (CCW) and Related Road Classifications

In developing the classification for CCW, a number of factors needed to be taken into considerations, including:

- Be the primary route connecting truck traffic from the existing northwest industrial area to the Perimeter Highway.
- Be able to serve as a link in the City of Winnipeg's inner ring road system.
- Provide good accessibility to the CentrePort Canada site both externally to the provincial highway system and internally to rail and air facilities in the City of Winnipeg.
- Provide continuity to and with a future PTH 1W Headingley By-Pass.

Perimeter Highway (PTH 100/101)

PTH 101 is classified as an expressway/future freeway which is similar to the TAC rural freeway divided classification and that classification will remain. With this classification, a grade separated crossing of the CP Glenboro Subdivision would be required.

PTH 1W / Future Headingley By-Pass

The future Headingley By-Pass is classified as a high speed rural expressway / future freeway.

CentrePort Canada Way

After taking all of the above noted factors into consideration it was decided to classify CCW as a suburban expressway which would result in a combination of road intersections including one interchange and several at-grade intersections that would be signalized as needed. The two railroad crossings would be a combination of a grade separation over the CP Carberry Subdivision (CP mainline) and an at-grade crossing of the CN Oak Point Subdivision (very low volume line), which could be grade separated in the future by relocating the rail line and using the CP grade separation.

CCW / Perimeter Highway Interchange

The interchange was classified as a system interchange and therefore all ramps are required to be free flow in the ultimate configuration. During interim stages, at-grade and signalized ramp connections are allowed on CentrePort Canada Way but not on the Perimeter Highway.

Minor Roads

Minor roads were classified as appropriate for their use and function and the classifications ranged from rural collectors to local roads.

Criteria	Perimeter Highway	CCW	PTH 1W By-Pass	CD Road	Loop Ramp	Single Lane Ramp
Road Classification	RFD	RFD (Modified)	RFD	UAD	N/A	N/A
TAC Design Classification	RFD-130	RFD-130	RFD-100	UAD-90	N/A	N/A
Design Speed	130 km/h	100 km/h	140 km/h	90 km/h	50 km/h	Varies 90 – 110 km/h
Posted Speed	110 km/h	80 km/h	110 km/h	N/A	N/A	N/A
Number of Lanes First Stage	2 NBD 2 SBD	2 EBD 2 WBD	2 EBD 2 WBD	1 + aux	1	1 -2
Number of Lanes Ultimate Stage	3 NBD 3 SBD	3 EBD 3 WBD	2 EBD 2 WBD	1 +aux	1	1 -2

Figure 12 – Basic Design Standards

Stage 2 Design and Construction

Fast Tracking Design and Construction of CentrePort Canada Way

The fast tracking of the CCW project was unique in many ways. To understand just how unique, consider the fact that construction of the Stage 1 DB component kicked-off in April 2010 while the Stage 2 functional design of the roadways did not start until May 2010. At that point, the roadway design was nothing more than a simple line drawing. Ultimately, 28 km of two lane roadways would be designed to connect the Stage 1 nodes to the highway network.

To meet a 2013 target date for the opening of the new facility, MIT made a number of strategic choices to compress the design and land acquisition processes into a 16 month window. The functional design, detailed design and land acquisition processes ran in parallel for six months. The detailed design was split into four separate design projects and the designs were developed in four different operational units within MIT. The land acquisition was split into two separate expropriations and the construction of the roadways was split into three separate contracts. To speed the construction process, the embankment was constructed using quarried limestone material rather than the native, high plastic, clay soils within the corridor.

Under normal circumstances, work on a project would never commence without first having possession of all necessary land. On the CCW project however, work had already started on the Stage 1 sites before the land requirements for the Stage 2 connecting roadways were even known. MIT made a conscious decision to accept the inherent risks after estimating the land requirements and considering land ownership in the area.

Figure 13 – Portion of Stage 2 CCW between PTH 101 Interchange and CPR Carberry Overpass

To compress the schedule, MIT made a decision to start the detailed design of the roadways before completing all of the functional design work. As issues were identified, either in the functional process or in the detailed process, the functional design was modified and those changes were then implemented by the four different detailed design teams. When the decision was made to run the processes in parallel, the expectation was that the amount of overlap would be minimal. However the actual overlap ran for a period of six months.

As the functional and detailed design processes continued into the spring of 2011, it became apparent that the expropriation process would need to begin immediately in order to meet the desired timeline of the project. At that point, there were still a few outstanding issues to be resolved. A decision was made to proceed with the initial expropriation, while deferring the expropriation of the remainder of the land until the outstanding issues were resolved.

The result was three processes running in parallel. To manage changes in the evolving design, weekly meetings were held between the functional and detailed design teams, the land buyers and the legal surveyors. Communication protocols were altered to put the detailed design team into direct contact with the legal surveyors and with decision makers throughout MIT. Changes in the functional design were incorporated into the Plan of Expropriation in a matter of days rather than weeks or months.

To begin construction as early as possible, MIT made a decision to split the work into three contracts. The first contract involved grading work in the areas with the fewest number of constraints. To minimise engineering effort, the size of the required embankment was estimated. Detailed design of the final pavement surface was deferred to a later date. To speed construction and minimise embankment movement of the over time, the grade was constructed using quarried limestone.

The second contract involved grading and concrete pavement work in the area with the greatest number of constraints. The third and final roadway contract involved the surfacing of the roadways constructed in the first contract. The division of activities between the three contracts was based on land availability, utility relocations and the amount of engineering effort required to complete the designs for the tender packages.

MIT has incorporated several innovative features into the design of CCW to improve pavement performance, reduce cost, address maintenance concerns and improve traffic operations. External agencies have been surveyed to improve our understanding of the practises being used elsewhere in North America to construct concrete roadways. MIT has also implemented changes in steel design that are at the leading edge of practise within North America.

Unique Design and Construction Elements – Implementation of Shoulder Gutter

One longstanding concern, from our maintenance forces, has been the use of asphalt curbing on approaches to grade separation structures. The intent of the curbing is to direct surface drainage to spillways to prevent erosion on the side slopes. A secondary benefit is a reduction in the potential for geotechnical failures on the side slopes of high embankments.

Increased precipitation over the last 20 years has not only increased the amount of flooding the Province has experienced, it has also greatly increased the number of slope failures experienced on high embankments. These slope failures are costly to repair and MIT has responded by rethinking our approach to protecting these slopes over the long term.

Flatter side slopes have been part of the solution, but it is also apparent that the use of asphalt curbing has played a role in these failures as well. Winter maintenance operations frequently destroy sections of curbing and the resulting breaks in the curb line direct drainage water towards the side slopes. Failures of the slopes have been noted directly below these breaks in the curb line. MIT has therefore sought out solutions that can properly direct surface drainage while being compatible with winter snow ploughing efforts.

The design of CCW has incorporated a concrete shoulder gutter developed by Florida DOT. The absence of a curb will make winter operations easier on our equipment and should eliminate damage to the drainage system caused by winter operations. The effectiveness of the solution will need to be evaluated, however MIT is hopeful that long term performance will improve with reduced maintenance costs.

Unique Design and Construction Elements – Steel Design of Jointed Concrete Pavement

MIT has implemented three significant changes in the steel design of the jointed plain concrete pavement planned for CCW. First, the design calls for corrosion resistant steel for both tie bars and dowels. Tie bars will be made from stainless steel and dowel bars will be zinc clad. Second, the number of dowels at the joints will be reduced. Thirdly, the use of tie bars will be increased, especially in the curves.

In 2011, and again in 2012, MIT conducted a survey of other highway agencies in North America to gain an understanding of current practices and emerging trends in the construction of concrete pavements. Our first question in the survey was:

> Does your agency currently use epoxy coated or stainless steel dowels in concrete pavements?

The results were that 77% of agencies use epoxy coated dowels, 6% use stainless steel and 17 % were classified as “other”. Southern states indicated that corrosion resistance was not a concern. Wisconsin and Minnesota both reported the use of stainless steel or zinc clad dowels is some instances. The survey indicated that northern states, in general, were considering corrosion resistant steel but had not yet moved to adopt the technology.

MIT considered the results of the survey along with our current steel design practices. Historically, MIT has used 38mm epoxy coated dowel bars, based in part, on the assumption that the cross sectional area of the bars will be reduced over time by corrosion. If corrosion resistant steel is used, would it not be possible to reduce the initial size of the bar? MIT also considered experience with dowel bar retrofit projects, both in Manitoba and in the United States. Typical practise in North America is to use 6 or 8 dowels per lane per joint in a retrofit project while using 10 to 12 dowels in new construction.

Our survey of North American practises included the question:

> How many load transfer dowels per joint per lane does your agency typically use for new concrete pavements?

The majority of agencies, 84%, reported using 11 or 12 dowels per lanes per joint. No agency reported using less than 9 dowels.

For CCW, MIT has decided to use zinc clad dowels. To mitigate the additional cost, the size of the dowels will be reduced to 35mm and the number of dowels will be reduced to eight per lane per joint. Based on our survey, MIT is the first agency in North America to construct a new concrete pavement using only eight corrosion resistant dowels per lane per joint.

MIT has also reconsidered the design of tie bars for CCW. Our past experience with the performance of centreline joints has been disappointing. Failures have occurred and have been especially prevalent on super-elevated curves. Problems have been noted with the alignment of tie-bars and with corrosion on older pavements. A review of the steel design practises of other agencies prompted a revision of our standards to reduce the spacing of tie bars from 1000mm to 750mm. Concerns related to super-elevated curves were addressed on an empirical basis. The spacing in the curves has been reduced from 1000mm to 500mm. The change to stainless steel tie bars will address the problems caused by corrosion.

Unique Design and Construction Elements – Concrete Appearance

Several years ago, MIT adopted a rolled concrete curb face for rural, high speed roadways. The intention of the change was to improve safety for motorists by eliminating barrier curb and the potential for losing control of a vehicle after impacting a vertical curb face. In situations where concrete curbing is used in combination with bituminous pavement, the solution works well. The contrast between the two materials provides drivers with good visual guidance. When concrete curbing is used in combination with a concrete median and concrete pavement, visual guidance is poor and operational problems become a concern.

MIT has moved to address the problem of poor visual guidance by increasing the contrast between the various components through the use of pigments added to the concrete mix. One project, involving barrier curb with a concrete island, has been constructed so far and the results were excellent. Pigments will be used again on CCW to increase the contrast between the concrete median and the concrete lanes. The use of pigmented concrete on CCW will give motorists excellent visual guidance wherever raised concrete islands or curbing exists.

Current Status and Summary

As of the time of writing (April 2013) the overall CCW project is 75% complete in terms of construction dollar value. Stage 1 is 85% complete and Stage 2 is 45% complete. The completion state of individual components is as follows:

- Stage 1 Structures – 90%;
- Stage 1 Grading and Drainage – 95%;
- Stage 1 Paving - 40%;
- Stage 2 Structures – 100%;
- Stage 2 Grading and Drainage 95%; and
- Stage 2 Paving – Yet to begin.

Opening of CCW remains on track for late fall of 2013. This assumes nominal weather conditions over the upcoming construction season.

Overall, the delivery of CCW and the unique fast track processes involved are considered to be a remarkable success. The goals and objectives set at the project initiation are being realized. There have been unanticipated issues, but the risk management processes put in place have managed them to date.