APEGM Progress Report for: #32101 - Cody Nowell EIT

Period beginning: **Oct 1, 2010** and ending: **Mar 1, 2013**. **(29 months)**

Submission Date:	Mar 17, 2013
Supervisor:	Monique Buckberger P.Eng. (#10033), Submitted on Mar 21, 2013
Period Employer:	PCL Constructors Canada Inc.
Job Title:	Project Engineer

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1. Give a description of the Engineering work experience you have obtained during this reporting period. Include information supporting the rest of your answers.

1. Project Overview

In October 2010 I moved from the CMHR to the Disraeli Bridges Project, a Public-Private-Partnership (P3) between PCL the City of Winnipeg and Plenary Roads Winnipeg for the redevelopment of the Disraeli Freeway. The project consisted of two new bridge structures adjacent to the existing CP overpass and red river bridge and a third active transport corridor (ATC) bridge constructed from the rehabilitated red river bridge piers as well as 1.5km of roadworks between Main Street and Hespeler Avenue. The project was delivered as a design-build with PCL as the Design Build General Manger.

This was the first project in the Winnipeg District to have the requirement of ISO 9001 and ISO 14001 compliance. From October 2010 until March 2013 I held the position of project engineer which meant that I would manage the field engineer staff on the river bridge, overpass and ATC. PCL had been selected as the preferred proponent in April 2011 with river bridge construction scheduled to start in November 2011 and overpass in April 2012 with completion of both on October 19th 2012 coinciding with the start of the ATC.

Construction activities during this period included foundation installation of precast concrete piles, steel piles and rock socketed caissons as well as footing and pier construction. Following that was steel girder erection, concrete deck construction, roadworks, commissioning and finally bridge demolition. Each project had its share of challenges, the river bridge foundations were built in contaminated soil and the overpass was nearly split in two due to the CP railway running below the roadway. My main duties for this period included:

- Managing field engineering staff and resources

- Developing, implementing and monitoring PCL’s Quality Management System (QMS) and Environmental Management System (EMS)

- Developing/designing engineered formwork

- Working with site superintendents and foreman to develop construction plans

- Establishing and monitoring permanent project survey control
- Concrete ordering and scheduling

- Preparing concrete quality work packages for PCL’s own forces labour

- Liason with field inspectors and consultants

- Project costing and forecasting through PCL's proprietary project management software

- Shop drawing review and processing

- Evaluating and monitoring PCL's labour productivities

- Updating and maintaining construction drawings and document control

- Developing low-level cost estimates and budgeting for construction activities

- Issue contracts and purchase orders to subcontractors

- Manage landscaping scope of work

2. Practical Experience

The first activity involved construction planning and developing a Quality Management System (QMS) and Environmental Management System (EMS). The team brought in a consultant to provide training and help the project become ISO compliant. We developed a QMS for self-performed concrete work, conducted an in-depth environmental assessment on all aspects of the project to determine which construction impacts were significant and were trained as accredited ISO auditors. PCL was obligated to be certified by an external ISO auditor which was done in January 2011. Internal ISO audits were conducted by the team to maintain continual development, improve effectiveness and prepare for the annual external audit. After each audit the QMS and EMS were refined to suit the needs of our company and our project. Overall both systems proved to be extremely effective in reducing non-conformance, minimizing rework and providing a high quality product to the owner.

As project engineer I had the responsibility of creating concrete quality work packages for our concrete work. The packages consisted of quality control checklists, layout drawings, construction lift drawings, engineered formwork as well as any relevant information from the spec. I needed an intimate understanding of both projects construction and sequencing to ensure the correct information was supplied to the field on time. The QC checklists were developed by the team to effectively ensure that all aspects of the specification were met and provide conformance.

In April 2011 the river bridge was underway with foundation and pier construction with the overpass in early stages of mobilization. With the overpass project starting in May, PCL brought in additional field engineering staff allowing myself to spend less time in the field and more time in the project office. A full time field engineer was assigned to each bridge and each had an engineering student working with them from May until September. If there were questions about the drawings or clarifications required in the field, the field engineers would filter those questions through me to be passed on to the consultant as an RFI. I was also responsible for mentoring my field staff and answering any questions they had regarding their work or relating to the project.

PCL's project team used an online server (PDC) for document control to ensure all necessary parties were identified on issues that related to their work. By using PDC it ensured that the most current material could be accessed by anyone at anytime, reducing the ability for errors since the project site and site office were physically separated. All field staff, for example, would be copied via email on a relevant RFI to the consultant; when the RFI response was submitted it would trigger an email notification to all persons copied indicating what action was to be taken. Since I would write nearly all RFI's it would ensure consistency and I could contact the engineer by phone should any additional clarification be required.

Over the summer and winter of 2011 I worked closely with the two project superintendents developing work plans, designing formwork, scheduling concrete pours and work sequencing in order to achieve maximum productivity. During this time they gave me insight into manpower requirements for common jobsite tasks, typical construction methodologies and job scheduling. Their mentoring and experience helped me gain an understanding and appreciation for construction management responsibilities. Also by better understanding their processes I could work with the project manager to better quantify and track specific areas of work. For example, the original project estimate had given a single productivity for fabricating, cycling and dismantling of the pier hammerhead formwork; however, the amount of work for each activity varied significantly. With the help of the superintendent I suggested these activities should be split into three separate productivities allowing much more accurate tracking and providing better information for future civil projects.

On this project I was fortunate to gain experience in the design of construction formwork and falsework mentoring under our corporate engineers. Between myself, the superintendent and our engineers we developed engineered plans to increase efficiency and minimize cost. Since I worked closely with each project I was able to go on site and talk with the crews and ask what parts of the design worked well and what aspects were difficult. These conversations allowed me to work with the engineers and revise the designs to not only meet the code requirements but meet the requirements of the workforce. One example of this was the scaffolding supports for the hammerhead soffit on the river bridge. Initially the design called for light aluminum scaffolding to be loose formed for each hammerhead, dismantled, and reassembled for the next pier. The scaffolding was quite light; however it was also quite intricate. I suggested to the superintendent we use a PCL standard steel modular deck with adjustable legs that could be cycled between hammerheads. After some discussion we determined fewer legs braced on the concrete footings would meet the requirements and allowed the decks to be cycled between hammerheads with a small crane, increasing productivity and reducing cost. This also reduced fabrication and dismantling time that the crew appreciated.

The winter and spring of 2010/2011 brought a significant amount of precipitation causing record flooding throughout the province. This negatively affected the river bridge pier construction as the initial construction plan involved placing rock into the waterway creating platforms adjacent to each river pier. Given the abnormally high river elevations the project team made the decision to abandon the rock bridge plan as it was no longer feasible and would not meet the project schedule. After several considerations the team decided to stage construction on modular steel barges. PCL solicited the services of Robishaw Engineering in Texas and their Flexifloat modular steel barges for this purpose. The barges were 7ft deep by 40ft long and 10ft wide, were capable of supporting 40 tons and would be used to stage pier construction and structural steel erection. This critical decision had a significant impact on the project since the piers could no longer be constructed as previously intended. PCL worked with the consultant and developed a plan for pre-casting the concrete piers supporting them off the steel pile foundations so construction would not be affected by river elevation. Temporary works off modular barges had never been attempted by PCL Canada and there was a significant learning curve for the entire project team. During the design iteration phase I learned a great deal about risk mitigation, scheduling, design development and negotiations through working with various subtrades and consultants. The work PCL performed over fall 2011 was most likely a once in a lifetime experience.

As per the design build agreement PCL was obligated to turn over both structures and roadworks to the owner by October 19th, 2012. The penalty for late delivery were liquidated damages in the order of $40 000 per day. When the project was bid a contingency was set aside for additional manpower and overtime in order to meet the original schedule and reduce risk. It took an incredible amount of resourcing and scheduling to ensure both projects would meet the deadline, long lead items such as expansion joints and bearings had to be ordered and approved months prior to installation. Also due to the significant change in the river pier construction plan from rock pads to steel barges the team worked frivolously to ensure the construction schedule would still be met. All river activities had to be complete before spring break up and during the entire barge operation the team had daily conference calls to track progress on site and adjust the schedule accordingly. PCL and our subcontractors worked 24 hours a day 7 days a week January through March 2012 to meet critical deadlines. The schedule for all activities was extremely tight, however with proper planning and organization the team was able to successfully complete all activities within a day of spring break up. I learned the significance of detailed construction planning and scheduling and its importance with project completion.

When PCL initially developed the project estimate there was only a conceptual design for the ATC with many aspects to be finalized later on in the project through design iterations. This meant that money was set aside for major items with no specific breakdown. When the ATC project started the project manager and I went through the finalized construction drawings and took off quantities for each piece of work, from there we created detailed cost codes for each item and assigned productivities based on the two previous bridges. Budgets and manhours were then calculated and entered into our project management software. Since some aspects of conceptual design were deleted and new aspects added we had to make sure we stayed within budget throughout design iterations and make adjustments as necessary. As the design was revised I developed cost estimates and compared them to our original budget, by learning from previous experience we were able to set up the job costing much more effectively to provide a more representative cost per item.

In addition to managing field staff on the ATC I also helped manage the landscaping scope of work. Over the winter of 2012 I arranged meetings with the subcontractors and architects to finalize soft and hard landscaping details throughout the project. It was important that all necessary shop drawings, approvals and materials were finalized before spring as the schedule was very tight. I developed tender packages for trades and compared their submissions to the specifications. Once the quotes were gathered I compared them to the budget and issued subcontracts as required. Working on landscaping was difficult at times since some details were not explicit on the drawings and we had to make sure the design was meeting the intent of the architect. I gained a lot of experience with managing expectations since we were working with a limited budget.

3. Application of Theory

The pier formwork system chosen for both projects was a steel plate girder provided by EFCO. The steel panels were assembled with structural bolts and were rigid enough to be used without external walers. As per the DBA it was a requirement for all of PCL's formwork and falsework to be designed and sealed by a professional engineer. Since I was assigned as the project engineer I worked with our corporate engineering team (Sean Lockyer and Warren Tutton) and superintendents to design all of the formwork systems on the project.

The first design I had reviewed and stamped by Warren was a 4.9m by 6.0m hoarding panel made out of common SPF 2x4 lumber. The panel was designed as a typical wall with studs spaced at 305mm o/c and additional diagonal bracing, with a horizontal chord to mate to a L52x52x4.8 angle to make the panel flyable. A 1 in 10 year wind event was used to evaluate the bending capacity of the 2x4 studs, and the lift capacity was determined with a 3:1 FS. The CISC steel handbook did not provide much direction with respect to steel angle design, therefore under direction from Warren I used literature from the AISC he provided and developed a spreadsheet to evaluate steel angles for tension, compression, and bending with failure under lateral torsional buckling. The panels were stacked around the river pier to retain heat during concrete operations.

I then worked with Sean on the bracing for the northern river pier, the forms were 12.0m in height and 20.0m in width and required bracing to resist wind loading and for plumb adjustment. EFCO provided details for assembling and erecting the plate girder forms; however they did not provide details on wind bracing only the magnitude and direction of the loads to be resisted. I reviewed these loads with Sean and corresponded with EFCO's engineer Ilya Mayer on the magnitude of wind loading for which they had designed (0.8 kPa from S269.3). The design also called for the bracing to carry a substantial uplift force caused by concrete pressures against the battered walls of the pier. Using a maximum concrete pressure of 48kPa the uplift force was 1100kN. We were able to circumvent this by anchoring the forms to the steel pile foundations and by including the dead load of steel formwork (670kN). Base plates were welded to the steel piles to thread a ½ inch diameter coil rod (40kN @ 2:1 FS) running vertically to the pier top in 12 locations. An EFCO yoke was run perpendicular to the steel wall forms along the top to resist concrete uplift pressure. By doing this the exterior bracing requirements were reduced significantly at a minimal cost and wind bracing could be accomplished with simple concrete deadmen. The sheet piling at the north side of the Pier SU8 was used to resist wind loading at the base of the pier by use of 600mm long EFCO prop-struts attached to steel angles welded to the piles.

Once the wind bracing was determined, the next challenge was designing formwork for infills inside the steel forms to match the taper of the pier ends. Either end of the 12.0m tall pier had a 45 degree nose battered at a 1:24 slope. The infills were difficult in that they had to resist high concrete pressures and had a complex geometry. In order to help our corporate engineers design the infill formwork I modeled the pier and EFCO panels in AutoCAD. Two options were initially considered:

1) Build the formwork out of wood by PCL's own forces. The studs would be made of plywood placed laterally to act as a diaphragm and distribute the load evenly along the ribs of the EFCO panel. The formwork would be intricate and difficult to build accurately, however we could control the construction schedule more easily.

2) Have a third party company cut the infills out of high density foam to the exact dimensions required, decreasing risk of improperly sized formwork. With this option we were under a higher schedule risk.

After evaluating each option, the first option was preferred due to less cost and schedule constraints. Another benefit to the wood forms is that they could be cycled to the two middle river piers once this pier was completed. Matt Falacinski helped Sean with the design by modeling the construction formwork and providing dimensions to the carpenter crew for each plywood diaphragm. The formwork was built in 4.9m tall pieces that could be lifted into place and were mirror images on each end. Overall the system was efficient and we were able to construct the pieces within the tolerances outlined in the specification.

In order to place concrete over the winter indirect fire heaters were needed at the base and top of the pier. The reinforcing steel and EFCO forms needed to be heated above freezing temperatures to prevent shocking the concrete. One issue with placing a heater at the pier top was the supplied walkway was not designed for the extra load the heater imposed. The superintendent and I decided it would be best to place the heater at the same level as the walkway to provide access to connections and set back far enough so it wouldn't interfere with workers. At the time, PCL's corporate engineers were not available I outsourced the project to a small engineering firm under the name ASD Enterprises. Ameen and I worked out a design for a platform that would slide over the edge of the EFCO form made of 50mm angle 1.8m by 1.8m decked with SPF 2x10 lumber. The platform was designed for a live load of 1.9 kPa and a concentrated load representing the heater base of 2.2kN. I used the spreadsheet I had developed for the hoarding panel to evaluate the strength from the imposed stresses and evaluated the welds based on the CISC.

After the first solid pier at the river bridge was constructed work began on the north and south abutments. Since its size was relatively small the south abutment was loose formed with wood. Using CSA 269.3 and ACI I designed a 3.0m tall by 4.9m wide form panel using 2x6 SPF lumber for studs and walers and ¾” plywood. The studs were spaced verticality at 305mm o/c with double 2x6 walers spaced

762mm laterally in five rows concentrated near the form bottom to maximize resistance to concrete pressures. The design was governed by the double waler 2x6 capacity in shear and by adding a third 2x6 the spacing of form ties could be larger therefore reducing required patching later on. I also added two pick points using common Hilti eyelets, steel plate and 2x6's nailed in between vertical studs with a 3:1 FS to make the panels modular and easy to handle with equipment. Since the abutment was quite slender (2m wide by 20m long) I tried to minimize the amount of ties running the abutment length at the ends. To do this I designed a 2x6 panel with horizontal studs spaced at 305mm o/c that was set inside the front and back forms held by vertical 2x6's nailed on the corners. A single EFCO superstud running vertically in the middle of the form acted as a stiffback held by two ¾" hi-tensile coil rods at top and bottom. The 230mm x 230mm Superstud had more than enough bending and shear capacity for the application and greatly reduced the amount of form ties required.

The next design I worked on was a spreader bar used to lift the pre-tied hammerhead reinforcing for the overpass piers. Each overpass pier had identical hammerhead reinforcing; therefore it was beneficial to create a mock-up hammerhead out of lumber to pre-tie reinforcing steel to fly into the forms in one piece. To reduce cost pieces from PCL's resource yard were recycled into a working unit. The design was built to CSA-S16-01 with a FS of 3.0. The main beam section was 14.6m in length made of an HSS 254x152x9.5 with two 4.2m HSS 152x152x13 extensions fastened with three 1" hi-tensile coil rod at each end for a total length of 19.5m. Two 1-1/2" steel lifting eyes were welded to the main beam with a 10mm fillet weld on a 1" base plate to distribute the load across the HSS and prevent local yielding. PCL U-clamps were installed along the beam length as pick points rated for 23.6kN @ 3:1 FS to distribute the load across the beam and carry the reinforcing cage without distortion. The beam was analyzed for bearing, moment and shear capacity. The wall thickness provided adequate shear and bearing by utilizing base plates with the primary mode of failure was determined as bending by lateral torsional buckling. Utilizing the spreader bar greatly increased productivity and improved safety by having the reinforcing tied on the ground instead of on the pier.

One of the biggest challenges I faced was determining how the massive overpass piers (6.0m tall x 11.0m wide x 1.1m thick) could be braced to resist wind loads efficiently. Drawings specified for the outer EFCO braces and form base to resist a lateral load of 31kN in tension and shear and inner braces to resist 13.3kN in tension and shear based on their configuration. The wind load was specified as 0.8 kPa or a 1 in 10 yr wind event from S269.3. As the piers were built in essentially an open field there was no solid material to brace to two designs were initially considered, the first being helical soil anchors and the second being concrete deadmen. I researched a type of helical soil anchor that could resist 22.2kN in tension at a 2:1 FS in Winnipeg soils and could be made sufficient by increasing the number of outer diagonal braces and installing them to match the brace angle. This solution would be very efficient as all the anchors could be installed in two days and would later be abandoned; however with the amount of underground utilities in the area and the cost per anchor this option was determined infeasible. The second option was the use of four concrete deadmen locked together for each brace. The problem was when wind was on the leeward side the brace would pull up on the deadmen and reduce its lateral shear capacity. To remedy this, steel cables were attached from the lower concrete footing to the form on the brace side to resist overturning in one direction and the deadmen/braces to resist the wind force in the other direction. This configuration also eliminated the need for interior braces based on the larger outer brace capacity. Since then I have suggested similar configurations on other projects to meet code requirements and it's proved to be very efficient.

The river bridge north abutment was designed as a box structure with a wide front and back wall and 750mm thick roof slab. The shoring design for the roof slab was subcontracted to a local scaffolding supplier and when the preliminary design was returned, the point loads on the scaffolding legs were much too great for the existing soil conditions. Due to space constraints additional shoring towers could not be added and the subsurface could not be prepared to adequately distribute the loads. Between myself, the superintendent and our engineers we came up with a system supported off the existing abutment walls. Double 6x6 SPF timbers were placed on the front wall footing braced at midspan to shore double W410x39 beams spanning the 8.0m roof length. Each bay of W410 beams was cross braced using 2” steel angle iron to prevent rotation under bending. The W410’s were spaced at 1.5m on center to pick up the legs of Peri MP120 scaffolding. Aluminum stringers spanned between the u-heads to carry 4x6 D.Fir spaced at 400mm o/c. Deflections were calculated based on unfactored liquid concrete forces; the slab was then precambered 28mm in the center before placing to achieve proper top of concrete elevations. The W410 beams and Peri scaffolding was PCL’s own equipment which saved rental costs and by elevating the formwork above the ground the team saved a significant amount of work involved in preparing the base.

The most efficient design I developed was the concrete deck formwork for both the river bridge and overpass, both bridges utilizing a concrete deck on steel girders. The PM’s and I went out to different suppliers for deck soffit and overhang formwork and had a lot of different options presented as well as ideas based on experience from previous bridges. We then stumbled upon a hanger (Borg) that sat on the girder flange and braced back to the web and held a 2x joist perpendicular to the girder sheeted with ¾” plywood. The particular configuration of our deck haunch made this the perfect application for that system. I evaluated the concrete and construction live loads and formwork dead load to determine it would allow for 600mm spacing with a 2x10 SPF joist. Up to a 2x14 joist could be used in the hanger to increase the spacing further however the ¾” plywood governed the design in bending. PCL had C49 overhang brackets in house and since we did not use a deck hoarding or power screed our brackets could be spaced up to 3ft. By maximizing the spacing it greatly reduced installation and stripping time as well as material costs. Based on our original budget between the two bridges we were able to achieve a cost savings of nearly $500 000.

There were two designs I developed using aluminum scaffolding as shoring, the overpass girder diaphragm and river bridge deck manhole. The overpass concrete deck extended past the girder end at the south abutment into a solid block across the end of the girders. The superintendent came up with a scaffolding plan using Aluma 44.5kN 1.2m x 1.2m frames and asked me to evaluate its integrity. Since Aluma scaffolding allowable loads carried a 2.2:1 FS I evaluated them based on true live and dead loads. After an analysis of the concrete live load I determined the interior legs were over capacity by around 15% since the load was biased to one edge of the frame it took 75% of the load. I increased the number of frames to bring the loading down per leg and also allow for a small working deck on the back end to make room for carpenters to install formwork. The legs would be sitting on a compacted granular base and 4x6 D.Fir mudsills to distribute the load to the soil and I determined the soil bearing resistance was more than adequate for the applied loads. The cost of the additional frames was minimal and ensured integrity of the formwork.

The second scaffold design was on the river bridge deck for the Manitoba Hydro manhole access. The deck was thickened around the manhole lid and had additional structural steel to create a vault under the slab. Since our Borg hangers couldn’t be used on the soffit I came up with a plan to use Aluma frames to bear on the bottom girder flange. There was a lot of complex geometry for the thickened edges and haunches around the manhole so to determine accurate loading I modeled the deck in AutoCAD and took representative cross sections. I was able to fit a 10ft x 4ft frame within the girder bay and have the legs bear fully on the flange cross braced along the bridge length. The stringers and joists were from Aluma with ¾” plywood decking wedged to the girder web to prevent rotation. This proved to be a very efficient and simple solution for a difficult forming area.

4. Other Work Experience

The new bridge structures were built adjacent to the existing structures to minimize traffic interruptions during construction. One issue with this was the need to work in close proximity to existing buildings with heavy equipment. PCL hired a third party adjuster to monitor and evaluate all existing buildings in the project area for damage due to construction. In several cases claims were made against PCL for disturbance from residents; however since there was a detailed record before construction it was shown that the damages had not been caused by construction. Having this forethought is an effective way to mitigate financial risk.

This project was my first experience where I had several direct reports to delegate work tasks and responsibilities. It was challenging for me at first working as their superior since we had been classmates in university. Also working out of the project office and being away from site did not allow me much time for face to face discussion and most of our correspondence was done via telephone or email. However difficult it was I knew that it was important for me to learn these skills to develop as a professional. As the project progressed and I was given more responsibilities I found it easier to manage my time and distribute my workload among my team and I've become more confident in my management skills.

With the design life of new civil infrastructure projects being greater than 75 years and the increasing popularity of P3 delivery models specifications are becoming much more stringent. The reason for this is the financeer may have an obligation (depending on the agreement) to maintain the structure over the finance period. The former is the case on the Disraeli project, with Plenary Roads maintaining the bridge for a 30 year period. In order to minimize risk, PCL needs to ensure that documentation is provided to verify that PCL has met all the requirements of the specification. Our QMS and EMS was one way we provided documentation to prove the specification had been met.

The design development of construction drawings was an interesting learning experience on this project. Since PCL is the design-build manager we work with consultants to provide a product that meets or exceeds the requirements of our client. This is advantageous to a contractor since the design ultimately governs overall cost and by reevaluating design details it allows PCL to mitigate risk and/or provide opportunity. An overall budget was submitted to the City in what we called our SR3 or 30% design deliverable submission, and was based on our response to RFP. Throughout design development PCL would review the consultant's submission making sure quantities were within limits specified in SR3 and that we remained on budget. Having input into the design through the review is a great way for a contractor to mitigate risk early on in a project.

Being involved in a majority of the engineering of temporary works during the summer I had an ethical responsibility to ensure that construction had met the design intent. There were several instances when I would visit site and notice that a shortcut had been taken or details changed (whether for better or worse) from what was noted on the drawings. As a part of the PCL team it was difficult for me as a junior engineer to bring up with the superintendent as it almost certainly meant additional rework, time and money. There were times however when the design would go above and beyond the requirements and I would always be sure to express my gratitude in these situations. One instance in particular was especially difficult, some scaffolding I had designed to shore up the underside of the abutment diaphragm had the stringers placed incorrectly. My design called for double 4x6 D.Fir stringers spanning 1.8m between the u-heads with 2x6 SPF stringers at 406mm o/c and ¾" plywood for decking. When I arrived on site I noticed the 4x6's were not placed side by side as drawn but placed on top of one another. This was a serious concern as the lower 4x6 would not be stabilized by the 2x6 deck and the deck load would not be transferred evenly to each stringer. I notified my superintendent of the issue and had an argument on how much rework was required to install the stringers correctly; I knew I could not budge on the issue as the probability of failure was high. Eventually after some reasoning I convinced him that it was absolutely necessary, and he obliged. These situations can be tough since I have a vested interest in saving time and money for the company but the safety of the team comes above all else.

The quality control requirements of our project were very substantial and much more than our team or workforce was used to. For example, the CSA requirements for concrete testing are one truck every

75m3; however our project specified testing concrete before and after placing with a concrete pump. This caused a significant delay in placing although it proved that a conforming product was being installed. The implementation of our QMS was a long and difficult process since it totally changed our typical construction methods. Once the team realized the benefits of reducing non-conformance the buy-in came a lot easier and our process have become commonplace. The system and lessons learned we developed on our project have been used to develop a district wide Quality Policy. A quality control plan must now be implemented on every major project, an outstanding accomplishment by our team.

Supervisor Agrees: I agree with the above statement.

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2. Please check the following options that apply:

2.1: During this reporting period, I have applied theory in:

- ✓ Analysis/Interpretation
- ✓ Project Design/Synthesis
- ✓ Testing/Verification
- ✓ Implementation

Supervisor Agrees: I agree with the above.

2.2: I have obtained experience by:

- ✓ Studying or being exposed to existing Engineering works
- ✓ Applying Designs as part of larger systems
- ✓ Experiencing the limitations of Engineering designs
- ✓ Experiencing time as a factor in the Engineering process

Supervisor Agrees: I agree with the above.

2.3: I was exposed to the following areas of Engineering management:

- ✓ Planning
- ✓ Scheduling
- ✓ Budgeting
- ✓ Supervision
- ✓ Project Management
- ✓ Risk Assessment

Supervisor Agrees: I agree with the above.

2.4: I was required to make decisions based on professional and ethical responsibilities to:

- ✓ The Public
- ✓ The Profession
- ✓ The Client and/or Employer
- ✓ Co-Workers
- ✓ The Environment

Supervisor Agrees: I agree with the above.

3. Describe any activities that have improved your Communication, Teamwork, or Interpersonal Skills in the following areas:

Oral Presentations:
I ran several meetings relating to surveying, engineering, landscaping etc. on all three bridges with the project team and subcontractors. Being the chair of a meeting for the first time I was initially nervous however after getting some advice from my managers I was able to handle the meeting items more effectively. By the third or fourth meeting I was able to take charge without feeling nervous and gained some confidence in my ability to speak in front of an audience.

I spent five days training in Toronto for PCLs business process orientation, during this training there were several team building exercises. At the end of the team building exercises the team would have to present their thoughts/ideas/creations to the rest of the group (30+). One exercise was to try and explain a difficult technical topic to a person with no experience using analogies. I was initially nervous although I ended up warming up part way through and our team won the challenge.

Written Documents:
The PCL district had existing timber walkway brackets the team wanted to use that had been cycled between projects, however were never engineered. Before Warren would seal a drawing he required me to do an in-situ stress test of the brackets. The brackets were installed as intended and loaded with test blocks weighing twice the design force for a specified duration noting any deflections. I created a report outlining all the details, specifications and dimensions of materials, loads and deflections. With this report Warren had confidence the bracket was sufficient for the construction intent and sealed the drawing.

During the planning stages of our EMS and QMS plans, I helped the team developing procedures for meeting our ISO requirements. I was given portions of the QMS relating to surveying, record keeping and document control to write which was reviewed by the project team and became part of the quality plan.

Interaction with Others:
Starting Disraeli as a project engineer has allowed me to have more interaction with the management team including superintendents, project managers and construction manager. I am involved in weekly team progress meetings and meetings with the consultant and subcontractors for work on the bridges and provide input when necessary.

I worked closely with our project superintendents and corporate engineers on various tasks. Our engineers are based out of Edmonton and it was sometimes difficult to explain ideas through certain media. Often we would conduct conference calls for brainstorming sessions using the telephone along with email to forward sketches to one another. After we developed a relationship the conversations became much easier as we learned to understand the others thought processes. Working with our corporate engineering team has taught me how to become more explicit when describing my designs or ideas and how to describe them clearly.

Other:
My past two project at PCL were almost entirely field work, at Disraeli I would be almost entirely in the office. This was a challenge when trying to get information to and from site when my field engineer and superintendent were in the field. We came up with a simple solution, installing a long distance two-way radio in my office that had all available radio channels with over a mile of range. Having this in the office made it easy to follow up or contact my field engineer if I needed to contact him urgently, and vice-versa. This was an inexpensive solution that proved to be a very valuable communication tool.

Supervisor Agrees: I agree with the above comments.

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4. During this period, I had to consider the social implications of my work in the following areas:

The Disraeli Freeway is a main downtown arterial and carry a high AADT to and from the CBD. The project is very much in the public eye and with a high profile client such as the City of Winnipeg it is important PCL maintains their public perception. All bridge works are visible by passers-by, and the project is very often featured in local news. When making decisions on site I had to not only consider the needs of our project but our reputation as a design-build contractor.

Construction in civil infrastructure projects has a much more stringent specification and tolerances with high performance materials than typical commercial construction. Since this bridge will be in service for more than fifty years carrying high amounts of vehicular and pedestrian traffic, PCL had an obligation to notify the engineer of record on any non-conformances regardless of their nature. A deficiency of any kind to the structure could have significant implications on its performance and safety.

Supervisor Agrees: I agree with the above comments.

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5. Examples of my ability to work effectively as part of a team, during this period, include:

This project was the first in the Winnipeg district to have the requirement of ISO 9001 and ISO 13001 compliance. I worked with the management team through meetings and formal training to develop the first Quality Management and Environmental Management Systems (QMS and EMS). Initially there was a steep learning curve for the project team, and a lot of construction methodologies had to be redeveloped to meet the requirements of the Design-Build Agreement. It was also my first opportunity to work closely with project managers and superintendents which gave me a much better understanding of each of managements roles and responsibilities.

I was able to work directly with the superintendent and professional engineers from other companies to develop formwork and falsework designs and understand different types of personalities. I also worked with the superintendents developing construction plans to ensure maximum productivity, such as formwork cycling and other construction methods.

Supervisor Agrees: I agree with the above comments.

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6. Examples of my ability to assume responsibility include:

As the head field engineer on the project I managed all field engineering staff and in the summer of 2011 there were 5 field engineers that were my direct reports. I provided all information to them regarding design changes or RFI's, survey layout drawings and concrete lift packages. They reported to me on quantity and productivity which I would enter and review with the project manager and also report any issues on site that I could review with upper management.

When PCL decided to pull the trigger on steel barges for pier construction I was responsible to develop preliminary drawings for equipment access and crane radius/capacity. Myself and the project coordinator iterated several alternatives and discussed with the consultants/subtrades. I ensured access was feasible for equipment and the size of barge platform roughly suited crane capacity. Designs were refined and sent to the marine engineer to verify and stamp.

Supervisor Agrees: I agree with the above comments.

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7. I have shown progress since the last report (where applicable) as follows:

Changing titles from field engineer at the CMHR to project engineer at Disraeli has certainly helped me step out of a field role and move into more of a management role. Having to manage a field engineering team was challenging and has also helped me in developing more management soft skills. I'm working closer with project managers now which has given me a better understanding of their roles and how they approach a given situation.

I have certainly improved my design engineering skills with respect to common practices, knowledge base and practicality. I learned that easy design and easy construction do not often go hand-in-hand and there has to be a level of compromise between both parties. I also learned the importance of doing site visits and inspections, sometimes what I think is a good idea or design may not be practical for the application and modifications must be made.

Supervisor Agrees: I agree with the above comments.

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8. I feel myself to be lacking in exposure to, or requiring improvement in, the following areas:

I would like to have a better understanding of engineering codes and standards relating to construction. Generally I will speak with our corporate engineer and he would provide me with the specific loading requirements for my design. If I knew which codes were applicable to my design and have a better idea of the loading requirements it would help me become more independent as a designer. I would also like to improve on the use of steel and aluminum in design of temporary structures since my experience has been with mostly in wood design. Specifically how non-symmetrical cross or HSS sections react under bending as these materials are often readily available on a construction site.

Having the responsibility to manage a field engineering team has been challenging, especially since some of us had graduated together and been friends from university. In order to develop as a manager feel I need to work on my management soft skills.

Supervisor Agrees: I agree with the above comments.

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9. I would like to provide the following additional, relevant information:

With the Disraeli project bid as a P3 and the requitement of the project being ISO compliant there was an enormous amount of preplanning as well as a tremendous effort by the management team to develop and implement an entirely new QMS and EMS. Planning and scheduling started nearly a year before construction as this was something never done before in the Winnipeg district. It took a lot of dedication for the team to entirely change the way PCL would typically execute work and it gave me a great appreciation for how adaptive we became to overcome such great obstacles.

Supervisor: Monique Buckberger P.Eng. (#10033) (First Registered: Feb 18, 1999)

I make the following evaluation and recommendation regarding the progress report for this MIT:

I support Cody's application for 29 months of experience. Cody has developed and enhanced skills over several months which support my full recommendation. He was put in a stretch role and excelled within that role. During the Disraeli Bridge Project, I was able to observe Cody's evolution from entering into a new role to successfully fulfilling expectations and then taking on additional responsibilies. Once again I fully support Cody's application for 29 months of engineering work experience.

In my opinion, during this reporting period, (Oct 1, 2010 - Mar 1, 2013) (29 months), Cody has completed an equivalent of *29* months full time engineering work experience.

Please show my comments to the MIT.
