Northeast Consultants Memorial University EN 2050 P.O. Box 4200 St. John's, NL A1B 3X5

L. Osmond, P. Eng Dept of Transportation and Works PO Box 8700 Prince Philip Drive Confederation Building A1B 4J6

February 4, 2013 Subject: Traverse Brook Bridge Replacement

Dear Mr. Osmond,

The attached Project Plan provides an overview of Northeast Consultants' plan for the engineering design and analysis of the of the Traverse Brook Bridge replacement, as required for ENG 8700 – Civil Project.

In the attached report you will find a description of the Project, and a breakdown of Northeast's of requirements. The report outlines our design procedure and includes a list of tasks, indicating how work will be divided among our personnel. Also included are the schedule, costs, risks and deliverables associated with the project.

Northeast invites questions or comments regarding the Project Plan and looks forward to discussing them with you.

Sincerely,

Rana Patey

Project Manager

Northeast Consultants

cc: Dr. S. Bruneau



Engineering 8700 – Civil Project Project Plan – Traverse Brook Bridge Replacement



Rana Patey Brett Evans Mark Harvey Gary Caul

Prepared for: Dr. Steve Bruneau

Client: Department of Transportation and Works

Date: St. Johns, NL

Location: St. John's, NL



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	Project Description



1.0 PROJECT DESCRIPTION

The Department of Transportation of Works (hereby known as DTW) is a branch of the Government of Newfoundland and Labrador, responsible for provincial transportation infrastructure and public works. The Highway Design and Construction Division (hereby known as the Highways Division) has responsibilities which include the design and construction of roadways, bridges, marine terminals, and airstrips. [1]

Northeast Consultants have been selected to analyze and design a pre-stressed New England Bulb Tee girder bridge as a replacement bridge for Traverse Brook, on Route 320 (AKA J.R. Smallwood Blvd) between the towns of Gambo and Hare Bay. The Project includes the design of a two-lane road bridge with a simply supported, 36.5 metre span. Glass-fibre-reinforced polymer will be used for the design of the concrete deck slab and barrier wall.

The purpose of the Project is to assist the Highways Division with a cost comparison of pre-stressed concrete girders versus traditional reinforced concrete girders. The existing bridge currently consists of six traditional reinforced concrete girders, however Northeast's goal is to design a bridge which uses five pre-stressed New England Bulb Tee girders with a cost savings of approximately \$50,000. This cost reduction can be applied to future bridges constructed by DTW.



Figure 1: Satellite Photo of Region (bridge indicated in red) [2]





Figure 2: Satellite Photo of Bridge (bridge indicated in red) [2]

2.0 STATEMENT OF PROJECT REQUIREMENTS

Northeast Consultants will be working under the guidance of the Highways Division to design a replacement for Traverse Brook Bridge. Northeast will determine the geometry of the structure as well as design the bridge to meet all relevant codes and guidelines, as outlined in the Methodology section of this report. Design of the roadway is not required. The components of the bridge to be designed are as follows:

- Shallow foundations
- Pre-stressed girders
- Deck slab
- Barrier Walls



3.0 METHODOLOGY

3.1 Scope of Work

The scope of work includes the geometric layout of the structure in accordance with the Transportation Association of Canada's guidelines and analyzing and designing the structure in accordance with the Canadian Highway Bridge Design Code (CSA S6-06). [3] This includes the shallow foundations, pre-stressed girders, deck slab and barrier walls. Northeast Consultants is required to submit a full set of design notes as well as a detailed set of design drawings.

The layout of the geometry of the structure includes the total freeboard under the bottom of the girders using one hundred year flow (Q_{100}) , the bridge width according to the design of a Rural Collector Undivided road with a speed limit of 80 km/h (RCU 80), and the depth of the abutments according to geotechnical reports. To find Q₁₀₀, the watershed area has to be delineated and the rational method and flood frequency analysis are applied to determine the maximum height of Traverse Brook beneath the bridge. The maximum height of the river is then compared to the elevation of the bottom of the girders on the bridge. The minimum allowable freeboard is one meter. Survey information was received for this comparison and if the height of the road is sufficient for one meter freeboard then no changes will be made to the road alignment. The bridge width is determined from the width of an RCU 80 road with extra width added for the placement of barriers on either side of the bridge. To determine the abutment depth, two boreholes were drilled, one on each end of the bridge, to find the depth of bedrock and to take soil samples. The results of these tests were conveyed to Northeast in the geological report provided by DTW. It is preferred to place the abutments on bedrock; therefore the depth of bedrock will determine the depth of the abutments. The analysis and design of the abutments, pre-stressed girders, deck slab, and barrier walls will be an iterative process involving multiple dead and live load scenarios. The abutments will be analyzed and designed for sliding and overturning and the rest of the elements will be analyzed and designed for resisting loads.

3.2 Group Organization and Roles

Northeast Consultants divides work among its personnel according to their expertise and experience. While many tasks are allocated to individual team members, any issues that may arise are addressed by Northeast as a team. Additionally, many tasks are completed in groups of two. The following description of each group member outlines each member's individual responsibilities:



Rana Patey - Project Manager

Rana is Northeast's Project Manager. She is responsible for client contact, scheduling and chairing meetings, receiving design code and software from course instructors, and ensuring schedule milestones are met. Rana also performs extensive design work as well as hydrology calculations.

Mark Harvey - Planner/Scheduler

Mark is Northeast's planner/scheduler. He is primarily tasked with creating and updating the Project schedule, as well as preparation of reports such as meeting minutes/agendas, the Project Plan, and the final report/presentation. He is also responsible for assisting the group with quantity take-offs, cost estimation, and various design work.

Brett Evans - Project Coordinator (Design)

Brett is mainly responsible for design and drafting work. Tasks completed by Brett include hydrology calculations, determination of live loads, and design work. Brett's proficiency with AutoCAD led him to become primarily responsible for Northeast's drafting work.

Gary Caul - Project Coordinator (Estimation)

Gary is primarily responsible for cost estimation and quantity take-offs. He also assists extensively with design, drafting, and planning/scheduling. Gary's experience with prestressed beam fabrication gives him useful background knowledge which is beneficial to Northeast Consultants.

3.3 Meetings

Project Meetings

Northeast regularly holds group meetings which do not adhere to a regular schedule. Meetings often take place on weekends. The frequency and length of these meetings is largely dependent on Northeast's workload and the proximity to Project milestones and deadlines. These meetings are usually held in the Civil Senior Design Laboratory at Memorial University.

Business Meetings

According to ENG 8700 schedule, one hour business meetings are held each Monday at 3:30 PM. During these meetings, all groups present a progress report. These



meetings are chaired by Mr. Justin Skinner and are always held in the Civil Senior Design Laboratory.

Instructor Consultation

Each Thursday afternoon at 3:30 PM, informal meetings take place between Northeast and course instructors Mr. Justin Skinner and Dr. Amgad Hussein in the Civil Senior Design Laboratory. During these meetings, the instructors provide design assistance as well as any other guidance that may be required.

Client Meetings

Client meetings are held regularly on Wednesdays at 3:00 PM at the Confederation Building - West Block. During these meetings, Northeast presents work completed since the previous meetings, discusses upcoming work, receives advice and guidance, and defines exactly which tasks will be completed before the following meeting. Northeast prepares an agenda for each meeting and meeting minutes are distributed to DTW, Mr. Justin Skinner, and all members of Northeast Consultants.

3.4 Design Principles

Northeast intends to complete the Project according to DTW guidelines, using the following design codes, design aids, and computer software:

- Codes:
 - Canadian Highway Bridge Design Code: CSA S6-06 [3]
 - Concrete Design Handbook: A23.3-02 [4]
- Design Guides/Textbooks
 - Pre-stressed Concrete Institute Bridge Design Manual
 - Handbook of Steel Drainage and Highway Construction Products [5]
 - Structural Analysis Textbook [6]
 - Regional Flood Frequency Analysis for the Island of Newfoundland [7]
- Software:
 - S-FRAME
 - Microsoft Office Suite (Word, Excel, Powerpoint, Project)
 - AutoCAD

Over the course of the Project, Northeast may find other design aids or computer software to assist in the design process. Before proceeding to use any aids not shown on the above list, Northeast will ensure DTW finds it to be acceptable.



3.5 Cost Estimating Strategy

Northeast Consultants has previous experience in cost estimation, which is an essential component of the Project. Once design and drafting work has been completed, the drawings will be used to perform quantity take-off analysis to determine the estimated quantities of construction materials required. Once these quantities have been determined, cost estimation will take place. Northeast is currently exploring cost estimation options, and plan to use a resource such as R.S. Means Costworks or Yardsticks to obtain the Project's total construction cost. Northeast will work with DTW to determine the most appropriate resource for cost estimation. This cost estimate is to be used by DTW to determine whether a design using pre-stressed girders is more cost effective than the design currently in use.



3.6 Reporting and Deliverables

Northeast will prepare regular progress reports, as well as minutes and agendas for all client meetings. These progress reports are presented at weekly business meetings. A final report and presentation will be prepared for Project completion.

Northeast's required Project deliverables are described in Section 7.0 - Project Deliverables.

4.0 TASKS

The Project can be broken down into several primary tasks which are as follows: preparatory work, hydrology, bridge design, detailed cost analysis, and preparation of deliverables. Preparatory work includes obtaining preliminary data such as the geotechnical report, survey data, and relevant codes and software. Also included in preparatory work was the preliminary research of pre-stressed concrete beams. The hydrology work associated with the Project consists of delineating the Traverse Brook drainage basin, using the rational method and flood frequency analysis, and determining the 100-year flow depth. Bridge design includes calculation of dead and live loads, and design of all components of the bridge: footings/abutments, girders, deck, and jersey barriers. During each design stage drafting, quantity take-off analysis, and extensive review of design codes will take place. Once all design work has been completed, data obtained from quantity take-off analysis will be used to perform a detailed cost analysis. Finally, all design drawings, calculations, and cost information will be compiled in a final report which will be submitted to both DTW and course instructors in both a hard copy and electronic copy. A final presentation will also be prepared, to be presented to the ENG 8700 class.

A list of all tasks, sub-tasks, and assigned personnel can be found in Appendix B.

5.0 SCHEDULE

Attached in Appendix C is a Gantt Chart schedule which displays all project tasks. Tasks are generally allocated one or two weeks for completion. Tasks commence on Wednesdays after Northeast's regular client meeting. Previous tasks are reviewed with the client before the next task is presented. Some overlap can be seen between tasks, allowing team members to begin new tasks while other members review previous work, correct errors, and make adjustments based on recommendations from the client and course instructors.



6.0 COSTS

Northeast does not expect to accrue exceptional costs during the completion of the Project. Expenses include but may not be limited to the following:

- Transportation costs to attend client meetings
- Cost of printing and binding reports
- Cost of log books

7.0 DELIVERABLES

Upon completion of the Project, Northeast Consultants will supply the Department of Transportation and Works with the following documentation:

- A full set of design drawings
- Completed analysis and design calculations
- Final report including
 - Information on FRP concrete design
 - Detailed cost estimate

8.0 RISKS

Some risks facing Northeast Consultants related to the Project are:

- Inexperience with software such as S-FRAME
- Availability for Northeast personnel to work together on project due to varying academic schedules
- Cancelled meetings due to possibility of storms in the winter season
- Unfamiliarity with bridge design and pre-stressed concrete design

These risks can be effectively mitigated by effective time management and assistance from course instructors and other faculty members. Effective time management and alternative communication such as emails will reduce the impact of a missed meeting. This will also minimize the impact of academic schedule conflicts between personnel. Faculty members at Memorial University have indicated their availability to assist Northeast with any issues that may be encountered during design.



9.0 REFERENCES

- [1] Government of Newfoundland and Labrador: http://www.tw.gov.nl.ca/department/branches/road_and_air/highway.html, July 22, 2011 [Feb 2, 2013].
- [2] Map of Traverse Brook. 2013. Scale undetermined; Mark Harvey; using 'Google Maps'. < https://maps.google.ca/?ll=48.84461,-54.084063&spn=0.039144,0.090895&t=h&z=14> (January 2013)
- [3] Canadian Highway Bridge Design Code, CSA S6-06, 2006
- [4] Concrete Design Handbook, 3rd Ed., Cement Association of Canada, Ottawa, On., 2006
- [5] Handbook of Steel Drainage and Highway construction products, 2nd Ed., Corrugated Steel Pipe Institute, Cambridge, On., 2007
- [5] Structural Analysis, 8th Ed., R.C. Hibbeler, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2012.
- [7] Rollings, Ken, P. Eng. "Regional Flood Frequency Analysis for the Island of Newfoundland." Internet: http://www.env.gov.nl.ca/env/waterres/reports/rffa/index.html#2, December 1999 [January 2013]



APPENDIX A – STATEMENT OF QUALIFICATIONS

Northeast Consultants



Rana Patey Brett Evans Mark Harvey Gary Caul



We Offer:

- Environmental Engineering
- Geotechnical Engineering
- Structural Engineering
- Construction
- Drafting and Design
- Mining
- Consulting and Testing
- Costing and Scheduling



Company Statement

Here at Northeast Consultants, We work to provide our clients with the highest quality of work and ensures a private and professional environment for your engineering project. Our team is comprised of a very skilled group of individuals who bring experience from various fields such as design, structural and geotechnical engineering as well as the construction industry. We guarantee that our work will meet, or exceed all your expectations and do so at an efficient cost according to your needs.

Project Involvement

- Long Harbour Processing Plant Project
- Integrated Community Sustainability Plan
- Sir Robert Bond Bridge Rehab
- Conception Bay South Bypass Noise Assessment
- CSA Fenestration Testing
- Wooddale Road Bid Packaging
- Fixed Link to Bell Island Feasibility Study
- Interchange Connecting Paradise Subdivisions to TCH
- Churchill Falls Project
- RNC Headquarters
- Town of Paradise Igor Flood Repairs
- Waterman Extension in Conception Bay South
- CNRL's Horizon Oil Sands Project



Rana Patey

- Dept of Transportation & Works
- HJ O'Connell Construction



Brett Evans

- Town of St. Jacques Coombs Cove
- Dept of Transportation & Works
- ACAN Windows INC
- Stantec Consulting

Rana Patey is a term eight civil engineering student at Memorial University. She has experience in costing, estimating and contractor supervision from working in the Heavy Civil Construction Industry and with the Provincial Government. These experiences have allowed her to gain knowledge in road and bridge construction, cast-in- place concrete construction, cost tracking, preparing bid packages, and quantity takeoffs. In addition Rana has gained extensive knowledge in large scale building construction as she has spent her last two work terms with H.J O'Connell at the Long Harbour Processing Plant Site.

Rana's main fields of interest are in heavy civil construction and structural design.

Brett Evans is a term eight, civil engineering student at Memorial University. Since starting the engineering program at MUN, Brett has participated in five work terms. The first with the municipality of St Jacques – Coomb's Cove, where he developed a five year strategic plan for the community. The next two terms he worked with the Department of Transportation where he investigated a potential link from Bell Island to the rest of Newfoundland, and also an intersection for the town of Paradise to join the TCH. The fourth work term was with ACAN windows where Brett conducted CSA testing on the company's products and helped improve their ratings. Finally, Brett was employed by Stantec Consulting to perform soil grade analysis on the Long Harbour Sandy Pond Residue Storage Area and Dams and will graduate in April 2013.

Brett's Interests include design, drafting heavy civil construction.



Mark Harvey

- Dept of Transportation & Works
- Pennecon Heavy Civil
- Nalcor Energy



Gary Caul

- Strescon Ltd
- BAE NewPlan Group
- North American Construction
 Group
- Pennecon Heavy Civil Ltd

Mark Harvey is a civil engineering student, currently enrolled in his final academic semester. Over the course of his degree, he has gained experience mainly in the project management field. He is knowledgeable of construction management practices, as well as the processes involved with development of mega-projects. Mark has worked on large projects such as the new RNC headquarters, the Lower Churchill Project, and the Long Harbour nickel processing facility, and also worked at the Churchill Falls hydroelectric generation facility.

Mark's primary interests are construction management and environmental engineering.

Gary Caul is a term 8 Civil Engineering student at Memorial University of Newfoundland. He has project management experience from creating a project manager training manual for Strescon Limited, a precast concrete manufacturer in Saint John, NB. As a civil site inspector with BAE NewPlan Group in St. John's, NL, he followed municipal construction standards for water, sewer and road construction. For North American Construction Group, in Fort McMurray, Alberta, he tracked production statistics for dyke construction in the mining industry. He was in Labrador City and Goose Bay with Pennecon Heavy Civil Limited where he created and maintained final turnover documentation. His focus is project management in the construction industry and a continued development of leadership qualities.

Skills and Attributes:

- AutoCAD
- Microsoft Office
- S-Frame
- Solidworks
- EPANet
- HEC-RAS
- Eagle Point
- Surveying

Standards and Codes:

- CISC-ICCA: Handbook of Steel Construction
- CSA Standard A23.3-04: Design of Concrete
 Structure





Northeast Consultants

C/O Faculty of Engineering & Applied Science Memorial University of Newfoundland



APPENDIX B - TASK LIST



Task/Sub-task	Personnel	Required Documents/Software
Preliminary Work		
Obtain relevant codes and software	GROUP	N/A
Obtain data from client	GROUP	N/A
Research pre-stressed concrete beams	GC	Personal communication - Strescon Ltd.
Project Planning		The second states and the second states of the second states and the second states and the second states and the
Create schedule	МН	Microsoft Project
Create Project Plan	MH/GC	Microsoft Word
Hydrology		and the second states and the
Rational method/flood frequency analysis	RP	N/A
Delineate drainage basin	BE	N/A
Determine 100-year flow depth	RP	N/A
Preliminary Design		
Calculation of dead loads and design moments	MH/GC	CSA S6-06, S-FRAME
Calculation of live loads and design moments	BE/RP	CSA S6-06, S-FRAME
Geometry		The second of a second back of the
Determine locations of footings	BE	Survey
Determine elevations of footings, deck	RP	Geotechnical report
Footings and abutments		and the second
Section design	GROUP	A23.3-02, CSA S6-06
Code check	RP	A23.3-02, CSA S6-06
Materials take-off	MH/GC	N/A
Drafting	BE	AutoCAD
Design of girders		and the second of the
Girder selection	GROUP	PCI Bridge Design Manual
Code check	RP	A23.3-02, CSA S6-06
Materials take-off	MH/GC	N/A
Drafting	BE	AutoCAD
Design of deck and jersey barriers	Sector Man	
Section design	GROUP	A23.3-02, CSA S6-06
Code check	RP	A23.3-02, CSA S6-06
Materials take-off	MH/GC	N/A
Drafting	BE	AutoCAD
Project Close-out		The second s
Preparation of deliverables	GROUP	Microsoft Office Suite
Preparation of report and presentation	MH/GC	Microsoft Office Suite



APPENDIX C - SCHEDULE

ID	0	Task Name	Duration	Start	Finish	n 13, '13 M T W T F	Jan 20, '13 S S M T W T IF	Jan 27, '13	Feb 3, '13	Feb 10, '13	Feb 17, '13	Feb 24, '13 S S M T W T F	Mar 3, '13 S S M T W T F	Mar 10, '13 S S M T W T F	Mar 17, '13	Mar 24
1														ii ii		
2		Preparatory Work	10 days	Tue 1/15/13	Mon 1/28/13		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1									
3		Obtain data from client	1 day	Thu 1/17/13	Thu 1/17/13					·				ł		ļ.
4	11	Obtain software and relevant codes	7 days	Thu 1/17/13	Fri 1/25/13	· · · · ·										
5		Research pre-stressed concrete beams	2 days	Thu 1/17/13	Fri 1/18/13					1						
6	11	Project planning	10 days	Tue 1/15/13	Mon 1/28/13	5 Gina 19	-						1			
7		Hydrology	7 days?	Mon 1/21/13	Tue 1/29/13	5				:						:
8	1	Delineate drainage basin	4 days?	Mon 1/21/13	Thu 1/24/13	3										
9	1	Rational method/flood frequency analysis	4 days?	Mon 1/21/13	Thu 1/24/13	5				1						14 14
10		Determine 100-year flow depth	7 days?	Mon 1/21/13	Tue 1/29/13	3	(:	
11	-	Bridge Design	33 days?	Fri 1/25/13	Tue 3/12/13	5										:
12		Calculation of dead loads	3 days?	Fri 1/25/13	Tue 1/29/13	3				*****						
13	112	Determine elevations	3 days?	Fri 1/25/13	Tue 1/29/13	3									-	
14	11.6	Calculation of live loads	5 days?	Wed 1/30/13	Tue 2/5/13	8		-			1				4	
15		Footings and Abutments	10 days?	Wed 2/6/13	Tue 2/19/13	5	:		-			1		1		
16		Structural design	5 days?	Wed 2/6/13	Tue 2/12/13	3								1		
17	10.0	Code check	5 days?	Wed 2/6/13	Tue 2/12/13	3	-	Ē	-							÷
18	110	Materials takeoff	5 days?	Wed 2/6/13	Tue 2/12/13	3					:			-		1
19	15	Drafting	10 days?	Wed 2/6/13	Tue 2/19/13	8	:									
20		Girders	10 days?	Wed 2/13/13	Tue 2/26/13	5		5 5		~				-		
21	100	Structural design	10 days?	Wed 2/13/13	Tue 2/26/13	3				C					-	:
22	1	Code check	10 days?	Wed 2/13/13	Tue 2/26/13	3			and a second	-			:			
23		Materials takeoff	10 days?	Wed 2/13/13	Tue 2/26/13	\$				-					: :	
24	law	Drafting	10 days?	Wed 2/13/13	Tue 2/26/13	3	-					-	1	:	1	1
25		Deck	10 days?	Wed 2/27/13	Tue 3/12/13	5			1000			-	14CCC55			
26	19	Structural design	5 days?	Wed 2/27/13	Tue 3/5/13	5						0			1	
27	32.00	Code check	5 days?	Wed 2/27/13	Tue 3/5/13	5	;		10.00							;
28	10	Materials takeoff	5 days?	Wed 2/27/13	Tue 3/5/13	5						(
29	110	Drafting	10 days?	Wed 2/27/13	Tue 3/12/13	3						-	1			
30	10	Detailed Cost Analysis	10 days?	Tue 3/5/13	Mon 3/18/13	5					1		-	-	-	
31	-	Deliverables	10 days?	Mon 3/18/13	Fri 3/29/13					1	:				-	
32	11.00	Preparation of final documents	5 days?	Mon 3/18/13	Fri 3/22/13	6	1						-			-
33	1	Preparation of report and presentation	5 days?	Mon 3/25/13	Fri 3/29/13	5					1			111111		-
	10														-	

Project: Northeast Schedule - Feb 2	Task		Progress		Summary	-	External Tasks		Deadline	-5
Date: Mon 2/4/13	Split		Milestone	÷	Project Summary	<i>∽</i> −− <i>∽</i>	External Milestone	0		
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