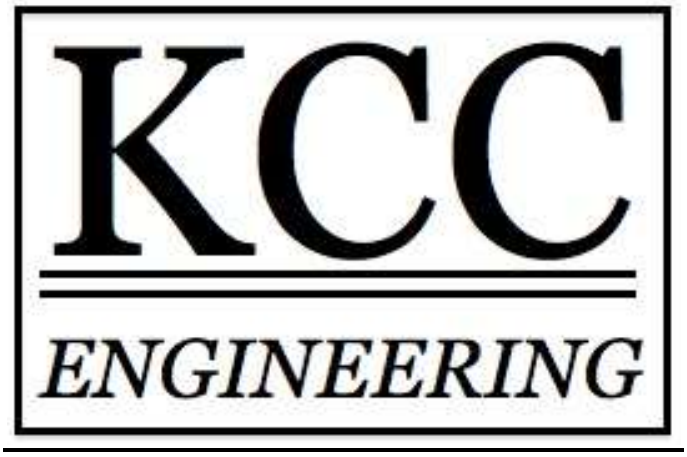
Engineering 8700:
Canadian Red Cross Disaster Management Center, Major's Path, St. John's, NL



Team:
Steven Kent
Michael Chafe
Donald Campbell
Sekai Musoki

Client:
ACUREN Group Inc.
Bradley Ackerman, P. Eng.

Presented to:
Dr. Stephen Bruneau, P. Eng.
February 3, 2013

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3 February 2013

Bradley Ackerman, P. Eng.
ACUREN Group Inc.
112 Forest Road
St. John's, NL A1A 1E6

Dear Mr Ackerman,

Please find enclosed the Project Plan for the Canadian Red Cross Disaster Management Center - Structural Design prepared by KCC Engineering. This Project Plan has been prepared as part of the fulfillment of KCC Engineering's contract with ACUREN Group Inc., in which KCC has committed to completing the structural design for the aforementioned building.

This document is furnished with a detailed execution plan for the project. The document opens with a description of KCC's role in this venture and a statement of the project requirements. The remainder of the document will be laid out as follows:

1. **Methodology:** This section will describe the approach that the group will use from start to finish, as well as the different roles played by each group member as well as our client. It will also include the design principles that will be implemented and proposed cost estimating strategy. Lastly, this section will provide the desired outcomes of the project which will also take account of the reporting and deliverables as well as the team's troubleshooting methods.

2. **Tasks:** This section will break up the project into primary tasks and subtasks, allocated personnel for each task and estimate the duration of each task.

3. **Schedule:** The schedule will include a rendering of the whole project outlining the major tasks and milestones. It will also have a brief description of all the key points and a method for tracking. This section will also summarise how the project schedule will be enforced, modified and reported.

4. **Costs:** This will provide an estimated break down of the costs that group will incur for the planning and execution of the project.

5. **Deliverables:** A list of the different deliverables to be provided by KCC Engineering at the conclusion of the project.

6. **Risks:** Lastly this section will highlight any foreseen vulnerabilities in the project execution that the team expects to encounter.

We would like to thank Dr. Bruneau for assisting us in the preparation of this project plan by providing a guide document. Also, this document could not have been prepared without your help and advice which we greatly appreciate. Any constructive criticism on this document would be greatly appreciated as KCC's goal is to produce a product of the highest quality.

Sincerely,

Steve Kent
KCC Engineering

Mike Chafe
KCC Engineering

Donald Campbell
KCC Engineering

Sekai Musoki
KCC Engineering

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1.0 Project Description

The Canadian Red Cross put out a request for architectural concepts for an expansion to their disaster management facility on Major's Path, St. John's, NL. The concept that was selected was one submitted by Ron Fougere Associates LTD. The concept proposed an addition of approximately 620m^{2}of floor space to the southern side of the facility. The new space will contain a lobby and reception area, a training center, an emergency operating control room with a radio station and communication tower, washroom facilities, and a bay garage for utility vehicle storage. Also to be included in the garage area is a mezzanine area for storage.

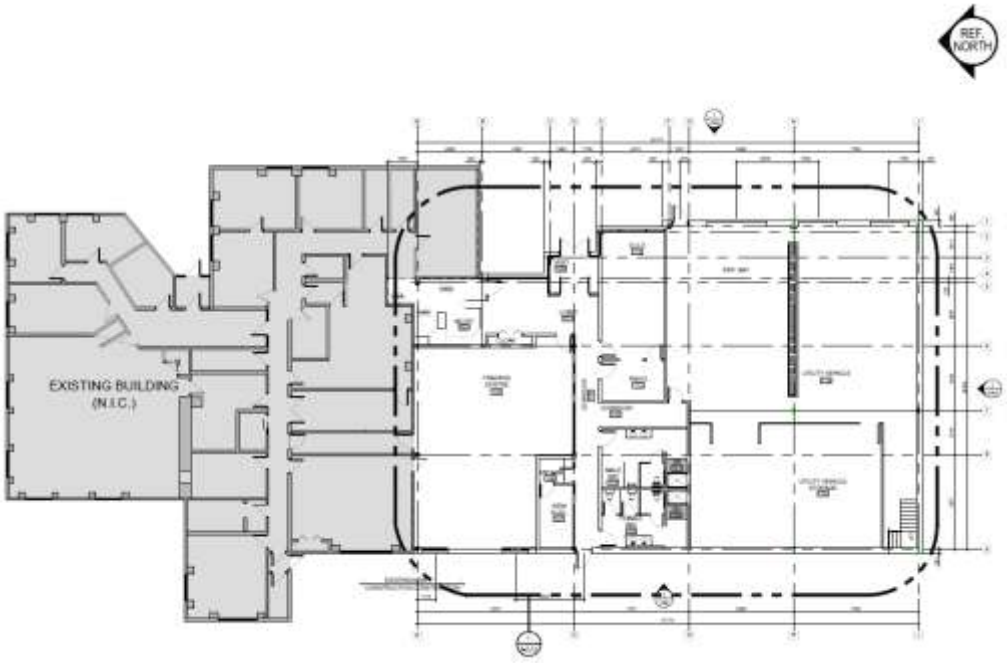

Figure 1: Architectural Plan of Proposed Expansion (Ron Fougere Associates, June 2011)

KCC Engineering's role in this project will be in selecting and designing the structural system of the building. The selection and execution of our structural design will be influenced by the maximum and minimum spans of the building, cost of materials and labour, fire/sound resistance requirements, ease of construction, and familiarity of design. During the design phase KCC Engineering will also need to consider the requirements of NSB Solutions Inc., the mechanical/electrical consultants on the project. During the design of the roof and floor systems considerations will be given for

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the placement of mechanical equipment (i.e plumbing, duct work, rain water leaders) and electrical components (i.e fuse panels, electrical wires, lighting)

2.0 Statement of Project Requirements

The requirement of KCC Engineering for this project is to provide complete structural design and consultation services for Ron Fougere Associates Ltd. Working from layout plans, building elevations, and cross section drawings provided by the Architect, KCC is responsible for selecting an appropriate structural system for the building. In their selection of the system KCC must consider:

- Span lengths within the structure.
- NBCC 2010 requirements for post disaster structures.
- Fire/Sound resistance.
- Cost of materials and ease of construction.
- Deflection requirements for serviceability.
- Variability of design to accommodate electrical/mechanical elements.

Once an appropriate Structural system has been selected for design KCC will be responsible for delivering issued for construction drawings for:

- Beam/truss roof system.
- Column/load bearing wall system.
- Foundation design.
- Floor slab design
- Fire wall design for F.R.R walls.
- Mezzanine area for storage.
- Brick veneer facing for building. (Designed for wind loads)

Throughout the design process KCC Engineering will be required to maintain an up-to-date cost estimate for construction of the structural elements of the building. KCC Engineering will also be responsible for reporting to both the Client and it's peers on a weekly basis. The client report will occur during regularly scheduled meetings where KCC will:

- Provide updates on progress.
- Request materials and information from the client.

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- Receive updates on changes on scheduling or design requirements as requested by the client.

Any urgent communication between KCC and the Client will be facilitated via email or phone conversation. The peer report will occurring during regular Monday meetings at which KCC will present a progress report to classmates outlining progress over the past week and planned activities for the following week.

3.0 Methodology

The Canadian Red Cross Disaster Management Center will be comprised of a pin connection steel frame structure with concrete footings and base slab as well as a fire resistant masonry wall separating the office area from the garage bay. Due to its intended purpose as a post-disaster structure, it will be designed with the highest constraints of the code.

Various other methods of construction were considered before choosing a steel frame as the primary structural system. A comparison chart outlining the pros and cons of several building material types can be found in Appendix B. Overall, steel was chosen due to several straightforward observations: Many existing single storey buildings in the area have similar building structure. Steel is easily accessible and is in abundance in the province. Steel is a functional solution to a garage type building and office space combination. Span ranges for steel seem to coincide and fit within tolerances for this type of building (~11m).

3.1 Approach

The overall design of the structure will be carried out by a "top down" process first of all by calculation of roof wind and snow loads according to NBCC 2010 code. Following this, the design of the roof, walls, beams, joists, columns and bracing will be designed as well as the footings, base slab and masonry wall between the offices and garage bay. Geotechnical data has been acquired and area is to be designed with a bearing capacity of 150kPa. Next will require the use of the mechanical electrical design drawings and changes to the structure will be made to accommodate HVAC, electrical and plumbing systems. Following this, details regarding specific connection details and fireproofing information will be considered. A site grading plan will be provided and

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details regarding the site surrounding the building will be considered. During this time, a cost analysis will be produced and updated regularly to keep track of costs. Design drawings will be devised in CAD software which will show specific details of the various structural components. A final report and presentation will be prepared upon completion of the design in April 2013.

3.2 Division of Effort

The group has been assigned specific roles within the project. Steve Kent will be lead structural design, Mike Chafe will take on Cost and scheduling, Donald Campbell will head up the document control and drafting aspects and Sekai Musoki will be responsible for administrative duties. Client meetings will be held on Wednesdays at 1pm at ACUREN headquarters. Group meetings will be held Sundays and Tuesdays in preparation for Monday's weekly business meeting and Wednesday's Client meeting. Additional meeting times will be at the discretion of the members.

3.3 Client Interaction

Brad Ackerman, the representative from ACUREN, has offered to assist us in any way possible during the design stage. His role is to present us with advice as well as answer any questions we may have. A preliminary site tour has been conducted and we have been presented a package of drawings, codes and other useful material for the design process.

3.4 Design Principles

Design will be conducted in accordance with NBCC 2010, CSA S16 Steel Design, CSA A23.1 Concrete Design, CSA A371 Masonry Design and CSA 086 Wood Code. Principles and knowledge gained from previous design courses and structural analysis practices will also be utilized. Load analysis will be completed using S-Frame software and verified with hand calculations.

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3.5 Cost Estimating

RS Means Costworks as well as Microsoft project will be used to devise and track cost analysis throughout the design stage. Incurred costs that come with everyday activities will be tracked such as travel, materials and printing costs. In addition, a detailed cost estimate outlining the general costs for construction of the building will be determined.

3.6 Desired Outcomes

Ideally, the design process should go smoothly and if all aspects of the proposal are taken into account, then the resulting tender document should reflect the actual design and cost estimate. It is our goal to complete the design on time and to put our utmost effort into planning and preparation so that our work as students can meet or exceed the industry standard that all professional engineering firms are expected to uphold.

3.7 Reporting and Deliverables

Weekly meeting minutes that are recorded from each session will be updated following the meeting and sent out to client, contractor and teachers as to keep everyone up to date and informed on present matters. Individuals will review minutes before the start of the following Wednesday's meeting to allow for further questions and discussion. A schedule with various milestones will be provided in the coming weeks and as these milestones are met or surpassed, progress reports will be presented to the client. The attainment of design milestones will also be presented to the teaching representatives in weekly business meetings as they are reached.

3.8 Troubleshooting

Any issues with the design aspect or problems regarding attainment of materials or software will be directed towards the Client Mr. Ackerman or towards the teaching representatives Dr. Bruneau and Dr. Hussein.

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4.0 Tasks:

4.1 Select Structural System

- Duration [~13 days]
- Subtasks
  - Review structure details [5 days]
  - Research structural system options [4 days]
  - Analyze and compare all structural systems [3 days]
  - Select preferred structural system for design [1 day]
- Personnel
  - All group members
- Resources
  - Client-supplied architect drawings
  - Structural system design span chart

4.2 Preliminary Frame and Footing Design

- Duration [~4 weeks]
- Subtasks
  - Calculate snow and wind loads on building [4 days]
  - Design roof to bear load [3 days]
  - Select column and beam locations [3 days]
  - Design beams, columns, bracing and load-bearing walls [16 days]
  - Calculate loads transferred and design footings [16 days]
- Personnel
  - Steven Kent
- Resources
  - NBCC 2010 handbook
  - CSA S16 Steel Code
  - CSA A23.1 Concrete Design Code
  - CSA 086 Wood Code
  - S-Frame
  - S-Steel
  - AutoCAD

4.3 Building Design Details

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- Duration [~3 weeks]
- Subtasks
  - Design concrete slab [8 days]
  - Mezzanine details [8 days]
  - Structural steel details [8 days]
  - Masonry wall details [7 days]
  - Design brick veneer [8 days]
- Personnel
  - Steven Kent, Mike Chafe
- Resources
  - NBCC 2010 handbook
  - AutoCAD
  - Applicable codes

4.4 Cost Estimate

- Duration [Ongoing throughout design process]
- Subtasks
  - Identify quantities of individual materials
  - Track applicable costs
- Personnel
  - Mike Chafe
- Resources
  - RS Means Cost

4.5 Design Drawings

- Duration [~2 weeks]
- Subtasks
  - Use S-Frame and S-Steel to design structural elements
  - Create 3-Demensional models of the building
- Personnel
  - Mike Chafe
- Resources
  - S-Frame
  - S-Steel
  - Auto CADD

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4.6 Site Grading Plan

- Duration [~1 week]
- Personnel
  - Sekai Musoki
- Resources
  - Existing site grading plan
  - AutoCAD

4.7 Report and Presentation Submission [Ongoing throughout semester]

- Duration [Ongoing throughout semester]
- Subtasks
  - Distribute sections between group members depending on area of knowledge [Ongoing throughout semester]
  - Review and combine all sections of report [8 days]
  - Create final presentation [5 days]
  - Proof read and review final report and presentation [4 days]
  - Final presentation [1 day]
- Personnel
  - Donald Campbell
- Resources
  - Microsoft Word

5.0 Schedule

The Canadian Red Cross Post Disaster Structure Project will be Designed during the 2013 winter semester. This allows approximately 10 weeks for this structure to be designed and presented on the scheduled deadline of April 1st, 2013. This timeline is adequate enough to undertake all of the design aspects of this venture. A Gantt chart outlining the major tasks involved in the design can be viewed in Appendix A.

Due to complications involving software licensing, the project schedule is presented on a Microsoft Excel format and will be converted to Microsoft Project once the proper licenses are acquired.

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The schedule is divided up into several main design stages. These stages include:

- Selection of structural system
- Preliminary frame and footing design
- Building design details
- Cost estimate
- Design drawings
- Site grading plan
- Report and presentation

Within these tasks are several subtasks which further breakdown the expected progression of the project. The completion of each of these tasks will represent the milestones for the project, as these are the major steps involved. The purpose of this schedule is to ensure that all components of the venture are being completed within reasonable time and that the hard deadline of April 1st, 2013 is met or exceeded. Due to inexperience in the field, the timelines allocated to the various subtasks are only estimated values as it is uncertain how long some of these tasks will take to complete. As the project progresses, the actual schedule will be updated and compared to the initial schedule and these updates will be expressed in the weekly business meetings.

6.0 Costs

KCC Engineering will be incurring expenses throughout the design process. As software licenses and design codes are being provided by Memorial University, the majority of the expenses will be printing related. The cost of basic office and supplies will also be a large contributor. Below is a table of KCC Engineering's anticipated costs for the successful completion of this project.

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Item	Cost per unit	# of units	Cost	Comments
Travel to weekly meetings (Using CRA $/km rates)	0.52	120	$62.40	Estimating one meeting per week
Printing Services	0.05	200	$10.00	The rate used was for black and white printing on A4 paper.
Binders	5	9	$45.00	
Design Pads	5	3.5	$17.50	Memorandum for hand calculations.
Log Books	3	4	$12.00	
		Total Cost	$146.90	

Figure 2: Projected Expenses

7.0 Deliverables

KCC Engineering will be responsible for providing deliverables to both the client and instructor throughout this project. Any such deliverables will be conveyed in a timely and efficient manner if at all possible.

7.1 Client Delivery Mode

With regards to the client, deliverables will be conveyed to Mr. Ackerman via email where appropriate. Should email be impractical, electronic deliverables will be conveyed on a CD ROM or USB drive, delivered by a member of the KCC team. Any hard copies of deliverables shall be conveyed in a similar fashion. Typically, delivery will occur during regular weekly meetings, however extra deliveries will be made if deemed necessary. Such deliverables may include, but not be limited to:

- Weekly meeting minutes (hard/soft)
- Design calculations (hard)
- Issued for construction drawings (hard/soft)
- Final report draft (soft)
- Computer aided frame analysis (soft)

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7.2 Instructor Delivery Mode

With regards to the instructor, deliverables will be conveyed to Stephen Bruneau during the scheduled lecture periods. Any deliveries made outside this time shall be done so via email or direct delivery to Dr. Bruneau's office by a member of the KCC team. Should email be impractical, electronic deliverables will be conveyed on a CD ROM or USB drive. Such deliverables may include but are not limited to:

- Weekly progress reports (hard)
- Final report (hard/soft)
- Final presentation (soft)
- Individual Log Books (hard)

8.0 Risks

Throughout the project issues may arise that will threaten KCC Engineering's progress. It is hopeful that whatever pitfalls are encountered, they can be overcome with minor rescheduling and extra working hours. Some issues may be completely unforeseeable, however such some likely risks include:

- Client unavailability due to travel, or other professional obligations.
- Illness among the small design team.
- Licensing issues with software.
- Difficulty overcoming unfamiliarity with software or design codes.
- Delays in drafting due to inexperience.
- Shortage of AutoCAD capable computers at Memorial.

References

- Ron Fougere Associates Ltd, Issued Dec 2011. “Canadian Red Cross Disaster Management Center, Newfoundland and Labrador Architectural”

- CSA Standard A23.3-04 Design of Concrete Structures, 2008

- CSA Standard S16-09 Design of Steel Structures, 2010

- CSA Standard A371-04 (R2009) Masonry Construction for Buildings, 2009

Appendix A – Project Gantt Chart

Tasks	January													
	21-Jan	22-Jan	23-Jan	24-Jan	25-Jan	26-Jan	27-Jan	28-Jan	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb	3-Feb
Select Structural System														
Review Structure Details														
Research Structural System Options														
Analyze and Compare all Structural Stystems														
Select Preferred Structural System for Design														
Preliminary Frame and Footing Design														
Calculate Snow and Wind loads on Frame														
Design Roof to bear Load														
Select Column and Beam Locations														
Design Beams, Columns, Bracing & Walls														
Design Concrete Footings														
Building Design Details														
Concrete Slab														
Mezzanine Details														
Structural Steel Details														
Masonry Wall Details														
Design of Veneer Brick for Wind Loads														
Cost Estimate														
Track Quantities of Materials														
Track Costs														
Design Drawings														
Create Design Drawing Drafts														
Site Grading Plan														
Layout Site Grading Plan														
Report and Presentation														
Distribute and Write Report Sections														
Compile Individual Report Sections														
Create Final Presentation														
Proof Reading and Review														
Final Presentation														

Tasks	February													
	4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb	11-Feb	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb
Select Structural System														
Review Structure Details														
Research Structural System Options														
Analyze and Compare all Structural Stystems														
Select Preferred Structural System for Design														
Preliminary Frame and Footing Design														
Calculate Snow and Wind loads on Frame														
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Layout Site Grading Plan														
Report and Presentation														
Distribute and Write Report Sections														
Compile Individual Report Sections														
Create Final Presentation														
Proof Reading and Review														
Final Presentation														

Tasks													
	18-Feb	19-Feb	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	1-Mar	2-Mar
Select Structural System													
Review Structure Details													
Research Structural System Options													
Analyze and Compare all Structural Stystems													
Select Preferred Structural System for Design													
Preliminary Frame and Footing Design													
Calculate Snow and Wind loads on Frame													
Design Roof to bear Load													
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Design Drawings													
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Site Grading Plan													
Layout Site Grading Plan													
Report and Presentation													
Distribute and Write Report Sections													
Compile Individual Report Sections													
Create Final Presentation													
Proof Reading and Review													
Final Presentation													

Tasks														M
	3-Mar	4-Mar	5-Mar	6-Mar	7-Mar	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar	16-Mar
Select Structural System														
Review Structure Details														
Research Structural System Options														
Analyze and Compare all Structural Stystems														
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Report and Presentation														
Distribute and Write Report Sections														
Compile Individual Report Sections														
Create Final Presentation														
Proof Reading and Review														
Final Presentation														

Tasks	arch												
	17-Mar	18-Mar	19-Mar	20-Mar	21-Mar	22-Mar	23-Mar	24-Mar	25-Mar	26-Mar	27-Mar	28-Mar	29-Mar
Select Structural System													
Review Structure Details													
Research Structural System Options													
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Layout Site Grading Plan													
Report and Presentation													
Distribute and Write Report Sections													
Compile Individual Report Sections													
Create Final Presentation													
Proof Reading and Review													
Final Presentation													

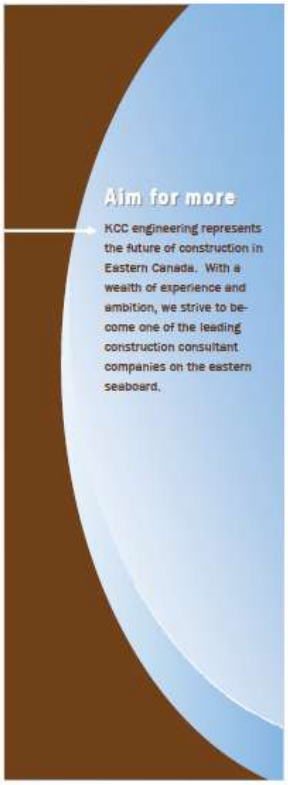
Tasks			
	30-Mar	31-Mar	1-Apr
Select Structural System			
Review Structure Details			
Research Structural System Options			
Analyze and Compare all Structural Stystems			
Select Preferred Structural System for Design			
Preliminary Frame and Footing Design			
Calculate Snow and Wind loads on Frame			
Design Roof to bear Load			
Select Column and Beam Locations			
Design Beams, Columns, Bracing & Walls			
Design Concrete Footings			
Building Design Details			
Concrete Slab			
Mezzanine Details			
Structural Steel Details			
Masonry Wall Details			
Design of Veneer Brick for Wind Loads			
Cost Estimate			
Track Quantities of Materials			
Track Costs			
Design Drawings			
Create Design Drawing Drafts			
Site Grading Plan			
Layout Site Grading Plan			
Report and Presentation			
Distribute and Write Report Sections			
Compile Individual Report Sections			
Create Final Presentation			
Proof Reading and Review			
Final Presentation			

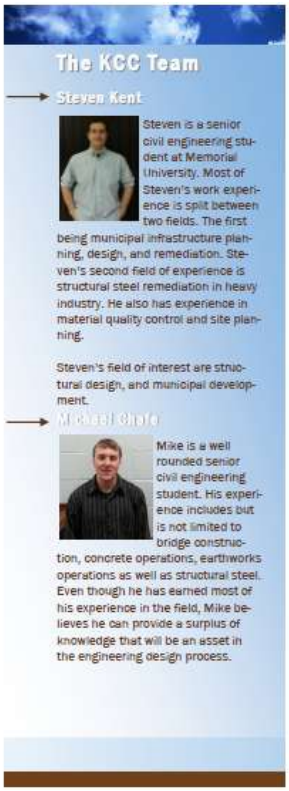
Appendix B – Structural System Comparison

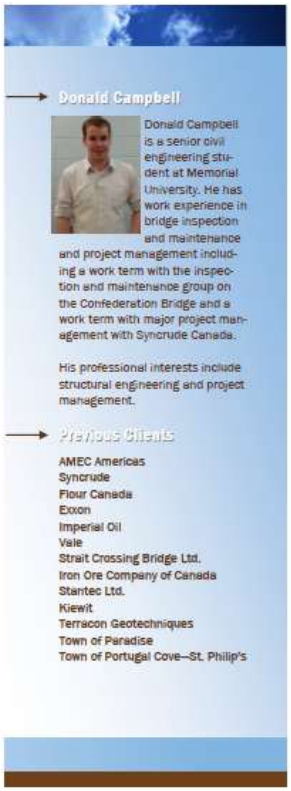
Structural System Comparison Table			
System	Pros	Cons	Ranking
Timber	- Cheap - Easy to alter over time - Easy construction in any condition - Smaller dead loads	- Weaker material - Low fire resistance - Risk of rotting/warping - short lifespan	4
Steel	- Strong and Consistent Material - Change over time - Construct in any condition - High supply - No bracing (rigid frame) - Lighter load	- Expensive - Columns have to fit within walls - Fire resistance coating required - Requires Offsite fabrication & transportation	1
Concrete	- Sound resistant - Fire Resistant - No bracing - Easy Delivery - High Strength	- Slow Construction (rebar/curing) - High variability in strength - high labour costs (formwork/pouring/finishing/curing) - Laboratory Testing Required - High Dead Loads	2
Masonry	- Sound Resistant - Fire Resistant - Minimum offsite fabrication - Easy to alter over time	- Highly Variable Material - Labour Intensive - No experience in this type of construction - Low availability/quality of workmanship of Masons in Province - High Dead Loads	3

Table 1: Structural system comparison chart

Appendix C – Statement of Qualifications







Student Group

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