CDNL Engineering Consultants

Tilt-up Concrete Panel Building Design

Lawton's Drug Store, Elizabeth Ave., St. John's, NL

CHIMO Construction Management Ltd.

CDNL Engineering Consultants

Safety. Serviceability. Satisfaction.

CDNL Engineering Consultants
c/o Engineering 8700 Project Group 6
Faculty of Engineering and Applied Science
Memorial University of Newfoundland
St. John's, NL
AIB 3X5

Mr. Karl Green
CHIMO Construction Management Limited
1 Crosbie Place
St. John's, NL
A1B 3Y8

January 29th, 2010.

Dear Mr. Green:

The enclosed document is a Project Plan developed by CDNL Engineering Consultants for CHIMO Construction Management Limited for the tilt-up panel building design of a Lawton's Drugs Building.

This Project Plan includes a project description and the task requirements for the project, a description of the methodology to be used in project execution, the primary and subtasks associated with design, methodology of scheduling and other items of importance to delivering the project successfully.

If you have any questions or concerns regarding the contained documentation, we would be pleased to discuss them with you.

Sincerely,
CDNL Engineering Consultants

Laura Bennett	Dana Dalton
Nick Coates	Chris Willette

cc: Dr. Steve Bruneau, ENGI 8700 Course Instructor

CONTENTS

APPENDICES

1.0 PROJECT DESCRIPTION

CDNL Engineering Consultants (CDNL) has been contracted to design a two storey tilt up concrete panel building for CHIMO Construction Management Ltd (CHIMO). The building will be used to house a new Lawton's Drugs Store to be located at the current Dominion grocery store site on Elizabeth Avenue-East. The building is to be free standing and approximately 11,200 square feet in area. See Figure 1 for an aerial view of the building location.

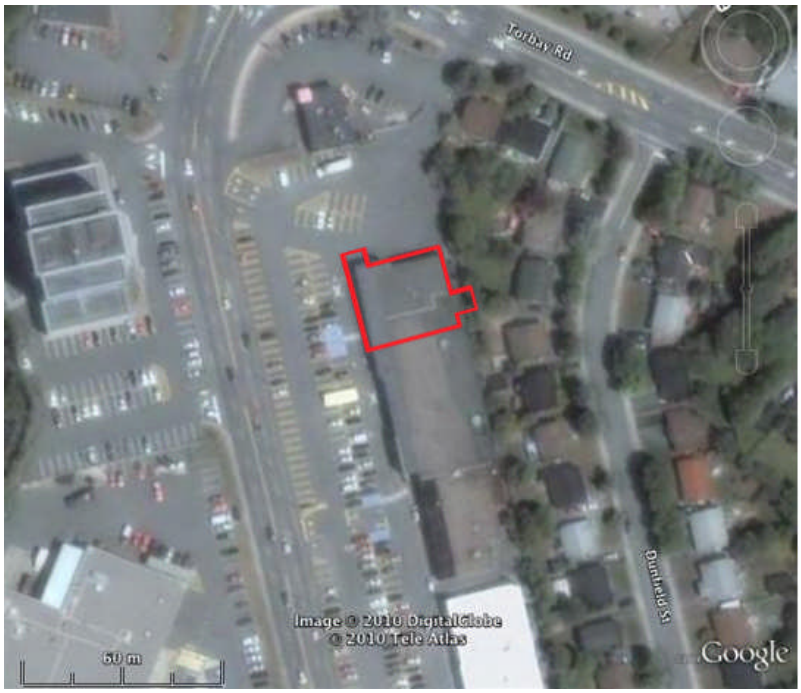

Figure 1 – Location of future Lawton's Drug Store

The building will be of steel and reinforced concrete construction. The first phase of construction consists of site preparation and pouring of the slab on grade. The footings or shallow foundations are next and consist of strips which extend below the frost line to transfer the weight from the walls and columns to the earth. The walls are tilt up concrete panels. In this method the walls are formed on a concrete slab and once cured are then tilted from horizontal to vertical with a crane, braced into position and connected to the footings. JW Lindsay Construction, a contractor from Nova Scotia specializing in concrete panel tilt-ups will perform the lifting of the panels. The structure will have six interior steel columns with beams running in both the north-south and east-west directions. These beams along with the roof trusses and intermediate floor joists can then be tied into the wall panels by attachment plates that were previously secured. The structure will then stand and the braces will be removed. The intermediate storey will have a concrete slab floor which will rest on a metal decking between columns and must be designed for the additional loads from storage. The entire building will be two storeys high except for the receiving area in the back of the building, which will be one storey. [6]

2.0 PROJECT REQUIREMENTS

CHIMO Construction Management Ltd has contracted CDNL Engineering Consultants to complete the design for:

Tilt-up Panel Walls: Precast reinforced concrete walls to be designed for all exterior walls and will include cut-outs for windows and entrances. The panels will be the main load bearing elements of the building and will require careful analysis for loads during tilting.

Columns: Six interior structural steel columns of known location and length extend from the foundation to the top of the building. Columns are to support intermediate floor slab and roofing systems.

Structural Beams: Structural steel beams run between columns in both the north-south and east-west directions. Beams are designed to support lateral loads and the weights of the intermediate floor slab and roofing system.

Roof Trusses: Trusses extend in the east-west direction and connect to concrete panel walls. Truss height is specified in architectural drawings.

Intermediate Floor Joists: Floor joists run in the east-west direction and connect to concrete panel walls. Joist height is specified in architectural drawings.

Intermediate Floor Slab: Reinforced concrete slab on metal decking to support additional live load of 150 lb/ft^2 required for storage on the second floor.

Roof System: Roof system consists of metal deck with steel roof framing. Detail provided in architectural drawings but must be checked for structural strength.

Connections: Design of connections for structural steel elements such as footings, floor joists, roof trusses and beams to panel walls.

Cost Estimate: Estimates required for all structural design work provided in the project.

To meet the project requirements, CDNL will conduct research on tilt-up concrete panel buildings and have constant communication with the client.

3.0 METHODOLOGY

3.1 Project Approach

In the winter of 2010, CDNL was partnered with CHIMO to develop the design, drafting and cost estimation for a two storey tilt-up concrete panel building to accommodate a new Lawton's Drugs Store on Elizabeth Avenue-East, St. John's, NL. A project of this size and nature requires careful consideration and planning before any designing is commenced in order to establish a clear understanding of the client's, CHIMO, needs and the scope of work to be met during the project. The approach of CDNL is to deliver this project with a balanced level of the client's expectations and the design requirements stated by the applicable construction and design codes while achieving safety, serviceability and satisfaction in all aspects of the project.

In the initial stage of the project, CDNL is to conduct research of the design of tilt-up panel buildings and communicate with the client to gain a better understanding of the tasks required to complete the design. The tilt up panel design process is new to the company, therefore researching the design requirements and past projects will be necessary for successful completion of the project. CDNL believes that a clear knowledge of the tasks that will be undertaken and frequent communication with the client provides opportunity to complete the project with less room for error. CHIMO has provided CDNL with architectural drawings of the building to illustrate the requirements for the project. With aid from the client and the tilt-up panel building research, a preliminary schedule has been developed which includes a breakdown of all the known major tasks and milestones. This schedule will be subject to change as the project progresses. It is the intent of CDNL to keep this schedule as up to date as possible as it will play a major role in keeping the client informed of the progress of the project and allow CDNL to budget time accordingly.

The design tasks and analyses to be completed during this project are outlined in the project schedule. CDNL plans to have each of its members play active roles in the design processes. The major design tasks have been broken down and scheduled for completion based on their dependency to commence other tasks. Designs by one person will be checked over by another person to verify the design is completed correctly. As the designs are finalized, the team will break off into groups to begin drafting. Persons will alternate between design and drafting until all designs have been completed. Ensuring that the schedule is followed at this stage is important as there is much work to do in a specified time in order to complete the project on schedule.

The next stage in the project is the material take-offs and cost estimate. This will commence after all designs and drafting have been finalized. Each person will determine the costs associated with a certain quantity of material or labour hour and the estimates will be compiled in an excel spreadsheet. The client has offered assistance in determining the unit prices for materials and the costs associated with labour.

The final report and presentation will be an ongoing task throughout the duration of the project. CDNL has chosen to do this so that if time becomes an issue, these final items will not be left until the last minute. The final report will also serve as a means of keeping

track of completed tasks.

3.2 Group Organization, Roles and Meetings

The members of CDNL contribute an extensive background in structural engineering and construction management experience to this project. Company members have discussed their experience and preference for certain roles within the group and have assigned positions to individuals who best fit the role and will provide the most benefit in that position. All group members will take an active part in the design, analysis and drafting processes. The following is a description of each person's role within the group and their delegation in the tilt-up concrete panel building project:

Dana Dalton (Project Manager) – CDNL's Project Manager's overall responsibility is the successful planning and execution of the project, defining tasks and assigning responsibility with the group. She is responsible for the ongoing work on the progress and final reports, communicating with the client and the final presentation of all documents. Dana will also be responsible for the final analysis and approval of the structural steel design prior to submission to the client for review.

Nick Coates (Project Engineer) – The Project Engineer is responsible for scheduling tasks and keeping the project schedule up to date. He is responsible for keeping track of all items of the project being worked on and their stages of completion. Nick will also be responsible for the final analysis and approval of the concrete slab and connections prior to submission to the client for review.

Laura Bennett (Lead Designer / Research & Development) - The responsibility of the Lead Designer is to confirm and record all designs being worked on at any time and to ensure no item is neglected throughout the project duration. The role of Research and Development entails developing a higher understanding and educating the team of the processes involved in this project. Laura will also be responsible for the final analysis and approval of the tilt-up concrete panel design prior to submission to the client for review.

Chris Willette (Lead Drafter / Quality Management) – As Lead Drafter, Chris will be responsible for developing lists of drawings required for each project element, keeping record of all drawings being worked on, and the final approval of all drawings prior to submission to the client for review. He is also responsible for the development of all working spreadsheets for the project, in effort of producing work with high standards of quality and consistency.

Any member of CDNL may call a meeting with the group at any point that they feel one is necessary. Weekly update meetings are scheduled to take place on the day prior to the meeting with the client to discuss the activities of each member in the prior week and items that need to be addressed or discussed with the client.

Please see Appendix A for CDNL's Summary of Qualifications.

3.3 Client Interaction and Role

CDNL plans to keep CHIMO involved in each stage of the project. CDNL and CHIMO have decided to meet weekly at the CHIMO Office, located at 1 Crosbie Place, however, the meeting times may change based on the client's needs. These meetings will serve as opportunity to update the client on the project status and to ask questions about ongoing tasks. CHIMO will be provided with an agenda the day before the scheduled meeting and will receive a copy of the meeting minutes within two days of the meeting. Between meetings, communication through email will be the primary interaction between CDNL and the client.

CHIMO's role is to provide guidance and additional information about the project and designs when necessary and to inform CDNL if they lose sight of the task at hand. It is the responsibility of CDNL to use proper communication with the client to ensure that their needs are met and the final designs

3.4 Design Principles

There are many design principles which can be applied to a tilt up panel building. All designs will be completed by applying the most recent versions of *the Canadian Standards Association (CSA)* design codes and the *National Building Code of Canada (NBCC)* [3]. The six interior columns, roof structure including metal deck with steel roof framing as well as structural beams which run will be designed using the *CISC Handbook of Steel Construction, 9th Edition* [2]. The roof and floor joists will be designed using CANAM Canada *Joist Design and Joist Catalogue*[7]. These joists can be picked by depth, span and loading. Tilt up panel walls will be designed using Chapter 13 of the *CAC Concrete Design Handbook, 3rd Edition* [1]. The connections for the structural steel elements such as footings, joists and beams to the panel walls will be designed using a combination of the *CAC Concrete Design Handbook, 3rd Edition* and *CISC Handbook of Steel Construction, 9th Edition* [2].

3.5 Cost Estimating Strategy and Level of Accuracy

CDNL plans to complete all cost estimating after the completion of designs and drafting. Material take-offs will taken from the final drawings and compiled into an Excel spreadsheet, created specifically for the cost estimation. CHIMO has offered assistance in determining the most recent unit material prices and cost of labour hours.

As drafting is completed, a list containing all the materials used in the designs will be compiled. This list will then be split among members of CDNL for material take-offs. The individual efforts will be combined in one spreadsheet where estimates will be finalized.

The client has requested that the cost estimate be within an accuracy of plus or minus five percent (±5%).

3.6 Desired Outcomes

As the engineering consultant for CHIMO it is CDNL's "contractual" obligation to design the structural components of the Lawton's Drugs building. However, this project does not only consider that the building be structurally sound but must contain other outcomes and traits such as:

- *Cost effectiveness*: each component must meet standard set by the industry codes but must allow for the construction of the building to be feasible.
- *Safe and reliable structure*: by meeting the design codes, the building can be constructed to meet all the needs of the client and last for years to come.
- *High quality of planning and scheduling*: providing the client with a thorough project plan and well thought-out schedule CDNL can produce a building design and cost estimate within the required deadline.
- *Simplicity in manufacturing of panels*: by designing panel schedule in which with simple repetition of shapes and minimal formwork and reinforcement changes, wall sections can be manufactured on site and easily installed
- *Proper documentation*: since this may be used by the client good documentation of how the design process was completed will prove very useful in the construction phase
- *Effective reporting*: as a requirement of the course a final report and presentation will be required. CDNL will supply an exceptional but brief report to the class and clients summarizing the characteristics, problems and outcomes of the project.
- *Clear and concise drafting*: after designing the building structure a clear and concise plan will need to be drafted of it components. These drafts will provide CHIMO with the structural steel layout, panel dimensions and reinforcement locations.
- *Establishing an exceptional relationship with client*: by developing a good relationship with the client CDNL can obtain an abundance of knowledge about the construction industry and improve engineering designs and practices.

Also, CDNL must analyze design results to provide constructive and creative engineering solutions that reflect social and environmental sensitivities.

3.7 Reporting and Deliverables

Project reporting is a very effective tool used to highlight and display progress to the client and in this particular case to the class. Gathering the enormous amount of data, calculations and drafts compiled by the group, CDNL can summarize four months work into a well developed technical report. The course requires a midterm and final progress report which has been scheduled to be continuously complied during the term and tasks are completed. However, this is not all the reporting that will be completed by the

company. Weekly meetings are held both with the client and the class. This requires CDNL to produce weekly minutes, weekly progress and schedule updates along with any issues encountered. These reports are conveyed both orally and through email. Table 1.0 illustrates the required project deliverables and their status of completion.

Deliverable	Quantity	Date	Status
Statement of Qualifications (SOQ)	1	January 13, 2010	Complete
Project Work Plan	1	January 29, 2010	Complete
Mid term Progress Report	1	February 16, 2010	N/A
Progress Report Presentation (Copy)	1	February 15, 2010	N/A
Final Report	1	April 5, 2010	N/A
Report Appendices	1	April 5, 2010	N/A
Final Report Presentation (Copy)	1	April 6, 2010	N/A
Weekly Minutes (Client Meetings)	9	N/A	22% Complete
Weekly Agenda (Client Meetings)	10	N/A	20% Complete
Weekly Progress Updates (Class Meetings)	9	N/A	33% Complete

Table 1.0 - Deliverables

3.8 Troubleshooting

As problems arise throughout the project, CDNL plans on handling issues in a systematic manner. The first step is to identify the problem and discuss what may have caused it. Possible causes may be misunderstanding of the tasks or design codes or a judgement error by one or all of the CDNL members. If the issue is small it will be dealt with within the group. If the issue requires further input, CDNL will contact the client or seek help from an engineer faculty member. Once the problem is resolved, the project can move forward. All problems or issues will be documented and discussed with the client at the following update meeting. CDNL believes it is important to keep record of all problems that may occur so that they will be prevented or resolved easily in future tasks.

4.0 TASKS

Regarding the design of the Lawton's Drugs Building on Elizabeth Avenue, the work can be broken down into six primary tasks with a number of subtasks included under each of these. These include preparatory work, design of the tilt-up concrete panels, design of the structural steel elements, design of the floor and roof of the structure, drafting, cost estimation and the accompanying administrative work. The task duration, allocation of personnel and requirements in terms of standards, references and computing aids are displayed in tabular format in Appendix B.

4.1 Preparatory Work

Prior to beginning the actual design of the structure, research must be carried out by CDNL to familiarize the group with the applicable codes and standards used during design. In particular, extra time will have to be put into the study of tilt-up panels due to our lack of experience with this method of construction. After studying all the available resources, a preliminary schedule with rough dimensions will be constructed for the tilt-up panels and steel members, to be reviewed by the client. Once these concepts are approved by the client, the last step which must be completed prior to detailed design is the calculation of the loads the building will be subjected to. These will be determined using the live loads specified by the client, the approximate dead load based on initial materials estimates or code minimums and the data provided by the *National Building Code of Canada* [3] for the building's location.

4.2 Design of Roof and Floor

The first step in design will be to determine the requirements for the roof and second storey floor of the building, as these will contribute to the dead loads carried by the walls and steel members. The structural requirements for the roof, a steel deck supported on steel roof trusses, will be determined using the *National Building Code Canada* [3] environmental data and standards while the second storey floor, a concrete slab supported on steel decking and joists, has a specified requirement of 150 lb/sq. ft, which must be provided for in addition to the *National Building Code Canada* [3 standards, due to its intended use as a file storage facility. Analysis will be completed in the structural analysis soft ware *S-Frame Release 9.0.*

4.3 Design of Tilt-Up Concrete Panels

With the dead load from the floor and roof firmly determined we now have enough information to proceed with detailed design of the concrete tilt-up wall panels. Using the preliminary schedule approved by the client, a number of templates will be established which take advantage of the similarity of various panels to limit the number of panel types which must be designed for. Unlike most structural members the design of tilt-up panels is

twofold; it must meet the applicable standards both during and after construction. The panel is first designed as a load bearing wall and will then be redesigned as a slab such that it can resist the stresses of lifting, which may require the inclusion of extra reinforcement or even complete redesign. Since this will likely be the largest task, CDNL will make use of spreadsheets to check any standard calculations involved in the design of each panel type. Analysis will be completed in the structural analysis soft ware *S-Frame Release 9.0.*

4.4 Design of Structural Steel Elements

The last structural elements designed will be the steel columns, beams, joists and their associated connections. There are a total of six steel columns extending from the foundation to the roofing system. The main structural beams run between columns on the intermediate floor and building roof. The floor and roof joists do not require design but selected based on the specified spans and depths designated in the architectural drawings and the loads that will be calculated in the early stages of design. The selection will be made from the by the CANAM Canada *Steel Joist Catalogue* [7]. Analysis will be completed in the structural analysis soft ware *S-Frame Release 9.0.*

4.5 Drafting

Plans provided by the client cover most aspects of the architecture of the building as well as some structural elements but detailed design of concrete panels, structural steel and second storey floor will be added by CDNL's drafter. These drawings will be of sufficient quality to illustrate all important design features and allow for materials takeoffs. Work will begin on this task once the first element of design and analysis has been completed and, depending on the sequence in which the design tasks are finished, may require the use of extra personnel to keep pace with the project schedule.

4.6 Cost Estimation

The materials take-offs will be completed by the group after the finalizing the structural analysis and drafting. Material take-offs will be compiled in an estimation spreadsheet. The client has offered assistance in obtaining values for the cost of unit materials and labour associated with the project.

4.7 Administrative Work

Over the course of the project many administrative duties will need to be completed. They fall into two main categories; items required at regular intervals and items to be completed at milestones. The regular interval items include the completion of meeting minutes and agendas which arise from weekly meetings with the client, as well as progress updates given each week to the assembled groups and course instructor. The group will share this work throughout the duration of the project. The milestone items

consist of the Work Plan, the midterm Progress Report/Presentation and the Final Report/Presentation. These items will be ongoing until their milestone date and updated by the project manager.

5.0 SCHEDULE

Before a project schedule can be created, a project manager should typically have a work breakdown structure (WBS), a time estimate for each task, and a resource list with availability for each resource. For this particular project our schedule has been separated based on the three main structural components: tilt up panels, structural steel and concrete slab floors. Each component must then be broken into subtasks. As with any engineering design a good grasp of the fundamentals is key. This requires thorough research at the initial stages of the project. Next are the actual design features which must meet the codes set forth by the Cement Association of Canada [1], Canadian Institute of Steel Construction [2] and the National Building Code of Canada [3]. Both hand calculations and computer software are used to calculate bending moments and shear forces. Each of the tilt up panels has been grouped with similar panel of the same dimensions making the design process more efficient. However, there are some panels that have been classified as “special cases” in which the dimensions are irregular and additional designs are necessary. Similarly, most steel components may be grouped due to the symmetry of the building and standard dimensions. Before the tilt up panels are designed all snow, wind and earthquake loading will be calculated along with the second floor and roof design and loads which will be applied to the exterior walls.

Once the design phase has be completed final drafts of the building components must be carried out. Rough sketches of the building segments have been compiled in the design phase and now only need to be constructed in a presentable fashion using AutoCAD.

The final step in the project plan is cost estimation. From the building designs concrete, rebar and structural steel quantities can be determined. Working closely with the client’s estimation files and experience an accurate project cost can be established.

Sometimes task durations are not yet available, it may be possible to create something that looks like a schedule, but it will essentially be a work of fiction. This is somewhat the case for the design of the concrete tilt up panels for the new Lawton’s Drugs building. Tilt-up panel building technology has not been utilized in many structures in the province of Newfoundland and Labrador so there is limited knowledge as to how long it may take to complete the project. Extra time has been allotted to this task because the duration is unknown. Milestones have been established for the project progress report, final presentation and all client meetings.

Microsoft Project has been selected as the tool to produce the project schedule. A group member has been assigned to the production of this schedule. Also the group’s project manager will enforce it along with the guidance of the client and professor, Dr. Steve Bruneau. As progress continues tasks may need some modification or split into subtasks to make tracking easier. Microsoft project allows for any modifications to easily be performed.

A copy of the preliminary project schedule can be found in Appendix C.

6.0 COSTS, DELIVERABLES AND RISKS

6.1 Costs

The costs associated with this project will be minimal for CDNL Engineering Consultants as we are not producing models. The two main areas where costs will be associated are for printing and binding services as well as transportation to CHIMO Construction Ltd. For printing and binding services each member of CDNL has initially contributed $20.00, for a total of $80.00. The breakdown of money already spent is can be found in Table 2.0

Items	Cost	Balance ($80.00)
SOQ printing for Match Night (5 Colour Copies)	12.00	68.00-
Project Binder Supplies	15.00	53.00-

Table 2.0 – Costs

If additional money is needed each member will contribute another $20.00 per person with any remaining balance being divided and returned upon completion of the project. All money and cost related items is managed and recorded by Laura Bennett.

Regarding the transportation costs to CHIMO Construction Ltd. Offices, CDNL members are taking turns driving to the meetings from university so it will balance itself out over the next 10 weeks.

6.2 Deliverables

Engineering Consultants aims to be an environmentally friendly company. To reduce our footprint we will only be producing hardcopies of documents as they are required by the client and instructor.

For the client the day before a meeting a meeting agenda is sent electronically and it is up to them whether they choose to print the document. Meeting minutes are also sent electronically to the client the day after each meeting so they can be reminded of what was said and the actions items to be completed before the next meeting. Hardcopies are produced if requested and when work done by CDNL needs to be reviewed by CHIMO. Hardcopies of the deliverables for the instructor, such as work plan, term break progress report and final report will also be submitted to CHIMO. The final report will also contain the complete structural drawings for the structural steel, intermediate floor, roof and tilt up panels.

The instructor is carbon copied on the meeting agendas and is given softcopies of all the course deliverables, such as work plan, term break progress report and final report.

Hardcopies of the course deliverables are also submitted to the instructor.

6.3 Risks

There is little vulnerability within this project; however, a big risk for CDNL is the design of the tilt up reinforced concrete panels. CDNL does not have much experience with tilt-up panel buildings and it may take a little longer to complete the design which should have been accounted for in the schedule. This project involves an extensive amount of designing and drafting therefore time may be an issue if CDNL falls behind on its schedule and there is risk of the project not being completed on time or certain tasks being rushed. Other risks may include the unavailability of the client for meetings due to their other projects.

7.0 REFERENCES

[1] Cement Association of Canada. (2005). *Concrete Design Handbook, Third Edition*.

[2] Canadian Institute of Steel Construction. (2006). *Handbook of Steel Construction Ninth Edition.*

[3] National Research Council of Canada: Institute for Research in Construction. (2005). National *Building Code of Canada Part 4, Structural Design*.

[4] Bruneau, S. (2010). *Guide to Writing an Engineering Project Plan*. Retrieved January 24, 2010, from Memorial University, Civil Engineering 8700 Design Project CourseWebsite: http://www.engr.mun.ca/~sbruneau/teaching/8700project/classof2010/

[5] American Concrete Institute (1980). *Tilt-Up Construction ACI Compilation No. 4.*

[6] American Concrete Institute (1986). *Tilt-Up Construction ACI Compilation No. 7.*

[7] Canam Group Inc. (2010). *Joists: Joist Catalogue/Joist Design (Metric).* Retrieved January 26, 2010, from CANAM Canada, Technical Publications: http://www.canam-steeljoist.ws/www/v4/ePublica.nsf/fa_ListePubSeg!OpenForm&pub=Technical&frame=ecanamj

Appendix A SUMMARY OF QUALIFICATIONS

(5 Pages)

CDNL Engineering Consultants

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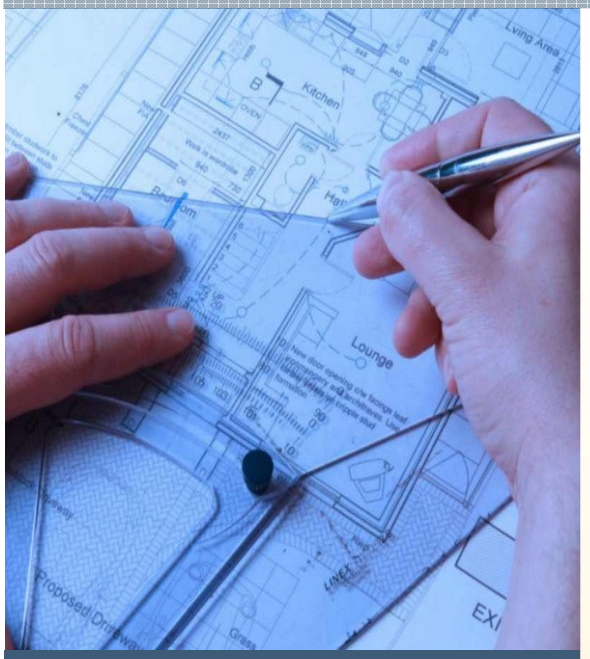
Safety. Serviceability. Satisfaction.



SAFETY

We aim to ensure the safety of our employees and clients through careful attention to detail and knowledge of industry standards

SERVICEABILITY

In addition to providing a safe final product we strive to maintain efficiency and elegance in our designs

SATISFACTION

We seek to meet and exceed the expectations of clients in all our endeavors in order to encourage lasting relationships

MISSION STATEMENT

At CDNL Engineering Consultants we strive to deliver to the needs of our clients with the highest standards in service, quality, safety and reliability. CDNL Engineering aspires to maintain strong work ethic and friendly working environments and aims to establish close relationships with clients to ensure services provided satisfy and exceed expectations.

ABOUT US

CIVIL ENGINEERING SOLUTIONS

CDNL Engineering Consultants is comprised of individuals with a vast array of work experience that contributes to the diversity of engineering services that can be provided by the company. We provide engineering services in the following areas:

- Structural Design and Analysis
- Geotechnical Engineering
- Hydrotechincal Engineering
- Environmental Engineering
- Construction
- Offshore Structural Design and Analysis

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CHRIS WILLETTE

Department of Transportation and Works

North American Construction Group

Nalcor Energy

Chris is a senior civil engineering student at Memorial University and will be graduating in April 2010. Through participation in the co-operative program he has been able to gain experience in the fields of heavy civil construction, road design, cost estimation, computer modeling and drafting, transmission tower design, project supervision and planning. While working with the Department of Transportation and Works he participated in the design of the Foxtrap Bypass and St. Lawrence Bridge realignment as well as construction of the Trans Labrador Highway and Churchill River Bridge. During 2007 – 2008 Chris helped update the tower testing system for the Lower Churchill Project transmission line and developed a computer model for ice build up on the line. Also, while working with North American at the Syncrude Aurora Site he participated in project management and the development of standardized safety/equipment training checklists.

DANA DALTON

Department of Education

Xstrata Zinc – Brunswick Mine

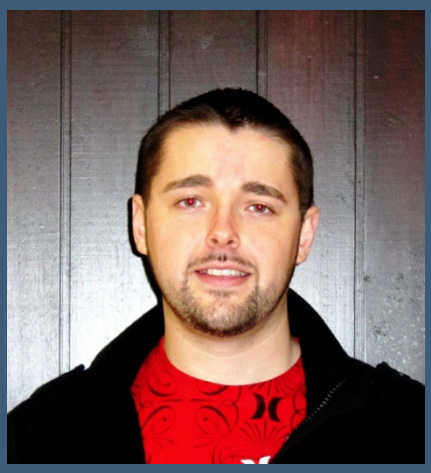
Jacques Whitford Stantec

Technip Canada Limited

American Bureau of Shipping

Dana is currently enrolled in her final academic term of the Civil Engineering Co-op Program at Memorial University. During this program, she was given opportunity to work in several engineering industries; however, the focus of her work experience remains in the field of structural engineering. Dana has been involved in structural steel design and analysis for both the onshore and offshore industries with Xstrata Zinc and Technip Canada Limited. Dana has also been exposed to geotechnical engineering through asphalt testing and aggregate and soil testing while working with Jacques Whitford Stantec. Throughout this experience, Dana has gained valuable knowledge and practice in creating technical documents, evaluating and applying engineering standards, performing quality assurance checks and feasibility analyses and working with clients to complete design projects.

NICK COATES



Department of Transportation and Works

RJG Construction

Rock Construction

Defence Construction Canada

North American Construction Group

A highly determined and skilled project manager and field coordinator, Nick has experience in all areas of the construction environment, including job take off and cost estimating. With almost two years of project management experience with the Government of Newfoundland and Labrador, Defence Construction Canada and North American Construction he has been involved in building construction, upgrades, demolition, environmental reclamation, road construction and even mining. Nick has been exposed to large reinforced concrete construction, structural steel designs and gained an abundance of surveying knowledge by working part time for a small construction company in St. John's.

LAURA BENNETT

Transport Canada

City of St. John's

American Bureau of Shipping

Syncrude Canada Ltd.

Doris Engineering

Laura is a Term 8 civil engineering student at Memorial University. Her strength lies in her ability to work independently as well as in a group setting. Her previous work experience is broad ranging from the shipping industry to municipal works to the oil and gas industry. Two notable examples of Laura's work experience include sanitary/storm sewer modeling and base slab design for a gravity based structure. She has a proven ability to learn new technologies quickly and her meticulous attention to detail makes her an invaluable member for the CDNL team.

Technological Capabilities

- AutoCAD
- Microsoft Office
- STADD
- ArcGIS
- Geostudio
- CONSEC
- HEC-HMS
- MicroStation
- Macro Programming
- Eagle Point

Codes and Standards

- CISC-ICCA: Handbook of Steel Construction S16.1
- CSA Standard A23.3-04—Design of Concrete Structures
- Canadian National Building Code (2005)
- DNV Standards
- ABS Standards for Ship Building
- City of St. John's Specifications Manual
- ASTM Geotechnical Standards
- Transportation Association of Canada Manual

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CDNL Engineering Consultants

c/o Engineering 8700 Project Group 6
Faculty of Engineering and Applied Science
Memorial University of Newfoundland
St. John's NL, AIB 3X5

cdnlengineering@gmail.com

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Appendix B TABLE OF REQUIRED TASKS (1 Page)

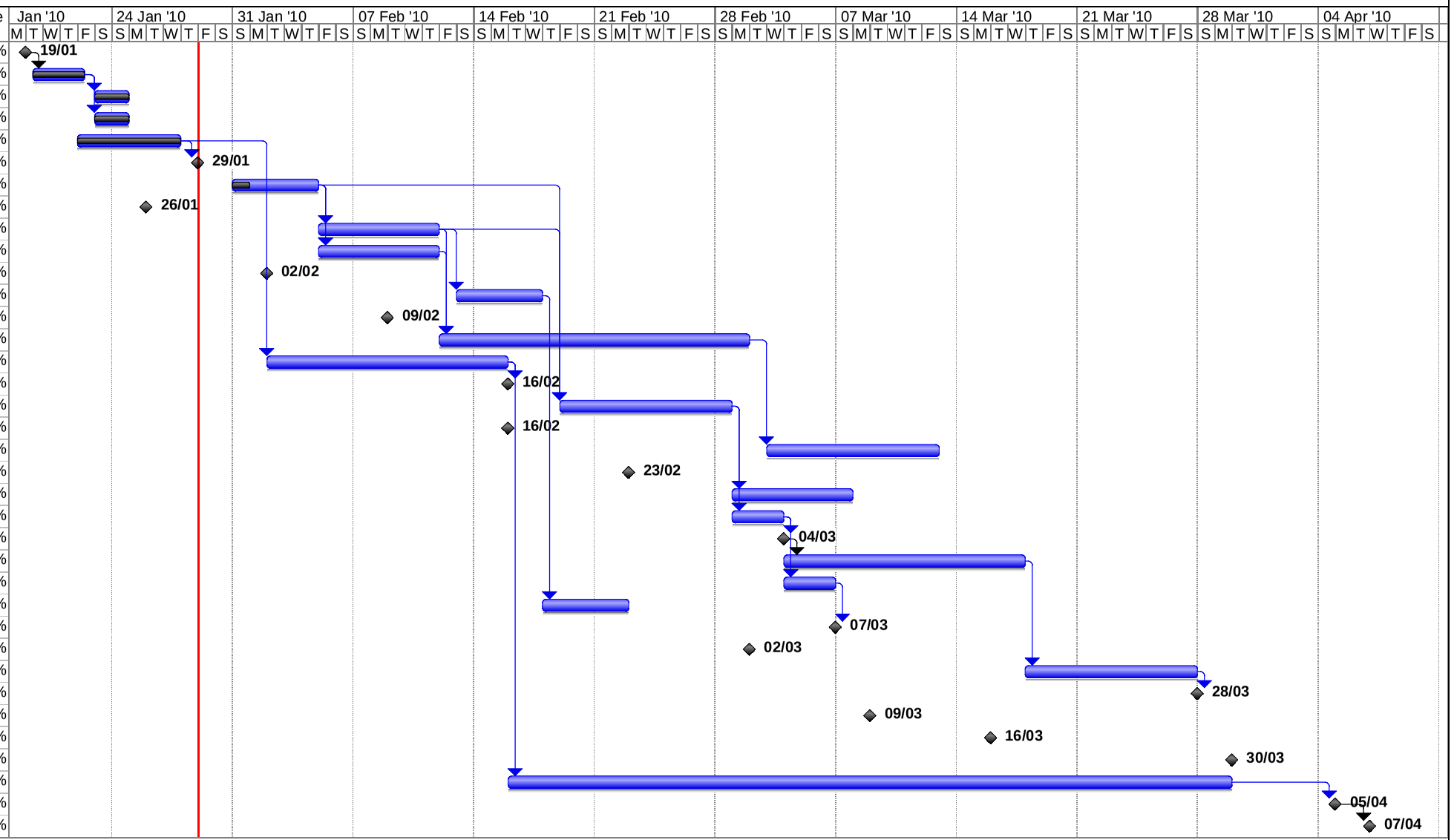
Table of Required Tasks

Primary Tasks	Subtasks	Personnel	Duration (days)	Resource Requirements
Preparatory Work	Research	Dana, Chris, Nick, Laura	3	NBCC, CSA, References
	Structural Steel Schedule	Dana	2	CSA, Excel
	Panel Schedule	Nick	2	CSA, References, Word
	Calculate Loads	Chris	5	NBCC, Excel
Design Floor and Roof	Design and Analyze Roof	Nick	7	CSA, S-Frame
	Design and Analyze Floor	Nick	7	CSA, S-Frame
Design Concrete Panels	Calculation Sheets	Chris	1	Excel
	Design and Analyze as Walls	Laura	9	CSA, S-Frame
	Design and Analyze as Slabs	Laura	9	CSA, S-Frame
Design Structural Steel	Design and Analyze Columns	Dana	3	CSA, S-Frame
	Design and Analyze Beams	Dana	4	CSA, S-Frame
	Design and Analyze Joists	Dana	4	CSA, CAN-AM
	Design and Analyze Connections	Dana	2	CSA
Drafting	Draft Floor	Chris	5	AutoCAD
	Draft Roof	Chris	5	AutoCAD
	Draft Concrete Panels	Chris	10	AutoCAD
	Draft Structural Steel	Chris	7	AutoCAD
Cost Estimate	Tally Sheets	Chris	14	Excel
	Construct Estimate Sheet	Client, Dana, Chris, Nick, Laura	10	Excel, Building Guide
Administrative Work	Meeting Minutes and Agenda	Dana, Chris, Nick, Laura	1	Word
	Progress Updates	Dana, Chris, Nick, Laura	1	Word
	Work Plan	Dana, Chris, Nick, Laura	6	Word, Excel, Project
	Midterm Report/ Presentation	Dana, Chris, Nick, Laura	14	Word, Excel, Project
	Final Report/ Presentation	Dana, Chris, Nick, Laura	42	Word, Excel, Project

Appendix C PRELIMINARY SCHEDULE (1 Page)

ENGI 8700 - Civil Engineering Project
Lawton's Drug Building
Preliminary Schedule
8% Complete

ID	Task Name	Duration	Start	Finish	% Complete
1	Project Kick Off Meeting	0 days	Tue 19/01/10	Tue 19/01/10	100%
2	Project Research	3 days	Tue 19/01/10	Fri 22/01/10	100%
3	Tilt up Panel Schedule	2 days	Sat 23/01/10	Mon 25/01/10	80%
4	Structural Steel Schedule	2 days	Sat 23/01/10	Mon 25/01/10	100%
5	Develop Work Plan	6 days	Fri 22/01/10	Thu 28/01/10	100%
6	Project Work Plan Submission	0 days	Fri 29/01/10	Fri 29/01/10	0%
7	Calculate Loads	5 days	Sat 30/01/10	Thu 04/02/10	30%
8	Project Meeting 2	0 days	Tue 26/01/10	Tue 26/01/10	0%
9	Design Second Storey Floor	7 days	Fri 05/02/10	Fri 12/02/10	0%
10	Design Roof	7 days	Fri 05/02/10	Fri 12/02/10	0%
11	Project Meeting 3	0 days	Tue 02/02/10	Tue 02/02/10	0%
12	Draft Second Storey Floor	5 days	Sat 13/02/10	Thu 18/02/10	0%
13	Project Meeting 4	0 days	Tue 09/02/10	Tue 09/02/10	0%
14	Design Tilt up Panels	18 days	Fri 12/02/10	Tue 02/03/10	0%
15	Develop Progress Report	14 days	Mon 01/02/10	Mon 15/02/10	0%
16	Progress Report Presentation	0 days	Tue 16/02/10	Tue 16/02/10	0%
17	Design Structural Steel Beams/Joists	10 days	Fri 19/02/10	Mon 01/03/10	0%
18	Project Meeting 5	0 days	Tue 16/02/10	Tue 16/02/10	0%
19	Draft Tilt up Panels	10 days	Wed 03/03/10	Sat 13/03/10	0%
20	Project Meeting 6	0 days	Tue 23/02/10	Tue 23/02/10	0%
21	Draft Structural Steel	7 days	Mon 01/03/10	Mon 08/03/10	0%
22	Design Interior Steel Columns	3 days	Mon 01/03/10	Thu 04/03/10	0%
23	Design Work Complete	0 days	Thu 04/03/10	Thu 04/03/10	0%
24	Material Take Offs	14 days	Thu 04/03/10	Thu 18/03/10	0%
25	Draft Interior Steel Columns	3 days	Thu 04/03/10	Sun 07/03/10	0%
26	Draft Roof	5 days	Thu 18/02/10	Tue 23/02/10	0%
27	Drafting Complete	0 days	Sun 07/03/10	Sun 07/03/10	0%
28	Project Meeting 7	0 days	Tue 02/03/10	Tue 02/03/10	0%
29	Project Estimation	10 days	Thu 18/03/10	Sun 28/03/10	0%
30	Project Estimation Complete	0 days	Sun 28/03/10	Sun 28/03/10	0%
31	Project Meeting 8	0 days	Tue 09/03/10	Tue 09/03/10	0%
32	Project Meeting 9	0 days	Tue 16/03/10	Tue 16/03/10	0%
33	Final Project Meeting	0 days	Tue 30/03/10	Tue 30/03/10	0%
34	Final Report	42 days	Mon 15/02/10	Mon 29/03/10	0%
35	Submit Final Report	0 days	Mon 05/04/10	Mon 05/04/10	0%
36	Final Report Presentation	0 days	Wed 07/04/10	Wed 07/04/10	0%



Project: Preliminary_Project_Schedule
Date: Fri 29/01/10

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Contact Information

Client
Mr. Karl Green
CHIMO Construction Management Ltd.
1 Crosbie Place
St. John's, NL
A1B 3Y8
Phone:(709) 739-5900
Email: kgreen@crosbiegroup.com

Instructor
Dr. Steve Bruneau
EN-4013
Faculty of Engineering and Applied Science
Memorial University of Newfoundland
St. John's, NL
A1B 3X5
Phone: (709) 737-2119
Fax: (709) 737-4042
Email: sbruneau@mun.ca

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CDNL Engineering Consultants

c/o Engineering 8700 Project Group 6
Faculty of Engineering and Applied Science
Memorial University of Newfoundland
St. John's NL, AIB 3X5

cdnlengineering@gmail.com