Design of Ore Crushing Facility
Work Plan

CONSULTANT

Superior Consulting
Karl Hartmann
Jarrod Evans
Kayla Parsons
Glenn Finlay

CLIENT

SNC-Lavalin/BAE-Newplan
Ray Bailey (P.Eng)
Nick Gillis (P.Eng)

January 27, 2012
ENGI 8700 Civil Design Project
Instructor: Dr. Stephen E. Bruneau

Memorial University of Newfoundland
Faculty of Engineering and Applied Science
St. John's NL Canada
A1B 3X5

January 27, 2012

Ray Bailey (P.Eng) & Nick Gillis (P.Eng)
SNC-Lavalin/BAE-Newplan
1133 Topsail Rd
Mount Pearl, NL Canada

Dear Mr. Bailey & Mr. Gillis:

The enclosed document describes, in detail, the goals to be accomplished by our team to successfully complete all work issued by SNC-Lavalin/BAE-Newplan for the design of an Ore Crushing Facility located in St. Lawrence, Newfoundland.

The document highlights both the major and minor tasks required for completion of the project and also describes the various roles and responsibilities of each team member. Resources that are required for each task are well documented within the work plan. These include the specific software, personnel, and documentation that will be utilized to complete each individual task. In addition, a calendar of all important events such as meetings with the client, instructor business meetings, and team discussions are illustrated. We believe the work plan presents a clear layout of expectations for designing an Ore Crushing Facility which will assure we meet all milestones in an efficient manner.

If there are any questions concerning our work plan, we would be pleased to discuss them with you at your convenience.

Regards,

Superior Consulting

Superior Consulting

cc: Dr. S. Bruneau, ENGI 8700 Instructor

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1.0 Project Description

Superior Engineering has been contracted by SNC-Lavalin/BAE-Newplan to design an Ore Crushing Facility in St. Lawrence, Newfoundland for Canada Fluorspar Inc.

Figure 1-1: General Location

The ore crushing facility will consist of a steel frame building with a run of mine (ROM) storage capacity of 1200-1500 tons and an associated crushing plant. The main storage area will be single storey; however the crushing plant will require two storeys to allow direct end dumping from trucks into the crusher.

Figure 1-2: Site Map

Superior Engineering will be required to investigate framing options and carry out the structural design of the building, as well as an associated cost estimate. Components of the structure that will require design are the:

- Primary and secondary framing
- Foundation
- Slab on grade
- Retaining wall

In addition to the above requirements, some minor architectural tasks will be performed. These tasks are primarily for use in the quantity takeoffs and cost estimate.

2.0 Statement of Requirements

This project involves the design of a suitable facility to store and process fluorspar mined in St. Lawrence. The structure must house a crushing system for processing the fluorspar, while protecting the operation from weather conditions.

2.1 Client Requirements

- An enclosed area capable of storing 1200-1500 tons of fluorspar
- Capability to operate large machinery within the enclosed structure such as a front end loader and 20-ton tandum dump truck
- Capability of structure to support large mechanical doors and cranes
- Capability of foundation to support loads generated by a large crushing machine
- A small office for administrative work
- Conform to National Building Codes

2.2 Resources Required

- Handbook of Steel Construction – 10th Edition
- Handbook of Concrete Construction
- National Building Code 2005
- Software such as Microsoft Office, StructurePoint, S-Steel, and AutoCAD
- Resources such as Environment Canada historical data and RS Means construction data

2.3 Key Deliverables

- Technical drawings of the structural and civil components of the facility design
- Cost estimate of the entire project broken down into units
- Schedule of the expected duration of the project
- Written report and presentation

3.0 Methodology

3.1 Group Organization

Given the scale of this project, there will be a number of tasks that require our team to assume roles for successful completion of this project including:

- Project Manager
- Project Engineer
- Structural Engineer
- Draftsperson
- Administrative Assistant

Job titles shall be alternated throughout the duration of the project to give each member of the team equal experience.

3.1.1 Project Manager

- Overseeing completion of all major and minor tasks
- Mitigating associated risks within the project
- Final review of all documentation and presentations
- Ensuring a safe work environment

3.1.2 Project Engineer

- Updating schedule to reflect alterations in timeline
- Overseeing cost estimating procedures
- Budgeting associated project costs

3.1.3 Structural Engineer

- Verifying software analysis computations including design loads
- Ensuring proper completion of drawings
- Ensuring all work conforms to appropriate codes and standards

3.1.4 Draftsperson

- Producing a general arrangement drawing
- Creating technical drawings
- Interpreting/Comparing existing AutoCAD drawings

3.1.5 Administrative Assistant

- Organizing meetings (client, instructor, and group meetings)
- Acting as liaison between client and group
- Documenting meeting minutes
- Formatting all reports and presentations

3.2 Client Interaction

Superior Consulting aims to work closely with SNC-Lavalin/BAE-Newplan throughout the entire project. Currently, client interaction has been limited to defining objectives and deliverables for the project. For the remainder of the project, the client's role will include attending meetings, providing relevant information, addressing changes that occur, reviewing submitted work, and providing a mentorship role to the team in a timely manner.

3.2.1 Meetings

Meetings will play a vital role in the successful completion of the project. They will provide a platform to share information concerning the project. Information will constantly be flowing between client, team members, and professors. As such, it is important that meetings are scheduled on a regular basis (as shown in Appendix 1).

Client Meetings will be held on a weekly basis or as needed. Meetings will typically be two hours in duration or as long as required. In attendance will be all team members and a representative of SNC Lavalin. Topics to be discussed are:

- How the project is moving forward
- Issues concerning progress of the project
- Responsibilities of the team
- Specifications of the design
- Information concerning the cost of the project

Meetings with professors will be held once a week or as required. Meetings will typically be less than an hour in duration or as long as required. In attendance will be all team members and Dr. Bruneau. Topics to be discussed are:

- Progress of project process
- Issues concerning progress
- Responsibilities of the team
- Specifications of the design
- Information concerning the cost of the project
- The relationship between the client and the team

Meetings to consult with various professors will be scheduled as needed.

Team Meetings will typically be held three times a week. Meetings will be an hour in duration or as long as required. In attendance will be all team members. Topics to be discussed are,

- Responsibilities of each member of the team
- Specifications of the design of the project
- Information concerning the cost of the project
- Upcoming goals and deadlines
- Designating responsibility
- Set upcoming meetings

3.2.2 Reporting

Reporting will be maintained on a regular basis via weekly progress reports. These reports are to be passed in to the instructor and consist of the following information:

- Status of major past, present, and future tasks
- Updated version of schedule
- Changes to the project
- Issues with the project
- Statement of targets for upcoming week(s)

3.3 Cost Estimating Strategy

Our team plans to use RS Means software as a guide for producing unit costs associated with the cost estimate. However, we are aware that using RS Means software has potential for inaccuracy so where applicable, we plan to contact various contracting companies. Utilizing contractor's estimating knowledge will ensure that we obtain an accurate unit cost list. We will strive to only use RS Means software if we cannot attain necessary information from these companies.

3.4 Trouble Shooting

Not all problems that arise can be foreseen so thought into dealing with unexpected problems is important. The first step to solving unforeseen problems will be to address the problem within the team and consider an appropriate solution. The team will have tutorials for using software packages, numerous resources from the library, and previous design experience that may help to eliminate any problems that arise. If problems remain, the team will enlist the experience of the civil department's engineering professors. The team can also communicate with the client on matters that specifically relate to the project, if a solution is not readily available. Overall, problems will be eliminated through the use of available resources.

4.0 Tasks

4.1 Task Flow Chart

The Design of the Ore Crushing Facility contains five main tasks:

- Analysis of Design Criteria
- Design of Structure
- Design of Foundation
- Architectural Selection
- Cost Estimate

Before overall design of the building is initiated, research and data collection for the project is required. This includes setting an appropriate building size which takes into account the machinery characteristics (size, turning radius, etc.) and stock pile characteristics (area, height, etc.). Another aspect to consider is the safety requirements to be followed during the design phase. Typical weather patterns for the area are required for determining relevant loads the building will experience throughout its design life. These may include:

- Snow Loads
- Wind Loads
- Rain Loads

Designing the Structural Framing System is the next step of the project. The first subtask is to select an appropriate system for the given scenario. Next is to perform both Design Load Analysis and Software Analysis of the structure. Once the electronic model of the structure is complete, the final drawings of the system can be created. Our group will be following the order illustrated below for drawing creation:

As a group, we believe it is more efficient to complete the structure drawings directly after the electronic model of the structure and complete the foundation drawings after the

electronic model of the foundation is complete. This process would mitigate confusion by following a logical flow from structure design to foundation design.

For foundation design, three main subtasks must be completed:

- Foundation Selection
- Design Load Analysis
- Foundation Dimensions and Reinforcement

Our group will determine the type of foundations needed for the building prior to determining the design loads. Following selection of foundation type and design loads, the foundation dimensions and reinforcement will be determined through software analysis and compared with hand calculations. Included in foundation dimensions and reinforcement will be the calculation of the slab on grade and retaining wall dimensions and reinforcement.

The last component of the building design is Architectural Selection. This contains all subtasks which do not affect the overall stability of the structure and include:

- Siding
- Roofing
- Finishes

Once the design is complete, our main objective is to produce a cost estimate. This includes measuring the quantities of all materials used, producing an appropriate and accurate unit cost list, and calculating the total cost of our project.

We believe that closely following our flow chart objectives will produce accurate results and ensure the project is completed in an efficient manner.

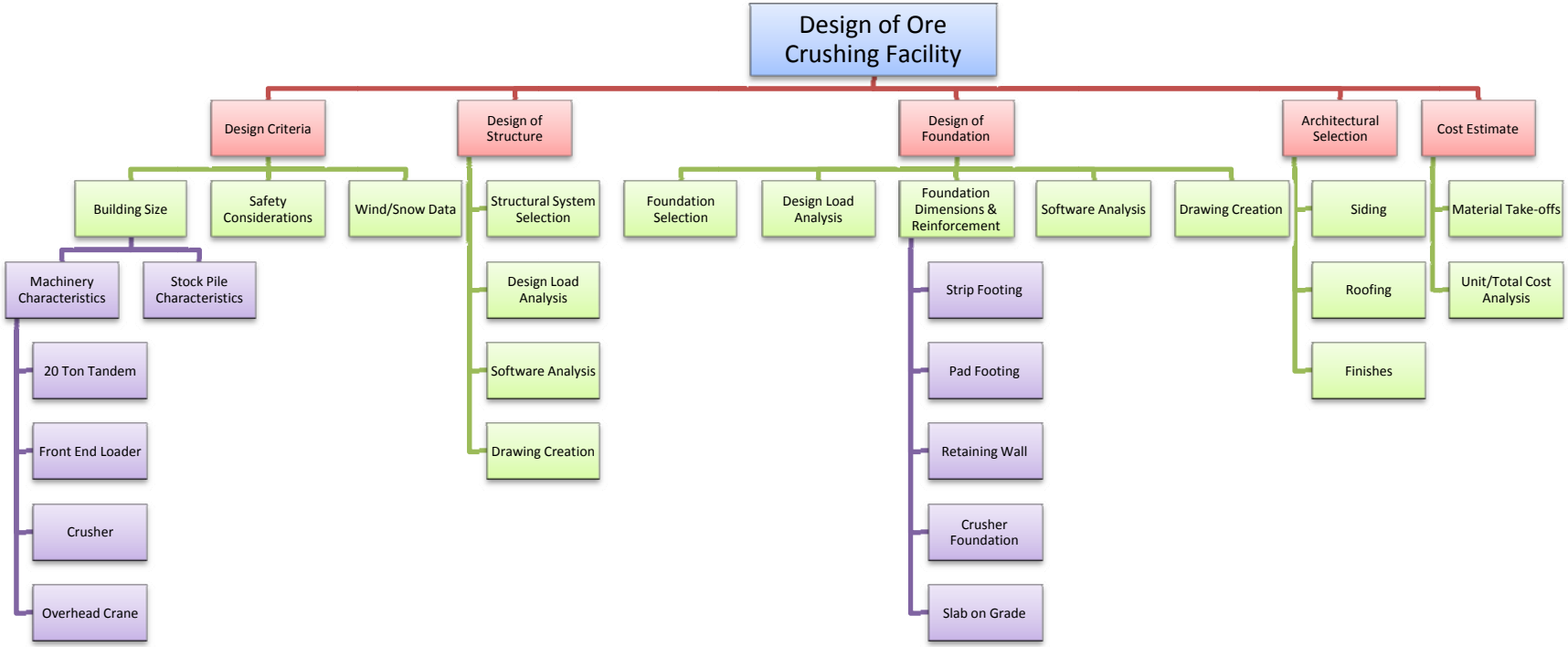


Figure 4-1: Flow Chart

4.2 Task Matrix

The individual task matrix delineates primary and sub tasks into work that can be completed by an individual group member. The matrix assigns an individual to each task and illustrates what resource they will utilize to complete the associated task. The software required throughout this design project will include:

- S-Frame and S-Steel
- Structure Point (SP-Mats, SP-Walls, SP-Column)
- RS-Means
- Auto-CAD

S-Frame and S-Steel will be used to complete the structural aspects of the building design, RS-Means will aid in the production of the cost estimate, and detailed drawings will be drafted in Auto-CAD. Different programs included in the Structural Point software will be used to assist with the design of the various concrete foundation sections. All software analysis will be compared against hand calculations. Currently, the availability of Structure Point software is unconfirmed; therefore, if we are not granted access to this software, we are prepared to complete all calculations by hand. However, it is confirmed that all other mentioned software is available.

Consultation with the civil engineering staff will be utilized throughout the design process. We anticipate utilizing the following instructors:

- Dr. Adluri for consultation regarding steel connections
- Dr. Hussein for assistance with concrete design
- Dr. Snelgrove for discussion regarding construction methods during cost estimation

Information provided by the client will be applied throughout the design process. Guidance will be required from the client in the architectural stage of the project.

To ensure efficiency of the project, group members with experience in a particular task will lead on those aspects of the project. To achieve optimal learning experience from the design project, no individual group member will complete every subtask under a given project task. As illustrated in the personnel distribution column of the task matrix:

- Jarrod Evans will lead the foundation and footing design
- Kayla Parsons will draft majority of drawings
- Glenn Finlay will lead the cost estimate
- Karl Hartmann will perform the majority of structural analysis

Primary Tasks	Individual Tasks	Personnel				Resources Utilized
		Glenn	Kayla	Karl	Jarrod	
Design	Research Front End Loader Char's	x				CAT Document
Criteria	Research 20 Ton Tandem Truck Char's		x			Online Resource
	Area Allowances for Misc Building Req's	x				Client Supplied Data
	Research Crusher Char's				x	Documentation From Client
	Determine Overhead Crane Req's				x	Client Supplied Data
	Determine Wind/Snow Data			x		NBC 2005
	Determine Safety Req's		x			NBC 2005
	Determine Stock Pile Char's	x				Client Supplied Data
	Determine Optimal Size of Building	x	x	x	x	Use Previous Task Findings
Design of	Sketch General Argmt of Structure				x	Hand Sketch
Structure	Determine Design Loads				x	NBC 2005
	Software Model Creation			x		S-Frame
	Software Analysis of Structure			x		S-Frame
	Interpret/Verify Software Results	x				Consult Dr. Hussein
	Structural Drawing Creation		x			Auto-CAD
	Selection of Structural System	x	x	x	x	Consult Dr. Hussein
Design of	Determining Design Loads		x			NBC 2005
Foundation	Design Strip Footings			x		SP-Mats
	Design Pad Foundations		x			SP-Mats
	Design Retaining Wall				x	SP-Walls
	Select Pillar-Column Connection			x		Consult Dr. Adluri
	Design Pillars	x				SP-Column
	Design Crusher Foundation	x			x	SP-Mats
	Design Slab on Grade			x		SP-Mats
	Design Main Foundations				x	Consult Dr. Hussein
	Footing/Foundation Drawing Creation		x			Auto-CAD
	Determined using Previous Tasks	x	x	x	x	Use Previous Task Findings

Primary Tasks	Individual Tasks	Personnel				Resources Utilized
		Glenn	Kayla	Karl	Jarrod	
Architectural	Selection of Siding	x				Client Supplied Data
Design	Selection of Roofing		x			Client Supplied Data
	Selection of Perlins		x			Client Supplied Data
	Design Door Framing				x	Client Supplied Data
	Design of Stairs			x		Client Supplied Data
	Design of Gutter/Drainage System	x				Client Supplied Data
	Misc. Installations				x	Client Supplied Data
Cost	Material Take-offs	x				Use Design Drawings
Estimate	Unit Cost Analysis	x				RS-Means
	Total Cost Analysis			x		Use Previous Task Findings

Figure 4-2: Task Matrix

5.0 Schedule

5.1 Description of Schedule

5.1.1 Design Criteria

This component of the work plan consists of collection of necessary data and information required to commence subsequent phases of the work plan. This stage also includes ensuring the group attains access to necessary software and design guidelines required to complete the project. Sizing of the building will be completed at this stage based on ore storage, equipment manoeuvrability, equipment clearance, and allowances for miscellaneous items.

5.1.2 Design Loads

The task involves calculation of dead, live, snow, wind and (potentially) seismic loads expected to act on the Ore Crushing Building. The design loads will be calculated through the use of previous researched data in conjunction with applicable guidelines.

5.1.3 Selection of Structural System

In this task we will look at structural system options and select one that is economical, practical, and satisfies the loading configuration applied on the structure.

A sketch of the general arrangement of the structure, with member lengths and support conditions, will be prepared for use in modelling and drafting.

5.1.4 Model Creation

This item includes inputting the structure geometry and previously calculated loading configurations into S-Frame and sizing structural members using S-Steel. Forces throughout the structure will be compared with hand calculations.

5.1.5 Structural Drawing Creation

This phase of the work plan involves drafting the structure with AutoCAD as it has been designed in previous tasks.

5.1.6 Selection of Foundation

Loads expected to be supported by the foundation will be obtained from the structural model and from the Design Criteria task (weight of ore, equipment, crusher etc.) and used in determining the appropriate footing type to support them. Safety, serviceability and economy will all be taken into consideration in the foundation selection process.

5.1.7 Analysis of Foundation

Design of the foundation will proceed with the use of S-Concrete, SP-Column, SP-Mats, and SP-Wall given that we will have access to them. In the event that these programs are not available to us, design will proceed by hand with use of the Concrete Design Handbook.

5.1.8 Foundation Drawing Creation

This phase of the work plan involves drafting of the foundation with AutoCAD as it has been designed in previous tasks.

5.1.9 Architectural Selection

This task includes selection of architectural components of the structure (siding, stairs, finishes etc.) to ensure delivery of a complete product to the client.

5.1.10 Quantity Takeoffs

This portion of the work plan requires drawings and dimensions completed from previous tasks to ensure accurate quantity calculations.

5.1.11 Unit/Total Costs

Using the quantities obtained in the previous task and unit prices, we will arrive at a final cost estimate for delivery to the client.

5.2 Use of Schedule

The schedule will be used as a loose guideline to ensure tasks are completed in a manner conducive to early completion of the project, allowing us to allot time for review of the work and preparation for the presentation. The schedule will be presented to our client along with progress reporting at our weekly client meetings. Weekly reports will include a short summary of work completed during the previous week and should also include explanations for any deviations from the schedule. Following weekly meetings, the schedule changes will be updated and future weeks will be adjusted based on current information at the time of the update.

		January				February																										March										
Task	Dur.	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	1	2	3	4	5	6	7	8	9	10	11
Design Criteria	4																																												
Design Loads	1																																												
Selection of Struct Sys	3																																												
Model Creation	3																																												
Struct Drawing Creation	7																																												
Selection of Footing	1																																												
Analysis of Foundation	7																																												
Found Drawing Creation	7																																												
Architectural	3																																												
Quantity Takeoffs	4																																												

Figure 5-1: Schedule

6.0 Costs

The associated costs of successfully completing this project are expected to be minimal. The costs of the project include transportation to and from meetings, printing drawings, and printing and binding reports. There will not be any costs associated with testing, computer software, or site visits (as we cannot visit the site location).

ITEM	EST. COST
Transportation	90.00
Printing	50.00
Binding	40.00
Total	**180.00**

Figure 6-1: Cost Table

7.0 Deliverables

Deliverables to be expected upon successful completion of the project include both hard and soft copies. The hardcopies of deliverables include the work plan, technical drawings for the structural, civil, and architectural design; quantity-take offs, cost estimate, and the final report. The softcopies of deliverables are to be submitted in a PDF format and include technical drawings, quantity-take offs, cost estimate, final report, all models, and the final presentation. All submitted deliverables to the client and the instructor shall be done both in person and via email.

8.0 Risks

Risk associated with the successful completion of this project includes the availability of software, availability of information, and the time constraints. All software that the team wishes to use in designing the project may not be readily available due to costs. This risk will be adverted through using hand calculations. Information between the client and team may not always be readily available due to unforeseen issues or vacations. This risk will be minimized through proper planning and organization to address all issues as early as possible. The time constraint on the project may prove challenging, however, proper planning and time management will help to minimize this risk.

9.0 References

[1] Bruneau, S. E. (2011). *Final Year Capstone Design Project Course Guide for Students and Clients – ENGI 8700. Fourth Edition.*

[2] National Research Council of Canada. (2005). *National Building Code of Canada 2005.*

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

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

Appendix 1 – Calendar of Events

January 2012 Calendar of Events

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4	5	6 Team Meeting	7
8	9 Business Meeting Team Meeting SNC Meeting	10	11 Team Meeting Submitted SOQ	12 Match Night	13 Team Meeting	14
15	16 Business Meeting Team Meeting SNC Meeting	17	18 Team Meeting	19	20 Team Meeting	21
22	23 Business Meeting Team Meeting SNC Meeting	24	25 Team Meeting	26	27 Team Meeting Submit Work Plan	28
29	30 Weekly Report Business Meeting Team Meeting SNC Meeting	31 Design Criteria				

February 2012 Calendar of Events

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1 Team Meeting Design Loads	2	3 Team Meeting	4 Select Struct Sys.
5	6 Weekly Report Business Meeting Team Meeting SNC Meeting	7 Struct Model Creation	8 Team Meeting	9	10 Team Meeting	11
12	13 Weekly Report Business Meeting Team Meeting SNC Meeting	14 Struct Dwg Creation	15 Team Meeting Select Footing	16	17 Team Meeting	18
19	20 Break	21 Break	22 Break Analysis of Fnd.	23	24 Team Meeting	25
26	27 Weekly Report Business Meeting Team Meeting SNC Meeting	28	29 Team Meeting Fnd. Dwg. Creation			

March 2012 Calendar of Events

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1	2 Team Meeting	3 Architectural
4	5 Weekly Report Business Meeting Team Meeting SNC Meeting	6	7 Team Meeting Quantity Take Offs	8	9 Team Meeting	10
11	12 Weekly Report Business Meeting Team Meeting SNC Meeting	13 Unit Total Cost	14 Team Meeting	15	16 Team Meeting	17
18	19 Weekly Report Business Meeting Team Meeting SNC Meeting	20	21 Team Meeting	22	23 Team Meeting	24
25	26 Weekly Report Business Meeting Team Meeting SNC Meeting	27	28 Team Meeting	29	30 Team Meeting	31

April 2012 Calendar of Events

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2 Submit Final Report	3 Final Presentation	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Appendix 2 – Summary of Qualifications

SUPERIOR • CONSULTING

...Providing Superior Results

OUR•VISION

Superior Consulting is dedicated to working closely with the client to achieve an optimal solution. Maintaining the highest level of professionalism, integrity, efficiency and safety in our relationships with clients.

OUR•TEAM

Experience in civil design and offshore oil and gas projects.

Knowledge of project management and cost estimating procedures.

Supported improvement initiatives required by the Integrity Management Program for the SeaRose FPSO.

Kayla Parsons

Construction knowledge in the earthworks, highway, concrete, and heavy civil fields.

Practical experience gained from exposure to a variety of work environments.

Familiar with Project Management and Cost Estimation.

Glenn Finlay

OUR•TEAM

Experience in Marine Structural Engineering, Environmental Site Assessments and Remediation.

Enjoy problem solving and finding creative solutions to challenges.

Interested in incorporating environmental best practices into future work.

Karl Hartmann

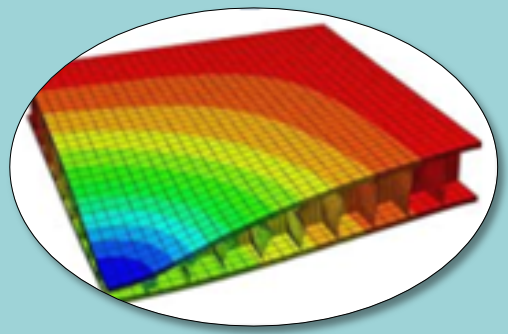
Jarrod Evans

Experience working with companies in the municipal, heavy civil, and construction industry.

Knowledgeable in technical writing, design of municipal systems, and cost estimates.

Inter-personal skills required to complete work within in a professional manner.

EXPERIENCE • WITH



<u>Employers</u>

SNC Lavalin

Newfoundland Power

Husky Energy

Stantec

Nalcor

CBCL Ltd.

Tiller Engineering

HJ O'Connell

AMEC Earth & Environmental

Pennecon Heavy Civil Ltd

Transportation & Works

Department of Municipal Affairs

<u>Software</u>

SAP

EaglePoint

S Steel

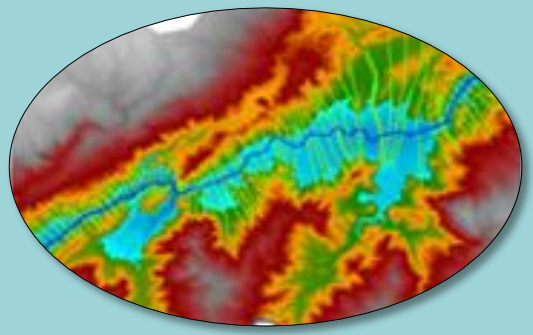
HEC-RAS/HMS

Microsoft Office

S Frame

ABAQUS

AutoCAD



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