UBC Social Ecological Economic Development Studies (SEEDS) Student Report

Life Cycle Assessment of The Civil and Mechanical Engineering Building Cayley Van Hemmen University of British Columbia CIVL 498C November 18, 2013

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PROVISIO

This study has been completed by undergraduate students as part of their coursework at the University of British Columbia (UBC) and is also a contribution to a larger effort – the UBC LCA Project – which aims to support the development of the field of life cycle assessment (LCA).

The information and findings contained in this report have not been through a full critical review and should be considered preliminary.

If further information is required, please contact the course instructor Rob Sianchuk at rob.sianchuk@gmail.com



Life Cycle Assessment of The Civil and Mechanical Engineering Building

CIVL 498C: Life Cycle Assessment University of British Columbia

Due: November 18, 2013

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1.0 Executive Summary

This report contains an in-depth Life Cycle Analysis of the Civil and Mechanical Engineering (CEME) Building at the University of British Columbia in Vancouver, British Columbia. The life cycle analysis scope includes the envelope and structure of CEME from cradle to gate, that is, from the building's product manufacturing to end of construction stage.

The methods used to achieve a detailed analysis included contributions from two authors. The first author included a thorough on screen takeoff of CEME's level three elements including foundations, walls/floors above and below grade, roof structure and interior partition walls. The second contributor then assessed the quality of the initial study and made improvements to the accuracy of that study. An impact assessment was then performed on each element to determine its contribution by impact category to overall impacts for CEME as a whole. The results of the impact assessment were then compared to 22 other institutional buildings at UBC to determine how CEME equated.

It was determined that CEME's had less of an environmental impact than the majority of other buildings at UBC as it's impact category values were lower than the benchmark's value. Furthermore, CEME's level three element "A23 Upper Floor Construction" contributed the most in all seven impact categories included in the Athena Impact Estimator. Finally, it was discovered that the product stage had a larger impact that the construction stage for all level three elements, it was approximately 80-90% larger in all cases.

This report also includes interpretations of the results such as recommendations for LCA use to be put in practice and an author's reflection of the project and CIVL 498C as a whole.

2.0 General Information on the Assessment

1.1 Purpose of the assessment

The purpose of this assessment is to evaluate the environmental performance of the Civil and Mechanical Engineering Building (CEME) throughout the life cycle of the building. Its intended use is to be used as a tool to evaluate what the main sources of environmental impact in an institutional building's design are and to investigate how to reduce a building's impact. Furthermore this study can be used as a materials inventory for CEME. Policy makers can also use the study to help influence the decisions they make when establishing new sustainability guidelines for new construction to be performed at UBC.

The study is intended for comparative assertions as it compares the environmental performance of the CEME building next to 22 other academic buildings located on campus at UBC. The function the buildings have in common is square footage and their environmental impacts will be compared to each individual building, as well as the benchmark value.

The intended audience for this study is the University of British Columbia, other academic institutions and industry professionals. Industry professionals can include institutional building owners, engineers, architects and building developers who are interested in learning about how to perform an Life Cycle Assessment on new construction or learn more about the Life Cycle Assessment process for buildings in general. It can further be used by any individuals involved in the developmental planning department or policy making at UBC as a reference tool.

In terms of comparing CEME to other buildings at UBC, the level of detailed required for each building will vary according to the individual performing each separate LCA study. Some individuals will have more detailed and accurate models due to the level of information available to them, while others will not as the are working with older drawings. Because this report will be for UBC planning purposes only, the benchmark value will contain a variety of very detailed reports and undetailed reports. As the average value is taken, the level of detail required should be as detailed as the user can make it with the information they have available. This model of CEME has been improved from the previous LCA study, and is as thorough as it can be with the information that was available.

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1.2 Identification of building

The Civil and Mechanical Engineering building is approximately 111, 159 square feet and is divided into five sections, Areas 1, 2, 3, 4, 5. Table 1 below describes the purpose of each of the five sections. The building itself cost \$6.7 Million dollars when it was constructed and was completed within two years from 1974 to 1976. The net present value of the construction is \$16, 720, 000. The calculations for this number can be found on the attached excel spreadsheet. The architect and engineers who conducted the design process was Philips, Barnett, Architects and Engineers.

Area	Building Intended Use
1	Mechanical Engineering Laboratory and Shops.
2	Mechanical Engineering Laboratory and Offices.
3	Common Facilities
4	Civil Engineering Laboratory and Offices
5	Pollution Control and Surveying

Table 1 - Description of CEME's 5 Areas

The building is located at 2002 – 6250 Applied Science Lane, Vancouver, BC, Canada, V6T 1Z4. The primary use of the CEME is as an institutional learning facility for civil and mechanical engineering students, office space for civil and mechanical engineering professors as well as an administrative building for the two faculties respectively. There are nine classrooms in the building, twenty-nine laboratories, seventy-two offices and eight large multipurpose study spaces/workspaces. There are four different types of laboratories in the building: soil, environmental, mechanical and computer. The five sections can be divided into 4 categories, basement, main floor, upper floor and penthouses. The penthouses are used mainly for mechanical purposes.

CEME's structure can be described as concrete columns supporting concrete beams, which support a precast T-Beam joist floor. The exterior walls are made of predominantly pre-cast concrete panels and concrete block walls. The interior walls are made up of a variety of concrete block, wood stud and steel stud walls. The window glazing is assumed to be standard with aluminum frames and insulated steel stud wall panel with asbestos. 1" insulation and asphalt roofing for a precast concrete t-beam is assumed for the roof structure.

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1.3 Other Assessment Information

Table 2 listed below provides a summary of assessment information.

Client for Assessment	Completed as coursework in Civil Engineering
	technical elective course at the University of
	British Columbia.
Name and qualification of the assessor	<u>First Author</u>
	Cayley Van Hemmen – Civil Engineering Student
	2013
	Second Author
	Tyler Algeo – Civil Environmental Engineering
	Student 2011
Impact Assessment Method	Impact Assessment Method:
	Mid Point Impact Estimation Method TRACI,
	Version 2012 (Tool for the Reduction and
	Assessment of Chemical and Other Environmental
	Impacts)
	Impact Estimator:
	Athena Impact Estimator Version 4.2.0208
Point of Assessment	37 years.
Period of Validity	5 years.
Date of Assessment	Completed in December 2013.
Verifier	Student work, study not verified.

Table 2 - Summary of CEME's Assessment Information

3.0 General Information On The Object of Assessment

2.1 Functional Equivalent

ISO14044 defines a function unit to be "A performance characteristic of the product system being studied that will be used as a reference unit to normalize the result of the study." Essentially it is a unit that defines and quantifies what is being produced by the product system as a whole in respect to inputs and outputs in the Life Cycle Assessment Study. It defines the function one measures the performance of a system over. The most common functional unit to use to incorporate an entire building is meters squared of floor area, which was used in this assessment. Functional units are important for this intended application of CEME's LCA as LCA is commonly used as a decision-making support tool in the design process. The function unit is very important when comparing one building to another building, as it is the normalizing factor between them when comparing impacts. Therefore, if a policy maker were deciding on how large to construct a building, they would consider the function unit of CEME's functional equivalent.

Aspect of Object of Assessment	Description
Building Type	 CEME is an institutional building containing: Office Spaces Classroom Spaces Multipurpose Rooms / Study / Workspaces Soil and Environmental Laboratories Computer Laboratories Mechanical Laboratories Penthouses
Technical and Functional requirements	Not a LEED Building therefore do not need to meet and special regulatory requirements. However, building was required to meet the National Building Code and the BC Building Code ¹ , which was established in 1973.

¹ Author Unknown - Office of Housing and Construction Standards (2013). *History of British Columbia Regulations*. Retrieved from <u>http://www.housing.gov.bc.ca/pub/regHistory.pdf</u>

The client specifically requested the following building	
requirements that are unique to CEME:	
- A "Civil Engineering Design Studio" within the	
building to give students the opportunity to work	
together and collaborate in groups to mirror the	
industry working environment. ²	
- Environmental/Soil/Mechanical Laboratories to	
teach various subjects such as solid waste	
management, geotechnical and environmental	
engineering principles. ³	
Design Occupancy	
The design drawings do no specify the design number of	
building occupants. However, as per UBC classroom	
services, the current capacity for rooms 102, 1202, 1204,	
1206, 1210, 1212, 1215 is approximately 303 occupants. ⁴	
This number does not include the administrative offices or	
laboratories. A more accurate representation would be	
around 600 but this is approximate.	
Pattern of Use	
The building was designed for maximum occupancy during	
weekdays between the building hours of 07:00 – 23:00.	
The building service life was not specified on the drawings	
and the information is not listed on the UBC classroom	
services website. Therefore as per	
www.technicalguidelines.ubc.ca it states all key building	

² University of British Columbia (2013). *Civil Engineering Design Studio For Undergraduate Students*. Retrieved from http://www.civil.ubc.ca/about/facilities/designstudio.php

³ University of British Columbia (2013). *Environmental Laboratory*. Retrieved from http://www.civil.ubc.ca/home/env_lab/

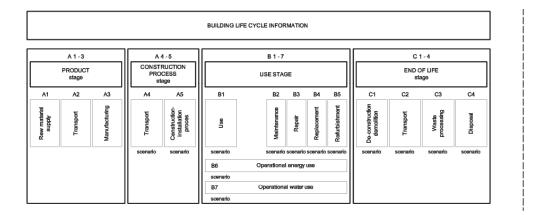
⁴ University of British Columbia (2013). *Buildings and Classrooms, Civil and Mechanical Engineering*. Retrieved from <u>http://www.students.ubc.ca/classroomservices/buildings-and-classrooms/?code=CEME</u>

envelopes should have a service life of 100 years unless it is
a temporary structure. In this case, it is not. ⁵

Table 3 - Functional Equivalent With Respect To CEME

2.2 Reference Study Period

The required service life for CEME is assumed to be 100 years, as it is not explicitly stated on the drawings. 100 years is a typical value for institutional buildings. For our LCA model however, it is assumed the service life of CEME to be set to 1 year, as the study is a cradle to gate assessment. This is because the life Cycle Inventory Assessment results focus on only the manufacturing/transportation/installation of materials in the building's construction. This will allow the maintenance and operational energy, end-of-life states and supplementary information beyond the building life cycle to be excluded from the buildings life cycle assessment scope. The replacement rates for building materials were not included in scope as



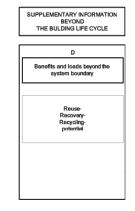


Figure 6 — Display of modular information for the different stages of the building assessment

Figure 1 - Display of Building Cycle Information

they were not part of CIVL 498C. Those three excluded states are shown below as categories B, C, and D.

2.3 Object of Assessment Scope

The scope of this study is assumed to be the entire product system of CEME including its structure, envelope and operational energy. This includes all structures from the foundations to

⁵ University of British Columbia (2013). *Performance Objectives*. Retrieved from http://www.technicalguidelines.ubc.ca/technical/performance_obj.html

the roofing. There are no deviations from the scope that are excluded. In order to ensure the cradle-to-gate scope is accurate, the LCA encompasses associated transportation affects, the manufacturing of the materials and the construction of the overall structure/envelope. It was decided to use CIQS (Canadian Institute of Quantity Surveryors) as it is a Canadian standard format. Each element is a major component that fulfills the same function in every building. The system divides the elements into 4 categories: Level 1 'Major Elements', Level 2 'Group Elements', Level 3 'Elements', and Level 4 'Sub-Elements.' ⁶ For this project, only Level 1 elements 'Shell' and 'Interior Materials' are included. The elements chosen can be shown in the

Level 1	Level 2	Level 3
A SHELL	A1 SUBSTRUCTURE	A11 Foundations
	A2 STRUCTURE	A21 Lowest Floor Construction
		A22 Upper Floor Construction
		A23 Roof Construction
	A3 EXTERIOR ENCLOSURE	A31 Walls Below Grade
		A32 Walls Above Grade
B INTERIORS	B1 PARTITIONS & DOORS	B11 Partitions

Figure 2 - CIQS Elements Division For CEME

Figure 2. These elements were specifically chosen as they only include the shell and envelope of the building. The remaining interior Level 2 elements (Finishes, fittings and equipment) were excluded accordingly. Furthermore, The Level 1 elements, 'C - Services', 'D - Site and Ancillary Work' and 'Z - General Requirement' either fit into the Operation and Maintenance of the building which is not part of the scope of this cradle to gate assessment, or were not applicable. As stated earlier, CEME contains two floors, the main floor on grade as well as an upper second floor. The building also includes a basement and a couple penthouses. All building foundations support this structure. The table below describes in further detail what in contained in each CIQS section for the scope of this project.

⁶Sianchuk, R. (2013). CIQS Elemental Format. Retrieved from http://civl498c.wikispaces.com/file/view/Final%20Project_CIQS%20Elements_071013.pdf/457652562/Fin al%20Project_CIQS%20Elements_071013.pdf

CIVL 4	198C Level 3 Elements	Description	Quantity (Amount)	Units
		 All column footings (F.1-31, f.Str, f.ramp) All strip footings (f.A., f.B., f.B./C/E/E 		m²
A11	Foundations	 All strip footings (f.A, f.B, f.B/C/E/F, f.B/C/E/F-2, f.C, f.D, f.G, f.J, f.JJ, f.JJJ) 	6555.4	111
A21	Lowest Floor Construction	 Concrete Slab On Grade (First Floor Construction In CEME) 	6555.4	m²
A22	Upper Floor Construction	 Concrete Slab (Second Floor CEME) IConcrete Precast Double T (Second Floor CEME) Columns and beams supporting the first and second floors 	7006.0	m²
A23	Roof Construction	 Open Web Steel Joists (Roof Structure) Concrete Precast Double T (Roof Structure) Columns and beams supporting the roof. 	4286.0	m²
A31	Walls Below Grade	 All basement walls were determined to be only exterior. 	447.1	m²
A32	Walls Above Grade	 All remaining exterior walls (excluding basement walls) Includes extra basic materials in the window frames surrounding the building. 	6055.0	m²
B11	Partitions	 All interior walls (There were no basement interior walls) 	9363.3	m²

Table 4 - CEME's Building Definition

3.0 Statement of Boundaries and Scenarios Used In This Assessment

3.1 System Boundary

The system boundary includes the unit processes, geographical area and time period we are studying. For the assessment of CEME, the life cycle modules included are the A1-3 Product Stage and the A4-5 Construction Process Stage. The table below Illustrates a general overview of what upstream and downstream processes support these modules over the reference study period.

		UPSTREAM PROCESSES	DOWNSTREAM PROCESSES
A1-3	A1	- At this point the	- Disposal of wastes
Product Stage	Raw Material	material enters the	that result from
	Supply	system boundary.	extraction of raw
		- Searching For Raw	materials.
		Materials	
		- Investigative work for	
		resources.	
	A2	- Preparing materials for	- Receiving materials
	Transport	delivery to	and processing
		manufacture. (EX.	them. (EX.
		Wrapping in Styrofoam	Removing
		for protection etc.)	packaging)
	A3 Manufacturing	 Preparing materials for manufacturing (Ex. Cutting lumber etc.) 	 Disposal of excess material wastes due to manufacturing
			process.
A4-5 Construction Process Stage	A4 Transport	 Preparing materials for delivery. 	- Receiving materials on the construction site.
	A5	- Moving materials	- Disposal of
	Construction	when ready for	construction waste
	Installation Process	installation.	and excess
		- Preparation work	materials.
		before installation –	- At this point the
		EX. Installing	material leave the
		formwork for concrete slab.	system boundary.

Table 5 - CEME Upstream and Downstream Processes

3.2 Product Stage

The process information included for the product phase includes extraction of raw materials, manufacturing of products, generation of the energy input, production of ancillary materials, packaging, transportation up to production gate and construction site, collection and transport of waste, and waste management.

3.2.1 Extraction of Raw Material Production

LCI data collection includes impacts associated with the extraction of raw materials. It includes all impacts such as emissions to air, water and land from the extraction phases. For example, all activities that are associated with mining a resource will be encompassed, such as the technique of separating valuable ore from waste. Transportation of the raw material extracted to a manufacturing plant is also included in this phase. It is important to note that some land impact measures cannot be addressed, such as loss of biodiversity, because of its complexity and the fact it is already tracked by other regulatory bodies.⁷

3.2.2 Manufacturing of products

Athena states the manufacturing stage begins with the delivery of resources to the manufacturing plant and is finished when the product is ready to be transported to the next stage. Let it be aware that the Athena LCA Impact Estimator combines the resources extraction and manufacturing stage for simplicity when reporting results.

3.2.3 Generation Of Energy Input

The method of refining is a good example that illustrates effect of the amount of generation of energy input depending on the material in the product stage. For example, steel made in integrated plants requires more energy to make than if steel was made in mini-mills from scrap feedstock energy.⁸

3.2.4 Production of Ancillary Materials

Production of ancillary materials can also be included in the life cycle of a product depending on the system boundary. For example, in the production of corrugated packaging, containerboard

⁷ Athena Sustainable Building Materials Institute (2013). *Technical Details*. Retrieved from http://www.athenasmi.org/resources/about-lca/technical-details/

⁸ Markus Engineering Services, Athena Sustainable Building Materials Institute (2002). Cradle to Gate Life Cycle Inventory: Canadian and US Steel Production By MIL Type. Retrieved from http://www.athenasmi.org/wp-content/uploads/2011/10/1_Steel_Production.pdf

mills ancillary inputs such as wood and paper pulp, pulping and bleaching chemicals and wood fiber production are included.⁹

3.2.5 Packaging

Packaging is also included in various LCA modules depending on the material being produced. For example, particleboard is packaged and stacked in a warehouse before it is shipped to site. The material used to package it and the energy required to package it is all included in the production stages.¹⁰

3.2.6 Transportation Up To Production Gate

Transportation to the production site usually is one of the larger contributors to the production module stage. As per the exercise in CIVL 498C, it was evident that by speeding up the transportation process the material would be delivered much faster and more likely to use less waste. Transportation is also included in the production module, but only encompasses the emissions that come from the transportation from the manufacturing plant to the construction site.

3.2.7 Collection and Transport of Waste and Waste Management Processes.

Collection, transport and disposal of waste is usually included in the manufacturing models. For example, an LCA of particleboard includes all processes involved in the transportation of on-site waste at the production plant.¹⁰ Furthermore, the impacts associated with waste disposal are included and are outlined in "Section 3.3.4 – Waste Management Processes In Construction Stage"

3.3 Construction Stage

The process information included for the construction phase accounts for the following four categories: transportation from manufacturing stage, storage of products, installation and waste management.

⁹ PE-Americas, Five Winds International, Corrugated Packaging Alliance (2010). *Corrugated Packaging Life Cycle* Assessment Summary Report. Retrieved from

http://www.corrugated.org/upload/LCA%20Summary%20Report%20FINAL%203-24-10.pdf

¹⁰ Athena Sustainable Materials Institute (2013). A Cradle-to-Gate Life Cycle Assessment of Canadian Particleboard – 2013 Update. Retrieved from http://www.athenasmi.org/wp-content/uploads/2013/10/CtoG-LCA-of-Canadian-PB-Update.pdf

3.3.1 Transportation From The Manufacturing Gate to the Construction Site

The effect of transportation of materials from the manufacturing gate to the construction site will only have a large impact if the material being delivered is widely available. For example, the transportation impact will be very low for concrete as concrete is produced in a large number of locations. However, specialty items that are only produced in one city will have a large transportation effect as it will have to specially be either shipped in by train or by airplane depending on the construction sites location.¹¹ All of the transportation distances are based on regional surveys and therefore will account for differences in location.¹²

3.3.2 Storage of products, including the provision of heating, cooling, humidity etc.

Depending on where the construction is taking place, heating/cooling might be required for materials on site. Athena takes this into account as best it can, by accounting for the proportion of energy that will be needed for storage of materials. In the case of the concrete wall, if a slab-on grade were to be construction in a cold climate like Fort McMurray in the winter season, heating would be required during the casting and curing process. Athena accounts for the difficulties whether the wall will be constructed in cold climates below zero, so they factor a proportion of energy needed to heat concrete equal to the time of the year in that location where the temperature drops below zero. ⁷

3.3.3 Installation of the product into the building (including ancillary materials) and on site transformation of construction products.

The Athena impact estimator software also take into account all of the energy used to build and erect the element in the construction phase. For example, it will include all energy associated with building a cast-in-place concrete wall, such as assembling the formwork and rebar, and pouring the concrete. The database will include all transportation of materials, such as the energy it takes for on-site equipment to move rebar on site using either forklifts or cranes.⁷

3.3.4 Waste management processes on the construction site and waste handling until final disposal. The Athena Impact Estimator Software includes waste management in construction. Continuing from the early example of a concrete wall being construction, Athena takes into account that

¹¹ Athena Sustainable Materials Institute (2013). *Frequently Asked Questions – Impat Estimator For Buildings*. Retrieved from <u>http://calculatelca.com/fags/#ie4b_project_data</u>

¹² Athena Sustainable Materials Institute (2013). Athena Impact Estimator V 4.2 Software and Database Overview. Retrieved from <u>http://calculatelca.com/wp-</u> content/uploads/2011/11/ImpactEstimatorSoftwareAndDatabaseOverview.pdf (Page 19)

there will be approximately 5% of concrete lost due to spillage/dumping and also accounts for the approximate reuse of formwork until it has degraded to the point of waste. Assumptions of overall waste of materials are made, in the case of the concrete wall; it would be an overall 10% loss.⁷ The process includes all transportation energy factors for disposal as well.

4.0 Environmental Data

4.1 Data Sources

4.1.1 LCI Data Collection Overview

Typically LCI databases are developed by using input and output data on a material to create flow models that illustrate the activities of a product in its supply chain. Data is collected using survey questionnaires or representative industry data that include questions about a products inputs and outputs of the product that accounts for 99% of energy flows. The data is collected from a specific group of producers, typically middle of the line companies that are not the best or worst in their field, in order to get a more accurate representative model. Regional differences are accounted for in these databases.¹³

4.1.2 Athena LCI Database

Currently, Athena maintains their LCI database. They are an independent third-party separate from the NREL and build their database without any trade or government sources. Athena experts with background in LCA connect with the construction industry to conduct life cycle inventories on various products using survey questionnaires. Athena is unique in that they try to include all materials used in the construction of an item. For example, Athena collects information on not only a gypsum wallboard, but also information on the specific type of mud used for taping to finish the wallboard. Their LCI databases also include information on construction/demolition processes, transportation and energy use, as well as standard information on building materials.¹⁴

4.1.3 US LCI Database

The US LCI Database concept was developed on May 1, 2001 from a conference given by Ford Motors.¹⁵ It gained quick support and was created by an advisory group of 45 individuals who represented the following industries: Manufacturing, Government, Non-Government and LCA

¹³ Trusty. W, Athena Sustainable Materials Institute (2010). An Overview of Life Cycle Assessments: Part One of Three Retrieved from "Online Bulding Safety Journal" at <u>http://www.athenasmi.org/wp-</u> content/uploads/2012/05/BSJ overview life cycle assessment.pdf

¹⁴ Athena Sustainable Materials Institute (2013). *LCI Databases*. Retrieved from <u>http://www.athenasmi.org/our-software-data/lca-databases/</u>

¹⁵ National Renewable Energy Laboratory (2013). U.S. Life Cycle Inventory Databases. Retrieved from <u>http://www.nrel.gov/lci/about.html</u>

Experts. This advisory board came together to create a 20-page document outlining the development guidelines for the LCI database, including their goal of creating "publically available LCI data modules for commonly used materials, products and processes." In 2009, the NREL outlined a detailed plan to continue to improve the quality of the LCI Database by identifying the critical areas that needed improvement and created goals to improve that area. These goals are outlined in the figure below from the NERL website:

Project Management	Data Management	LCI Data	Communications
 Complete annual operating plan. Establish advisory boards. Develop a business plan. Partner with national and international efforts. 	 Define a data quality protocol. Revise data formats and protocols. Complete database updates. 	 Fill data gaps. Expand the database. Maintain current data. 	 Identify user needs. Develop a communications plan. Update Web site and project documents.

Figure 3 - US LCI Database Action Plan

Currently, the US LCI Database is run and managed by a two-man project management team from the National Renewable Energy Laboratory, Michael Deru and Alberta Carpenter, both of whom have professional backgrounds in life cycle analysis.¹⁶

4.2 Data Adjustments and Substitutions

The largest issue presented in this model was that it had no material specifications listed for any of the concrete/rebar used. These inconsistencies are laid out in the Annex D – Inputs and Assumptions section of the report. As it was assumed that the concrete was 25 MPa, but the impact estimator only allows the user to select either 20 MPa or 30 MPa, material substitutions were used to illustrate the difference in impacts in entering 25 MPa of concrete into the model instead of 20 Mpa. The process I used is described in the following 7 steps:

Step 1:Determine the impacts for the singular wall that is assumed to be 25 Mpa.This was done by showing the reports for the wall on the Athena Impact Estimator.

¹⁶ National Renewable Energy Laboratory (2013) *Project Management Team.* Retrieved from <u>http://www.nrel.gov/lci/project_team.html</u>

		PRODUCT		CON	STRUCTION PRO	CESS		USE	E			END OF LIFE			TOTAL E	FFECTS	
				Construction- installation			Replacement	Replacemen	Operational Energy Use							Operational	
Summary Measures	Manufacturing	Transport	Total	Process	Transport	Total	Manufacturing	t Transport	Annual	Total	Material	Transport	Total	Non-Transport	Transport	Energy Use	Totai
Fossil Fuel	26224.89093	936.0176704	27160.9086	3906.75483	1812.71658	5719.471418	0	0	0	0	2038.5357	689.962183	2728.49788	32170.1815	3438.69644	0	35608.8779
Consumption (MD)																	
Global Warming	2350.308751	67.84892541	2418.157676	301.757771	139.245807	441.0035782	0	0	0	0	137.025688	53.0753504	190.1010384	2789.09221	260.170083	0	3049.262293
Potential (kg CO2 eq)																	
Acidification Potential	12.34473961	0.328572734	12.67331235	2.40562785	0.64407239	3.049700239	0	0	0	0	1.83843593	0.24522314	2.083659067	16.5888034	1.21786826	0	17.80667165
(kg SO2 eq)																	
HH Particulate	4.642286683	0.010014124	4.652300807	0.24497403	0.01996085	0.264934886	0	0	0	0	0.04812862	0.00760299	0.055731617	4.93538934	0.03757797	0	4.97296731
(kg PM2.5 eq)										-							
Eutrophication	0.910352824	0.023585697	0.933938521	0.14271611	0.04648434	0.18920045	0	0	0	0	0.12247374	0.01770075	0.140174496	1.17554267	0.0877708	0	1.263313467
Potential																	
(ko N eo)	1.59969E-05	2.71222E-09	1.59996E-05	8.129E-07	5.5502E-09	8.18455E-07					5.9871E-09	2 44545 00	8.10249E-09	1.6816E-05	1.0378E-08		1.68262E-05
Ozone Depletion	1.59969E=05	2.71222E=09	1.59996E-05	8.129E-07	5.5502E-09	8.18455E-07	0	0	0	•	5.9871E-09	2.1154E-09	8.10249E-09	1.6816E-05	1.0378E-08	0	1.68262E-05
Potential (kg CFC-11 eq)																	
Smog Potential	131.7044974	11.62070249	143.3251999	73.4151703	22.7745485	96.18971884	0	0	0	0	65.2118287	8.67110248	73.88293122	270.331496	43.0663535	0	313.3978499
(kg 03 eq)																	

Step 2:Determine the impacts for only the concrete material in the same volume as the original wallminus the concrete lost to waste (5%). Use the impact estimator to see the summary of impacts.

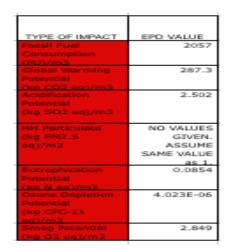
		PRODUCT		CONSTRUCTION PROCESS				US	E			END OF LIFE			TOTAL I	FFECTS	
Summary Measures	Manufacturing	Transport	Total	Construction- installation Process	Transport	Total	Replacement Manufacturing	Replacemen t Transport	Operational Energy Use Annual	Total	Material	Transport	Total	Non-Transport	Transport	Operational Energy Use	Total
Fossil Fuel Consumption (MJ)	9266.397223	636.8488093	9903.246032	1712.67095	1024.54211	2737.213066	0	0	0	0	1557.25044	491.7397	2048.99014	12536.3186	2153.13062	0	14689.44924
Global Warming Potential (kg CO2 ec)	1256.678801	45.98174376	1302.660545	146.812451	78.6626657	225.475117	0	0	0	0	104.674798	37.8270831	142.5018815	1508.16605	162.471493	0	1670.637543
Acidification Potential (kg SO2 eq)	5.83966041	0.223243832	6.062904242	1.41869958	0.36398577	1.782685355	0	0	0	0	1.40439295	0.17477183	1.579164778	8.66275294	0.76200144	0	9.42475437
HH Particulate (kg PM2.5 eq)	3.218038794	0.006797932	3.224836727	0.19039838	0.01127895	0.201677332	0	0	0	0	0.03676576	0.00541869	0.042184456	3.44520294	0.02349558	0	3.46869851
Eutrophication Potential (kg N eg)	0.138761304	0.016020375	0.154781679	0.08199817	0.02626859	0.108266764	0	•	0	0	0.09355847	0.01261542	0.106173895	0.31431795	0.05490439	0	0.369222338
Ozone Depletion Potential (kg CPC-11 eq)	1.23248E-05	1.83863E-09	1.23266E-05	6.1991E-07	3.1355E-09	6.23043E-07	0	°	0	0	4.5736E-09	1.5077E-09	6.08123E-09	1.2949E-05	6.4818E-09	0	1.29557E-0
Smog Potential (kg O3 eq)	70.39484421	7.895726357	78.29057056	43.4859148	12.8706462	56.35656097	0	0	0	0	49.8157325	6.17994063	55.99567316	163.696492	26.9463132	0	190.642804

Step 3:Take original wall impacts and minus the "extra wall materials" impacts. This will give you
the impacts to build the wall (includes the formwork, rebar etc.) but minus the concrete.

		PRODUCT		CON	STRUCTION PR	OCESS		US	E			END OF LIFE			TOTAL I	FFECTS	
Summary Measures	Manufacturing	Transport	Total	Construction- installation Process	Transport	Total	Replacement	Replacemen t Transport	Operational Energy Use Annual	Total	Material	Transport	Total	Non-Transport	Transport	Operational Energy Use	Total
Fossil Fuel Consumption (MJ)	16958.49371	936.0176704	27160.9086	3906.75483	1812.71658	5719.471418	0	0	0	0	2038.5357	689.962183	2728.49788	32170.1815	3438.69644	0	35608.8779
Global Warming Potential (kg CO2 eo)	1093.62995	67.84892541	2418.157676	301.757771	139.245807	441.0035782	0	0	0	0	137.025688	53.0753504	190.1010384	2789.09221	260.170083	0	3049.262293
Acidification Potential (kg SO2 eq)	6.505079203	0.328572734	12.67331235	2.40562785	0.64407239	3.049700239	0	0	0	0	1.83843593	0.24522314	2.083659067	16.5888034	1.21786826	0	17.80667165
HH Particulate (kg PM2.5 eq)	1.424247888	0.010014124	4.652300807	0.24497403	0.01996085	0.264934886	0	0	0	0	0.04812862	0.00760299	0.055731617	4.93538934	0.03757797	0	4.97296731
Eutrophication Potential (kg N eg)	0.771591519	0.023585697	0.933938521	0.14271611	0.04648434	0.18920045	0	0	0	0	0.12247374	0.01770075	0.140174496	1.17554267	0.0877708	0	1.263313467
Ozone Depletion Potential (kg CFC-11 eg)	3.67215E-06	2.71222E-09	1.59996E-05	8.129E-07	5.5502E+09	8.18455E-07	0	0	0	0	5.9871E-09	2.1154E-09	8.10249E-09	1.6816E-05	1.0378E-08	0	1.68262E-05
Smog Potential (kg O3 eq)	61.30965318	11.62070249	143.3251999	73.4151703	22.7745485	96.18971884	0	0	0	0	65.2118287	8.67110248	73.88293122	270.331496	43.0663535	0	313.3978499

Step 4:Find an EPD for concrete manufacturing. The EPD/m3 is shown below. I chose the
Mix Code: 3F1EG9D1 and Plant: Martinez from Central Concrete at
http://www.nrmca.org/sustainability/EPDProgram/Central_Concrete_EPD.pdf
This EPD gave a value for primary energy consumption. The value is incorrect but is
used for purposes of illustrating my knowledge to calculate the final impact value.
The was no value given for HH Particulate so I assumed a value of 1 for purposes of this

Test. The EPD Values are shown below.



Step 5: Multiply the EPD values by the hollowed out concrete volume.

(Original Concrete Volume 267.5, Concrete Volume With Waste Excluded: 254.78)

	EPD VALUE	MANUFACTURING
Fossil Fuel Consumption	2057	524082.46
(M3)/m3 Global Warming Potential	287.3	73198.294
(kg CO2 eq)/m3 Acidification Potential (kg SO2 eq)/m3	2.502	637.45956
HH Particulate (kg PM2.5 eq)/m3	NO VALUES GIVEN. ASSUME SAME VALUE as	3.218038794
Eutrophication Potential (kg N eg)/m3	0.0854	21.758212
Ozone Depletion Potential /kg CFC-11 eg//m3	0.000004023	0.00102498
Smog Potential (kg 03 eq)/m3	2.849	725.86822

Step 6:Re-add the newly calculated impact back into the Step 3 Phase
(The impact values for the formwork, rebar etc. Minus the concrete).These final values are the new impacts the wall would have if it included 25 MPA instead
of 20 MPA as assumed.

		PRODUCT		CON	STRUCTION PRO	DCESS		US	ε			END OF LIFE			TOTAL E	FFECTS	
		-		Construction- installation				Replacemen							_	Operational	
Summary Measures		Transport	Total	Process	Transport	Total	Manufacturing	t Transport	Annual	Total	Material	Transport	Total	Non-Transport	Transport	Energy Use	Total
Fossil Fuel Consumption (MD)	541040.9537	936.0176704	541976.9714	3906.75483	1812.71658	5719.471418	0	0	0	0	2038.5357	689.962183	2728.49788	32170.1815	3438.69644	0	550424.9407
Global Warming Potential (kg CO2 eo)	74291.92395	67.84892541	74359.77288	301.757771	139.245807	441.0035782	0	0	0	0	137.025688	53.0753504	190.1010384	2789.09221	260.170083	0	74990.87749
Acidification Potential (kg SO2 eq)	643.9646392	0.328572734	644.2932119	2.40562785	0.64407239	3.049700239	0	0	0	0	1.83843593	0.24522314	2.083659067	16.5888034	1.21786826	0	649.4265712
HH Particulate (kg PM2.5 eq)	4.642286683	0.010014124	4.652300807	0.24497403	0.01996085	0.264934886	0	0	0	0	0.04812862	0.00760299	0.055731617	4.93538934	0.03757797	0	4.97296731
Eutrophication Potential (kg N eg)	22.52980352	0.023585697	22.55338922	0.14271611	0.04648434	0.18920045	0	0	0	0	0.12247374	0.01770075	0.140174496	1.17554267	0.0877708	0	22.88276416
Ozone Depletion Potential (kg CFC-11 eq)	0.001028652	2.71222E-09	0.001028655	8.129E-07	5.5502E-09	8.18455E-07	0	0	0	0	5.9871E-09	2.1154E-09	8.10249E-09	1.6816E-05	1.0378E-08	0	0.001029481
Smog Potential (kg O3 eq)	787.1778732	11.62070249	798.7985757	73.4151703	22.7745485	96.18971884	0	0	0	0	65.2118287	8.67110248	73.88293122	270.331496	43.0663535	0	968.8712257

Step 7: The next step would be to upload these results back into Athena

4.3 Data Quality

There are 5 different types of uncertainty present in the CEME LCA model, data, model, temporal, spatial and variability. Below is a description of each type of uncertainty present in the model and an example.

4.3.1 Data Uncertainty

Data uncertainty is present in two stages of an LCA, the inventory analysis stage and the impact assessment stage.¹⁷ Within the Inventory Analysis Stage, there are four different types: collection, allocation methods used to create data, inaccuracy or no data. All of these stems from an LCI database having either empirical inaccuracy, incomplete or outdated measurements and missing data. Within the Impact Assessment Stage, there are two uncertainties: uncertainty in lifetimes of substances and travel potential. An example that might be present in an LCI database is that data uncertainty might exist from human error. For example, the instrumentation might not be calibrated properly or might be used incorrectly.

4.3.2 Model Uncertainty

Model uncertainty could include linear vs. non-linear modeling in the inventory analysis stage and characterization factors may be unknown in the impact assessment stage.¹⁸ The impact estimator assumes that ecological processes act linearly. This is not always the case; in fact many processes are non-linear.¹⁵ Moreover, characterization factors may be incorrect as they are calculated using very simplified environmental models, which in turn have their own uncertainties.¹⁵ A good example of this is that LCA does not take into account the sensitivity of

http://civl498c.wikispaces.com/file/view/Week8_Uncertainty.pdf/462592198/Week8_Uncertainty.pdf ¹⁸Henriksson, J., Guinee, J. Heijungs, R., de Koning, A., and Green, D. (2013). *A Protocol for Horizontal Averaging of Unit Process Data – Including Estimates For Uncertainty*. Retrieved from <u>http://download.springer.com/static/pdf/295/art%253A10.1007%252Fs11367-013-0647-</u>

¹⁷Sianchuk, R. (2013). *Week 8 – Uncertainty In LCA*. Retrieved from

^{4.}pdf?auth66=1384919586 ba8dbe506d38cdf91d24f54e9165ba52&ext=.pdf

the surrounding environment in regards to the computation of acidification factors.¹⁵ It is unlikely that model uncertainty plays a large part in CEME as the building is located in a controlled surrounding environment, with mostly commonly used materials that have common characterization factors.

4.3.3 Temporal Uncertainty

Differences in industrial yearly production of factory emissions and data vintage are common temporal uncertainty factors in the inventory analysis stage.¹⁴ For example, LCI commonly uses emission data rates that are determined from taking an average value, dividing emissions overall by production over a certain period of time.¹⁵ Therefore, if more emissions were produced during the first half of the year when a material was purchased, the data would not be accurate. Furthermore, emissions usually differ by year as well, and the mean value is taken over all years of data that have been accumulated. Emissions from an early decade are often very different than modern emissions but only a mean value is usually taken, a cause of data vintage. During the impact assessment stage, the two types of temporal uncertainty are effects of climate and interpretation of impacts over time. For example, wind speed and temperature vary per region but also vary per time periods. As temporal variation is not available over short time periods in the inventory analysis stage, it will affect the impact assessment. Impacts over time uncertainty are caused due to the differences in lifetimes of substance's impact categories, as something like global warming potential differs depending on the time period to investigate effects.

4.3.4 Spatial Uncertainty

Spatial uncertainty is caused by regional differences between manufacturing plants. It is caused due to unavailability of data for specific regions, as it is usually unknown. Furthermore, much of the LCA site-specific data is applicable to Europe as it has been calculated using detailed environmental information from that area. However, it might not be applicable to the United States or Canada. For example, Canada might have different eutrophication creation factors than Europe does.

4.3.5 Variability Between Objects/Sources Uncertainty

Variability between objects and sources includes differences between factories, different technologies that produce the same product and differences in human exposure patterns. Variability in life cycle inventories will occur due to the different production techniques manufacturing firms use to develop the same product. Human exposure patterns differ as every

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human varies in body weight, consumption of food, etc. and therefore their human toxicity potential will vary.

4.3.6 Quality of LCI Databases

The quality of the LCI databases is standard. The oldest database as per the Athena Sustainable Materials Institute is from 1999, and on aluminum frames.¹⁹ Most of the databases are very recent and updated, the majority are newer than 2005. For this project, to reduce uncertainty, as a reader one must interpret the LCA results cautiously as many uncertainties are present. CEME draws information from various sections, the largest being from the concrete and steel products sections The quality of those are quite high as they are as recent as 2005 and have been updated from the original 1993 data. Furthermore, they also include production profiles from the US LCI databases, one of the largest existing databases.

¹⁹ Athena Sustainable Materials Institute (2013). Database Details. Retrieved from <u>http://www.calculatelca.com/wp-content/uploads/2012/10/LCI_Databases_Products.pdf</u>

5.0 List of Indicators Used For Assessment And Expression of Results

The impact assessment method used in this project was Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI). The impact estimator software used was the Athena Impact Estimator for Buildings Version 4.2.02. The following tables below illustrate the 7 impact categories used in the impact assessment of CEME and include: a general description of the cause/effect chain model, its category indicator and a list of potential endpoint impacts.

Impact Category	Global Warming Potential						
Midpoint Impact	The absorption of infrared radiation. This in turn causes the						
	atmosphere temperature to increase.						
Category Indicator	Kg CO₂ eq						
Cause/Effect Chain	Emissions to Air \rightarrow Infrared Radiation Absorbed \rightarrow Causes increase in						
Model	global temperature, change in sea levels and precipitation $ ightarrow$ Leads to						
	human health impacts, agricultural/forestry/special/water resource						
	effects, and coastal area damage.						
Potential Endpoint	- Sea levels rising due to glaciers melting.						
Impact	- Tree mortality decreases due to reduction in water caused by						
	regional warming.						
	- Global precipitation increase.						
	- Floods and droughts becoming more common.						
	- Less fresh water availability.						
	- Changing Ecosystems ²¹						
Characterized By	- US EPA – TRACI						
	- Intergovernmental Panel on Climate Change (IPCC)						

Global Warming Potential²⁰

Table 6 - Impact Category - Global Warming

²⁰Sianchuk, R. (2013). Week 6 – Impact Assessment. Retrieved from http://civl498c.wikispaces.com/file/view/Week6 Impact%20Assessment.pdf/458461904/Week6 Impact %20Assessment.pdf

²¹ National Geographic (2013). *Effects of Global Warming*. Retrieved from <u>http://environment.nationalgeographic.com/environment/global-warming/gw-effects/</u>

Impact Category	Ozone Depletion Potential					
Midpoint Impact	Change in the ozone layer due to emissions of CFC ⁻¹¹					
Category Indicator	Kg CFC ⁻¹¹ eq					
Cause/Effect Chain	Emissions to Air $ ightarrow$ Causes Reduction of the Ozone Layer in					
Model	Stratosphere $ ightarrow$ Increases UBV concentration on earth $ ightarrow$					
	Species/Material Damages, Human Health Impacts, Agricultural					
	Effects					
Potential Endpoint	- Human Heath impacts such as UV mutation, skin cancers, etc.					
Impact	 Changes in plant growth – UV lighting activated defence 					
	proteins in plants, increases vitamin production,					
	increases/decreases growth rate depending on plant,					
	increases/decreases plan size depending on plant, and affects					
	plant composition.					
Characterized By	- US EPA – TRACI					
	- World Meteorological Organization (WMO)					

Ozone Depletion Potential²⁰

Table 7 - Impact Category - Ozone Depletion

Eutrophication Potential²⁰

Impact Category	Eutrophication Potential
Midpoint Impact	Effect on algae growth in water bodies with high N and P content. It
	includes the probability of nitrogen entering a water body.
Category Indicator	Kg N eq.
Cause/Effect Chain	Water Emissions and presence in water body $ ightarrow$ Growth of algae and
Model	weeds $ ightarrow$ Oxygen depletion in water due to dead biomass and release
	of toxins
Potential Endpoint	- Stratification of warm waters during the summertime.
Impact	(Hypoxia)
Characterized By	- US EPA – TRACI

Table 8 - Impact Category - Eutrophication Potential

Acidification Potential²⁰

Impact Category	Acidification Potential
-----------------	-------------------------

Midpoint Impact	Effect on increasing the acidity of water and soil due to the formation of acidifying H+ ions in relation to SO_2
Category Indicator	Kg SO ₂ eq.
Cause/Effect Chain	Air emissions, the emission surrounding atmospheric concentrations
Model	& environment(Including temperature and climate) $ ightarrow$ Deposition $ ightarrow$
	Leaching of AI, H+ ions, and nutrient cations acidifies water/soil
	sources $ ightarrow$ Causes changes to ecosystem and reduces plant and
	animal mortality.
Potential Endpoint	 Acid Rain causes fish/frog mortality to decrease.
Impact	- Causes plant mortality to decrease.
Characterized By	- US EPA – TRACI

 Table 9 - Impact Category - Acidification Potential

Smog Formation Potential²⁰

Impact Category	Smog Potential		
Midpoint Impact	Capacity to influence the photochemical creation of ozone in the		
	troposphere.		
Category Indicator	Kg O ₃ eq.		
Cause/Effect Chain	Air emissions in combination with VOC's/NO _x S/Temperature/Sunlight		
Model	ightarrow High ozone concentration in troposphere $ ightarrow$ Reduced		
	photosynthesis and human's inhaling smog $ ightarrow$ Decreases		
	human/plant mortality and has negative affects on human health.		
Potential Endpoint	- Causes human health impacts such as Asthma, bronchitis and		
Impact	emphysema and could lead to premature death.		
Characterized By	- Leads to the following negative human health impacts:		
	asthma, heart disease, chronic breathing, emphysema,		
	pneumonia, premature births in pregnant women and low		
	birth weights.		

Table 10 - Impact Category - Smog Potential

Human Health and Respiratory Effects Potential²⁰

Impact Category	Human Health Criteria - Air
Midpoint Impact	Capacity to influence human exposure to <10 microns air bourne

	particulate matter.	
Category Indicator	Kg PM _{2.5} eq.	
Cause/Effect Chain	Humans inhale air emissions $ ightarrow$ Human alveoli receive particulate	
Model	matter $ ightarrow$ Human body reacts to harmful substances in particulate	
	matter $ ightarrow$ Causes negative human health impacts	
Potential Endpoint	- Causes human health impacts such as Asthma, bronchitis and	
Impact	emphysema and could lead to premature death.	
Characterized By	- US EPA – TRACI	

Table 11 - Impact Category - Human Health Criteria

Fossil Fuel Consumption²⁰

Impact Category	Fossil Fuel Consumption	
Midpoint Impact	Feedstock and embodied energy of a material that is used to	
	transform or transport raw materials into a building.	
Category Indicator	MJ – Mega-Joules	
Cause/Effect Chain	Construction processes cause energy to be used to create materials	
Model	and to construct buildings $ ightarrow$ energy and electricity used $ ightarrow$ energy	
	used from fossil fuels causes CO_2 emissions $ ightarrow$ Same endpoints as	
	global warming, water and land pollution, etc.	
Potential Endpoint	- Water and Land Pollution	
Impact	- Thermal Pollution	
	- National Security Impacts. ²²	
Characterized By	- Unique to Athena Sustainable Materials Institute as it directly	
	relates to building construction.	

Table 12 - Impact Category - Fossil Fuel Consumption

²² Union of Concerned Scientists (2002). The Hidden Cost of Fossil Fuels. Retrieved from <u>http://www.ucsusa.org/clean_energy/our-energy-choices/coal-and-other-fossil-fuels/the-hidden-cost-of-fossil.html</u>

6.0 Model Development

The following sections will describe first how the original model was developed and then how it was improved and resorted using CIQS format.

6.1 Original Model Development

The first author, Tyler Algeo, used OnScreen Takeoff Version 3.6.2.25 to model CEME. The drawings used are illustrated in the table below and were compiled from the UBC LBS Facilities and Capitol Planning Records Department:

Description of Drawing
Overview of Site Plan
Area 4 – Ground Floor Plan
Area 1 and Area 5 – Ground Floor Plan
Area 2 – Ground Floor Plan
Area 5 – Ground Floor Plan
Area 4 – Second Floor Plan
Area 2 – Second Floor Plan
Area 3 – Second Floor Plan
Area 2 – Basement, Penthouses
All Areas – Roof Plan
All Areas – Building Sections
Area 1 and Area 2 – Building Sections
All Areas – Elevations Part 1
All Areas – Elevations Part 2
All Areas - Wall Sections
All Areas – Window Details
All Areas – Stair Details
All Areas – Building Details
All Areas – Foundation Layout Part 1
All Areas – Foundation Layout Part 2
All Areas – Foundation Layout Part 3
All Areas – Foundation Layout Part 4
Area 2 – Structural Ground Floor
Area 3 – Structural Ground Floor
Area 4 – Structural Ground Floor
Area 5 – Structural Ground Floor

Table 13 - List of CEME Drawings Used In LCA

OnScreen Takeoff was used to model the elements in the following assembly groups: Foundations, Floors, Walls, Columns and Beams, Roofs, and Extra Basic Materials. The elements were then recorded in the "Annex D - Inputs and Assumptions Document" for the original measurements taken in the OnScreen Takeoff. Then the elements were inputted into the Athena Impact Estimator. Due to limitations of Athena, many of the inputs had to be manipulated in order to obtain the correct volumes and areas. The changes made from the actual values measured in OnScreen Takeoff to the ones inputted in Athena are also recorded on the Annex D document. A separate "Assumptions" tab records any assumptions made for each element.

6.1.1 Original Model Assembly Groups

<u>Assembly</u> Group	Labeling	Modeling Information
Foundations	 On-Grade slabs were based on thickness of slab, Ex. "OnGradeSlab1-4 was a 4" slab. Three types of footings were present: Column, Strip Footings and Basement Walls. Column footings formatted "f.#" where the number corresponded to the number of footings in the drawings. Strip Footings formatted "f.A" where the letter A would change depending on what type of strip footing it was. Basement walls used same labeling as Strip Footings 	 Foundation Slabs modeled using Area Condition on OnScreen Takeoff Column Footings modeled using Count Condition Strip Footings modeled using linear condition. Volumes of strip footings were summed and broken down and adjusted for the IE. See Assumptions Annex D for further information.
Floors	 Named using short form of what they represent. For example "SuspSlab" represented suspended slab. 	 Suspended Slabs, Precast concrete T-Beams and Slabs on Grade modeled using Area Condition of Onscreen. Stairs were modelled as a footings by approximating the thickness and then measured angularly to find the volume. T-beam floors were divided into a small span and long length to ensure they could be inputted into impact estimator (But retained the same area)
Walls	 Walls were labeled as per the following diagram: Wall - exterior/interior (exterior) Wall height (4' 6") We.1-0406-6 Wall Type (1 - Precast) Wall thickness (6") Figure 1: Wall Takeoff Nomenclature Each wall type corresponds to the following labeling: 1 - Precast 2 - Concrete Block 3 - Poured Concrete Wall 4 - Wood Stud Wall 5 - Concrete Block Fire Wall 6 - Partial Height Wood Stud Wall 7 - Wood Stud Wall with Type 1 Insulation 8 - Wood Study Wall with Type 2 Insulation 9 - Steel Stud Wall 10 - Steel Stud Partition Wall 	 Doors were counted and measured in OnScreen Takeoff using the Count Condition. Walls were measured in OnScreen Takeoff using the Linear Condition. Concrete block walls were estimated to have a longer length to accommodate for the fact that they are only supposed to be 200mm in length but the impact estimator only allows 6in or 8in thicknesses. Windows in CEME typically illustrated as per below sketch: Operable Inoperable Window Wall Wall The Wall section of the above window could not be modeled in IE as each wall assembly only has one window imput, therefore the materials were added into "Extra Basic Materials" All windows were considered to be inoperable

The following table describes how the original model was labeled.

Columns and Beams	 Columns labeled as "C.#." or "C.#.#" The first # corresponds to each building area (1, 2, 3, 4, 5) while the second represents corresponds to the level (First Floor, Second Floor, Basement, Penthouse) 	 in the model to simplify the inputs. See Assumptions Annex D for further information. Columns counted using OnScreen Takeoff Count Condition Supported Area was calculated using OnScreen Takeoff Area Condition. See Assumptions Annex D for further information.
Roofs	- The only roof type modeled was the Open Web Steel Joist.	 Roof was modeled using the Area condition of OnScreen Takeoff Area Condition.
Extra Basic Materials	 Gypsum Board, Insulation, Steel and Wood were the extra materials modeled for the windows. They are labeled accordingly. 	- Used to model the window condition wall section as per the "Walls" subsection.

Table 14 - Original Model Assembly Groups

6.1.2 Inaccuracies in the Original Model

The interpretation of CEME's drawings posed the largest number of inaccuracies in the model. Many assumptions needed to be made about every single assembly characteristic, such as assuming the rebar used is #4 and that the live loads are assumed to be 75 psi. There is no way to check these numbers without the full set of drawings, which were not available. There were also elements present in the model that was outside of the ability for the Impact Estimator to Model, or outside of the scope of the assessment. These most significant one that is excluded is the underside of the overhangs in CEME are too complex for the Impact Estimator to model as they are made from plaster. Furthermore, the foundations were treated to have a constant thickness while in actuality they have a variety due to their function of accommodating different large lab equipment. Moreover, the penthouses located on the roof were unable to be modeled as there were corrugated metal sheeting around a frame of columns and open webbed steel joists, and the impact estimator did not have the capacity to include the unique wall envelope, only the columns. Another inaccuracy introduced from the original model was that the drawings were hand drawn and scanned, which added difficulty when trying to find limits during measuring of objects.

6.2 CIQS Sorting

The re-sorted Level 3 elements can be found in Annex D – Impact Estimator Inputs and Assumptions. The following table below gives a brief description of what is included in each CIQS category for CEME.

LEVEL 3 ELEMENT	WHAT IS INCLUDED IN THIS CATEGORY SPECIFIC
	<u>TO CEME</u>
A11 Foundations	- Column Footings

	- Strip Footings
A21 Lowest Floor Construction	- Slab on grade
	- Mezzanine Floor Slab
A22 Upper Floor Construction	- All Second Level Floors
	- All Penthouse Floors
	 All Columns and Beams Supporting the
	Upper Floors (Excluding columns and
	beams supporting the roof)
A23 Roof Construction	 Roofing structural frame and insulation
	 Assumed Roofing Membrane
	 All Columns and Beams Supporting the
	Roof Structure
A31 Walls Below Grade	 All exterior walls in the basement level.
	 Corresponding windows and doors.
A32 Walls Above Grade	- All exterior walls above grade.
	 Corresponding windows and doors.
B11 Partitions	- All Interior walls above and below grade.

Table 15 - CIQS Elements

6.3 Model Improvements

Unfortunately, the previous OST for CEME became corrupted and was lost. Therefore the previous author's version of OnScreen Takeoff 3.6.2.25 could not be used with the newer version of OnScreen Takeoff 3.9. It was assumed that his results were accurate unless proven otherwise. Below is a table that illustrates the upgrades to the original model that were made. These improvements are also found in Annex D – Impact Estimator Inputs and Assumptions that outlines the changes in further detail.

Improvements to Make	How I Improved The Model.	Picture of Footing Used For Assumption	Results From Takeoff
Tyler stated in previous report: "The column footing model does not include the section of the column that extends below the ground of the footing, which was left out due to insufficient drawing detail.	As there is no footing schedule, to improve the model to include the footing undernead the ground, I assumed a conservative measurement for each footing based on the Typical Column footing detail D-D located on drawing 306-07-202. As I don't have the previous OST file, I started a new OST and measured the dimensions of the footing underneath the ground to be 1' x 2' x 3'. I then counted the footings for each area. As per the typical footing detail, I also added 8 #4 rebar - 3 ft long as per the cross section which classifies them as 'long' rebar. I then added this footing value to the Athena Impact Estimator by finding the total area of all footings per area (Areas defined on drawings) and adding them by area.	And	Area 1 Footings: 52, Area 2 Footings: 18, Area 3 Footings: 31, Area 4 Footings 39, Area 5 Footings: 17
Tyler modelled the basement walls as footings as per his assumption on Page 13. They need to be changed as they should be modelled as walls.	I had to perform a new OST to double check the wall calculation. I then deleted the "Basement Walls" section modelled as a footing from the Athena file and replaced it with a new file with the new measurements modelled as a wall.		Area 2 Basement Walls: 298 lf, Area 4 Basement Walls: 357 lf. There is no basement for Areas 1, 3, and 5.
Double Check Penthouse Roof Calculations. Tyler had 5441.6 sf for the pent house roofs, when the actual value was 5257 sf.	Calculated actual square footage for penthouse roofs. Divided each penthouse roof by area. Modified each penthouse to be unique so it could have correct dimensions. Changed to steel materials.		Total Area for Penthouses: 5275 sf.
Mezzanine Not Included In Floor Slab Calculations	Added Mezzanine Floor Slab.		Mezzanine Floor Slab = 35'7* x 39'9''

 Table 16 - Detailed Description of CEME Model Improvements

6.4 Reference Flow and Bill of Materials

A reference flow is defined as the measure of the outputs that fulfills the function expressed by the functional unit in a given product system²³ The purpose of a reference flow is to decipher the functional unit into particular product flows.²⁴ In CEME's case, the reference flow is a materials list of the product, which is the overall building and envelope. The following table illustrates the bill of materials/reference flow per Level 3 Element for CEME.

Level 3 Element	Materials	<u>Quantity</u>	<u>Units</u>
A11 Foundations	Concrete 30 MPa (flyash av)	504.45	m3
A11 Foundations	Rebar, Rod, Light Sections	1.46	Tonnes
	6 mil Polyethylene	2282.06	m2
A21 Lowest Floor Construction	Concrete 20 MPa (flyash av)	251.12	m3
	Welded Wire Mesh / Ladder Wire	1.94	Tonnes
	Concrete 30 MPa (flyash av)	1235.20	m3
A22 Upper Floor Construction	Hollow Structural Steel	6.16	Tonnes
	Rebar, Rod, Light Sections	107.63	Tonnes
	#15 Organic Felt	28426.93	m2
	24 Ga. Steel Roof (Commercial)	877.72	m2
	Ballast (aggregate stone)	275598.34	kg
	Concrete 30 MPa (flyash av)	894.20	m3
	Extruded Polystyrene	6550.44	m2 (25mm)
	Galvanized Decking	42.83	Tonnes
	Galvanized Sheet	4.95	Tonnes
	Modified Bitumen membrane	1615.61	kg
A23 Roof Construction	Nails	2.14	Tonnes
	Open Web Joists	38.90	Tonnes
	Precast Concrete	31.67	m3
	Rebar, Rod, Light Sections	235.15	Tonnes
	Roofing Asphalt	83877.45	kg
	Screws Nuts & Bolts	0.01	Tonnes
	Solvent Based Alkyd Paint	468.80	L
	Type III Glass Felt	56853.86	m2
	Welded Wire Mesh / Ladder Wire	0.40	Tonnes
A31 Walls Below Grade	Concrete 20 MPa (flyash av)	149.88	m3
AST MAILS BEIOM GLAGE	Rebar, Rod, Light Sections	0.07	Tonnes

²³Sianchuk, R. (2013). *Week 8 – Uncertainty In LCA*. Retrieved from

http://civl498c.wikispaces.com/file/view/Week8_Uncertainty.pdf/462592198/Week8_Uncertainty.pdf ²⁴ Weidema, B., Wenzel, H., Petersen, C., Hansen K. (2004). *The Product, Functional Unit and Reference Flows in*

LCA. Retrieved from http://www2.mst.dk/Udgiv/Publications/2004/87-7614-233-7/pdf/87-7614-234-5.PDF

	1/2" Regular Gypsum Board	5134.75	m2
	3 mil Polyethylene	476.46	m2
	Aluminum	44.95	Tonnes
	Concrete 20 MPa (flyash av)	747.66	m3
	Double Glazed No Coating Air	2054.36	m2
	EPDM membrane (black, 60 mil)	3074.58	kg
	Expanded Polystyrene	136.71	m2 (25mm)
	Extruded Polystyrene	4390.83	m2 (25mm)
	FG Batt R11-15	1622.95	m2 (25mm)
A32 Walls Above Grade	Galvanized Sheet	2.60	Tonnes
A32 Walls Above Grade	Galvanized Studs	1.58	Tonnes
	Joint Compound	5.12	Tonnes
	Nails	3.00	Tonnes
	Paper Tape	0.06	Tonnes
	Rebar, Rod, Light Sections	36.79	Tonnes
	Screws Nuts & Bolts	0.07	Tonnes
	Small Dimension Softwood Lumber, kiln-dried	0.05	m3
	Solvent Based Alkyd Paint	12.38	L
	Water Based Latex Paint	2.80	L
	1/2" Regular Gypsum Board	6974.37	m2
	5/8" Regular Gypsum Board	157.90	m2
	Concrete 20 MPa (flyash av)	256.46	m3
	Concrete Blocks	33835.43	Blocks
	Double Glazed No Coating Air	0.10	m2
	Expanded Polystyrene	13.02	m2 (25mm)
	Extruded Polystyrene	521.47	m2 (25mm)
	FG Batt R11-15	6804.86	m2 (25mm)
	Galvanized Sheet	17.18	Tonnes
	Galvanized Studs	2.69	Tonnes
B11 Partitions	Joint Compound	7.12	Tonnes
	Mortar	647.02	m3
	Nails	1.62	Tonnes
	Oriented Strand Board	1906.92	m2 (9mm)
	Paper Tape	0.08	Tonnes
	Rebar, Rod, Light Sections	132.67	Tonnes
	Screws Nuts & Bolts	0.12	Tonnes
	Small Dimension Softwood Lumber, kiln-dried	76.94	m3
	Solvent Based Alkyd Paint	74.28	L
	Water Based Latex Paint	176.54	L

Table 17 - Bill of Materials for CEME

7.0 Communication and Assessment of Results

7.1 Life Cycle Results

The following figures below displays the building results for CEME. Each impact category (Fossil Fuel Consumption, Global Warming etc.) is expressed as a total of 100%, with the percentage displayed for each level 3 elements. A summary table is also provided to show where the data was contrived. As shown below, in CEME, the element with the largest impact in all categories is the A22 Upper Floor Construction. This is probably because CEME has a large surface area. In regards to life cycle stages, the largest 'hotspot' impacts come from the manufacturing stages over the construction stages. As we determined to use a service life input of 1 year, the use and end of life stages will have little to no impact.

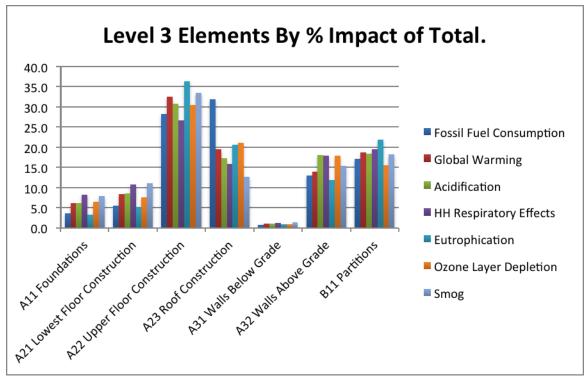


Figure 4 - Level 3 Elements By % Impact of Total Impact Category

	Fossil Fuel								Eutrophicati		Ozone Layer			
	Consumption	Percentage	Global Warming	Percentage	Acidification	Percentage	HH Respiratory	Percentage	on	Percentage	Depletion	Percentage	Smog	Percentage
	(MJ)	%	(kg CO2eq)	%	(moles of H+eq)	%	(kg PM10eq)	%	(kg Neq)	%	(kg CFC-11eq)	%	(kg O3eq)	%
A11 Foundations	1110126.93	3.6	151704.1056	6.2	1032.50658	6.2	352.760345	8.3	47.0752011	3.3	0.000772141	6.5	24784.108	7.9
A21 Lowest Floor Construction	1717008.961	5.5	203558.1601	8.3	1413.109036	8.4	455.6418455	10.7	72.2942456	5.1	0.000899181	7.6	34875.5057	11.1
A22 Upper Floor Construction	8790328.105	28.2	796421.8465	32.5	5137.719045	30.7	1137.719915	26.7	513.547042	36.3	0.003614713	30.5	105249.812	33.5
A23 Roof Construction	9952991.027	31.9	476959.238	19.4	2896.625645	17.3	674.8783929	15.8	292.660473	20.7	0.002499943	21.1	39711.1974	12.6
A31 Walls Below Grade	234616.9352	0.8	24773.07364	1.0	173.7651849	1.0	53.22292293	1.2	12.0688636	0.9	0.000104367	0.9	4200.15362	1.3
A32 Walls Above Grade	4055133.507	13.0	342723.9213	14.0	3010.677596	18.0	763.6939485	17.9	167.616286	11.8	0.00211271	17.8	48204.2671	15.3
B11 Partitions	5326507.244	17.1	457793.5617	18.7	3067.65166	18.3	831.1097712	19.5	310.537926	21.9	0.001839863	15.5	57415.298	18.3
TOTAL	31186712.71	100.0	2453933.907	100.0	16732.05475	100.0	4269.027141	100.0	1415.80004	100.0	0.011842918	100.0	314440.342	100.0

Table 18 - Level 3 Elements By % Impact In Table Format

This concludes the building declaration section of the report. The next four sections that are included are Annexes that are a reflection of the author's experience as well as a further interpretation of the results and how they can be used effectively in society. The annexes are as follows:

- 1. Interpretation of Assessment Results
- 2. Recommendations for LCA Use
- 3. Annex C Author Reflection
- 4. Annex D Impact Estimator Inputs and Assumptions

8.0 Annex A – Interpretation of Assessment Results

8.1 Benchmark Development

Benchmarking is useful in LCA as it is an iterative tool that allows industry professionals, researchers and the general public to easily make sense of LCA-based information. It allows individuals to compare their products impacts with another products impacts.²⁵ In the case of CEME, it can be compared to other buildings at UBC, in terms of the 7 environmental impacts illustrated in Section 5.0 of this report. The most beneficial tool of a benchmark is to allow individuals to easily interpret the results of an LCA analysis, as many find it easier to compare a result to a benchmark that represents an average, rather than just looking at a number that represents global warming potential. The functional equivalence of a benchmark normalizes the data.

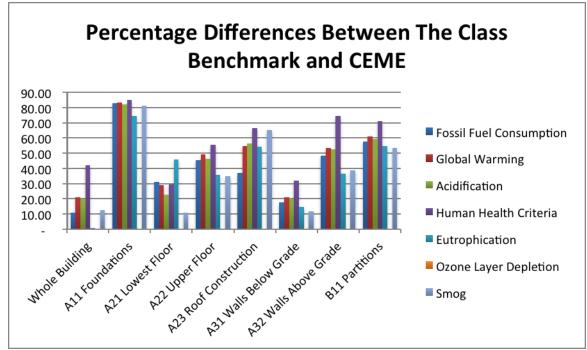
Defining the goal and scope of a project is important for model development as well as benchmark development. When developing the goal, the following question must be asked, "Where will the information be put to use?" In CEME's case, the information will be used for comparative assertions with the other 22 buildings being evaluated, which is defined under the goal category in ISO 14044. The goal will state the reasons for carrying out the study instigate discussion and determine the intended audience all of which are necessary to determine what will be compared for the benchmark. The scope definition will define what is being included in the benchmark, what is to be compared.

8.2 UBC Academic Building Benchmark

8.2.3 Comparing CEME to UBC Building Benchmark

The following table and chart below illustrates CEME compared to the class benchmark. The following buildings were not included in this graph due to lack of information uploaded in stage 4: Chemistry North, Wesbrook, Geography, Chemistry South Wing, Pharmacy, Douglas Kenny.

²⁵ Nissinen, A., Heiskanen, E., Grönroos, J., Honkanen, A., Katajajuuri, J.-M., Kurppa, S. (2009). - Developing LCAbased benchmarks for sustainable consumption for and with users Retrieved from <u>http://orgprints.org/11268/1/LCA.pdf</u>





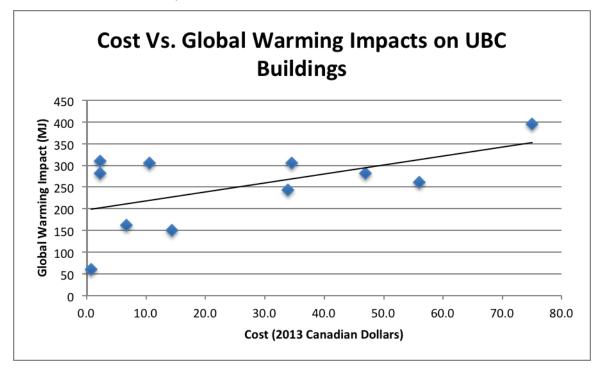
CIQS Level 3 Element	Building	Fossil Fuel Consumption	Global Warming	Acidification	Human Health Criteria – Respiratory	Eutrophication	Ozone Layer Depletion	Smog
		(IM)	(kg CO2eq)	(moles of H+eq)	(kg PM10eq)	(kg Neq)	(kg CFC- 11eq)	(kg O3eq)
Whole Building	Benchmark	4,555.82	386.82	2.68	0.96	2.01E-01	1.61E-06	45.54
Whole building	CEME	4,106.60	306.02	2.14	0.56	0.2	0	39.79
A11 Foundations	Benchmark	979.55	139.47	0.88	0.33	3.88E-02	7.40E-07	20.04
	CEME	169.35	23.14	0.16	0.05	0.01	0	3.78
A21 Lowest Floor	Benchmark	379.95	43.79	0.28	0.10	1.85E-02	2.09E-07	5.96
Construction	CEME	261.92	31.05	0.22	0.07	0.01	0	5.32
A22 Upper Floor	Benchmark	2,291.89	222.78	1.36	0.36	1.09E-01	5.18E-07	23.08
Construction	CEME	1,254.69	113.68	0.73	0.16	0.07	0	15.02
A23 Roof Construction	Benchmark	3,695.56	244.35	1.55	0.48	1.52E-01	1.13E-06	26.49
	CEME	2,322.16	111.28	0.68	0.16	0.07	0	9.27
A31 Walls Below Grade	Benchmark	638.16	70.17	0.49	0.18	2.62E-02	3.73E-07	8.40
AS1 Walls below Glade	CEME	524.75	55.41	0.39	0.12	0.03	0	9.39
A32 Walls Above Grade	Benchmark	1,300.08	121.24	1.05	0.51	4.71E-02	6.08E-07	12.95
A32 Wails Above Glade	CEME	669.63	56.59	0.5	0.13	0.03	0	7.96
B11 Partitions	Benchmark	1,337.24	124.59	0.81	0.31	6.62E-02	4.68E-07	13.18
BIIFALUUUUS	CEME	568.87	48.89	0.33	0.09	0.03	0	6.13

Table 19 - Benchmark Values Compared To Level 3 Elements

The Level 3 Element with the largest percent difference from the benchmark value is A11 Foundations. This could be due to the lack of detailed footing drawings for the building. I improved this value as outlined in Section 6.0 as the previous author of this report did not include any material of the footings below the ground. However, there is still a large difference between the benchmark. With more detailed drawings, a better representation of CEME's footing structure could be developed and more likely it would be a smaller percentage difference from the benchmark. A lot of the categories have a large percentage difference with the benchmark as well, such as A23, A32, and B11. This could be due to the large amount of concrete used in the building structure.

8.2.3 UBC Building Global Warming Vs. Cost Impacts

The figure below compares the difference between total cost and global warming potential of a building for all the buildings at UBC. Generally, the graph shows a trend that the more money a building costs, the higher the global warming impact it will have on the environment. This makes sense as when a building costs more, it uses more materials and therefore has a larger impact on the environment. CEME is on the bottom half of the trendline. This is probably due to the fact that it is mostly constructed out of concrete, which is a relatively cheap material. It follows the trendline accurately.





9.0 Annex B – Recommendations for LCA Use

The following topics discuss the recommendations to operationalize LCA in building design.

9.1 Importance of Life Cycle Modules Beyond Product and Construction Stages

The scope of this assessment did not include the life cycle modules beyond the cradle to gate stages; it only included the product and construction modules. However, it is very important to consider the use and end of life modules as they have to account for a large amount of environmental impacts. For example, the use stage includes maintenance, repair, replacement and refurbishment stages. Many products have replacement cycles, meaning they need to be replaced after a certain time period as they are no longer functional. Over the lifetime of a building, a product could be replaced a number of times, could add additional product and construction stages to the buildings overall impact. If mechanical systems are included in a buildings life cycle analysis, the operation and maintenance stages have an even larger impact than the construction stages. Furthermore, at the end of life stage, an extremely large amount of energy is used to disassemble a building. All of these stages have a significant impact. For example, imagine how many times it would take a single dump truck to remove all the debris from a large high rise that was demolished. The use and end of life cycles have a large contribution to a buildings overall impact, and therefore must be considered.

9.2 LCA Applied in Design to Manage the Environmental Performance of Buildings

By using LCA as a tool for competitive assertions, during the design stage, users can compare their buildings design to current buildings in practice to see how they measure up. By using the impact estimator, users can determine which components contribute the largest impacts on the environment. They then can manipulate their building design in the impact estimator using a trial and error process to decrease their components impacts.

9.3 Availability and Quality of Data and Benchmarks

In the case of this study, we have used a benchmark value consisting of 22 buildings that are contained at UBC. In practice currently, there is a much larger surplus of benchmarks available

for European buildings than for American buildings.²⁶ There are many building benchmarks available, but not all can be applied appropriately to any building LCA study, it depends on the context. For example, a residential building benchmark would not be applicable in the LCA study of CEME. Appropriate benchmarking for buildings must ensure the buildings are the same time, for example if they are all institutional building, and must also have the buildings place in the same geographical area with similar climates.²⁷ For products, when using a benchmark value, the product must have the same use function (the reason the functional unit is defined). There are many benchmarks available in products currently, but they all vary in type.

9.4 Issues in Application

In this study, the impact categories we prioritized were the ones included in TRACI as well as Fossil Fuel Consumption, which is included in the Athena Impact Estimator. However, issues in real life application arise in choosing which impact categories are most important as individual's opinions are influenced by their own personal experiences. For example, during an CIVL 498C lecture, an aversion survey was performed by the class. During this exercise, the students were asked to rank the value they put on importance for each impact category listed. The activity was done as a personal reflection. After they were completed, the students were told to discuss with their groups why they chose what they did and to re-rank the categories. After re-ranking, almost every student changed his or her original numbers. This was because many presented reasonable arguments that the other group members might not have thought of. For example, after individual ranking and speaking with my group, there was a person who's sister who developed a lung condition due to HH particulates in the air in China. I then gave a higher ranking to the HH Particulates as her story inspired me to. Therefore, the issues in application/interpretation can vary according to whom is deciding their importance.

9.5 Steps to Operationalize LCA Methods

The steps I would take to operationalize LCA methods at UBC are as follows:

²⁶ De Cristofar, L., Konig, H., (2012). Benchmarks for Life Cycle Costs and Life Cycle Assessment of Residential Buildings. Retrieved from <u>http://www.tandfonline.com/doi/pdf/10.1080/09613218.2012.702017</u>

²⁷ Peng, T. National Ready Mixed Concrete Association (2011) – *MIT Research: Life Cycle Assessment of Residential Buildings.* Retrieved from <u>http://www.nrmca.org/sustainability/CSR06%20-</u>%20MIT%20Research%20LCA%20of%20Residential%20Buildings.pdf

- Conduct a separate LCA study on all UBC buildings to determine a benchmark value (As determined in this study) Have an individual with LCA professional background (Rob Sianchuk) to check over the study to determine they are accurate.
- Use this benchmark value to determine where UBC's buildings currently fall in comparison to other universities.
- Every time a new building is being considered, use the UBC building benchmark value to determine where UBC's buildings fall in comparison to the previous buildings at UBC.
- Ensure architect and engineers have the information from the LCA benchmarks so they can use this information to influence their design when working for UBC.

10.0 Annex C - Author Reflection

10.1 Previous Experience

My only previous exposure to LCA prior to this class was learning about it in my LEED Green Building Associates Prep class given by UBC Continuing Studies. Life Cycle Analysis was introduced in the "Materials and Resources" module and how it can be applied in LEED. In this class I learned about what LCA was and how LCA can be used in practical design to compare various products. It introduced the limitations to LCA and a brief overview of the process to perform one. Furthermore the class introduced the comparison tool BEES and the Athena Impact Estimator. In respect to sustainability, since the beginning of my term as a civil engineering student at UBC sustainability in building design has been a major focus. I have taken a couple classes regarding sustainability, including CIVL 201 and CIVL 202, and at present CIVL 405.

10.2 Overview of CIVL 498C

CIVL 498C focuses on giving student an overview of what LCA is. It provides students with an understanding of the standards and methodologies of LCA and how to interpret/understand LCA studies. The course progressed through four main topics, including the history/current state of LCA, the overall structure of LCA through a detailed explanation of ISO 14044 and 14040, the development of a whole building LCA study and uncertainty in current LCA practices.

10.3 Interest in CIVL 498C and LCA of A Building

What interested me most about CIVL 498C was that we were going to learn about how to perform our own LCA study on a building at UBC. I thought this would be an applicable skill to have, especially for future LEED projects I might get to work on. Furthermore, I thought it would be interesting to look at some of the building drawings at UBC to expand on my skills of identifying materials in structures and my onscreen takeoff skills. Below are two graphs illustrating the differences from my expectations from before the project compared what I actually learned after performing the final project. The biggest change as illustrated in the graphs is the amount I actually learned about the LCA process. In class we got a brief overiew of many topics, but what I liked about the final project was that I learned about certain subjects such as uncertainty and LCI Databases in further detail. Moreover, I found we got an overview of what last years students did, and we could contribute ourselves to their previous reports.

This made my work feel productive, as I was not just repeating work they had already done, but I was contributing my own ideas and improving on the previous author's model. That is why I increased the percentage of "Analyzing the Results of a LCA Study."

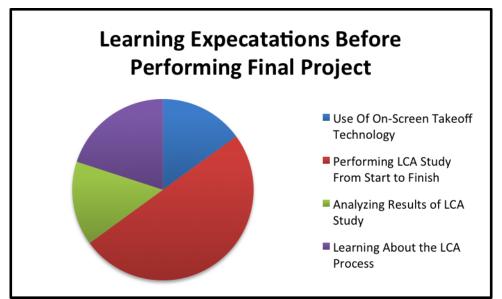
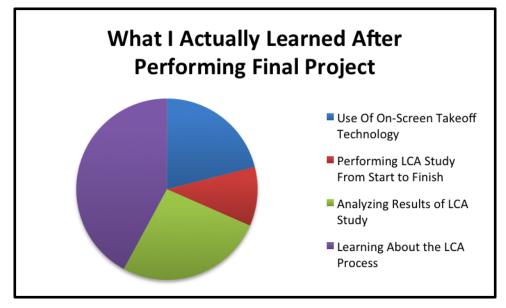


Figure 7 - Table Displaying Learning Expectations Before Performing Final Project





10.4 CEAB Graduate Attributes Demonstrated

The table below illustrates on which of the 12 CEAB Graduate attributes I believe I demonstrated in this project:

A 44-11-12-1			
Attribute		Select the content code most	
		appropriate for each attribute	Comments on which of the CEAB graduate attributes you believe you had to demonstrate during your final project
Name	Description	from the dropdown menue	experience.
1 Knowledge Base	Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.	A = applied	I applied basic building knowledge on how to read construction plans when working on this project. I expanded on my previous skills as I spent hours pouring over the CEME drawings.
2 Problem Analysis	An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.	A = applied	I had to use problem analysis to work out how to use the two new different softwares introduced in this course: The Onscreen Takeoff Software and the Athena Impact Estimator. I have never used these programs before, so I had to us problems solving to learn how to upload files, and manipulat the previous data in the report.
2 Investigation	An ability to conduct investigations of complex problems by	IDA = introduced, developed &	The final project highly focused on an investigation of a provinue student's LCA of CEME. Thad to interpret their provin
3 Investigation	An adding to characterize investigations of comments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.	applied	The final project highly focused on an investigation of a previous student's LCA of CEME. I had to interpret their previo work on the impact estimator in Athena, as well as interpret their data to ensure their assumptions were correct and t his previous work was accurate.
4 Design	An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.	N/A = not applicable	Designing solutions was not applicable in this course as our project revolved around taking a previous model and manipulating it.
5 Use for Engineering Tools	An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.	IDA = introduced, developed & applied	The Athena Impact Estimator Tool as well as the On Screen Takeoff was introduced, developed and applied for this project.
6 Individual and Team Work	An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.	IDA = introduced, developed & applied	I had to use teamwork throughout the course when working on group assignments and quizzes. This previous knowled from the team activities was helpful when I was writing the final report, escecially the final Annexes.
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7 Communication	An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.	A = applied	I had to use communication with my fellow classmates to discuss the final project if I was unsure of how to proceed. Furthermore I used communication when I contacted various individuals who worked for UBC when searching for mor information about the CEME building.
8 Professionalism	An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.	A = applied	I believe I had to apply professionalism when meeting with the professor to discuss the final project.
9 Impact of Engineering on Society and the Environment	An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.	IDA = introduced, developed & applied	The final project allowed me to see how beneficial LCA can be in practice to analyze all impacts the construction of a building could have on the environment. As engineers, we are socially responsible to know the impacts of our jobs. L cycle analysis helped me understand the entire construction process from product manufacturing to the end of life st of a building. This concept was reiterated throughout the final project as a major theme. I definitely applied this skill
10 Ethics and Equity	An ability to apply professional ethics, accountability, and equity.	N/A = not applicable	Not Applicable.
11 Economics and Project Management	An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.	IA = introduced & applied	Life Cycle Costing was introduced in the course. In order to find our building's cost in 2013 dollars, we applied basic economics, more specifically, the concept of Net Present Value.
		ID = introduced & developed	As LCA is a relatively new concept in building design and analysis, in the long term I see knowing how an LCA works to

11.0 Annex D – Impact Estimator Inputs and Assumptions

The inputs and assumptions are illustrated below. The excel file can be found in Dropbox.

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	Project Name			CEME	1
1	Project Location	1	1	Vencouver	
1	Building Life Expectancy			1 year	
1	Building Type	1	1	ingth tionel	
	Building Type Operating Energy Consumption			-18A-	
Assembly Group	Assembly Type	Assembly Name	Anno	reptions and Calculations	
A11					
Foundations					
	1.2 Concrete Fosting				
		12.1 - Column Footings (F.5-31, 1.9tr.)	(amo)		
			Fly ash concentration was not detailed in draw		roentage was assumed to be average.
			Consist of a variety of reber. The most commi length = width = agt (5421) = 79	on grade was chosen	
			Thickness approximated as fillrohes based of	o common Trickness	
		12.2 -Strip Footing (LA, FB, FB/C/E/F,	Thickness accounted as filmines based of RACE/F-2, 10, 10, 10, 11, 111, 1110		
			Fly ash concentration was not detailed in draw		roentage was assumed to be average.
			Consist of a variety of rebar. The most commu	on grade was chosen	
			Length = sqit (area) = 50 Width = length /18in *24in		
			Adjustments to the dimensions were necessar	y to make them fit the inputs	into the impact Estimator - the same
		Column Fosting Rese Area 1			
			Fly ash concentration was not detailed in draw		roentage was assumed to be average.
			Consist of a variety of reber. The most commu	on grade was chosen	
			eigh = with = agt (Shchchri) = 17.6 Thickness assumed to be 15.		
		Column Footing Base Area 2	The Part State of the State of the		
			Fly ash concentration was not detailed in draw	sings, therefore the fivesh per	centrace was assumed to be average.
			Consist of a variety of reber. The most commu-		
			length = width = agit (18x3x2x1) = 10.4	-	
1	1		Thickness assumed to be 15.		
1	1	Column Footing Base Area 3		in an in state of the local	
	1		Fly set concentration was not detailed in draw Consist of a variety of reber. The most commo	enge, meletore the tyseh per of grade was chosen	the tage was assumed to be average.
1	1	1	enoth = with = ant (hchrish) = 15.6		
1	1		enoth = width = ant (3c3c1c21) = 13.6 Thickness assumed to be 11.		
	1	Column Footing Rese Area 4			
			Ply ash concentration was not detailed in draw		contage was assumed to be average.
1	1	1	Consist of a variety of reber. The most commu	on grade was chosen	
	1		erath = with = act (3c3r1c39) = 15.3 Thickness assumed to be 15		
1	1	Column Footing Base Area 5			
			Fly ash concentration was not detailed in draw Consist of a variety of reber. The most commo	rings, therefore the flyssh per	contage was assumed to be average.
				on grade was chosen	
			enoth = width = aot (3c2cts17) =10.1 Thickness assumed to be 15.		
A 24 1 country			THEN MAN ASSUMED IN CR. 15.		
A21 Lower					
Floor	1				
Construction					
1	1.1 Concerte Stab on Grade	11.1 - OnGraditab1-4			
1	1		Fly set concentration was not detailed in draw	eings, therefore the fluish ne	contace was assumed to be suprace
	1		Length & Witth = Stat (Area) = Stat (529-60.0		
	1	11.2 - OnGradikat2-5			
	1		Fly ash concentration was not detailed in draw	rings, therefore the flyesh pe	centage was assumed to be average.
1	1	1	Length = Sigit (area) = agit (4969) = 70.5		
1	1	11.3 - OnGradilab2-8	Width = 70.5 / new width x old with = 70.5/41	- mil 1	
1	1		Fly ash concentration was not detailed in draw	rings, therefore the flyach ce	extreme ad of bemusias any spatners
1	1		Length = width = agit (area) =agit (7215) = 64	19	
		114-OrGedRebi-10			
			Fly ash concentration was not detailed in draw Length = soft (area) = SORT(2127) = 48.1	ings, therefore the typish pe	centage was assumed to be average.
			With = length / 8 * 10 = 57.8		
		Mezzanine Floor Slab	The Party of the P		
			Fly ash concentration was not detailed in draw	rings, therefore the flysch per	rearises was assumed to be average.
			Length - 357" x 389"	-	
A22 Upper					
Floor	1				
Construction	1				
States and and	5.1 Suspended Steb				
		51.1 - Suspiliab1, stairceae siab,			
	1	stainase intermediate siab			
	1		Concrete flysish percentage not specified and		in the defined in which the other
	1		Live load not specified in drawings. Assumed Span chosen to be 2011, width = area / span	ro per seses un other mettal	unal durang in workly of CEME
1			730/20=30.8		
	5.2 Concerts Precast Double T		·		
		521 - Precast/T-Stab/F-4			
1	1		Concrete flysch percentage not specified and Live load not specified in drawings. Assumed	Assumed to be average	includes in vision of Contract
1	1				and according in workly of Carelia
			Span chosen to be 30%, number of bays = are 62700 / 30 / 10 = 309	and the set of the set	
	3.1 Concrete Column and Concrete	-			
1	Beam.				
1	I	311-618 628 632 638 642	Column Rey and Span determined by taking t	our area that only more your ?	a decided by the comber of columns
1	1		Live load not specified in drawings. Assumed		
	1		Number of beams = number of columns -1 = 1		and a second or only a
1	1	1	Span = Rey size = soft (supported area)		
1	1		Scen = Rev size = act (209.8) = 17.8		
1	1	31.2-014.04,03,05			
1	1	1	Column Rey and Span determined by taking t Live load not specified in drawings. Assumed	To per based on other lowing	ional building in viginity of CEME
1	1	1	Number of beams = number of columns -1 = 1		and a second or second
1	1		Span = Rey size = soft (supported area)		
1	1		Scen = Rev size = act (215.8) = 17.8		
1	1	313-62	Column Rey and Span determined by taking t	our area that only more provide	A shined by the symptotic of sales
	1		Live load not specified in drawings. Assumed		
1	1		Number of beams = number of columns -1 = 2	23 - 1 = 22	over control of evening or calling
1	1		Span = Rev size = apt (supported area)		
1	1	1	Span - Rey size - soft (\$10.8) - 22.6		

CEME - ASSUMPTIONS - ATHENA® Environmental Impaot Estimator

		21.4-625	Column Rey and Span determined by taking four area that columns were in, divided by the number of columns,
			Live load not specified in drawings. Assumed 75 per based on other institutional building in vicinity of CEME
			Number of beams = number of columns -1 = 10 - 1 = 9 Sigen = Rey size = agit (supported area)
			ticen = Rev size = sort (497.2) = 22.3
		21.5-c.1-High	Column Rey and Span determined by taking floor area that columns were in, divided by the number of columns,
			Live load not specified in drawings. Assumed 75 per based on other institutional building in vicinity of CEME
			Number of beams = number of columns -1 = 31 - 1 = 30 Span = Bey size = soft (supported area)
			Scen = Rev size = act (200.0) = 19.2
	3.2 Concrete Column and No Beam	321-62265p	•
		421-622 649	Column Bay and Span determined by taking floor area that columns were in, divided by the number of columns,
			Live load not specified in drawings. Assumed 75 pat based on other institutional building in vicinity of CEME from = Rey size = sort (supported area)
			Span = Rey size = soft (265) = 17.2
		322-64	Column Rey and Span determined by taking floor area that columns were in, divided by the number of columns,
			Live load not specified in drawings. Assumed 75 per based on other institutional building in vicinity of CEME
			Sigan = Rey size = agit (supported area) Sigan = Rey size = agit (510) = 22.0
A23 Roof		1	
Construction			
4 Roots	4.1 Cost Web Steel Joint		
		41.1 - Steel-Joist	Drawings contain virtually no specifics on the Cinen Web Reel Joint roofing systems.
			Drawings contain virtually no specifics on the Open Web Steel Joist roofing systems. Uve load not specified in drawings. Assumed 75 psf based on other institutional building in violatly of CEME
			Roof consists of 1 1/2" built up explicit roof, but not specified. Approximated by "Ridruded Polystyrene, Glass Roof is topped with explicit but not specified. Approximated with impact Ratimator's "Roofing Asphait"
1		1	Above Open Web Steel Joist is corrugated steel that the drawings do not detail - assumed to be a commercial
1			Roof width easumed 30 to fit input parameter, apan = area / roof with 40140 / 30 = 1338
1		41.2 - Steel Joint Part	
1			Drawings contain virtually no specifics on the Open Web Steel Joist rooting systems. Use load out specified in drawings, Assumed 15 out haved on other both blood in United of CENE
1			Live load not specified in drawings. Assumed 75 pt/ based on other institutional building in vicinity of CEME Above Open Web Steel Joist is corrugated steel that the drawings do not detail - assumed to be a commercial
1			Roof width assumed to be 15%, span = area / width 6039 / 15 = 402.6
1	4.2 Concrete Precest Double T		
		421 - Precast-T-Slab-R-4	Drawings contain virtually no specifics on the Open Web Steel Joist rooting systems.
1			Live load not specified in drawings. Assumed 75 per based on other institutional building in vicinity of CEME
			Roof consists of 1 1/2" built up expirat roof, but not specified. Approximated by "Extruded Polystyrene, Glass
			Roof is topped with eapheit but not specified. Approximated with impact Ratimator's "Roofing Asphait" Above Open Web Steel Joint is corrugated steel that the drawings do not detail - assumed to be a commercial
			Span chosen to be 345, number of bays = area / span / bay size
1		ACI Roof Construction Steel Joint Per	14 + 2360 / 24 / 10
			Drawings contain virtually no specifics on the Open Web Steel Joint roofing systems.
			Live load not specified in drawings. Assumed 75 pat based on other institutional building in vicinity of CEME Roof consists of 1.10° built up asphalt roof, but not apecified. Approximated by "Skhuded Polystyrene, Giasa
			Fer
			Roof is topped with explait but not specified. Approximated with impact Estimator's "Roofing Asphait" Above Open Web Steel Joint is compared steel that the drawings do not detail - assumed to be a commercial
			steel roof system.
			All previous perthouse roof assumptions still apply. Only dimensions of the roof were incorrect and modified as per "blodel improvements" tab.
		A22 Roof Construction Steel Joint Fe	
			Drawings contain virtually no specifics on the Open Web Steel Joint rooting systems.
			Live load not specified in drawings. Assumed 75 pat based on other institutional building in vicinity of CEME Roof consists of 1.10° built up exphait roof, but not specified. Approximated by "Skhuded Polystyrene, Giasa
			Roof is topped with explain but not specified. Approximated with impact Satimator's "Roofing Asphait"
			Above Open Web Steel Joist is corrugated steel that the drawings do not detail - assumed to be a commercial All previous penthouse roof assumptions attli apply. Only dimensions of the roof were incorrect and modified as
1		A23 Roof Construction-Steel-Joint-Pe	per "Nicdel Improvements" tab.
1		THE THE OF BELLEVILLE PROPERTY AND THE	
1			Live load not specified in drawings. Assumed 75 per based on other institutional building in vicinity of CEME
1		1	Roof consists of 1.10° built up asphalt roof, but not specified. Approximated by "Extruded Polystyrene, Glass Roof is topped with asphalt but not specified. Approximated with impact Ratimator's "Roofing Asphalt"
1		1	Above Open Web Steel Joist is comunicated steel that the drawings do not detail - assumed to be a commercial
1			All previous perthouse not assumptions still apply. Only dimensions of the not were incorrect and modified as per "Model Improvements" tab.
1		A23 Roof Construction-Steel-Joist Pe	n4
1			Drawings contain virtually no specifics on the Open Web Steel Joist roofing systems. Uve load not specified in drawings. Assumed 75 pt/ based on other institutional building in vicinity of CEME
1			Raof consists of 1 1/2" built up asphalt roof, but not specified. Approximated by "Ridruded Polystyrene, Glass
1		1	Roof is topped with explait but not specified. Approximated with impact Estimator's "Roofing Asphait" Above Open Web Steel Joist is comugated steel that the drawings do not detail - assumed to be a commercial
1			All previous perthouse tool assumptions still apply. Only dimensions of the tool were incorrect and modified as
1	3.1 Concrete Column and Concrete		per "Model Improvements" tab.
1		211-010020032030042	Follows Day and Gran datawing the tailors and that solutions
1		1	Column Rey and Span determined by taking floor area that columns were in, divided by the number of columns, Live load not specified in drawings. Assumed 75 pat based on other institutional building in vicinity of CEME
1			Number of beams = number of columns -1 = 120 - 1 = 119
1	3.2 Concrete Column and No Ream	I	Supported area and number of columns changed to accommodate CIOS Sorting
1		321-622 650	Column Bay and Span determined by taking floor area that columns were in, divided by the number of columns,
1			Lisumn say and span determined by taking hour area that columns were in, divided by the number of columns, Live load not specified in drawings. Assumed 75 pat based on other institutional building in vicinity of CEME
			Supported area and number of columns changed to accommodate CIQS Sorting
A31 Walls Relow Grade			
Below Grade	Reservent Willia		
1		Area 2 Basement Walls	Assume basement wells are 70° - As per difference in elevations
1			Fly ash concentration was not detailed in drawings, therefore the flysch percentage was assumed to be average. Consist of a variety of reber. The most common grade was chosen
1			Assume thickness is if when in resity it is f
1		Area 4 Basement Walls	Assume basement waits are 70° - As per difference in elevations
			Fly ash concentration was not detailed in drawings, therefore the flyssh percentage was assumed to be average. Consist of a veriety of reber. The most common grade was chosen
A32 Walls			
Above Grade			
	2.1 Concrete Till-up		

211-we1-0406-6	
	Concrete flyach percentage not specified and assumed to be average
	Reber not specified in drawings and assumed to be 84
	Dimensions were adjusted to account for imited thickness options Type of "Tin Rigid insulation" not specified in drawings and assumed to be "Polystyrene Extruded" insulation
	EIE Length + Length / EIE Thickness * Actual Thickness EIE Length + 109 / 5.5 * 6 + 118.9
21.2 - we 1-000-6	
	Concrete fiyash percentage not specified and assumed to be average Rebar not specified in drawings and assumed to be 84
	Dimensions were adjusted to account for limited thickness options
	Type of "fin Rigid insulation" not specified in drawings and assumed to be "Polystyrene Extruded" insulation File Length +Length / File Thickness * Actual Thickness
	EE Length = 110 / 5.5 * 6 = 120
21.3 - we.1-0700-6	Concrete flyesh percentage not specified and assumed to be average
	Reber not specified in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options
	Type of "In Rigid insulator" not specified in drawings and assumed to be "Rolystyme Extruded" insulation
	Giscing not specified for windows in drawing and assumed to be "Standard Giscing" EIE Length + Length / EIE Thickness * Actual Thickness
	Ell Langth + 200 / 5.5 *8 + 218.2
214-we147074	Concrete fiyesh percentage not specified and assumed to be average
	Reber not specified in drawings and assumed to be #4
	Dimensions were adjusted to account for imited thickness options Type of "Tin Rigid insulation" not specified in drawings and assumed to be "Polystyrene Extruded" insulation
	FIE Length +Length / FIE Thickness * Actual Thickness
21.5 - we 14906-6	EIE Langth = 279 / 5.5 * 8 = 304.4
	Concrete fijnsh percentage not specified and assumed to be average
	Reter not specified in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options
	Type of "In Rigid insulation" not specified in drawings and assumed to be "Polystyme Extruded" insulation
	ElE Length +Length / ElE Thickness * Actual Thickness ElE Length = 202 / 5.5 * 6 = 220.4
21.8 - we 1-1000-8	
	Concrete fijsish percentage not specified and assumed to be everage Reber not specified in drawings and assumed to be 84
	Dimensions were equated to eccount for limbed thickness options
	Type of "fin Rigid insulation" not specified in drawings and assumed to be "Polystyrene Extruded" insulation File Length + Length / File Thickness * Actual Thickness
	EiE Lancth = 73 / 5.5 * 6 =79.6
21.7 - we.1-1400-6	Concrete fijnah percentage not apecified and assumed to be average
	Rebar not specified in drawings and assumed to be #4
	Dimensions were adjusted to account for limited thickness options Type of "Tin Rigid insulation" not specified in drawings and assumed to be "Polystyrene Rutruded" insulation
	Giazing not specified for windows in drawing and assumed to be "Standard Giazing"
	EIE Langth +Langth / EIE Thickness * Actual Thickness EIE Langth = 70 / 5.5 * 6 = 75.4
21.8-we144074	
	Concrete fysich percentage not specified and assumed to be average Reber not specified in drawings and assumed to be 84
	Reber not specified in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options
	Type of "fin Rigid insulation" not specified in drawings and assumed to be "Rolystyrene Extruded" insulation Grazing not specified for windows in drawing and assumed to be "Standard Grazing"
	Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wals, "Steel Interior" for
	EIE Length +Length / EIE Thickness * Actual Thickness EIE Length = 477 / 5.5 * 6 = 520.4
21.9 - we 1-1506-6	
	Concrete flyash percentage not specified and assumed to be average Reber not specified in drawings and assumed to be 84
	Dimensions were adjusted to account for imited thickness options
	Type of "fin Rigid insulation" not specified in drawings and assumed to be "Rolystyrene Extruded" insulation Giscring not specified for windows in drawing and assumed to be "Standard Giscring"
	ElE Length + Length / ElE Thickness * Actual Thickness ElE Length = 71 / 5.5 * 6 = 77.5
21.10 - we.1-1000-0	ele Lengel + /1/5.5 * 6 + //.5
	Concrete flyash percentage not specified and assumed to be average
	Reber not specified in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options
	Type of "Tin Rigid insulator" not specified in drawings and assumed to be "Polystyrene Extruded" insulation
	Charles and second address in the second
	Giscring not specified for windows in drawing and assumed to be "Standard Giscring" Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
	Glading not specified for whole-s in drawing and easumed to be "Standard Glading" Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EIE Langth + Langth + EIE Thickness * Actual Thickness
21.11 - wa.1-1806-8	Clacing not specified for wholes in drawing and assumed to be "Standard Clacing" Door type not specified in the drawings and assumed to be "Stael Exterior" for exterior wells, "Stael Interior" for EIE Langth = Langth / EIE Thickness * Actual Thickness EIE Langth = 405 / 5.5 * 8 = 454.7
21.11 - we 1-1606-6	Clicking not specified for wholes in drawing and assumed to be "Standard Clicking" Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EIE Langth = Langth = 406 / 5.5 * 6 = 454.7 Concrete fyesh percentage not specified and assumed to be average
21.11 - we 14906-0	Glacting not specified for windows in drawing and essured to be "Standard Glacting" Door type not specified in the drawings and assumed to be "Starel Exterior" for exterior wells, "Steel Interior" for EIE Langth • viangth / EIE Thickness * Actual Thickness EIE Langth • dtb / 5.5 * 5 + 464.7 Concrete flysish percentage not specified and assumed to be sverage Rober not appetified in drawings and assumed to be #4
31.11 - wa 1.1808-8	Glacting not specified for windows in drawing and essumed to be "Standard Glacting" Door type not specified in the drawings and assumed to be "Standard Glacting" for exterior wells, "Steel Interior" for Sill Langth + 406 / 5.5 * 5 + 404.7 Concrete fysish percentage not specified and assumed to be sverage Risker not specified in drawings and assumed to be 84 Dimensions were adjusted to account for initial thickness options Type of "In Rigid Insulation" not specified assumed to be "Review"
21.11 - wa 1-1606-6	Clicking not specified for wholews in drawing and essumed to be "Standard Clicking" Door type not specified in the drawings and assumed to be "Stael Exterior" for exterior wells, "Stael Interior" for EIE Langth - Longth / EIE Thickness * Actual "Thickness EIE Langth - 400 / 5.5 * 5 + 404.7 Concrete typesh percentage not specified and assumed to be average Risker not specified in drawings and assumed to be ## Dimensions were adjusted to account for imited thickness options
21.11-we.1-1606-6	Clicking not specified for windows in drawing and essumed to be "Standard Clicking" Door type not specified in the drawings and assumed to be "Standard Clicking" for exterior wells, "Steel Interior" for EIE Langth ~ 2017/5.5 *5 ~ 644.7 Concrete fysich percentage not specified and assumed to be seerage Robor not appointed in drawings and assumed to be 64 Dimensions were adjusted to account for imited thickness options Type of "Sin Rigid Insulation" not specified in drawings and assumed to be "Rolystyrene Extruded" insulation Discription of specified for windows in drawing and assumed to be "Rolystyrene Extruded" insulation Discription of specified for windows in drawing and assumed to be "Standard Clicking" Door type not specified for windows and assumed to be "Standard Clicking" Door type not specified for windows and assumed to be "Standard Clicking" Door type not specified for windows and assumed to be "Standard Clicking" Door type not specified for windows and assumed to be "Standard Clicking"
	Silicting not specified for windows in drawing and essumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Statel Exterior" for exterior wells, "Steel Interior" for EIE Langth • 40b / 5.5 * 8 + 464.7 Concrete flysch percentage not specified and assumed to be swenge Rober not appointed in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options Type of "In Rigit insulation" not appointed to account do to be "Standard Globing" Door type not specified for windows in drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawing and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" EIE Langth + 4.07.5 * 6 + 45.8
	Sixcling not specified for windows in drawing and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Clobing" for exterior wells, "Steel Interior" for SIE Langth + 400 / 5.5 * 6 + 464.7 Concrete figure percentage not specified and assumed to be seeinge Rebar not specified in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options Type of "Inin Rigid Insulation" not appendic in drawings and assumed to be "Relystyme Extruded" insulation Sixcling not specified for windows in drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Standard" for electron wells, "Steel Interior" for Stating not specified in the drawings and assumed to be "Standard Clobing" Door type not specified in the drawings and assumed to be "Standard Clobing" Door Stating not specified in the drawings and assumed to be assumed to be "Standard Stating" for station wells, "Steel Interior" for Stating not specified in the drawings and assumed to be assumed to be "Standard Clobing" Door type not specified in the drawings and assumed to be assumed to be "Standard Clobing" for electron wells, "Steel Interior" for Stating not specified in the drawings and assumed to be assumed
	Sixting not specified for windows in drawing and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Elie Langth + (Angth / Elie Thoisness * Actual Thiskness Elie Langth + (Att / 5.* % + 464.7 Concrete figure percentage not specified and assumed to be seenge Reter not specified in drawings and assumed to be #H Dimensions were adjusted to account for initial diskiness options Type of "Init Rigit Insulation" not specified and assumed to be "Standard Cisting" Disorder of specified for windows in drawings and assumed to be "Standard Cisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Elie Langth - u.angth / Elie Thoirness * Actual Thickness Elie Langth - europy / Elie Thickness application to instand the drawing Risk not appending in drawings and assumed to be #H
	Sixting not specified for windows in drawing and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Statel Exterior" for exterior wells, "Steel Interior" for SIE Langth + 406 / 5.5 * 6 + 406.7 Concrete figues percentage not specified and assumed to be sverage Reter not specified in drawings and assumed to be 54 Dimensions were adjusted to account for limited thickness options Type of "In Rigit Insulator" not specified and assumed to be "Statystymen Extruded" insulation Giscling not specified for windows in drawings and assumed to be "Statystymen Extruded" insulation Giscling not specified for windows in drawings and assumed to be "Statystymen Extruded" insulation Giscling not specified in the drawings and assumed to be "Statystymen Extruded" insulation Giscling not specified in the drawings and assumed to be "Statystymen Extruded" insulation Giscling not specified in the drawings and assumed to be "Statystymen Extruded" insulation Giscling not specified in the drawings and assumed to be "Statystymen Extruded" insulation Staty and the drawing and assumed to be "Statystymen Extruded" insulation Staty and the drawing and assumed to be "Statystymen Extruded" insulation Staty and the drawing and assumed to be weeke Reter not specified in the drawing and assumed to be evenge Reter not specified in a drawing and assumed to be Statystymen Extruded" insulation Type of "In Rigit insulator" not specified and tablemes options Type of "In Rigit insulator" in substring and assumed to be "Relystymen Extruded" insulation
	Sixcing not specified for windows in drawing and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Clobing" for exterior wells, "Steel Interior" for SIE Langth + 400 / 5.5 * 8 + 404.7 Concrete figure percentage not specified and assumed to be seenge Reformed and the specified in drawings and assumed to be SH Dimensions were adjusted to account for limited thickness options Type of "Inin Rigid Insulation" not specified and assumed to be "Standard Clobing" Dimensions were adjusted to account for limited thickness options Type of "Inin Rigid Insulation" not specified in drawings and assumed to be "Standard Clobing" Door type not specified in the drawings and assumed to be "Standard Clobing" Door type not specified in the drawings and assumed to be "Standard Clobing" Door type not specified in the drawings and assumed to be "Standard Clobing" Door type not specified in the drawings and assumed to be "Standard Clobing" Door type not specified in the drawings and assumed to be "Standard Clobing" for eldenion wells, "Steel Interior" for Stating not appecified in the drawings and assumed to be "Standard Clobing" Door type not specified in the drawings and assumed to be account for interior for eldenion wells, "Steel Interior" for Stating not appecified in the drawing and assumed to be stating and assumed to be stating the advector specified and assumed to be stating the advector specified in drawing and assumed to be stating advector account for instating the thickness options
	Sixting not specified for windows in drawing and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Elis Langth + 400 / 5.5 * 8 + 404.7 Concrete figure percentage not specified and assumed to be seenge Rober not specified in drawings and assumed to be 44 Dimensions were adjusted to account for imited thickness options Type of "Inin Rigid Insulation" not specified and assumed to be "Robel Cisting" Door type not specified in the drawings and assumed to be "Robel Cisting" Door type not specified in the drawings and assumed to be "Robel Cisting" Door type not specified in the drawings and assumed to be "Robel Cisting" Door type not specified in the drawings and assumed to be "Robel Cisting" Door type not specified in the drawings and assumed to be "Robel Cisting" Door type not specified in the drawings and assumed to be "Robel Cisting" Door type not specified in the drawings and assumed to be seenge Rober not appelified in dependent and assumed to be seenge Rober not appelified in dependent of the drawings and assumed to be "Robel Cisting" Concrete figsin percentage not specified and assumed to be "Robel Cisting" Door type of "In Rigid Insulation" not specified in drawings and assumed to be "Robel Cisting" Door type of the drawings and assumed to be "Robel Cisting" Door type of the drawings and assumed to be "Robel Cisting" Door type of the drawings and assumed to be "Robel Cisting" Door type of the drawings and assumed to be "Robel Cisting" Door type of the drawings and assumed to be "Robel Cisting" Door type of the drawings and assumed to be "Robel Cisting" Door type of the drawings and assumed to be "Robel Cisting" Door type of the drawings and assumed to be "Robel Cisting" Door type not specified for windows and assumed to be "Robel Cisting" Door type not specified for windows and assumed to be "Robel Cisting" Door type not specified for windows and assumed to be "Robel Cisting" Door type not specified for windows and assume
21.12 - ma.1.47804	Sincting not specified for windows in drawing and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Clobing" for exterior wells, "Steel Interior" for SIE Langth + 40b / 5.5 * 8 + 406.7 Concrete flysch percentage not specified and assumed to be evenge Rober not appointed in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options Type of "In Rigid Insulator" not appointed in drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawing and assumed to be "Standard Globing" Door type not specified in the drawing and assumed to be Standard Globing" Door type not specified to account to instead Thickness Stil Langth + 4.07.5.5 * 6 + 4.6.8 Concrete flysch percentage not specified and assumed to be "Standard Globing" Door type not specified to account to instead Thickness Stil Langth + 4.07.5.5 * 6 + 4.6.8 Concrete flysch percentage not specified and assumed to be "Standard Globing" Door type not specified to account to instead Thickness Stil Langth + 4.07.5.5 * 6 + 4.6.8 Standard Clobing - 5.5 * 6 + 4.6.8 Standard Clo
2112-me147304	Sixting not specified for windows in drawing and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard For exterior wells, "Steel Interior" for SIE Langth + 400 / 5.5 * 6 + 404.7 Concrete fipsin percentage not specified and assumed to be exercise Refer not specified in drawings and assumed to be 84 Dimensions were solubled to account for limited thickness options Type of "In Rigid Insulator" not specified and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be Standard Globing" Door type of "In Rigid Insulator" not specified and assumed to be "Standard Globing" Door type of specified in drawings and assumed to be "Standard Globing" Door type of "In Rigid Insulator" not specified in drawings and assumed to be "Standard Globing" Door type of "In Rigid Insulation" not specified in drawings and assumed to be "Standard Globing" Door type of type in type in the indows in drawing and assumed to be "Standard Globing" Door type of type in type in the specified in the drawing and assumed to be "Standard Globing" Door type of type in type in the specified in the drawing and assumed to be "Standard Globing" for standard wells. "Stare interior" for Star Langth - 420 / 55 * * 6 = 400.7 Door type and specified in the drawing and assumed to be assemble Exertin" for star in wells, "Stare interior" for Star Langth -
21.11 - we 1.4004 21.12 - we 1.47004 21.12 - we 1.48004	Sincting not specified for windows in drawing and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Clobing" for exterior wells, "Steel Interior" for SIE Langth + 40b / 5.5 * 8 + 406.7 Concrete flysch percentage not specified and assumed to be evenge Rober not appointed in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options Type of "In Rigid Insulator" not appointed in drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawings and assumed to be "Standard Globing" Door type not specified in the drawing and assumed to be "Standard Globing" Door type not specified in the drawing and assumed to be Standard Globing" Door type not specified to account to instead Thickness Stil Langth + 4.07.5.5 * 6 + 4.6.8 Concrete flysch percentage not specified and assumed to be "Standard Globing" Door type not specified to account to instead Thickness Stil Langth + 4.07.5.5 * 6 + 4.6.8 Concrete flysch percentage not specified and assumed to be "Standard Globing" Door type not specified to account to instead Thickness Stil Langth + 4.07.5.5 * 6 + 4.6.8 Standard Clobing - 5.5 * 6 + 4.6.8 Standard Clo
2112-me147304	Sixting not specified for windows in drawing and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Cisting" for exterior wells, "Steel Interior" for SIE Length + 40t / 55 * 8 + 404.7 Concrete flysin percentage not specified and assumed to be sverage Rober not specified in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options Type of "In Rigit Insulator" in the geofile in drawings and assumed to be "Rolystynene Extruded" insulation Gisting not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be sverage Rober not appetified in the drawings and assumed to be sverage Rober not appetified in drawings and assumed to be sverage Rober not appetified in drawings and assumed to be "Standard Gisting" Door type of "In Rigit in drawings and assumed to be "Standard Gisting" Door type of "In Rigit in drawings and assumed to be "Standard Gisting" Door type of specified in the drawings and assumed to be "Standard Gisting" Door type of specified in the drawings and assumed to be "Standard Gisting" Door type of specified in the drawings and assumed to be "Standard Gisting" Door type of specified in the drawings and assumed to be "Standard Gisting" Door type of specified in the drawings and assumed to be "Standard Gisting" Door type of specified in the drawings and assumed to be "Standard Gisting" Door type of specified in the drawings and assumed to be "Standard Gisting" for adjustion for a specified in the drawings and assumed to be "Standard" for Assid to account for limited thickness aption
2112-me147304	Sixting not specified for windows in drawing and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Cisting" for exterior wells, "Steel Interior" for SIE Langth + 400 / 55 * 8 + 404.7 Concrete flysin percentage not specified and assumed to be seerage Rober not appetited in drawings and assumed to be 84 Demansions were adjusted to account for limited thickness options Type of "In Rigit Insulation" not specified and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be seerage Rober not appetified in drawings and assumed to be #Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" for adaritor wells, "Steel Interior" for SiE Length + 200 / 55 * 8 + 2000 7 Concrete flysin percentage not specified and assumed to be "Standard Giscing" Door type of specified in drawings and assumed to be "Standard Giscing" Door type of specified in the drawin
21.12 - ma.1.47804	Sixting not specified for endows in drawing and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Cisting" for exterior wells, "Steel Interior" for SIX Length + 400 / 55 * 8 + 404.7 Concrete flysin percentage not specified and assumed to be seerage Rober not appetited in drawings and assumed to be 84 Dimensions were adjusted to account for inited thickness options Type of "In Rigit Insulator" not specified and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type not specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be State Exterior "for exterior wells, "Steel Interior" for Six Length + 40 / 55 * 6 + 45.8 Concrete flysin percentage not specified and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Door type of specified in the drawings and assumed to be "Standard Giscing" Concrete flysin percentage not specified and assumed to be "Standard Giscing" Door type of "In Right percentage not specified and assumed to be "Standard Giscing" Door type of "In Right percentage not assumed to be "Standard Giscing" Door type of speci
21.12 - ma 1-1700-6 21.12 - ma 1-1800-6	Sixting not specified for windows in drawing and assumed to be "Banaded Gisting" Door type not specified in the drawings and assumed to be "Balasi Educing" for exterior wells, "Steel Interior" for EIE Langth + 400 / 5.5 * 8 + 406.7 Concrete figure percentage not specified and assumed to be swenge Refer not specified in drawings and assumed to be #84 Dimensions were solution to account for limited thickness options Type of "Inin Rigit Insulation" not specified and assumed to be "Polyatynene Extruded" insulation Giscing not specified for windows in drawing and assumed to be "State Educing" Door type not specified in the drawings and assumed to be "State Educing" Door type not specified in the drawings and assumed to be "State Educing" Door type not specified in the drawings and assumed to be "State Educing" Extra rot specified in the drawings and assumed to be "State Educing" for educing "Steel Interior" for EIE Langth + 40.7 5 * 10 + 40.8 Concrete figure portertage not specified and assumed to be "State Educing" Concrete figure portertage not specified and assumed to be "State Educing" Door type of specified in the drawings and assumed to be "State Educing" Door type of specified in the drawings and assumed to be "State Educing" Door type of specified in the drawings and assumed to be "State Educing" Door type of specified in the drawings and assumed to be "State Educing" Door type not specified in the drawings and assumed to be "State Educing" Door type not specified in the drawings and assumed to be "State Educing" Door type not specified in the drawings and assumed to be "State Educing" Door type not specified in the drawings and assumed to be "State Educing" Door type not specified in the drawings and assumed to be "State Educing" Door type not specified in the drawings and assumed to be state assumed to be "State and Educing" Door type not specified in the drawings and assumed to be state assumed to be "State and Educing" Door type of the specified and assumed to be "State and Educ
21.12 - ma.1.47804	Sincting not specified for windows in drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Clocing" for exterior wells, "Steel Interior" for SIE Langth + 400 / 5.5 * 6 + 404.7 Concrete fipsin percentage not specified and assumed to be exercise Refer not specified in drawings and assumed to be 84 Dimensions were adjusted to account for limited thickness options Type of "In Rigid insulation" not specified and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type of "In Rigid Insulation" not specified and assumed to be "Standard Glocing" Concrete fipsin percentage not specified and assumed to be "Standard Glocing" Door type of "In Rigid Insulation" not specified in drawings and assumed to be "Standard Glocing" Door type of specified in the drawings and assumed to be "Standard Glocing" Door type of appelited in drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in the drawings and assumed to be "Standard Glocing" Door type not specified in
21.12 - ma 1-1700-6 21.12 - ma 1-1800-6	Sixting not specified for windows in drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Cisting" Elie Langth + 400 / 5.5 * 8 + 404.7 Concrete figure percentage not specified and assumed to be seenge Return not specified in microsoft for inflated fisioness options Type of "Inin Rigit Insulation" not specified and assumed to be "Standard Gisting" Door type not specified in microsoft of the seenge Return not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in the drawings and assumed to be "Standard Gisting" Door type not specified in drawings and assumed to be "Standard Gisting" Door type not specified in drawings and assumed to be "Standard Gisting" Door type not specified in drawings and assumed to be "Standard Gisting" Door type not specified in drawings and assumed to be "Standard Gisting" Door type not specified in drawings and assumed to be "Standard Gisting" Door type not specified in drawings and assumed to be "Standard Gisting" Door type not specified in drawings and assumed to be "Standard Gisting" Door type not specified for windows in drawing and assumed to be "Standard Gisting" Door type not specified in drawings and assumed to be "Standard Gisting" Door type not specified for windows in drawing and assumed to be "Standard Gisting"
21.12- ma 1.4700-6 21.12- ma 1.4800-6	Sincting not specified for windows in drawings and assumed to be "Banaded Gischig" Door type not specified in the drawings and assumed to be "Batel Exterior" for exterior wells, "Steel Interior" for EIE Langth + 400 / 5.5 * 8 + 406.7 Concrete fipsin percentage not specified and assumed to be seerage Refer not specified in drawings and assumed to be 84 Dimensions were adjusted to account for insted thickness options Type of "In Rigid insulation" not specified and assumed to be "Solystynene Extruded" insulation Garcete fipsin percentage not specified and assumed to be "Batel Exterior" for exterior wells, "Steel Interior" for Eie Langth + 401 / 5.5 * 8 + 408.8 Dimensions were adjusted for windows in drawings and assumed to be "Solystynene Extruded" insulation Garcete fipsin percentage not specified and assumed to be "Batel Exterior" for Eie Langth + 40 / 5.5 * 8 + 40.8 Concrete fipsin percentage not specified and assumed to be "Batel Exterior" for Eie Langth + 40 / 5.5 * 8 + 40.8 Concrete fipsin percentage not specified and assumed to be "Revised Gischig" Door type of "In Rigid Insulation" not specified in drawings and assumed to be "Revised of Extruded" insulation Garceting not specified in the drawings and assumed to be "Revised Gischig" Door type of winking in advantumed to be "Steel Exterior" for exterior wells, "Batel Interior" for Eie Langth - 40 / 5.5 * 8 + 40.8 Concrete fipsin percentage not specified in drawings and assumed to be "Revised Gischig" Door type of appendied for windows in drawing and assumed to be "Steel Exterior" for exterior wells, "Batel Interior" for Eie Langth - 40 / 5.5 * 8 + 40.8 Concrete fipsin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Batel Interior" for Eie Langth - 20 / 5.5 * 8 + 40.8 Concrete fipsin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Batel Interior" for Eie Langth - 20 / 5.5 * 8 + 40.8 Concrete fipsin percentage not specified and assumed to be "Revised Stearge" Door type n

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1			Giscting not specified for windows in drawing and assumed to be "Standard Giscting" Door type not specified in the drawings and assumed to be "Stael Exterior" for exterior walls, "Steel Interior" for
			ElE Length + Length / ElE Thickness * Actual Thickness ElE Length + 344 / 5.5 * 6 = 375.3
		21.15 - we.1-2100-6	
			Concrete flyesh percentage not specified and assumed to be everage Reber not specified in drawings and assumed to be #4
			Dimensions were adjusted to account for imited thickness options. Type of "Tin Rigid insulation" not specified in drawings and assumed to be "Polystyrene Ruttuded" insulation
			FIE Length + Length / FIE Thickness * Actual Thickness
	2.2 Concrete Rigck Well		6/6 Length = 275 / 5.5 * 8 = 297.8
		2.2.1 - we.2-1508-6	The impact Retinator assumes 200mm thick block Length of 6" thick block well multiplied by 0.762 to achieve
			Glacting not specified for windows in drawing and assumed to be "Standard Glacing" Door type not specified in the drawings and assumed to be "Steel Exterior" for extension, "Steel Interior" for
			EIE Length = Actual Length = 0.782 (200mm/8in)
	2.3 Cattlin Place		044.6 × 301 * 0.762
		23.1 - we.3-1300-0	Concrete flyach percentage not opeoffed and assumed to be everage
			Reber not specified in drawings and assumed to be #5
			Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel interior" for
			EIE Length = actual length / EIE thickness * actual thickness 08.0 = 80 / 0 * 0
		23.2 - we 3-1900-6	
			Concrete flyesh percentage not specified and assumed to be everage Reber not specified in drawings and assumed to be #5
			Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
			Glazing not specified for windows in drawing and assumed to be "Standard Glazing" EVE Length + actual length / EVE thickness * actual thickness
			ele Langer + ACLAR anger / ele Processa * actual transmas 84.8 = 113 / 8 * 0
1		233-we34700-6	Concrete flyach percentage not specified and assumed to be average
			Rebar not specified in drawings and assumed to be #5 Dimensions were adjusted to account for imited thickness options
			Globing not specified for windows in drawing and assumed to be "Standard Globing"
1			EIE Length + actual length / EIE thickness *actual thickness 30.8 = 41 / 8 * 6
1		23.4 - we-3-1800-8	Concrete fijnah percentage not specified and assumed to be average
1			Reber not specified in drawings and assumed to be #5
			Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be "lites! Exterior" for exterior wells, "Steel Interior" for
			EIE Length + actual length / EIE thickness *actual thickness 45 = 50 / 8 * 5
	2.5 Steel Stud		
		251-we91208-4	Door type rat specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
			Stud Weight not specified in the drawings and assumed to be Light. Giscting not specified for windows in drawing and assumed to be "Standard Giscting"
		25.2 - we 9-1300-4 - NR	
			Stud Weight not specified in the drawings and assumed to be Light. Gisting not specified for windows in drawing and assumed to be "Standard Gisting"
		25.3 - we.9-2000-4	Situd Weight not specified in the drawings and assumed to be Light.
6 Extra Resic Materials	6.1 Gypsum Board	•	
		61.1 - Win Asbestos	
1			Many window traines in the building contain panels that are steel stud wells with solid insulation and backing
1	6.2 Insulation		
	t 2 insulation	6.2.1 - Win Asbestos	Many window frames in the holidion contain names that are stead at of wells with anishing and hard-to-
	a 2 insulation	6.2.1 - WILADESDS	biany window transes in the building contain panels that are steel stud wells with solid insulation and backing board forced with esbestos. This was approximated by finding the materials in a square tool well with the steel
	6.2 Inwellion	8.2.1 - WE ADDRESS	board forced with exbestos. This was approximated by finding the materials in a square foot wall with the steel studa, extruded polystynene insulation, and OSB. The impact Estimator can not model asbestos. See and of
	6.2 Insulation		board forced with asbestos. This was approximated by finding the materials in a square foot wail with the steel
		8.3.1 - Win Astreeton	board forced with exbestos. This was approximated by finding the materials in a square foot wall with the steel studa, extruded polystynene insulation, and OSB. The impact Estimator can not model asbestos. See and of
			board forced with esteetins. This was approximated by finding the materials in a square foot wall with the steel study, extrudied polyteme insulation, and CSB. The impact Estimator can not model asbeetins. See and of Assumption table for calculations. Namy window frames in the building contain panels that are steel stud walls with solid insulation and backing
		8.3.1 - Win Asbestos 8.3.2 - Win Asbestos	board forced with extended. This was approximated by finding the materials in a square foot wall with the statel study, extrudied polyteme insulation, and CSB. The impact Estimator can not model asbeetos. See end of Assumption table for calculations
	5.3 Steel	5.5.1 - Win Asbestos	board forced with esteetins. This was approximated by finding the materials in a square foot wall with the steel study, extrudied polyteme insulation, and CSB. The impact Estimator can not model asbeetins. See and of Assumption table for calculations. Namy window frames in the building contain panels that are steel stud walls with solid insulation and backing
B11 Partitions	0.3 (Baa) 8.4 Witod	8.3.1 - Win Asbestos 8.3.2 - Win Asbestos	board forced with estewards. This was approximated by finding the materials in a square foot wall with the steel study, extruded polyterme insulation, and CSB. The impact Estimator can not model asbestos. See end of Assumption table for calculations Namy window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing
B11 Partitions	5.3 Steel	8.3.1 - Win Asbestos 8.3.2 - Win Asbestos	board forced with esteetios. This was approximated by finding the materials in a square foot wall with the steel study, extruded polyterme insulation, and CSB. The impact Estimator can not model asbeetos. See end of Assumption table for calculations. Namy window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 5.4.1 - Win Asbestos	board forced with esteeties. This was approximated by finding the materials in a square foot wall with the steel study, extruded polyterine insulation, and CSB. The impact Estimator can not model asbeeties. See end of Assumption table for calculations. Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Discovering figure percentage not specified and assumed to be everage Rebar not specified in drawings and assumed to be 94
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 5.4.1 - Win Asbestos	board forced with estavator. This was approximated by finding the materials in a square foot wall with the steel study, exhicute optiophysics insulation, and CSB. The impact Estimator can not model asbeets. See end of Assumption table for calculations Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain carels that are steel stud walls with solid insulation and backing Concrete flyash percentage not specified and assumed to be everage Raber not specified in drawings and assumed to be 84 Dimension were solitated to individuate in individuation in the building contain the inscience options
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 5.4.1 - Win Asbestos	board forced with estewards. This was approximated by finding the materials in a square foot wall with the steel stude, extruded polyteme insulation, and CSB. The impact Estimator can not model asbeeta. See end of Assumption table for calculations Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing is a study of the figure and assumed to be #4 Dimension were solited in drawings and assumed to be "Polystynene Estruded" insulation (Figure *Leage) / Bit Thiomese * Actual Thiomesa
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 5.4.1 - Win Asbestos	board forced with esteeties. This was approximated by finding the materials in a square foot wall with the steel study, extructed polyterine insulation, and CSB. The impact Estimator can not model asbeeties. See end of Assumption table for calculations. Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Concrete figure in provintinge not specified and assumed to be everage Rater not specified in drawings and assumed to be 84 Dimensions were adjusted to account for imbard trainings and assumed to be "Yolystynen Estruded" insulation
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 5.4.1 - Win Asbestos 2.1.16 - w. 1-1300-6	beard forced with estewards. This was approximated by finding the materials in a square foot wall with the steel study, exhicate polyaginese insulation, and CSB. The impact Estimator can not model estewards. See and of Assumption table for deculations. Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Containes fysion percentage not specified and assumed to be the "Polystynene Estruded" insulation SiGL Langth * 11 (SiG * 10 * 12 Concerts fysion percentage not specified and assumed to be average
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 5.4.1 - Win Asbestos 2.1.16 - w. 1-1300-6	beard forced with estewards. This was approximated by finding the materials in a square foot wall with the steel study, exhicate polyaginese insulation, and CSB. The impact Estimator can not model estewards. See and of Assumption table for deculations. Many window frames in the building contain panels that are sheel stud walk with acid insulation and backing Many window frames in the building contain panels that are sheel stud walk with acid insulation and backing Many window frames in the building contain panels that are sheel stud walk with acid insulation and backing Many window frames in the building contain panels that are sheel stud walk with acid insulation and backing Many window frames in the building contain panels that are sheel stud walk with acid insulation and backing Many window frames in the building contain panels that are sheel stud walk with acid insulation and backing Many window frames in the building contain panels that are sheel stud walk with acid insulation and backing Sciencrate Space particular and assumed to be everage Rebar not specified in drawings and assumed to be "Polystynene Estruded" insulation Sit Langth * Lingth / Sit * 12 Concrete Space particular for specified and assumed to be everage Rebar not specified in drawings and assumed to be set Sit Langth * Lingth / Sit * 12 Concrete Space particular for integer and assumed to be set Rebar not specified in drawings and assumed to be set Dimension were adjusted to account for integer to be the Dimension were adjusted to account for integer to be the Rebar not specified in drawings and assumed to be set Rebar not specified in drawings and assumed to be set Dimension were adjusted to account for integer to be set Dimension were adjusted to account for integer to be set Dimension were adjusted to account for integer to be set Dimension were adjusted to account for integer to be adjusted to be account for integer be account for integer beginsed to be account for integer be account for integer beginsed to be acc
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 5.4.1 - Win Asbestos 2.1.16 - w. 1-1300-6	board forced with estandism, This was approximated by finding the materials in a square foot wall with the steel stude, extruded polyteme insulation, and CSB. The impact Estimator can not model asbeets. See end of Assumption table for calculations Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Discoverse figure percentage not specified and assumed to be everage Relear not specified in drawings and assumed to be 94 Dimensions were adjusted to account for immed thickness options Type of "High insulation" not specified in drawings and assumed to be "Holystysene Estruded" insulation ESE Length * Langth * 15 Thiokness * Actual Thickness ESE Length * 11 / 55 * 6 * 12 Concrete figure percentage not specified and assumed to be seerage Relear on to pecified in drawing and assumed to be seerage Relear on to pecified in drawing and assumed to be seerage Relear on to pecified in drawing and assumed to be seerage Relear on to pecified in drawing and assumed to be seerage Relear on to pecified in drawing and assumed to be seerage Relear on to pecified in drawing and assumed to be 84
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 6.4.1 - Win Asbestos 2.1.10 - wil 1-1300-6 2.1.17 - wil 1-1300-6	board forced with estandist, This was approximated by finding the materials in a square foot wall with the steel stude, extruded polyterme insulation, and CSB. The impact Estimator can not model asbeets. See end of Assumption table for calculations Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Many window frames in the building contain panels that are steel stud walls with solid insulation and backing Discords figsing percentage not specified and assumed to be sverage Redex not specified in drawings and assumed to be 64 Dimensions were educated to account for immed thickness options Type of the Right insulation' not apecified in drawings and assumed to be "Polystynene Estruded" insulation SEI Length * Length ? EIS Thickness * Actual Thickness EIS Length * 11/3.5 * 6 * 12 Concrete figsing percentage not specified and assumed to be sverage Reburn of specified in drawings and assumed to be 54 Dimensions were educated to account for immed thickness options Type of 'tile Right insulation' not apecified and assumed to be Storage Reburn on specified in drawings and assumed to be 54 Dimensions were educated to account for immed thickness options Type of 'tile Right insulation' not apecified and assumed to be Storage Reburn on eye educated to account for immed thickness options Type of 'tile Right insulation' not apecified and resumes account of the storage and assumed to be 54 Dimensions were educated to account for immed thickness options Type of 'tile Right insulation' not apecified and resumes acoun
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 5.4.1 - Win Asbestos 2.1.16 - w. 1-1300-6	board forced with estandiation, and CSB. The impact satinator can not model estandiate objectment insulation, and CSB. The impact satinator can not model estandiate objectment insulation, and CSB. The impact satinator can not model estandiates. See end of Assumption table for calculations. Name window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing many window frames in the building contain panels that are sheel stud wells with solid insulation and backing many window frames in the building contain panels that are sheel stud wells with solid insulation and backing many window frames in the building contain panels that are sheel stud wells with solid insulation and backing many window frames in the building contain panels that are sheel stud wells with solid insulation and backing in the second of the impact and assumed to be 84. Dimensions were eduated to account for impact findings and assumed to be seconge Retar not specified in drawings and assumed to be 84. Dimensions were eduated to account for impact findings and assumed to be % buyetysene Extruded" insulation if E Length + 1 (55 % 18 > 12). Concrete fysich parcentage not specified and assumed to be % buyetysene Extruded" insulation ES Length + (Esgin / ES). This impact * Actual Thickness applies in the specified in drawings and assumed to be % buyetysene Extruded" insulation ES Length + (Esgin / ES). Thickness * Actual Thickness applies is the cost * 10 + 57 % 10 >
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 6.4.1 - Win Asbestos 2.1.10 - wil 1-1300-6 2.1.17 - wil 1-1300-6	board forced with estandiation, and CSB. The impact satinator can not model estandiate objectment insulation, and CSB. The impact satinator can not model estandiate objectment insulation, and CSB. The impact satinator can not model estandiate sate and of Assumption table for calculations. Name window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing many window frames in the building contain panels that are sheel stud wells with solid insulation and backing many window frames in the building contain panels that are sheel stud wells with solid insulation and backing frame window frames in the building contain panels that are sheel stud wells with solid insulation and backing in the second of this many expected in drawings and assumed to be % paystylene Extruded* insulation in ESE Length * 11.55.*8 ± 12.************************************
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 6.4.1 - Win Asbestos 2.1.10 - wil 1-1300-6 2.1.17 - wil 1-1300-6	board forced with estandiation, and CSB. The impact satinator can not model asbeets. See and of Assumption table for calculations. And CSB. The impact satinator can not model asbeets. See and of Assumption table for calculations. Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Discourse figuesh percentage not specified and assumed to be swenge Relear not specified in drawing and assumed to be 54 Dimensions were educated to account for imited thickness options Type of "In Rigid insulation" not specified in drawings and assumed to be "Relystysene Extruded" insulation EVEL Length + 11,55 * 6 * 12 Discrete figuesh percentage not specified and assumed to be swenge Relear not specified in drawings and assumed to be "Relystysene Extruded" insulation EVEL Length + 12,55 * 6 * 77.9 Discrete figuesh percentage not specified and assumed to be "Relystysene Extruded" insulation EVEL with Right percentage and assumed to be 84 Dimensions were educated to account for imited thickness options EVEL Length + 12,55 * 6 * 77.9 Discrete figuesh percentage intig specified and assumed to be # Polystysene Extruded" insulation EVEL = 116 Right Insulation" intige difficience applied and assumed to be "Polystysene Extruded" insulation EVEL = 116 Right Insulation" intige difficience applied and assumed to be
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 6.4.1 - Win Asbestos 2.1.10 - wil 1-1300-6 2.1.17 - wil 1-1300-6	board forced with estandism, and CSB. The impact satinator can not model asbeets. See and of Assumption table for calculations. And CSB. The impact satinator can not model asbeets. See and of Assumption table for calculations. Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Many window frames in the building contain panels that are sheel stud wells with solid insulation and backing Discorption figure parameters and assumed to be seeninge Relear not specified in drawing and assumed to be seeninge Relear not specified in drawing and assumed to be the Dimensions were edulated to account for imbard thickness options Type of "In Rigid Insulation" not specified and assumed to be seeninge Relear not specified in drawing and assumed to be the Dimensions were edulated to account for imbard thickness options Type of "In Rigid Insulation" not specified and assumed to be "Relystynene Extruded" Insulation EVE Length *Langth / EVE Trickness * Actual Thickness EVE United the specified in the drawings and assumed to be %olystynes Extuded" insulation Discrept *Langth / EVE Thickness * Actual Thickness EVE United *
B11 Partitions	0.3 (Baa) 8.4 Witod	5.3.1 - Win Asbestos 5.3.2 - Win Asbestos 6.4.1 - Win Asbestos 2.1.10 - wil 1-1300-6 2.1.17 - wil 1-1300-6	board forced with estandiation, and CSB. The impact satinator can not model estandiate objectment insulation, and CSB. The impact satinator can not model estandiate the set of Assumption table for calculations. Name window frames in the building contain panels that are shell stud wells with acid insulation and backing Many window frames in the building contain panels that are shell stud wells with acid insulation and backing Many window frames in the building contain panels that are shell stud wells with acid insulation and backing Many window frames in the building contain panels that are shell stud wells with acid insulation and backing Many window frames in the building contain panels that are shell stud wells with acid insulation and backing Many window frames in the building contain panels that are shell stud wells with acid insulation and backing Many window frames in the building contain panels that are shell stud wells with acid insulation and backing Many window frames in the building contain panels that are shell stud wells with acid insulation and backing frame window frames in the building contain panels that are shell stud wells with acid insulation and backing frame with the shell be the studies of the shell be that a shell shall be that and acid insulation and backing in the second to be 84. Dimensions were adjusted to account for imbed thickness options Type of "In Rigd insulation" on specified in drawings and assumed to be the Solystynene Estruded" insulation ESE Length + 11 (15.5 the 30 to 2000 the insulation assumed to be strange at the second to insulate the sheares applied in the second to insulate applications. Type of "In Rigd insulator" not specified in drawings and assumed to be "Rolystynene Estruded" insulation ESE Length + 165 the 2000 the insulator in the specified in drawings and assumed to be "Rolystynene Estruded" insulator insulator insulator insulator insulator insulators applied in a secure to be 84. Dimensions were adjusted to account to initis insulators applied in the sever
B11 Partitions	0.3 (Baa) 8.4 Witod	8.3.1 - Win Asbestos 8.3.2 - Win Asbestos 8.4.1 - Win Asbestos 2.1.16 - wil 1-1300-6 2.1.17 - wil 1-1500-6 2.1.18 - wil 1-1500-6	beard forced with estewater. This was approximated by finding the materials in a square foot wail with the steel stude, extruded polyteree insulation, and CSB. The impact satinator can not model asbeets. See end of Assumption table for calculations Many window frames in the building contain panels that are steel stud wais with solid insulation and backing Many window frames in the building contain panels that are steel stud wais with solid insulation and backing Many window frames in the building contain panels that are steel stud wais with solid insulation and backing Many window frames in the building contain panels that are steel stud wais with solid insulation and backing Many window frames in the building contain panels that are steel stud wais with solid insulation and backing Many window frames in the building contain panels that are steel stud wais with solid insulation and backing Concrete fysich percentage not specified and assumed to be everage Risker not specified in drawings and assumed to be "Polystylene Extruded" insulation Bis Langth + Lingth / Bis Thiokness + Actual Thickness Bis Langth + Lingth / Bis Thiokness + Actual Thickness Bis Langth + 11 / Si + 10 × 12 Concrete fysich percentage not specified and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be
B11 Partitions	0.3 (Baa) 8.4 Witod	8.3.1 - Win Asbestos 8.3.2 - Win Asbestos 8.4.1 - Win Asbestos 2.1.16 - wil 1-1300-6 2.1.17 - wil 1-1500-6 2.1.18 - wil 1-1500-6	beard forced with estewater. This was approximated by finding the materials in a square foot wail with the steel stude, extruded polyterene insultation, and CSB. The impact satinator can not model asbeets. See end of Assumption table for calculations. Many window frames in the building contain panels that are shell stud wais with solid insulation and backing Many window frames in the building contain panels that are shell stud wais with solid insulation and backing Many window frames in the building contain panels that are shell stud wais with solid insulation and backing Many window frames in the building contain panels that are shell stud wais with solid insulation and backing Many window frames in the building contain panels that are shell stud wais with solid insulation and backing Many window frames in the building contain panels that are shell stud wais with solid insulation and backing Many window frames in the building contain panels that are shell stud wais with solid insulation and backing Concrete fysich percentage not specified and assumed to be seenge Risker not specified in drawings and assumed to be "Polystylene Extruded" insulation Bis Langth + Lingth / Bis Thiokness + Actual Thickness Bis Langth + Lingth / Bis Thiokness + Actual Thickness Bis Langth + 11 / Sis * 10 + 12 Concrete fysich percentage not specified and assumed to be wenge Risker not specified in drawings and assumed to be seenge Risker not specified in drawings and assumed to be wenge Risker not specified in drawings and assumed to be wenge Risker not specified in drawings and assumed to be seenge Risker not specified in drawings and assumed to be wenge Risker not specified in drawings and assumed to be wenge Risker not specified in drawings and assumed to be wenge Risker not specified in drawings and assumed to be wenge Risker not specified in drawings and assumed to be wenge Risker not specified in drawings and assumed to be wenge Risker not specified in drawings and assumed to be wenge Risker not specifie
B11 Partitions	0.3 (Baa) 8.4 Witod	8.3.1 - Win Asbestos 8.3.2 - Win Asbestos 8.4.1 - Win Asbestos 2.1.16 - wil 1-1300-6 2.1.17 - wil 1-1500-6 2.1.18 - wil 1-1500-6	board forced with estanding This was approximated by finding the materials in a square foot wall with the steel stude, extruded polyterine insulation, and CSB. The impact satinator can not model asbeets. See end of Assumption table for calculations Many window frames in the building contain panels that are sheel stud walls with cold insulation and backing Many window frames in the building contain panels that are sheel stud walls with cold insulation and backing Many window frames in the building contain panels that are sheel stud walls with cold insulation and backing Many window frames in the building contain panels that are sheel stud walls with cold insulation and backing Many window frames in the building contain panels that are sheel stud walls with cold insulation and backing Concrete fysich percentage not specified and assumed to be everage Reter not specified in drawings and assumed to be 44 Dimensions were edulated to account for inflated thickness cotions Type of the Rigd insultation for apported in drawings and assumed to be "Polystylene Extruded" insulation Risk Length «Langth / EST Trickness * Actual Thickness EIE Length «L
B11 Partitions	0.3 (Baa) 8.4 Witod	8.3.1 - Win Asbestos 8.3.2 - Win Asbestos 8.4.1 - Win Asbestos 2.1.16 - wil 1-1300-6 2.1.17 - wil 1-1500-6 2.1.18 - wil 1-1500-6	beard forced with estewater. This was approximated by finding the materials in a square foot wall with the steel stude, extruded polyterene insultation, and CSB. The impact satinator can not model estewater. See end of Assumption table for decutations. Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Many window frames in the building contain panels that are sheel stud walls with acid insulation and backing Denomics flysch percentage not specified and assumed to be everage Risker not specified in drawings and assumed to be "Polystylene Estruded" insulation ESE Langth + 11 (25 ± 40 + 52 Concrete flysch percentage not specified and assumed to be "Polystylene Estruded" insulation ESE Langth + 11 (25 ± 40 + 52 Concrete flysch percentage not specified and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings and assumed to be everage Risker not specified in drawings

	222-912-0600-6	The impact Estimator assumes 200mm thick block. Length of 6" thick block well multiplied by 0.762 to achieve
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
		EIE Length + Actual Length + 0.762 (200mm/tin)
	223-91209004	85.3 + 125 * 0.782
		The impact Estimator assumes 200mm thick block. Length of 6" thick block well multiplied by 0.762 to echieve
		Door type not specified in the drawings and assumed to be "Steel Ederior" for exterior wals, "Steel Interior" for
		While assumed to be 9ft tail based on other wails the area File Length = Actual Length * 0.782 (200mmWin)
		201.4 = 343 * 0.702
	224-9121004	
		The impact Estimator assumes 200mm thick block. Length of 6" thick block well multiplied by 0.762 to achieve
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior walls, "Steel Interior" for EVE Length + Actual Length + 0.712 (200mm/Rin)
		35.8 = 47 = 0.762
	225-9121004	The impact Estimator assumes 200mm thick block. Length of if" thick block well multiplied by 1.016 to echieve
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EVE Length + Actual Length * 1.016 (200mm/Bin)
		9.1 = 9 * 1 010
	2:2.6 - wi 2:1300-8	The Impact Estimator assumes 200mm thick block. Length of if" thick block well multiplied by 1.016 to achieve
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
		EIE Length = Actual Length * 1.018 (200mm/8in)
	2:2.7 - wi.2-1206-6	24.4 = 24 * 1.018
		The impact Estimator assumes 200mm thick block. Length of 6" thick block well multiplied by 0.762 to achieve
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EVEL Length + Actual Length * 0.762 (200mm/EIn)
		481 = 605 * 0.762
	2.2.8 - w(2-1506-6	•
		The impact Estimator assumes 200mm thick block. Length of 6" thick block well multiplied by 0.762 to achieve Source and associated in the descine and associated by Marci Establish for achieve well. Marci Interior for a
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EIE Length + Actual Length * 0.782 (200mm/Kin)
		453.4 +565 *0.762
	22.9 - wL2-1606-6	The invest Calmain second When this bird I and all this bird had not matched to \$100 in actions
		The impact Estimator assumes 200mm thick block. Length of th thick block well multiplied by 0.752 to achieve Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EIE Length + Actual Length + 0.752 (200mm/Ein)
	2.2.10 - wi 2-1908-6	147.0 = 194 * 0.762
		The Impact Estimator essumes 200mm thick block. Length of 6" thick block well multiplied by 0.782 to achieve
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior walls, "Steel Interior" for
		EIE Length = Actual Length * 0.782 (200mn/8in) 673.6 = 684 * 0.762
	2.2.11 - wi.5-1000-8	10.0 - 001 - 1100
		The impact Estimator assumes 200mm thick block. Length of It" thick block well multiplied by 1.016 to achieve
		Door type not specified in the drawings and assumed to be "Reel Exterior" for exterior wells, "Steel interior" for EVE Length + Actual Length + 1.016 (200mm/lin)
		24.4 = 24 * 1.018
	2.2.12 - wi.5-1300-8	The lowest Calendar are used Writers this black is such at 40 field black and so Relation 4 data is achieved
		The impact Estimator assumes 200mm thick block. Length of it" thick block well multiplied by 1.016 to achieve Door time not area field in the drawings and assumed to be "State! Exterior" for exterior wells. "State! Interior" for
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel interior" for EVE Length = Actual Length = 1.016 (200mm/Bin)
23 Cashin Place		108.7 +107 *1.018
	235-wi3-1300-6	
	aland - Milar Takarta	Concrete figuely percentage not specified and assumed to be average
	2.2.5	Reber not specified in drawings and assumed to be #5
	2.2.2 10.2 10.010	Concrete flyach percentage not apecified and assumed to be average Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
		Risbar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Ederico" for exterior wells, "Steel Interior" for EIE Lood?+ actual inorth / EIE Incinese * actual thickness
		Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imbed thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
	238-931000	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Reel Exterior" for exterior wells, "Reel Interior" for EIE Length = actual length / EIE thickness * actual thickness to = \$27.8 * 6 Concrete flyach percentage not specified and assumed to be everage
		Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Reel Exterior" for exterior wells, "Reel Interior" for EIE Length = actual length / EIE thickness * actual thickness to = \$27.8 * 6 Concrete flyach percentage not specified and assumed to be everage
		Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Langth + actual length / ESE thickness * actual thickness the + 82 / 8 * 6 Concrete flysch percentage not specified and assumed to be average Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options
		Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Beel Ederic" for exterior wells, "Steel Interio" for ESE Length + actual length / ESE thickness * actual thickness 68 + 92 / 8 * 9 Concrete flysch percentage not specified and assumed to be exercise Rebar not appointed in drawings and assumed to be 95 Dimensions were adjusted to accurt for imited thickness options Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interio" for Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interio" for
	238-wi310008	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Baei Exterior" for exterior wells, "Steel Interior" for Elii Langth - actual length / Elii thickness * actual thickness the + 80 / 8 * 6 Concrete flysch percentage not specified and assumed to be exercise Rebar not specified in drawings and assumed to be 45 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete flysch percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete flysch percentage not specified and assumed to be werege
	238-wi310008	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for REE Length + actual length / EE thickness * actual thickness 68 + 92 / 8 * 8 Commits fijnish percentage not specified and assumed to be average Rebar not specified in drawings and assumed to be 95 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for
	238-wi310008	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + actual length / ESE thickness * actual thickness Bit + 82 / 8 * 8 Commiss fijnish percentage not specified and assumed to be exercise Rebar not specified in drawings and assumed to be 95 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not assumed to be 95 Dimensions were adjusted to account for limited thickness options Door to percented in the drawings and assumed to be 95 Dimensions were adjusted to account for limited thickness options
	238-wi310008	Rebar not specified in creatings and assumed to be 85 Dimensions were adjustation account for imited thickness options Door type not specified in the drawings and assumed to be "Beel Exterior" for exterior wells, "Reel Interior" for REE Langth + actual length / REE thickness * actual thickness bit + 82 / 8 * 6 Concrete flysch percentage not specified and assumed to be exercise Rebar not specified in drawings and assumed to be 45 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Beel Exterior" for exterior wells, "Steel Interior" for Concrete flysch percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete flysch percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete flysch percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externations were adjusted to account for Imted thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for REE Langth + acclusterior into adjusted to account for Imted thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for REE Langth + acclusterior into account for Imted thickness.
	238-wi310008	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + actual length / ESE thickness + actual thickness Bit + 82 / 8 * 8 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure provertage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure provertage not specified and assumed to be "Steel Exterior" for Concrete figure provertage not assumed to be 95 Dimensions were adjusted to account for limited thickness options Door type not specified in date assumed to be 95 Dimensions were adjusted to account for limited thickness options Door not appendic in the dimension and assumed to be 95
	235-wi3-1000-0 237-wi3-1000-0	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness * actual thickness the + 82 / 8 * 6 Concrete figure (the second assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be average Rebar for appendies in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness at 0.2 + 0.1 + 0.
	235-wi3-1000-0 237-wi3-1000-0	Rebar not specified in the single and sesumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for REE Length + actual length / REE thickness + actual thickness Bit + 82 / 8 * 6 Commits fijnish percentage not specified and assumed to be exercise Rebar not specified in the drawings and assumed to be 95 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Rebar not specified in the drawings and assumed to be #Steel Exterior for exterior wells, "Steel Interior" for Rie Length + actual length / REE thickness + actual thickness options Door type not specified in the drawings and assumed to be #Steel Exterior" for exterior wells, "Steel Interior" for Rie Length + actual length / REE thickness + actual thickness Mid + 47 / 81 + 6 Concrete figure protentage not specified and assumed to be #Steel Exterior" for exterior wells, "Steel Interior" for Rie Length + actual length / REE thickness + actual thickness Mid + 47 / 81 + 6
	235-wi3-1000-0 237-wi3-1000-0	Rebar not specified in otherwings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + social length / ESE thickness * actual thickness Bit + 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + actual length / ESE Thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + actual length / ESE Thickness bit = 47 / 8 * 6 Dimensions were adjusted to account for limited thickness options Door type not specified in crawings and assumed to be average Risker not specified in crawings and assumed to be the Externess Dimensions were adjusted to account for limited thickness options Door not specified in the drawings and assumed to be the Externess Externes for a device to account for limited thickness options Door not provide in the drawings and assumed to be the Externess Externes for active to not account for accertage instances for the Externes Externess Exter
	235-wi3-1000-0 237-wi3-1000-0	Reber not specified in creatings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Bitel Exterior" for exterior wells, "Revel Interior" for ERE Langth + south length / ERE thickness * actual thickness bit + 82 / 8 * 6 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 98eel Exterior" for exterior wells, "Steel Interior" for Concrete fiysch percentage not specified and assumed to be 98eel Exterior for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be 98eel Exterior for exterior wells, "Steel Interior" for Concrete fiysch percentage not specified and assumed to be 98eel Exterior for exterior wells, "Steel Interior" for Concrete fiysch percentage not specified and assumed to be 98eel Exterior for exterior wells, "Steel Interior" for EXERCISE adjusted to account for Interior thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EXERCISE adjusted to account for Interior thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EXERCISE adjusted to account for Interior thickness St.3 = 47 / 8 * 6
	238 - wi3-1800-6 238 - wi3-1800-6 238 - wi3-1800-6	Rebar not specified in otherwings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + social length / ESE thickness * actual thickness Bit + 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + actual length / ESE Thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + actual length / ESE Thickness bit = 47 / 8 * 6 Dimensions were adjusted to account for limited thickness options Door type not specified in crawings and assumed to be average Risker not specified in crawings and assumed to be the Externess Dimensions were adjusted to account for limited thickness options Door not specified in the drawings and assumed to be the Externess Externes for a device to account for limited thickness options Door not provide in the drawings and assumed to be the Externess Externes for active to not account for accertage instances for the Externes Externess Exter
	235-wi3-1000-0 237-wi3-1000-0	Rebar not specified in drawings and seasured to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length - actual length / ESE thickness + actual thickness Bit = 82 / 8 * 8 Concrete figure provertage not specified and assumed to be exercise Rebar not specified in drawings and assumed to be 95 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure provertage not apecified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure provertage not apecified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure provertage not apecified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Dimensions were adjusted to account for Imited Thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Distribution were adjusted to account for Imited Thickness Mid 2 = 47 / 8 * 6 Dimensions were adjusted to account for Imited Thickness Distributions were adjusted to account for Imited Thickness Distributions were adjusted to account for Imited Thickness Distribution were adjusted to account for Imited Thickness Distributions were adjusted to account for Imited Thickness Distribution in the drawings and assumed to be 80 Dimensions were adjusted to account for Imited Thickness Distribution in the adjusted to account for Imited Thickness Distribution in the adjusted to account for Imited Thickness Distribution in the adjusted to account for Imited Thickness Distributions were adjusted to account for Imited Thickness Distribution in the adjusted to account for Imited Thickness Distributions were adjusted to account for Imited Thickness Distributions were adjusted to account for Imited Thi
	238 - wi3-1800-6 238 - wi3-1800-6 238 - wi3-1800-6	Rebar not specified in creatings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Bitel Exterior" for exterior wells, "Reel Interior" for ESI Length - actual length / ESI thickness + actual thickness bit = 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 95 Extern not specified in the drawings and assumed to be 95 Rebar not specified in the drawings and assumed to be 95 Rebar not specified in the drawings and assumed to be 95 Extern to tapecified in the drawings and assumed to be 95 Rebar not specified in the drawings and assumed to be 95 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 95 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 95 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 95 Dimensions were adjusted to account for imited thickness options Door type not specified in drawings and assumed to be 36 Dimensions were adjusted to account for imited thickness add = 47 / 8 * 6 Dimensions were adjusted to account for imited thickness options Door type not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness add = 40 / 8 * 6 Ecount type in provertage not specified and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness add = 40 / 8 * 6
	238 - wi3-1800-6 238 - wi3-1800-6 238 - wi3-1800-6	Rebar not specified in creatings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Bitel Exterior" for exterior wells, "Batel Interior" for ESI Length + south length / ESI thickness * actual thickness bit + 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be seerage Rebar not specified in the drawings and assumed to be "Bitel Exterior" for exterior wells, "Batel Interior" for Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Bitel Exterior" for exterior wells, "Batel Interior" for Concrete flysch percentage not specified and assumed to be seerage Rebar not specified in the drawings and assumed to be "Bitel Exterior" for exterior wells, "Batel Interior" for Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Bitel Exterior" for exterior wells, "Bitel Interior" for EXERCISE and specified in the drawings and assumed to be "Bitel Exterior" for exterior wells, "Bitel Interior" for EXERCISE adjusted to account for imited thickness Bits = 47 / 8* 6 Dimensions were adjusted to account for imited thickness options Door type not specified in drawings and assumed to be average Rebar not specified in drawings and assumed to be average Rebar not specified in drawings and assumed to be average Rebar not specified in drawings and assumed to be average Rebar not specified in drawings and assumed to be average Rebar not specified in drawings and assumed to be "Bitel Exterior" for exterior wells, "Bitel Interior" for EXEL_ENGT+= attached to account for imited thickness options Door type not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness bit = 40 / 8* 6
	238 - wi3-1800-6 238 - wi3-1800-6 238 - wi3-1800-6	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length - actual length / ESE thickness - actual thickness Bit = 82 / 8 * 6 Concrete figure) percentage not specified and assumed to be exercise Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for External specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for External type into account for imited thickness options Door type not specified in the drawings and assumed to be Steel Dimensions were adjusted to account for imited thickness Sto 2 + 7 / 8 * 6 Dimensions were adjusted to account for imited thickness Sto 2 + 7 / 8 * 6 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be average Rebar not specified in drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Door type not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to
	238 - wi 3-1800-8 237 - wi 3-1800-8 238 - wi 3-1800-8 239 - wi 3-1800-8	Rebar not specified in otherwings and assumed to be 85 Dimensions were adjusted to account for imited hickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + south length / ESE thickness * actual thickness Bit + 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EXERCE to the specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length + actual length / ESE thickness * actual thickness St = 47 / 8 * 6 Dimensions were adjusted to account for limited thickness options Door type not specified in drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness St = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness St = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to acco
	238 - wi3-1800-6 238 - wi3-1800-6 238 - wi3-1800-6	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited hickness options Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for ESE Length - actual length / ESE thickness + actual thickness Bit = 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Ederivation were adjusted to account for limited thickness options Door top not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for EVEL and the steel intering and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assum
	238 - wi 3-1800-8 237 - wi 3-1800-8 238 - wi 3-1800-8 239 - wi 3-1800-8	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Batel Exterior" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness ⁺ actual thickness Bit + 82 / 8 * 6 Concrete figush percentage not specified and assumed to be average Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness at 3 = 47 / 8 * 6 Dimensions were adjusted to account for limited thickness at 3 = 47 / 8 * 6 Dimensions equalities in drawings and assumed to be 85 Dimensions even adjusted to account for limited thickness at 3 = 47 / 8 * 6 Dimensions even adjusted to account for limited thickness Door type not specified in the drawings and assumed to be 85 Dimensions even adjusted to account for limited thickness at 3 = 47 / 8 * 6 Dimensions even adjusted to account for limited thickness Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be storage Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness options Door type not specified in drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness 105 = 140 / 8
	238 - wi 3-1800-8 237 - wi 3-1800-8 238 - wi 3-1800-8 239 - wi 3-1800-8	Rebar not specified in creatings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length - actual length / ESE thickness + actual thickness Bit = 82 / 8 * 6 Commits fijnish percentage not specified and assumed to be exerning Rebar not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Estimations were adjusted to account for Imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Dimensions were adjusted to account for Imited Thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EXEL Length + actual length / ESE thickness + actual thickness Mit = 47 / 8 + 6 Dimensions were adjusted to account for Imited Thickness options Door type not specified in the drawings and assumed to be #SE Dimensions were adjusted to account for Imited Thickness Not = 40 / 8 + 6 Dimensions were adjusted to account for Imited Thickness Not = 40 / 8 + 6 Dimensions were adjusted to account for Imited Thickness options Door type not specified in the drawings and assumed to be #SE Dimensions were adjusted to account for Imited Thickness Not = 40 / 8 + 6 Dimensions were adjusted to account for Imited Thickness Not = 40 / 8 + 6
4 What line	23.4 - wi 3-1000-8 23.7 - wi 3-1000-8 23.8 - wi 3-1000-8 23.9 - wi 3-1000-8	Rebar not specified in creatings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Beel Ederic" for exterior wells, "Steel Interio" for REI Length + actual length / REI thickness * actual thickness M + 82 / 8 * 6 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness State - 47 / 8 * 6 Dimensions were adjusted to account for imited thickness State - 47 / 8 * 6 Dimensions even adjusted to account for imited thickness State - 47 / 8 * 6 Dimensions even adjusted to account for imited thickness State not specified in the drawings and assumed to be 85 Dimensions even adjusted to account for imited thickness State - 47 / 8 * 6 Dimensions even adjusted to account for imited thickness State not specified in the drawings and assumed to be 85 Dimensions even adjusted to account for imited thickness State not specified in the drawings and assumed to be 85 Dimensions even adjusted to account for imited thickness State not specified in the drawings and assumed to be 85 Dimensions even adjusted to account for imited thickness State not specified in the drawings and assumed to be 85 Dimensions even adjusted to account for imited thickness State not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in drawings and assumed to be 85 Dimensions even adjusted to account for imited thickness options
t Wood Stud	238 - wi 3-1800-8 237 - wi 3-1800-8 238 - wi 3-1800-8 239 - wi 3-1800-8	Rebar not specified in otherwings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be titlet Exterior" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness + actual thickness bit = 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness - actual thickness bit = 47 / 41 * 6 Concrete flysich percentage not specified and assumed to be average Riskin not specified in drawings and assumed to be average Riskin not specified in drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings a
4 Wead Stud	23.4 - wi 3-1000-8 23.7 - wi 3-1000-8 23.8 - wi 3-1000-8 23.9 - wi 3-1000-8	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length - actual length / ESE thickness + actual thickness Bit = 82 / 8 * 6 Concrete figsish percentage not specified and assumed to be exercise Rebar not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Estimations were adjusted to account for Imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figsish percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figsish percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figsish percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externations were adjusted to account for Imited Thickness options Door type not specified in the drawings and assumed to be assemge Rebar not specified in the drawings and assumed to be assemge Rebar not apecified in drawings and assumed to be assemge Rebar not apecified in drawings and assumed to be assemge Rebar not apecified in drawings and assumed to be 86 Dimensions were adjusted to account for Imited Thickness Still = 47 / 8 * 6 Dimensions were adjusted to account for Imited Thickness Still = 47 / 8 * 6 Dimensions were adjusted to account for Imited Thickness Still = 40 / 8 * 6 Dimensions were adjusted to account for Imited Thickness Still = 40 / 8 * 6 Dimensions were adjusted to account for Imited Thickness Still = 40 / 8 * 6 Dimensions were adjusted to account for Imited Thickness Still = 40 / 8 * 6 Dimensions were adjusted to account for Imited Thickness Still = 40 / 8 * 6
14 Wead Stut	23.4 - wi 3-1300-8 23.7 - wi 3-1300-6 23.9 - wi 3-1300-6 23.10 - wi 3-1800-6 23.10 - wi 3-1800-6 24.1 - wi 4-0200-6	Rebar not specified in otherwings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be titlet Exterior" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness + actual thickness bit = 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness options Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness - actual thickness bit = 47 / 41 * 6 Concrete flysich percentage not specified and assumed to be average Riskin not specified in drawings and assumed to be average Riskin not specified in drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings a
2.4 Wheel Stud	23.8 - wi3-1900-8 23.8 - wi3-1900-6 23.9 - wi3-1900-6 23.9 - wi3-1900-6 23.10 - wi3-1900-6	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited hickness options Door type not specified in the drawings and assumed to be "Beel Ederic" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness * actual thickness Bi = 82 / 8 * 8 Dimensions were adjusted to account for limited hickness options Door type not specified in the drawings and assumed to be "Beel Ederic" for exterior wells, "Steel Interior" for Ederivations were adjusted to account for limited thickness options Door type not specified in the drawings and assumed to be "Beel Ederic" for exterior wells, "Steel Interior" for Economic figure provertage not specified and assumed to be "Beel Ederic" for exterior wells, "Steel Interior" for Economic figure provertage not specified and assumed to be "Beel Ederic" for exterior wells, "Steel Interior" for Economic figure provertage not specified and assumed to be "Beel Ederic" for exterior wells, "Steel Interior" for Elif Length = actual length / ESI Eticiness * actual thickness options Door type not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be average Rebar not specified in the drawings and assumed to be 85 Dimensions were adjusted to account for limited thickness b0 = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness b0 = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness b0 = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness b0 = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness b0 = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness b0 = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness b0 = 40 / 8 * 6 Dimensions were adjusted to account for limited thickness b0 = 40 / 8 * 6 Dim
k 4 Wood Stud	23.8 - wi 3-1300-8 23.7 - wi 3-1300-8 23.8 - wi 3-1300-8 23.9 - wi 3-1300-8 23.9 - wi 3-1300-8 23.10 - wi 3-1300-8 24.1 - wi 4-0300-6 24.2 - wi 4-0300-6 24.2 - wi 4-0300-6	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited hickness options Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness + actual thickness Bi = 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for Externet specified in the drawings and assumed to be "Steel Ederic" for exterior wells, "Steel Interior" for EVEL and the specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Riskin not specified in the drawings and assumed to be average Ri
2.4 Wood Stud	23.8 - wi 3-1300-8 23.7 - wi 3-1300-8 23.8 - wi 3-1300-8 23.9 - wi 3-1300-8 23.10 - wi 3-1300-8 24.1 - wi 4-0300-8 24.2 - wi 4-0300-8 24.2 - wi 4-0300-8 24.2 - wi 4-0300-8	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Beel Ederice" for exterior wells, "Steel Interior" for ESI Length - actual length / ESI thickness * actual thickness Bi = 82 / 8 * 8 Dimensions were adjusted to account for imited thickness options Door type not specified in the drawings and assumed to be "Beel Ederice" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Beel Ederice" for exterior wells, "Steel Interior" for Door type not specified in the drawings and assumed to be "Beel Ederice" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Beel Ederice" for exterior wells, "Steel Interior" for Dimensions were adjusted to account for Imited thickness options Door type not specified in the drawings and assumed to be "Beel Ederice" for exterior wells, "Steel Interior" for ESI Length = actual length / ESI thickness * actual thickness Mid = 47 / 8* * 0 Door type not specified and assumed to be 85 Dimensions were adjusted to account for Imited thickness options Door type not specified in the drawings and assumed to be average Reter not specified in the drawings and assumed to be 86 Dimensions were adjusted to account for Imited thickness Di = 40 / 8 * 6 Dimensions were adjusted to account for Imited thickness options Door type not specified in the drawings and assumed to be 86 Dimensions were adjusted to account for Imited thickness Di = 40 / 8 * 6 Dimensions were adjusted to account for Imited thickness Di = 40 / 8 * 6 Dimensions were adjusted to account for Imited thickness Di = 40 / 8 * 6 Dimensions were adjusted to account for Imited thickness Di = 40 / 8 * 6 Dimensions were adjusted to account for Imited thickness Di = 40 / 8 * 6 Dimensions were adjusted to account for Imited thickness Di = 40 / 8 * 6 Dimensions were adjusted to account for Imited thickness Dis = 40 / 8 * 6 Dimensions
2.4 Wood Stud	23.8 - wi 3-1300-8 23.7 - wi 3-1300-8 23.8 - wi 3-1300-8 23.9 - wi 3-1300-8 23.9 - wi 3-1300-8 23.10 - wi 3-1300-8 24.1 - wi 4-0300-6 24.2 - wi 4-0300-6 24.2 - wi 4-0300-6	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length - actual length / ESE thickness * actual thickness Bit = 82 / 8 * 6 Dimensions were adjusted to account for imited thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Externations were adjusted to account for limited thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Still Length = actual length / ESE Trickness * actual thickness Mid = 47 / 8 * 6 Dimensions were adjusted to account for limited thickness options Data type not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be average Refer not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EVE 1.8 * 6 / 18 * 6 Dimensions were adjusted to account for limited thickness Stoe * 40 / 18 * 6 Dimensions were adjusted to account for limited thickness Stoe * 40 / 18 * 6 Dinterions were adjus
2.4 What Stud	23.8 - wi 3-1000-8 23.7 - wi 3-1000-8 23.8 - wi 3-1000-8 23.9 - wi 3-1000-8 23.10 - wi 3-1000-8 24.1 - wi 4-0000-8 24.2 - wi 4-0000-6 24.2 - wi 4-0000-6 24.3 - wi 4-1000-6 24.4 - wi 4-1000-6	Rebar not specified in drawings and sesumed to be 85 Dimensions were adjusted to account for initial thickness the x82 / 8 * 6 Dimensions were adjusted to account for initial thickness the x82 / 8 * 6 Dimensions were adjusted to account for initial thickness the x82 / 8 * 6 Dimensions were adjusted to account for initial thickness the x82 / 8 * 6 Dimensions were adjusted to account for initial thickness the x82 / 8 * 6 Dimensions were adjusted to account for initial thickness the x82 / 8 * 6 Dimensions were adjusted to account for initial thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure provertage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Distribution were adjusted to account for initial thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Distribution were adjusted to account for initial thickness this = aff * 6 Distribution in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EXE + adv 8 * 6 Discrete figsin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EXE + adv 8 * 6 Discrete figsin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for EXE + adv 8 * 6 Discrete figsin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interio
2.4 Wood Stud	23.8 - wi 3-1000-6 23.7 - wi 3-1000-6 23.8 - wi 3-1000-6 23.9 - wi 3-1000-6 23.10 - wi 3-1000-6 24.1 - wi 4-0000-6 24.2 - wi 4-0000-6 24.3 - wi 4-1000-6 24.5 - wi 4-1000-6 24.5 - wi 4-1000-6	Rebar not specified in drawings and sesumed to be 85 Dimensions were adjusted to account for imited thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length - actual length / ESE thickness * actual thickness Bit = 82 / 8 * 6 Dimensions were adjusted to account for imited thickness options Data type not specified in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be steerage Rebar not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figure percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Dimensions were adjusted to account for limited thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Distribution were adjusted to account for limited thickness Mid = 47 / 8 * 6 Dimensions were adjusted to account for limited thickness Distribution were adjusted to account for limited thickness Distributions were adjusted to account for limited thickness Distribution were adjusted to account for limited thickness Distributions were adjusted
2.4 Wood Stud	23.8 - wi 3-1000-8 23.7 - wi 3-1000-8 23.8 - wi 3-1000-8 23.9 - wi 3-1000-8 23.10 - wi 3-1000-8 24.1 - wi 4-0000-8 24.2 - wi 4-0000-6 24.2 - wi 4-0000-6 24.3 - wi 4-1000-6 24.4 - wi 4-1000-6	Rebar not specified in drawings and assumed to be 85 Dimensions were adjusted to account for imited thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length - actual singht / ESE thickness * actual thickness Bit = 82 / 8 * 6 Concrete figuin percentage not specified and assumed to be steerage Rebar not specified in the drawings and assumed to be 10 Dimensions were adjusted to account for imited thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Concrete figuin percentage not specified and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Dimensions were adjusted to account for limited thickness options Data type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for Distantions were adjusted to account for limited thickness Distantions were adjusted to account for limited thickness Distant adjusted in drawings and assumed to be 80 Dimensions were adjusted to account for limited thickness Distant to specified in the drawings and assumed to be 80 Dimensions were adjusted to account for limited thickness Distant to specified in the drawings and assumed to be 80 Dimensions were adjusted to account for limited thickness Distant not specified in the drawings and assumed to be 80 Dimensions were adjusted to account for limited thickness Distant not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE Length = actual length / ESE Thickness + actual thickness Distant not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" for ESE = 140 / 8 * 6

1	1	tione
	249-w(71300-6	
		Door type not specified in the drawings and assumed to be "lites! Exterior" for exterior wells, "lites! interior" for
		Reading Roard not specified and assumed to be Oriented Strand Roard
		Fibergiess insulation type not specified but based on usage and thickness assumed to be Batt insulation
	2.4.10 - wi.7-1508-8	
	A DECEMBER OF THE OWNER	Reading Roard not specified and assumed to be Criented Strand Roard
		Elections insulation have not specified but based on usage and this reasoned to be Batt insulation
	2.4.11 - wi.7-1800-8	
		"Recking Roard" not apeofied and assumed to be-Oriented Strand Roard
		Fibergiess insulation type not specified but based on usage and thickness assumed to be Batt insulation
	2412-wi8-100-6	
	2012 - 802 - 502 - 5	Door type not specified in the drawings and assumed to be "lites! Exterior" for exterior wells, "lites! interior" to
		"Racking Roard" not apecified and easured to be Criented Strand Roard
2.5 Steel St.	1	Eberdiese insulation troe not specified but based on usage and thickness assumed to be Ratt insulation
2.0 3694 36	25.4 - wi 9-1006-4	
	2010 1 1 10 10 10 10 10	Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel Interior" to
	25.5 - wi 10-1000-4	Stud Weight not apedified in the drawings and essured to be Light.
	20.0 - 91.10-1000-4	
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior wells, "Steel interior" for
		Stud Weight not specified in the drawings and assumed to be Light.
		Additional layer clearly visible on drawings but not specified. Assumed to be an additional 1/2" Drawall based (
	2.5.6 - wi.10-1300-4	
		Door type not specified in the drawings and assumed to be "Steel Exterior" for exterior walls, "Steel Interior" for
		Stud Weight not specified in the drawings and assumed to be Light.
		Additional layer clearly visible on drawings but not specified. Assumed to be an additional 1/2" Drywell based o
		hickness in drawing
Added to a	1578	34*

	3 og fit af Asbestos Walk		Total
Material	Quantity	UNIC	Quantity List
1/2" Regular Gypsum			
Roard	0.1822	m2	161.3716 m2
Extraded Polystyrene	0.145	m2 (25mm)	228.81 m2 (25mm)
Galvanized Studs	0.0013	Tonnes	2.0514 Tonnes
Crieffed Strang			
Board .	0.1297	m2 (9mm)	204.6666 m2 (9mm)
Company Name & Bolling	0.0000	Thomas .	a initia Tourney