# Life Cycle Assessment 2013 OF THE HEBB BUILDING

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CIVL 498C

November 18, 2013

# 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

2013

# Life Cycle Assessment

## OF THE HEBB BUILDING

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## Executive Summary

This LCA of the HEBB building is part of a series of studies being carried out simultaneously on respective buildings at UBC in an attempt to conduct environmental performance comparisons for future reference. The HEBB building is modeled using On-Screen Takeoff and Impact Estimator. Impact categories are listed for the building and its corresponding elements. Interpretations and recommendations are given for the use of LCA.

# Life Cycle Assessment of UBC HEBB Building

## 1.0 General Information on the Assessment

### Purpose of the assessment

The life cycle analysis of the UBC HEBB building is a study intended to present the building design's environmental impacts.

By establishing materials inventory and the corresponding environmental impacts, potential future performance upgrade assessments can be made easier. Environmental performance comparisons with other UBC buildings also becomes a possibility which means sustainable development guidelines for future construction projects can be created at UBC.

This study is mainly intended for those who are involved in building development and policy making at UBC such as the Sustainability Office. Others such as engineers, architects, and external parties are also potential audiences.

### Identification of building

The HEBB building, constructed in 1964, is located at 2045 East Mall, University of British Columbia. It was named after the first Head of the Physics Department, Dr.Thomas Carlyle Hebb.

The architect on the project was Thompson, Berwick & Pratt, and the cost of the construction was $1,398,503. The lecture theatre and the 5-floor tower was mainly used by the Departments of Physics and Engineering Physics. It is a reinforced concrete structure with brick facings and painted concrete.

### Other 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 | Zeyu Rocky Zhang, Civil Engineering Undergraduate |
| Impact Assessment method | OnScreen TakeOff 3.9.06<br>Impact Estimator 4.2.0208<br>TRACI 2.1 |
| Point of Assessment | 49 years. |
| Period of Validity | 5 years. |

|  |  |
|---|---|
| Date of Assessment | Completed in December 2013. |
| Verifier | Student work, study not verified. |

## 2.0 General Information on the Object of Assessment

### Functional Equivalent

Functional unit is a performance characteristic of the product system. It is used as a reference unit to normalize the results of the study.

| Aspect of Object of Assessment | Description |
|---|---|
| Building Type | Institutional |
| Technical and functional requirements | BC |
| Pattern of use | Monday to Friday (0800-1730), Sat/Sun/Holidays closed<br>General Purpose Room x3 Capacity = 54 students each<br>Tiered Large Group x1 Capacity = 375 |
| Required service life | 100 years |

### Reference Study Period

The service life of HEBB is 100 years according to UBC.

This study exclude modules B, C and D because it is a cradle-to-gate assessment. For comparison purposes, the use stage, end of life stage, and items beyond the system boundary are not considered.

### Object of Assessment Scope

The foundation assembly of HEBB is composed of concrete slab-on-grade and concrete footings. The wall assemblies for both the tower and theatre consist of concrete cast-in-place interior and exterior walls. A modified version of CIQS Level 3 Elements is used due to the purpose of the study. The use stage and the end of life stage are not considered.

| CIVL 498C Level 3 Elements | Description | Quantity (Amount) | Units |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| A11 | Foundations | Total area of the footing | 369.4968 | $m^2$ |
| A21 | Lowest Floor Construction | Total area of the slab-on-grade | 1898.386 | $m^2$ |
| A22 | Upper Floor Construction | Stairs area | 3878.531 | $m^2$ |
| A23 | Roof Construction | Roof Concrete Slab area | 1410.632 | $m^2$ |
| A31 | Walls Below Grade | Cast-In-Place Exterior surface area | 1049.674 | $m^2$ |
| A32 | Walls Above Grade | Cast-In-Place Exterior and Interior surface area | 3722.657 | $m^2$ |
| B11 | Partitions | Interior Partition Walls surface area | 1296.132 | $m^2$ |

## 3.0 Statement of Boundaries and Scenarios Used in the Assessment

### System Boundary

Life cycle modules included in the study are the product stage and the construction process stage. Module B, C, and D are excluded due to the nature of the analysis. The product stage includes raw material supply as source, transportation, then manufacturing to finish. The construction process stage starts with transportation, then installation to finish.

### Product Stage

During the manufacturing phase, energy consumption should be significant since the transforming of raw materials and transporting of the raw materials both require energy. The transporting of energy itself also requires energy. Resource use is needed for resource extraction, which is important for the manufacturing stage. Process involving packing, collection and relocation of waste are all part of the energy use within the product stage.

### Construction Stage

Energy use in transportation is dominant during the construction stage, especially for a concrete structure. For storage handling, temperature control has to be provided. Energy and resource are also needed for the handling of waste and the installation of the product.

## 4.0 Environmental Data

### Data Sources

The Athena LCI Database is created and managed by the Athena Institute. From the beginning, the Athena Institute has been conducting life cycle research. Their goal was to develop an ever-growing set of comprehensive, comparable life cycle inventory database for building materials and products. The database not only contain information on building materials and products, it also includes energy use, transportation, construction and demolition processes such as on-site construction, maintenance, and demolition and disposal. The data is regionally sensitive, taking into consideration relevant technology differences in different region.

The US LCI Database is created by the National Renewable Energy Laboratory of the US Energy Department. Its goal is to help life cycle assessment practitioners answer questions about environmental impacts. The database provides individual gate-to-gate, cradle-to-gate and cradle-to-grave accounting of the energy and material flows into and out of the environment that are associated with producing material, component, or assembly in the US.

### Data Adjustments and Substitutions

The partition walls were not correctly listed. They have been fixed for this report.

### Data Quality

Data uncertainty may be due to the collection/allocation methods used in creating data, the uncertainty in the substance lifetime, travel potential, or just inaccurate data. Model uncertainty may be due to the non-linear nature of the data, or the uncertain characterization factors. Temporal variability may be due to the effect of climate, the variability over time on impact interpretation, data validity as time changes, or the actual emissions over the years. Spatial variability may be due to the regional differences in environmental sensitivity, the distribution of emissions, or the regional differences between factories. Variability between sources may be due to the differences in human exposure patterns, technology differences, or the difference between factories.

The quality of the LCI database used in this study is quite high, as they are directly from the Athena Sustainable Materials Institute.

## 5.0 List of Indicators Used for Assessment and Expression of Results

The two main software tools used in this LCA study are the Athena Sustainable Materials Institute's Impact Estimator and OnCenter's OnScreen TakeOff. The study conducts materials quantity takeoff by performing linear area measurements of the building's structure and envelope. Then, with IE based on TRACI, a complete environmental impact profile can be made containing impact categories:

### Global warming potential

Cause Effect Chain: Air emission -> infrared radiation -> climate change affecting temperature, precipitation, and sea level

Category indicator = kg CO2e

Endpoint: Water resource effects, human health, agricultural effects, coastal damage

**Acidification potential**

Cause Effect Chain: Emission atmospheric concentration -> Deposition -> Leaching

Category indicator = kg SO2eq

Endpoint:  Ecosystem changes, plant and animal mortality

**Eutrophication potential**

Cause Effect Chain: Water emission -> Algae and Aquatic weed growth -> Oxygen shortage

Category indicator = kg Neq

Endpoint: Death of fish, toxicity to humans

**Ozone depletion potential**

Cause Effect Chain: Air emission -> Reduction of Ozone Layer -> Increased UVB reaching Earth

Category indicator = kg CFC-11eq

Endpoint: Agricultural Effects, Human health, Material Damage

**Photochemical smog potential**

Cause Effect Chain: Air emission -> tropospheric ozone concentrations -> human inhalation -> plant growth reduction

Category indicator = kg O3eq

Endpoint: human mortality, plant mortality

**Human health respiratory effects potential**

Cause Effect Chain: Air emission -> PM deposition in alveoli -> Body reacts to PM

Category indicator = kg PM2.5eq

Endpoint: Human Health, Human Mortality

**Weighted raw resource use**

Cause Effect Chain: Resource harvesting

Category indicator = kg

Endpoint: Resource depletion

## 6.0 Model Development

OnScreen TakeOff was used on imported digital plans to conduct materials quantity takeoff. The measurements generated OnScreen TakeOff are formatted in such a way that the Impact Estimator building LCA software can complete the takeoff process. Using the formatted takeoff data, the CIQS level 3 elements are modeled. The impact estimator is designed mainly to aid the building community in making more environmentally conscious material and design choices. The tool achieves this by applying a set of algorithms to the inputted takeoff data in order to complete the takeoff process and generate a bill of materials The Athena Life Cycle Inventory Database is then used to generate a cradle-to-grave LCI profile based on the bill of materials showing the impacts. Since this study is a cradle-to-gate assessment, the expected service life of the HEBB building is set to 1 year, which means the maintenance, operating energy and end-of-life stages of the building's life cycle are not considered.

Bill of Material of the building:

| A11 | Quantity | Unit |
|---|---|---|
| Concrete 30 MPa (flyash av) | 176.8860 | m3 |
| Rebar, Rod, Light Sections | 2.8405 | Tonnes |

| A21 | Quantity | Unit |
|---|---|---|
| Concrete 30 MPa (flyash av) | 199.3307 | m3 |
| Welded Wire Mesh / Ladder Wire | 1.7156 | Tonnes |

| A22 | Quantity | Unit |
|---|---|---|
| Concrete 30 MPa (flyash av) | 1493.6093 | m3 |
| Rebar, Rod, Light Sections | 213.2708 | Tonnes |

| A23 | Quantity | Unit |
|---|---|---|

| | | |
|---|---|---|
| #15 Organic Felt | 4649.8579 | m2 |
| 6 mil Polyethylene | 1496.1885 | m2 |
| Ballast (aggregate stone) | 56033.3556 | kg |
| Concrete 30 MPa (flyash av) | 216.2448 | m3 |
| Extruded Polystyrene | 8892.4878 | m2 (25mm) |
| Galvanized Sheet | 1.6806 | Tonnes |
| Nails | 0.4025 | Tonnes |
| Polyethylene Filter Fabric | 0.0534 | Tonnes |
| Rebar, Rod, Light Sections | 13.7436 | Tonnes |
| Roofing Asphalt | 15173.2496 | kg |
| Type III Glass Felt | 3563.8643 | m2 |

| A31 | Quantity | Unit |
|---|---|---|
| 1/2"  Regular Gypsum Board | 730.3472 | m2 |
| 6 mil Polyethylene | 704.3203 | m2 |
| Cold Rolled Sheet | 0.1341 | Tonnes |
| Concrete 30 MPa (flyash av) | 255.3989 | m3 |
| Extruded Polystyrene | 691.0262 | m2 (25mm) |
| Joint Compound | 0.7289 | Tonnes |
| Mortar | 19.3272 | m3 |
| Nails | 0.0694 | Tonnes |
| Ontario (Standard) Brick | 697.1496 | m2 |
| Paper Tape | 0.0084 | Tonnes |

| | | |
|---|---|---|
| Rebar, Rod, Light Sections | 8.9183 | Tonnes |
| Small Dimension Softwood Lumber, kiln-dried | 0.8554 | m3 |
| Solvent Based Alkyd Paint | 69.0776 | L |
| Water Based Latex Paint | 7.7059 | L |

| A32 | Quantity | Unit |
|---|---|---|
| 1/2"  Regular Gypsum Board | 4033.2786 | m2 |
| 6 mil Polyethylene | 3889.5472 | m2 |
| Aluminum | 6.5099 | Tonnes |
| Cold Rolled Sheet | 0.7407 | Tonnes |
| Concrete 30 MPa (flyash av) | 962.0415 | m3 |
| Double Glazed No Coating Air | 526.6749 | m2 |
| EPDM membrane (black, 60 mil) | 445.2739 | kg |
| Expanded Polystyrene | 6.5100 | m2 (25mm) |
| Extruded Polystyrene | 3816.1318 | m2 (25mm) |
| Galvanized Sheet | 0.1238 | Tonnes |
| Joint Compound | 4.0253 | Tonnes |
| Mortar | 106.7329 | m3 |
| Nails | 0.6408 | Tonnes |
| Ontario (Standard) Brick | 3849.9478 | m2 |
| Paper Tape | 0.0462 | Tonnes |
| Rebar, Rod, Light Sections | 33.2603 | Tonnes |
| Solvent Based Alkyd Paint | 382.0644 | L |

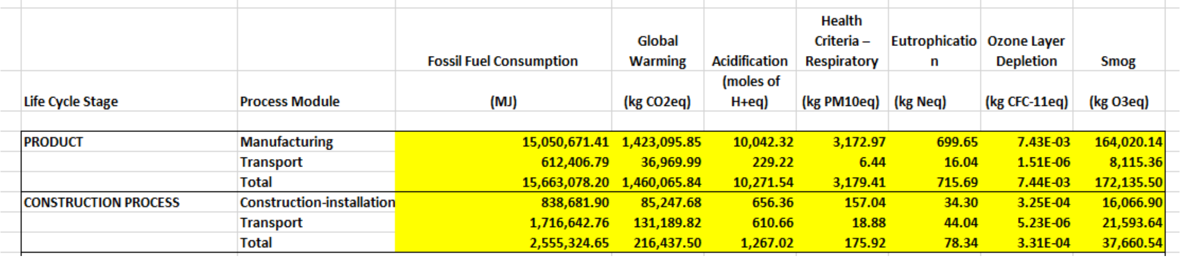
| B11 | Quantity | Unit |
|---|---|---|
| Aluminum | 1.1136 | Tonnes |
| Concrete 30 MPa (flyash av) | 302.0405 | m3 |
| Double Glazed No Coating Air | 99.3015 | m2 |
| EPDM membrane (black, 60 mil) | 76.1678 | kg |
| Nails | 0.2379 | Tonnes |
| Rebar, Rod, Light Sections | 10.6861 | Tonnes |
| Small Dimension Softwood Lumber, kiln-dried | 6.9206 | m3 |
| Water Based Latex Paint | 62.3477 | L |

Partition walls were not corrected listed in the input document. They have been fixed.

Reference flow is the measure of the outputs from processes in a given product system required to fulfill the function expressed by the functional unit.

## 7.0 Communication of Assessment Results

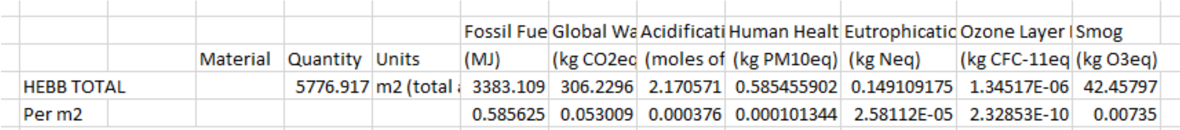
### Life Cycle Results



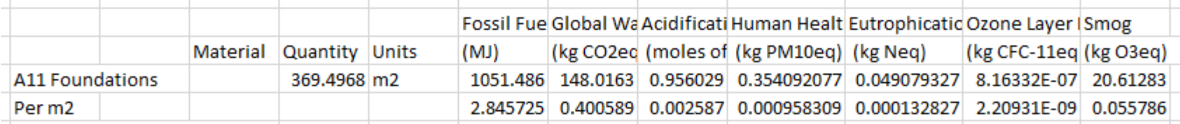
| | | Fossil Fuel Consumption | Global Warming | Acidification | Health Criteria – Respiratory | Eutrophication | Ozone Layer Depletion | Smog |
|---|---|---|---|---|---|---|---|---|
| Life Cycle Stage | Process Module | (MJ) | (kg CO2eq) | (moles of H+eq) | (kg PM10eq) | (kg Neq) | (kg CFC-11eq) | (kg O3eq) |
| PRODUCT | Manufacturing | 15,050,671.41 | 1,423,095.85 | 10,042.32 | 3,172.97 | 699.65 | 7.43E-03 | 164,020.14 |
| | Transport | 612,406.79 | 36,969.99 | 229.22 | 6.44 | 16.04 | 1.51E-06 | 8,115.36 |
| | Total | 15,663,078.20 | 1,460,065.84 | 10,271.54 | 3,179.41 | 715.69 | 7.44E-03 | 172,135.50 |
| CONSTRUCTION PROCESS | Construction-installation | 838,681.90 | 85,247.68 | 656.36 | 157.04 | 34.30 | 3.25E-04 | 16,066.90 |
| | Transport | 1,716,642.76 | 131,189.82 | 610.66 | 18.88 | 44.04 | 5.23E-06 | 21,593.64 |
| | Total | 2,555,324.65 | 216,437.50 | 1,267.02 | 175.92 | 78.34 | 3.31E-04 | 37,660.54 |

It is evident that during the manufacturing phase of the HEBB building, energy and resource consumption is very significant. This makes sense, since concrete requires a substantial amount of energy and raw material (gravel, sand, cement, aggregate) to be processed and manufactured. As for the construction phase, transportation takes lead in energy consumption.

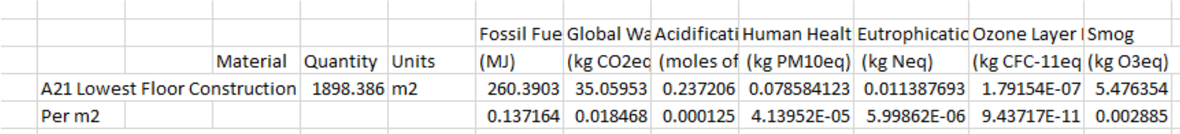
The production of cement is responsible for the discharge of carbon dioxide emissions. For one ton of cement manufactured, approximately one ton of carbon dioxide is emitted. Thus concrete is the main contributor to global warming potential. The by-product from concrete production is also one of the main cause for acidification, HH Respiratory effects, eutrophication, ozone depletion, and smog.



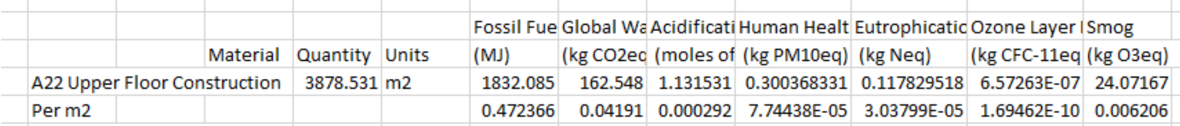
| | | | | Fossil Fue | Global Wa | Acidificati | Human Healt | Eutrophicatic | Ozone Layer I | Smog |
|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Quantity | Units | (MJ) | (kg CO2ec | (moles of | (kg PM10eq) | (kg Neq) | (kg CFC-11eq | (kg O3eq) |
| HEBB TOTAL | | 5776.917 | m2 (total | 3383.109 | 306.2296 | 2.170571 | 0.585455902 | 0.149109175 | 1.34517E-06 | 42.45797 |
| Per m2 | | | | 0.585625 | 0.053009 | 0.000376 | 0.000101344 | 2.58112E-05 | 2.32853E-10 | 0.00735 |



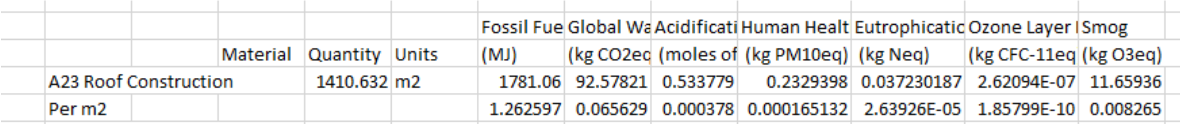
| | | | | Fossil Fue | Global Wa | Acidificati | Human Healt | Eutrophicatic | Ozone Layer I | Smog |
|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Quantity | Units | (MJ) | (kg CO2ec | (moles of | (kg PM10eq) | (kg Neq) | (kg CFC-11eq | (kg O3eq) |
| A11 Foundations | | 369.4968 | m2 | 1051.486 | 148.0163 | 0.956029 | 0.354092077 | 0.049079327 | 8.16332E-07 | 20.61283 |
| Per m2 | | | | 2.845725 | 0.400589 | 0.002587 | 0.000958309 | 0.000132827 | 2.20931E-09 | 0.055786 |



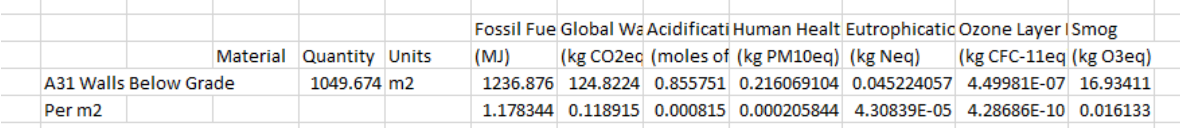
| | | | | Fossil Fue | Global Wa | Acidificati | Human Healt | Eutrophicatic | Ozone Layer I | Smog |
|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Quantity | Units | (MJ) | (kg CO2ec | (moles of | (kg PM10eq) | (kg Neq) | (kg CFC-11eq | (kg O3eq) |
| A21 Lowest Floor Construction | | 1898.386 | m2 | 260.3903 | 35.05953 | 0.237206 | 0.078584123 | 0.011387693 | 1.79154E-07 | 5.476354 |
| Per m2 | | | | 0.137164 | 0.018468 | 0.000125 | 4.13952E-05 | 5.99862E-06 | 9.43717E-11 | 0.002885 |



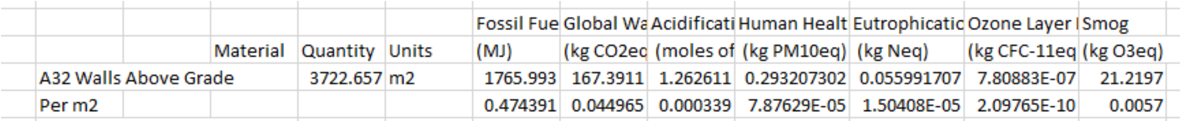
| | | | | Fossil Fue | Global Wa | Acidificati | Human Healt | Eutrophicatic | Ozone Layer I | Smog |
|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Quantity | Units | (MJ) | (kg CO2ec | (moles of | (kg PM10eq) | (kg Neq) | (kg CFC-11eq | (kg O3eq) |
| A22 Upper Floor Construction | | 3878.531 | m2 | 1832.085 | 162.548 | 1.131531 | 0.300368331 | 0.117829518 | 6.57263E-07 | 24.07167 |
| Per m2 | | | | 0.472366 | 0.04191 | 0.000292 | 7.74438E-05 | 3.03799E-05 | 1.69462E-10 | 0.006206 |



| | | | | Fossil Fue | Global Wa | Acidificati | Human Healt | Eutrophicatic | Ozone Layer I | Smog |
|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Quantity | Units | (MJ) | (kg CO2ec | (moles of | (kg PM10eq) | (kg Neq) | (kg CFC-11eq | (kg O3eq) |
| A23 Roof Construction | | 1410.632 | m2 | 1781.06 | 92.57821 | 0.533779 | 0.2329398 | 0.037230187 | 2.62094E-07 | 11.65936 |
| Per m2 | | | | 1.262597 | 0.065629 | 0.000378 | 0.000165132 | 2.63926E-05 | 1.85799E-10 | 0.008265 |



| | | | | Fossil Fue | Global Wa | Acidificati | Human Healt | Eutrophicatic | Ozone Layer I | Smog |
|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Quantity | Units | (MJ) | (kg CO2ec | (moles of | (kg PM10eq) | (kg Neq) | (kg CFC-11eq | (kg O3eq) |
| A31 Walls Below Grade | | 1049.674 | m2 | 1236.876 | 124.8224 | 0.855751 | 0.216069104 | 0.045224057 | 4.49981E-07 | 16.93411 |
| Per m2 | | | | 1.178344 | 0.118915 | 0.000815 | 0.000205844 | 4.30839E-05 | 4.28686E-10 | 0.016133 |



| | | | | Fossil Fue | Global Wa | Acidificati | Human Healt | Eutrophicatic | Ozone Layer I | Smog |
|---|---|---|---|---|---|---|---|---|---|---|
| | Material | Quantity | Units | (MJ) | (kg CO2ec | (moles of | (kg PM10eq) | (kg Neq) | (kg CFC-11eq | (kg O3eq) |
| A32 Walls Above Grade | | 3722.657 | m2 | 1765.993 | 167.3911 | 1.262611 | 0.293207302 | 0.055991707 | 7.80883E-07 | 21.2197 |
| Per m2 | | | | 0.474391 | 0.044965 | 0.000339 | 7.87629E-05 | 1.50408E-05 | 2.09765E-10 | 0.0057 |

|  |  |  |  | Fossil Fue | Global Wa | Acidificati | Human Healt | Eutrophicatic | Ozone Layer I | Smog |
|---|---|---|---|---|---|---|---|---|---|---|
|  | Material | Quantity | Units | (MJ) | (kg CO2eq | (moles of | (kg PM10eq) | (kg Neq) | (kg CFC-11eq | (kg O3eq) |
| B11 Partitions |  | 1296.132 | m2 | 765.7676 | 88.2392 | 0.657844 | 0.200436525 | 0.036606436 | 5.49591E-07 | 13.16877 |
| Per m2 |  |  |  | 0.59081 | 0.068079 | 0.000508 | 0.000154642 | 2.82428E-05 | 4.24023E-10 | 0.01016 |

# Annex A – Interpretation of Assessment Results (18)

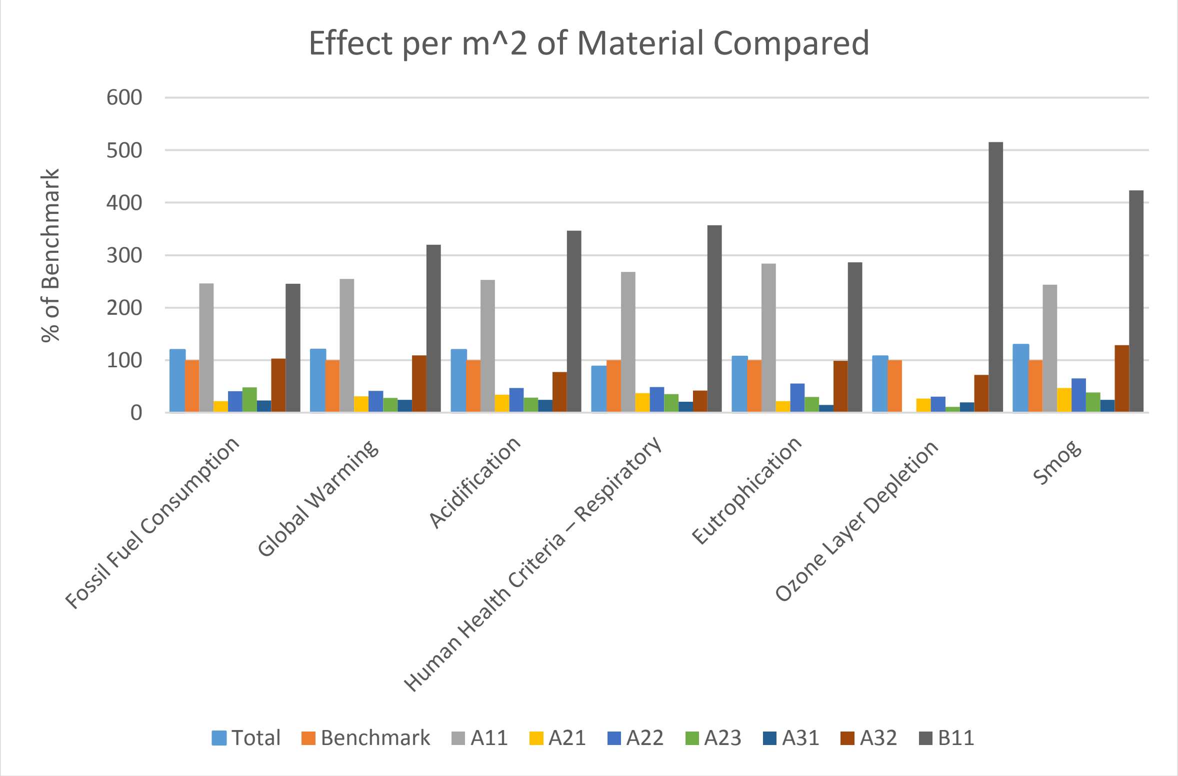
### Benchmark Development

Benchmarking in LCA is a way of analysis in conjunction with other similar studies. With benchmarking, further applications of LCA are made possible such as environmental performance comparisons across the buildings in a region over time and between different materials, structural types and building functions. It may also form a powerful tool to help inform policy makers in establishing quantified sustainable development guidelines for future constructions such as a set amount of reduction in certain aspects per year.

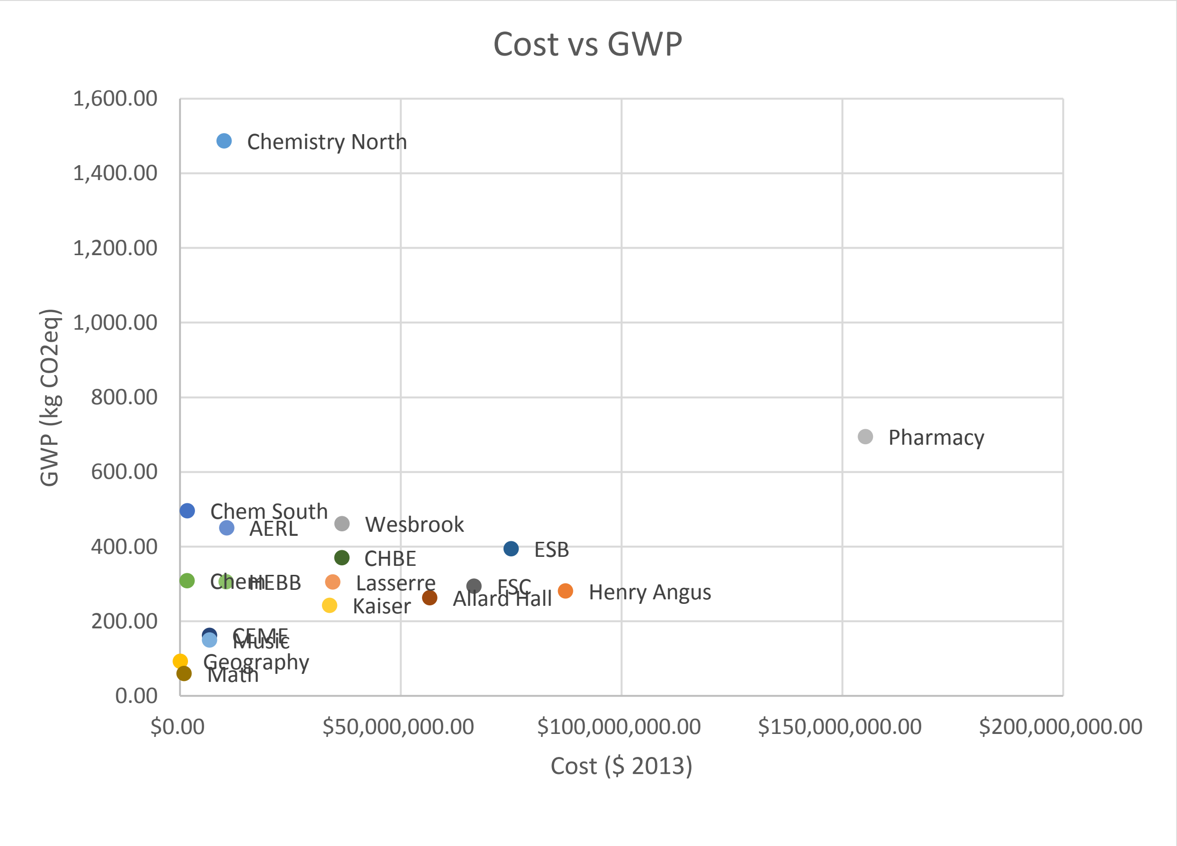
### UBC Academic Building Benchmark (12)

-describe and show your building results compared against the class benchmark in figure.

-discuss these comparisons



The overall environmental performance is not too far off from the benchmark. But there exists a large discrepancy for partition walls as they were not listed correctly. Other than that, footings seem to be the largest contributor to the impact categories.



From the chart, we could see that some of the really old buildings have both low costs and low global warming potentials. But for the majority, there exists a pattern of lower GWP for higher costs. This is likely due to the higher expense for selecting specific materials that have low contribution to GWP.

## Annex B – Recommendations for LCA Use (20)

Though only the product and construction stages are considered in this study, the other life cycle modules are as equally important as the initial two due to their nature and the possible issues that may arise as time passes by. A building is not a product for one time consumption. It requires maintenance throughout its life time, and there are disposal fees associated at the end. Because of the long service life of most buildings, the impacts it may have on the environment can accumulate greatly through use. Furthermore, there may actually be benefits beyond the system boundary. Reuse, recycling, and recovery of material are all elements that may not be very apparent straight up.

With the help of LCA, the environmental performance of the building can be improved. The wall insulation, roof insulation, and window type could be changed to reduce energy consumption. For example, replacing the 1’’ extruded polystyrene with 2.5’’ of foam polyisocyanurate insulation, replacing the standard glazed windows with low E silver argon filled glazing, and adding 7’’ of extruded polystyrene to the roof insulation could produce a total energy savings of approximately 160,000Gj over the building’s service life.

However, the building performance model is still only an approximate. Without high quality data and available benchmarks, the model’s use is limited. Plus, factors such as economics and logistics concerns must be considered. Investing in the more expensive foam polyisocyanurate and low E silver argon filled windows may not always be feasible due to project budget constraints.

Another issue is the prioritizing of impact categories. The associated parties may not always have the same concerns. Reducing energy consumption may not be the goal of the owner or client. LCA is a lens through which the building elements and the environmental impacts are linked together. The life cycle assessment of HEBB is done by doing the takeoffs and modeling the building using the Impact Estimator. It is up to the stake holders to decide which impact category they want to focus on.

For UBC, LCA can be utilized to help develop guidelines for on campus constructions. By looking at and comparing the cost vs gwp relations for example, standards can be set incrementally by the policy makers for all future projects.

## Annex C – Author Reflection (8)

As a student, I was briefly introduced to LCA in the 2nd year course, Introduction to Civil Engineering. Here in CIVL 498C, I gained further insight into the nature of the LCA and its applications. I took a look at its history, and understood its current state in North America. I went through the LCA section in the ISO standards, and completed a study following it. I familiarized myself with the CIQS elements format, the various tools including IE + OnScreen TakeOff, and used them in a LCA study for the UBC HEBB Building.

It interests me how important LCA can be in improving a design’s environmental performance. By measuring the environmental performance of products over their life cycle, LCA can show us exactly we need to do to achieve what we what. It’s a tool that everyone should care about.

| **Graduate Attribute** | | | |
|---|---|---|---|
| Name | Description | Select the content code most appropriate for each attribute from the dropdown menue | Comments on which of the CEAB graduate attributes you believe you had to demonstrate during your final project experience. |
| 1 Knowledge Base | Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program. | A = applied | Demonstrated |
| 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 | Demonstrated |
| 3 Investigation | An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions. | A = applied | Demonstrated |
| 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 | N/A = not applicable | |
| 5 Use fo 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. | IA = introduced & applied | Demonstrated |
| 6 Individual and Team Work | An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting. | DA = developed & applied | Demonstrated |
| 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 | Demonstrated |
| 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 | Demonstrated |
| 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 | A = applied | Demonstrated |
| 10 Ethics and Equity | An ability to apply professional ethics, accountability, and equity. | N/A = 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. | N/A = not applicable | |
| 12 Life-long Learning | An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the | N/A = not applicable | |

# Annex D – Impact Estimator Inputs and Assumptions (20)

HEBB TOWER Inputs

| Element | Quantity | Units | Assembly Type | Assembly Name | Input Fields | Known/Measured Information | IE Inputs |
|---|---|---|---|---|---|---|---|
| A11 Foundations | 222.3217 | m^2 | | | | | |
| | | | Footing | 1.2.1 Footing_F1a_Basement | Length (ft) | 4.25 | 4.25 |
| | | | | | Width (ft) | 2 | 8.42 |
| | | | | | Thickness (in) | 80 | 19 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.2 Footing_F1b_Basement | Length (ft) | 0.92 | 0.92 |
| | | | | | Width (ft) | 0.83 | 0.83 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1.2.3 Footing_F2a_Basement | Length (ft) | 5.17 | 5.17 |
| | | | | | Width (ft) | 2.5 | 10.53 |
| | | | | | Thickness (in) | 80 | 19 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.4 Footing_F2b_Basement | Length (ft) | 3.92 | 3.92 |
| | | | | | Width (ft) | 1.125 | 1.125 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.5 Footing_FA_Basement | Length (ft) | 152.5 | 152.5 |
| | | | | | Width (ft) | 3.5 | 3.5 |
| | | | | | Thickness (in) | 15 | 15 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.6 Footing_FB_Basement | Length (ft) | 280.29 | 280.29 |
| | | | | | Width (ft) | 2 | 2 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.7 Footing_FC_Basement | Length (ft) | 148.5 | 148.5 |
| | | | | | Width (ft) | 4 | 4 |
| | | | | | Thickness (in) | 15 | 15 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.8 Footing_FD_Basement | Length (ft) | 34 | 34 |
| | | | | | Width (ft) | 2 | 2 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash | - | average |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | % | | |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.9 Footing_FE_Basement | Length (ft) | 56.83 | 56.83 |
| | | | | | Width (ft) | 2.5 | 2.5 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.10 Footing_FF_Basement | Length (ft) | 22.42 | 22.42 |
| | | | | | Width (ft) | 2 | 2 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.11 Footing_FG_Basement | Length (ft) | 48.06 | 48.06 |
| | | | | | Width (ft) | 1.8 | 7.58 |
| | | | | | Thickness (in) | 80 | 19 |
| | | | | | Concrete (psi) | - | 4000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.12 Footing_FH_Basement | Length (ft) | 25.08 | 25.08 |
| | | | | | Width (ft) | 1.5 | 6.32 |
| | | | | | Thickness (in) | 80 | 19 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.13 Footing_FJ_Basement | Length (ft) | 30.5 | 30.5 |
| | | | | | Width (ft) | 2.75 | 2.75 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.14 Footing_FK_Basement | Length (ft) | 24.33 | 24.33 |
| | | | | | Width (ft) | 3 | 3 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete | - | 4000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | (psi) | | |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.15 Footing_FL_Basement | Length (ft) | 38.83 | 38.83 |
| | | | | | Width (ft) | 1.5 | 1.5 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.16 Footing_FM_Basement | Length (ft) | 29.67 | 29.67 |
| | | | | | Width (ft) | 2 | 2 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 1.2.17 Footing_FN_Basement | Length (ft) | 16.42 | 16.42 |
| | | | | | Width (ft) | 1.5 | 1.5 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | | | |
| A21 Lowest Floor Construction | 1241.926 | m^2 | | | | | |
| | | | SOG | 1.1.1 SOG_5''_Tower | Length (ft) | 115.62 | 115.62 |
| | | | | | Width (ft) | 115.62 | 115.62 |
| | | | | | Thickness (in) | 5 | 4 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A22 Upper Floor Construction | 2783.885 | m^2 | | | | | |
| | | | Stairs | 1.2.18 Stairs_South/North_Platform | Length (ft) | 141.74 | 141.74 |
| | | | | | Width (ft) | 5.33 | 4.26 |
| | | | | | Thickness (in) | 6 | 7.5 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.19 Stairs_South/North_Steps | Length (ft) | 182.83 | 182.83 |
| | | | | | Width (ft) | 5.33 | 5.33 |
| | | | | | Thickness (in) | 8 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Column Beam | 3.1.1 Column_Beam_Concrete Basement | Number of Columns | 25 | 25 |
| | | | | | Number of Beams | 5 | 5 |
| | | | | | Bay Sizes (ft) | 41.5 | 40 |
| | | | | | Supported Span (ft) | 12.5 | 12.5 |
| | | | | | Floor to Floor Height (ft) | 12 | 12 |
| | | | | | Live Load (psf) | 60, 100 | 75 |
| | | | | 3.1.2 Column_Beam_Concrete_GrndFlr | Number of Columns | 28 | 28 |
| | | | | | Number of Beams | 12 | 12 |
| | | | | | Bay Sizes (ft) | 41.5 | 40 |
| | | | | | Supported Span (ft) | 12.5 | 12.5 |
| | | | | | Floor to Floor Height (ft) | 12 | 12 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Live Load (psf) | 60, 100 | 75 |
| | | | | 3.1.3 Column_Beam_Concrete_SecondFlr | Number of Columns | 28 | 28 |
| | | | | | Number of Beams | 12 | 12 |
| | | | | | Bay Sizes (ft) | 41.5 | 40 |
| | | | | | Supported Span (ft) | 12.5 | 12.5 |
| | | | | | Floor to Floor Height (ft) | 12 | 12 |
| | | | | | Live Load (psf) | 60, 100 | 75 |
| | | | | 3.1.4 Column_Beam_Concrete_typFlr | Number of Columns | 28 | 84 |
| | | | | | Number of Beams | 12 | 36 |
| | | | | | Bay Sizes (ft) | 41.5 | 40 |
| | | | | | Supported Span (ft) | 12.5 | 12.5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Floor to Floor Height (ft) | 12 | 12 |
| | | | | | Live Load (psf) | 60, 100 | 75 |
| | | | Suspended Floor | 4.1.1 Floor_ConcreteSuspendedSlab_GrndFlr | Floor Width (ft) | 797.08 | 797.08 |
| | | | | | Span (ft) | 12.5 | 12.5 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Life Load (psf) | 60, 100 | 75 |
| | | | | 4.1.2 Floor_ConcreteSuspendedSlab_SecondFlr | Floor Width (ft) | 681.41 | 681.41 |
| | | | | | Span (ft) | 12.5 | 12.5 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Life Load (psf) | 60, 100 | 75 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 4.1.3 Floor_ConcreteSuspendedSlab_TypeFlr | Floor Width (ft) | 595.39 | 1786.16 |
| | | | | | Span (ft) | 12.5 | 12.5 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Life Load (psf) | 60, 100 | 75 |
| | | | | 4.1.4 Floor_ConcreteSuspendedSlab_Penthouse | Floor Width (ft) | 192.67 | 192.67 |
| | | | | | Span (ft) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Life Load (psf) | 60, 100 | 75 |
| | | | | | | | |
| | | | | | | | |
| A23 Roof Constru | 781.5233 | m^2 | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ction | | | | | | | |
| | | | Envelope | 5.1.1 Roof_ConcreteSuspendedSlab_Tower | Roof Width (ft) | 672.98 | 672.98 |
| | | | | | Span (ft) | 12.5 | 12.5 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Life Load (psf) | 27 | 45 |
| | | | | Insulation | Category | - | 4-Ply Built-up Asphalt Roof System - Inverted |
| | | | | | Material | Rigid Insulation | Extruded Polystyrene, Glass Felt |
| | | | | | Thickness (in) | 1 | 6 |
| | | | | Vapour Barrier | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 5 mil |
| | | | | | Thickness (in) | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A31 Walls Below Grade | 1049.674 | m^2 | | | | | |
| | | | Walls | 2.1.1 Wall_Cast-In-Place_W1_Ext_BrickClad_Basement_10" | Length (ft) | 453.73 | 567.16 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 10 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.2 Wall_Cast-In-Place_W1_Ext_BrickClad_Basement_11.75" | Length (ft) | 29 | 28.4 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 11.75 | 12 |
| | | | | | Concrete | - | 4000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | (psi) | | |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Categ | Paint | Paint |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | ory | | |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.3 Wall_Cast-In-Place_W1_Int_Basement_10" | Length (ft) | 157.75 | 197.19 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 10 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Doors | 4 | 4 |
| | | | | | Door Type | Solid Wood Door | Solid Wood Door |
| | | | | 2.1.4 Wall_Cast-In-Place_W1_Int_Basement_8" | Length (ft) | 301.07 | 301.07 |
| | | | | | Height (ft) | 12 | 12 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Thickness (in) | 8 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Doors | 7 | 7 |
| | | | | | Door Type | Solid Wood Door | Solid Wood Door |
| A32 Walls Above Grade | 2111.86 | m^2 | | | | | |
| | | | Walls | 2.1.5 Wall_Cast-In-Place_W2_Ext_BrickClad_GrndFlr_10" | Length (ft) | 336.67 | 420.84 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 10 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Windows | 9 | 9 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Total Window Area (ft2) | 501.99 | 501.99 |
| | | | | | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
| | | | | | Glazing Type | - | Standard Glazing |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Categ | Paint | Paint |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | ory | | |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.6 Wall_Cast-In-Place_W2_Ext_BrickClad_GrndFlr_11.75" | Length (ft) | 38.13 | 37.34 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 11.75 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylen 6 mil |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.7 Wall_Cast-In-Place-W2_Ext_GrndFlr_8" | Length (ft) | 156.97 | 156.97 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 8 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Windows | 7 | 7 |
| | | | | | Total Window Area (ft2) | 440.72 | 440.72 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
| | | | | | Glazing Type | - | Standard Glazing |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.8 Wall_Cast-In-Place_W2_Ext_Grndflr_AdditionalWall | Length (ft) | 175.81 | 175.81 |
| | | | | | Height (ft) | 4 | 4 |
| | | | | | Thickness (in) | 12 | 12 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash | - | average |

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  |  |  |  |  | % |  |  |
|  |  |  |  |  | Rebar | #5 | #5 |
|  |  |  |  | 2.1.13 Wall_Cast-In-Place_W3_Ext_BrickClad_TypeFlr_10'' | Length (ft) | 281.83 | 1056.87 |
|  |  |  |  |  | Height (ft) | 12 | 12 |
|  |  |  |  |  | Thickness (in) | 10 | 8 |
|  |  |  |  |  | Concrete (psi) | - | 4000 |
|  |  |  |  |  | Concrete flyash % | - | average |
|  |  |  |  |  | Rebar | #5 | #5 |
|  |  |  |  |  | Number of Windows | 13 | 39 |
|  |  |  |  |  | Total Window Area (ft2) | 570.2 | 1710.6 |
|  |  |  |  |  | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
|  |  |  |  |  | Glazing Type | - | Standard Glazing |
|  |  |  |  |  | Category | Plaster | Gypsum Board |
|  |  |  |  |  | Material | Plaster | Gypsum Regular |
|  |  |  |  |  | Thickness (in) | - | 0.5 |
|  |  |  |  |  | Category | Insulation | Insulation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.14 Wall_Cast-In-Place_W3_Ext_BrickClad_TypFlr_7.5" | Length (ft) | 32.92 | 92.58 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 7.5 | 8 |
| | | | | | Concrete (psi) | - | 4000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 2.1.15 Wall_Cast-In-Place_W3_Ext_Brickclad_TypFlr_8" | Length (ft) | 93.48 | 280.44 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 8 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Windows | 6 | 18 |
| | | | | | Total Window Area (ft2) | 341 | 1023 |
| | | | | | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
| | | | | | Glazing Type | - | Standard Glazing |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.19 Wall_Cast-In-Place_W4_Ext_BrickClad_SecondFlr_10" | Length (ft) | 280.08 | 350.1 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 10 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Number of Windows | 13 | 13 |
|  |  |  |  |  | Total Window Area (ft2) | 570.2 | 570.2 |
|  |  |  |  |  | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
|  |  |  |  |  | Glazing Type | - | Standard Glazing |
|  |  |  |  |  | Category | Plaster | Gypsum Board |
|  |  |  |  |  | Material | Plaster | Gypsum Regular |
|  |  |  |  |  | Thickness (in) | - | 0.5 |
|  |  |  |  |  | Category | Insulation | Insulation |
|  |  |  |  |  | Material | Styrofoam | Polystyrene Extruded |
|  |  |  |  |  | Thickness (in) | 1 | 1 |
|  |  |  |  |  | Category | Vapour Barrier | Vapour Barrier |
|  |  |  |  |  | Material | - | Polyethylene 6 mil |
|  |  |  |  |  | Thickness (in) | - | - |
|  |  |  |  |  | Category | Cladding | Cladding |
|  |  |  |  |  | Material | Norman Glazed Brick | Brick - Ontario (standard) |
|  |  |  |  |  | Thickness (in) | 4.75 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.20 Wall_Cast-In-Place_W4_Ext_BrickClad_SecondFlr_7.5 | Length (ft) | 194.53 | 182.37 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 7.5 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Windows | 6 | 6 |
| | | | | | Total Window Area (ft2) | 373.08 | 373.08 |
| | | | | | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
| | | | | | Glazing Type | - | Standard Glazing |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.21 Wall_Cast-In-Place_W4_Ext_BrickClad_SecondFlr_8" | Length (ft) | 93.5 | 93.5 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness | 8 | 8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | (in) | | |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Windows | 6 | 6 |
| | | | | | Total Window Area (ft2) | 341 | 341 |
| | | | | | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
| | | | | | Glazing Type | - | Standard Glazing |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.24 Wall_Cast-In-Place_W5_Ext_BrickClad_Penthouse_7.5" | Length (ft) | 33.17 | 31.1 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 7.5 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | 2.1.25 Wall_Cast-In-Place_W5_Ext_BrickClad_Penthouse_8" | Length (ft) | 294.44 | 294.44 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 8 | 8 |
| | | | | | Concrete (psi) | - | 4000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Windows | 18 | 18 |
| | | | | | Total Window Area (ft2) | 1003.14 | 1003.14 |
| | | | | | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
| | | | | | Glazing Type | - | Standard Glazing |
| | | | | | Category | Plaster | Gypsum Board |
| | | | | | Material | Plaster | Gypsum Regular |
| | | | | | Thickness (in) | - | 0.5 |
| | | | | | Category | Insulation | Insulation |
| | | | | | Material | Styrofoam | Polystyrene Extruded |
| | | | | | Thickness (in) | 1 | 1 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness (in) | - | - |
| | | | | | Category | Cladding | Cladding |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | | | Thickness (in) | 4.75 | - |
| | | | | | Category | Paint | Paint |
| | | | | | Material | - | Alkyd Solvent Based |
| | | | | | Thickness (in) | - | - |
| | | | | | | | |
| B11 Partitions | 990.1639 | m^2 | | | | | |
| | | | Walls | 2.1.9 Wall_Cast-In-Place_W2_Int_Grndflr_10" | Length (ft) | 91.67 | 114.59 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 10 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Doors | 4 | 4 |
| | | | | | Door Type | Solid Wood Door | Solid Wood Door |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 2.1.10 Wall_Cast-In-Place_W2_Int_GrndFlr_6" | Length (ft) | 73.22 | 54.92 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 6 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 2.1.11 Wall_Cast-In-Place_W2_Int_GrndFlr_7.5" | Length (ft) | 28.08 | 26.33 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 7.5 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 2.1.12 Wall_Cast-In-Place_W2_Int_GrndFlr_8" | Length (ft) | 260.48 | 260.48 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 8 | 8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Doors | 7 | 7 |
| | | | | | Door Type | Solid Wood Door | Solid Wood Door |
| | | | | 2.1.16 Wall_Cast-In-Place_W3_Int_TypFlr_10" | Length (ft) | 101.47 | 380.52 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 10 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Doors | 14 | 42 |
| | | | | | Door Type | Solid Wood Door | Solid Wood Door |
| | | | | 2.1.17 Wall_Cast-In-Place_W3_Int_TypFlr_5.75" | Length (ft) | 54.26 | 117 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 5.75 | 8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Windows | 6 | 18 |
| | | | | | Total Window Area (ft2) | 373.08 | 1119.24 |
| | | | | | Frame Type | Fixed, Aluminum Frame | Fixed, Aluminum Frame |
| | | | | | Glazing Type | - | Standard Glazing |
| | | | | 2.1.18 Wall_Cast-In-Place_W3_Int_TypFlr_8" | Length (ft) | 89.83 | 269.49 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 8 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Doors | 7 | 21 |
| | | | | | Door Type | Solid Wood Door | Solid Wood Door |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 2.1.22 Wall_Cast-In-Place_W4_Int_SecondFlr_10" | Length (ft) | 101.08 | 126.35 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 10 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Doors | 8 | 8 |
| | | | | | Door Type | Solid Wood Door | Solid Wood Door |
| | | | | 2.1.23 Wall_Cast-In-Place_W4_Int_SecondFlr_8" | Length (ft) | 88.08 | 88.08 |
| | | | | | Height (ft) | 12 | 12 |
| | | | | | Thickness (in) | 8 | 8 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | | Number of Doors | 7 | 7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Door Type | Solid Wood Door | Solid Wood Door |

HEBB Theatre Inputs

| Element | Quantity | Units | Assembly Type | Assembly Name | Input Fields | Known/Measured Information | IE Inputs |
|---|---|---|---|---|---|---|---|
| A11 Foundations | 147.1752 | m^2 | | | | | |
| | | | Footing | 1.2.1 Footing_L01&02_Lobby | Length (ft) | 47.83 | 47.83 |
| | | | | | Width (ft) | 2 | 2.58 |
| | | | | | Thickness (in) | 24.5 | 19 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |
| | | | | 1.2.2 Footing_L03a&05a_Lobby | Length (ft) | 58 | 58 |
| | | | | | Width (ft) | 5 | 5 |
| | | | | | Thickness (in) | 18 | 18 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |

| | | | | |
|---|---|---|---|---|
| | 1.2.3 Footing_L03b_Lobby | Length (ft) | 21.17 | 21.17 |
| | | Width (ft) | 2 | 2 |
| | | Thickness (in) | 18 | 18 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 1.2.4 Footing_L04_Lobby | Length (ft) | 77.75 | 77.75 |
| | | Width (ft) | 2 | 6.32 |
| | | Thickness (in) | 60 | 19 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 1.2.5 Footing_L05b&14_Lobby | Length (ft) | 52.75 | 52.75 |
| | | Width (ft) | 2 | 2 |
| | | Thickness (in) | 12 | 12 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |

|  |  |  |  |  |
|---|---|---|---|---|
|  |  | Rebar | #5 | #5 |
|  | 1.2.6 Footing_L06a_Lobby | Length (ft) | 20 | 20 |
|  |  | Width (ft) | 3 | 3 |
|  |  | Thickness (in) | 12 | 12 |
|  |  | Concrete (psi) | - | 4000 |
|  |  | Concrete flyash % | - | average |
|  |  | Rebar | #5 | #5 |
|  | 1.2.7 Footing_L06b_Lobby | Length (ft) | 18.25 | 18.25 |
|  |  | Width (ft) | 5 | 5 |
|  |  | Thickness (in) | 18 | 18 |
|  |  | Concrete (psi) | - | 4000 |
|  |  | Concrete flyash % | - | average |
|  |  | Rebar | #5 | #5 |
|  | 1.2.8 Footing_L08_Lobby_1'x1'6'' | Length (ft) | 247.48 | 247.48 |
|  |  | Width (ft) | 1.5 | 1.5 |
|  |  | Thickness (in) | 12 | 12 |
|  |  | Concrete (psi) | - | 4000 |
|  |  | Concrete flyash | - | average |

|  |  |  |  |  |
|---|---|---|---|---|
|  |  | % |  |  |
|  |  | Rebar | #5 | #5 |
|  | 1.2.9 Footing_L12_Lobby | Length (ft) | 32.08 | 32.08 |
|  |  | Width (ft) | 7.833333 | 6.26 |
|  |  | Thickness (in) | 6 | 7.5 |
|  |  | Concrete (psi) | - | 4000 |
|  |  | Concrete flyash % | - | average |
|  |  | Rebar | #5 | #5 |
|  | 1.2.10 Footing_LA_Lobby | Length (ft) | 10.92 | 10.92 |
|  |  | Width (ft) | 5.5 | 5.5 |
|  |  | Thickness (in) | 18 | 18 |
|  |  | Concrete (psi) | - | 4000 |
|  |  | Concrete flyash % | - | average |
|  |  | Rebar | #5 | #5 |
|  | 1.2.11 Footing_LB_Lobby | Length (ft) | 7.92 | 7.92 |
|  |  | Width (ft) | 4 | 4 |
|  |  | Thickness (in) | 18 | 18 |
|  |  | Concrete (psi) | - | 4000 |

|  |  |  |  |
|---|---|---|---|
|  | Concrete flyash % | - | average |
|  | Rebar | #5 | #5 |
| 1.2.12 Footing_LC_Lobby | Length (ft) | 6.67 | 6.67 |
|  | Width (ft) | 3.25 | 3.25 |
|  | Thickness (in) | 18 | 18 |
|  | Concrete (psi) | - | 4000 |
|  | Concrete flyash % | - | average |
|  | Rebar | #5 | #5 |
| 1.2.13 Footing_LD_Lobby | Length (ft) | 4 | 4 |
|  | Width (ft) | 2 | 2 |
|  | Thickness (in) | 12 | 12 |
|  | Concrete (psi) | - | 4000 |
|  | Concrete flyash % | - | average |
|  | Rebar | #5 | #5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A21 Lowest Floor Construction | 656.4604 | m^2 | | | | | |
| | | | SOG | 1.1.1 SOG_5"_Lobby | Length (ft) | 84.06 | 84.06 |
| | | | | | Width (ft) | 84.06 | 84.06 |
| | | | | | Thickness (in) | 5 | 4 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | | | |
| A22 Upper Floor Construction | 1094.646 | m^2 | | | | | |
| | | | Stairs | 1.2.14 Stairs_Theatre | Length (ft) | 65.42 | 65.42 |
| | | | | | Width (ft) | 65.5 | 82.74 |
| | | | | | Thickness (in) | 24 | 19 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Rebar | #5 | #5 |

| | | | | | |
|---|---|---|---|---|---|
| | Column Beam | 3.1.1 Column_Beam_Concrete_Lobby | Number of Columns | 10 | 10 |
| | | | Number of Beams | 10 | 10 |
| | | | Bay sizes (ft) | 20.83333 | 20.83 |
| | | | Supported span (ft) | 14.25 | 14.25 |
| | | | Floor to floor height (ft) | 10.5 | 10.5 |
| | | | Live load (psf) | 60, 100 | 75 |
| | | 3.1.2 Column_Beam_Concrete_Theatre | Number of Columns | 12 | 12 |
| | | | Number of Beams | 32 | 32 |
| | | | Bay sizes (ft) | 21 | 21 |
| | | | Supported span (ft) | 9.5 | 9.5 |
| | | | Floor to floor height (ft) | 26 | 26 |
| | | | Live load (psf) | 60, 100 | 75 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Suspended Floor | 4.1.1 Floor_ConcreteSuspendedSlab_Theatre | Floor Width (ft) | 789.2284 | 789.2284 |
| | | | | | Span (ft) | 9.5 | 9.5 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Life load (psf) | 60, 100 | 75 |
| | | | | | | | |
| | | | | | | | |
| A23 Roof Construction | 629.1085 | m^2 | | | | | |
| | | | Suspended Slab | 5.1.1 Roof_ConcreteSuspendedSlab_Theatre | Roof Width (ft) | 497.7644 | 497.7644 |
| | | | | | Span (ft) | 13.60417 | 13.60417 |
| | | | | | Concrete (psi) | - | 4000 |
| | | | | | Concrete flyash % | - | average |
| | | | | | Life load (psf) | 27 | 45 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Category | - | 4-Ply Built-up Asphalt Roof System - Inverted |
| | | | | | Material | Rigid Insulation | Extruded Polystyrene, Glass Felt |
| | | | | | Thickness (in) | 1 | 6 |
| | | | | | Category | Vapour Barrier | Vapour Barrier |
| | | | | | Material | - | Polyethylene 6 mil |
| | | | | | Thickness | - | - |
| | | | | | | | |
| A31 Walls Below Grade | | | | | | | |
| | | | | | | | |
| A32 Walls Above Grade | 1610.797 | m^2 | | | | | |
| | | | Walls | 2.1.1 Wall_Cast-In-Place_L01_Lobby_8" | Length (ft) | 34.54 | 34.54 |

| | | | | |
|---|---|---|---|---|
| | | Height (ft) | 17.3125 | 17.3125 |
| | | Thickness (in) | 8 | 8 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.2 Wall_Cast-In-Place_L02_Lobby_8" | Length (ft) | 14.17 | 14.17 |
| | | Height (ft) | 14.63542 | 14.63542 |
| | | Thickness (in) | 8 | 8 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.3 Wall_Cast-In-Place_L03a_Lobby_8" | Length (ft) | 39.58 | 39.58 |
| | | Height (ft) | 25.5 | 25.5 |

|  |  |  |  |  |
|---|---|---|---|---|
|  |  | Thickness (in) | 8 | 8 |
|  |  | Concrete (psi) | - | 4000 |
|  |  | Concrete flyash % | - | average |
|  |  | Rebar | #5 | #5 |
|  | 2.1.4 Wall_Cast-In-Place_L03b_Lobby_8" | Length (ft) | 5.92 | 5.92 |
|  |  | Height (ft) | 25.5 | 25.5 |
|  |  | Thickness (in) | 8 | 8 |
|  |  | Concrete (psi) | - | 4000 |
|  |  | Concrete flyash % | - | average |
|  |  | Rebar | #5 | #5 |
|  | 2.1.5 Wall_Cast-In-Place_L04_Lobby_8" | Length (ft) | 81.4 | 81.4 |
|  |  | Height (ft) | 16.47917 | 16.5 |

| | | | | |
|---|---|---|---|---|
| | | Thickness (in) | 8 | 8 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.6 Wall_Cast-In-Place_L05_Lobby_1'8" | Length (ft) | 4.75 | 7.92 |
| | | Height (ft) | 10.25 | 10.3 |
| | | Thickness (in) | 20 | 12 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.7 Wall_Cast-In-Place_L06_Lobby_1'8" | Length (ft) | 6.58 | 11 |
| | | Height (ft) | 10.25 | 10.3 |

| | | | | |
|---|---|---|---|---|
| | | Thickness (in) | 20 | 12 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.8 Wall_Cast-In-Place_L07_Lobby_8" | Length (ft) | 42.72 | 42.72 |
| | | Height (ft) | 18.25 | 18.3 |
| | | Thickness (in) | 8 | 8 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.9 Wall_Cast-In-Place_L08_Lobby_6" | Length (ft) | 24.81 | 18.61 |
| | | Height (ft) | 12 | 12 |
| | | Thickness (in) | 6 | 8 |

| | | | | |
|---|---|---|---|---|
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | | | | |
| | 2.1.10 Wall_Cast-In-Place_L09-10_Lobby_8" | Length (ft) | 113.12 | 113.12 |
| | | Height (ft) | 12 | 12 |
| | | Thickness (in) | 8 | 8 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.11 Wall_Cast-In-Place_L11_Lobby_10" | Length (ft) | 42.32 | 52.9 |
| | | Height (ft) | 12 | 12 |
| | | Thickness (in) | 10 | 8 |

| | | | | |
|---|---|---|---|---|
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | | | | |
| | 2.1.12 Wall_Cast-In-Place_L12a_Lobby_8" | Length (ft) | 38 | 38 |
| | | Height (ft) | 3 | 3 |
| | | Thickness (in) | 8 | 8 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.13 Wall_Cast-In-Place_L12b_Lobby_8" | Length (ft) | 31.92 | 31.92 |
| | | Height (ft) | 4.5 | 4.5 |
| | | Thickness (in) | 8 | 8 |
| | | Concrete | - | 4000 |

| | | | | |
|---|---|---|---|---|
| | | (psi) | | |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.14 Wall_Cast-In-Place_L13_Lobby_10" | Length (ft) | 27.5 | 34.38 |
| | | Height (ft) | 10.3 | 10.3 |
| | | Thickness (in) | 10 | 8 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |
| | 2.1.15 Wall_Cast-In-Place_L14_Lobby_11.75" | Length (ft) | 89.57 | 87.7 |
| | | Height (ft) | 10.3 | 10.3 |
| | | Thickness (in) | 11.75 | 12 |
| | | Concrete (psi) | - | 4000 |
| | | Concrete flyash % | - | average |
| | | Rebar | #5 | #5 |

|  |  |  |  |  |
|---|---|---|---|---|
|  | 2.1.16 Wall_Cast-In-Place_W6_Ext_BrickClad_Theatre_8" | Length (ft) | 365.74 | 365.74 |
|  |  | Height (ft) | 26 | 26 |
|  |  | Thickness (in) | 8 | 8 |
|  |  | Concrete (psi) | - | 4000 |
|  |  | Concrete flyash % | - | average |
|  |  | Rebar | #5 | #5 |
|  |  | Number of Doors | 2 | 2 |
|  |  | Door Type | Steel Exterior Door | Steel Exterior Door |
|  |  | Category | Plaster | Gypsum Board |
|  |  | Material | Plaster | Gypsum Regular |
|  |  | Thickness (in) | - | 0.5 |
|  |  | Category | Insulation | Insulation |
|  |  | Material | Styrofoam | Polystyrene Extrude |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | d |
| | | | Thickness (in) | 1 | 1 |
| | | | Category | Vapour Barrier | Vapour Barrier |
| | | | Material | - | Polyethylene 6 mil |
| | | | Thickness (in) | - | - |
| | | | Category | Cladding | Cladding |
| | | | Material | Norman Glazed Brick | Brick - Ontario (standard) |
| | | | Thickness (in) | 4.75 | - |
| | | | Category | Paint | Paint |
| | | | Material | - | Alkyd Solvent Based |
| | | | Thickness (in) | - | - |
| | | | | | |
| | | | | | |
| | | | | | |
| B11 Partitions | 305.9686 | m^2 | | | |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
|  | Walls | 2.1.17 Wall_Cast-In-Place_W6_Int_Theatre_6" | Length (ft) | 51.75 | 38.81 |
|  |  |  | Height (ft) | 26 | 26 |
|  |  |  | Thickness (in) | 6 | 8 |
|  |  |  | Concrete (psi) | - | 4000 |
|  |  |  | Concrete flyash % | - | average |
|  |  |  | Rebar | #5 | #5 |
|  |  | 2.1.18 Wall_Cast_In_Place_W6_Int_Theatre_8" | Length (ft) | 74.92 | 74.92 |
|  |  |  | Height (ft) | 26 | 26 |
|  |  |  | Thickness (in) | 8 | 8 |
|  |  |  | Concrete (psi) | - | 4000 |
|  |  |  | Concrete flyash % | - | average |
|  |  |  | Rebar | #5 | #5 |

HEBB TOWER Assumptions

| **Element** | **Assembly Type** | **Assembly Name** | **Assumptions** |
|---|---|---|---|
| A11 Foundations |  |  |  |

| | | | |
|---|---|---|---|
| | Footing | 1.2.1 Footing_F1a_Basement | The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be under 19.7”. The measured length was maintained, thicknesses were set at 19” and the widths were increased using the following calculations;<br>= [(Cited Width) x (Cited Thickness)] / (19”/12)<br>= [(2’) x (80”/12)] / (19”/12)<br>= 8.42 feet<br>The height from the bottom of the footing to the top of the footing, at an elevation of 365'3", is taken to be 6'8", as determined from measuring the structural drawings. |
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| | | 1.2.2 Footing_F1b_Basement | The depth of this deep mass concrete footing was taken to be 1'0". |
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| | | 1.2.3 Footing_F2a_Basement | The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be under 19.7”.  The measured length was maintained, thicknesses were set at 19” and the widths were increased using the following calculations;<br>= [(Cited Width) x (Cited Thickness)] / (19”/12)<br>= [(2.5’) x (80”/12)] / (19”/12)<br>= 10.53 feet<br>The height from the bottom of the footing to the top of the footing, at an elevation of 365'3", is taken to be 6'8", as determined from measuring the structural drawings. |
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| | | 1.2.4 Footing_F2b_Basement | |
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| | | 1.2.5 Footing_FA_Basement | |
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| | | 1.2.6 Footing_FB_Basement | |
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| | | 1.2.7 Footing_FC_Basement | |
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| | | 1.2.8 Footing_FD_Basement | |
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| | | 1.2.9 Footing_FE_Basement | |
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| | | 1.2.10 Footing_FF_Basement | |
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| | | 1.2.11 Footing_FG_Basement | Dimensions of the L-shaped footing determined from having a cross-sectional footing area of 12sf, setting thickness to 6'8", and from this calculating width to be 1.8' (from structural drawing).<br>The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be under 19.7”. The measured length was maintained, thicknesses were set at 19” and the widths were increased using the following calculations;<br>= [(Cited Width) x (Cited Thickness)] / (19”/12)<br>= [(1.8’) x (80”/12)] / (19”/12)<br>= 7.58 feet |
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| | | 1.2.12 Footing_FH_Basement | Dimensions of the L-shaped footing determined from having a cross-sectional footing area of 10sf, setting thickness to 6'8", and from this calculating width to be 1.5' (from structural drawing).<br>The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be under 19.7”. The measured length was maintained, thicknesses were set at 19” and the widths were increased using the following calculations;<br>= [(Cited Width) x (Cited Thickness)] / (19”/12)<br>= [(1.5’) x (80”/12)] / (19”/12)<br>= 6.32 feet |
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| | | 1.2.13 Footing_FJ_Basement | |
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| | | 1.2.14 Footing_FK_Basement | |
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|  |  | 1.2.15 Footing_FL_Basement |  |
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|---|---|---|---|
| | | 1.2.16 Footing_FM_Basement | |
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|---|---|---|---|
|  |  | 1.2.17 Footing_FN_Basement |  |
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|---|---|---|---|
| A21 Lowest Floor Construction |  |  | The Impact Estimator, SOG inputs are limited to being either a 4” or 8” thickness. Since the actual SOG thicknesses for the HEBB building were not exactly 4” or 8” thick, the areas measured in OnScreen required calculations to adjust the areas to accommodate this limitation.<br>The Impact Estimator limits the thickness of footings to be between 7.5” and 19.7” thick. As there are a number of cases where footing thicknesses are not within these limitations, their widths were adjusted accordingly to maintain the same volume of footing.<br>Concrete strength was set to 4000psi and an average % of concrete flyash was assumed.<br>Lastly, the North and South concrete staircases were modelled as footings. |
|  | SOG | 1.1.1 SOG_5"_Tower | The area of this slab had to be adjusted so that the thickness fit into the 4" thickness specified in the Impact Estimator. The following calculation was done in order to determine appropriate Length and Width (in feet) inputs for this slab;<br>= sqrt[((Measured Slab Area) x (Actual Slab Thickness))/(4”/12) ]<br>= sqrt[ (10,695.07 x (5”/12))/(4”/12) ]<br>= 115.62 feet |
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| | | | |
| A22 Upper Floor Construction | | | |

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|---|---|---|---|
| | Stairs | 1.2.18 Stairs_South/North_Platform | The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be greater than 7.5”. The measured length was maintained, thickness was set to 7.5” and the width was decreased using the following calculation;<br>= [(Cited Width) x (Cited Thickness)] / (7.5”/12)<br>= [(5.33’) x (6”/12)] / (7.5”/12)<br>= 4.26 feet |
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| | | 1.2.19 Stairs_South/North_Steps | The thickness of the stairs was estimateded to be 8 inches based on the cross-section structural drawings |
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|---|---|---|---|
| | Column Beam | 3.1.1 Column_Beam_Concrete Basement | It is modeled as if there are columns located along the load bearing wall along line B in the same fashion as the columns along line A (refer to structural drawings), even though they are not shown on the structural drawings.<br>Since the bay size is limited to a maximum of 40 feet in the Impact Estimator, 40 feet is used as the approximate bay size, whereas the actual bay size is 41.5 feet. |
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| | | 3.1.2 Column_Beam_Concrete_GrndFlr | It is modeled as if there are columns located along the load bearing wall along line B in the same fashion as the columns along line A (refer to structural drawings), even though they are not shown on the structural drawings.<br>Since the bay size is limited to a maximum of 40 feet in the Impact Estimator, 40 feet is used as the approximate bay size, whereas the actual bay size is 41.5 feet. |

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|  |  | 3.1.3 Column_Beam_Concrete_SecondFlr | It is modeled as if there are columns located along the load bearing wall along line B in the same fashion as the columns along line A (refer to structural drawings), even though they are not shown on the structural drawings.<br>Since the bay size is limited to a maximum of 40 feet in the Impact Estimator, 40 feet is used as the approximate bay size, whereas the actual bay size is 41.5 feet. |
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|---|---|---|---|
| | | 3.1.4 Column_Beam_Concrete_typFlr | It is modeled as if there are columns located along the load bearing wall along line B in the same fashion as the columns along line A (refer to structural drawings), even though they are not shown on the structural drawings.<br>Since the bay size is limited to a maximum of 40 feet in the Impact Estimator, 40 feet is used as the approximate bay size, whereas the actual bay size is 41.5 feet.<br>Typical Floor (TypFlr) values for number of columns and beams, were multiplied by 3 for EIE inputs to represent all typical floors (typical floor = 3rd, 4th, and 5th floors). |
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|---|---|---|---|
| | Suspended Floor | 4.1.1 Floor_ConcreteSuspendedSlab_GrndFlr | The Impact Estimator calculated the thickness of the material based on floor width, span, concrete strength, concrete flyash content and live load.<br>Concrete strength was set to 4000psi and an average % of concrete flyash was assumed.<br>As stated on the structural drawings, the live loads for floors are as follows: labs, classrooms, and theatre have specified live loads of 60psf; corridors, entrances, and stairs have specified live loads of 100psf. An average of these values of 75psf is used for EIE Inputs.<br>Typical Floor (TypFlr) value for floor width was multiplied by 3 for EIE input to represent all typical floors (typical floor = 3rd, 4th, and 5th floors).<br>All stated about roof envelope from architectural drawings is that it is comprised of 1" rigid insulation. For EIE Model, it is assumed to have a 4-Ply Built-up Asphalt Roof System - Inverted with Extruded Polystyrene, Glass Felt envelope material. Vapour barrier assumed to be polyethylene 6mil. |
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|  |  | 4.1.2 Floor_ConcreteSuspendedSlab_SecondFlr |  |
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|  |  |  |  |
|  |  | 4.1.3 Floor_ConcreteSuspendedSlab_TypeFlr |  |
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| | | | |
| | | 4.1.4 Floor_ConcreteSuspendedSlab_Penthouse | |
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| A23 Roof Construction | | | The live load was assumed to be 45 psf instead of the specified 27 psf and the concrete strength was set to 4,000psi with average flyash content. All stated about roof envelope from architectural drawings is that it is comprised of 1" rigid insulation. For EIE Model, it is assumed to have a 4-Ply Built-up Asphalt Roof System - Inverted with Extruded Polystyrene, Glass Felt envelope material. Vapour barrier assumed to be polyethylene 6mil. |
| | Envelope | 5.1.1 Roof_ConcreteSuspendedSlab_Tower | |
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| | | | |
| | | | |
| | | | |
| | | Insulation | |
| | | | |
| | | | |
| | | Vapour Barrier | |

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|---|---|
| A31 Walls Below Grade | The length of the concrete cast-in-place walls needed adjusting to accommodate the wall thickness limitation in the Impact Estimator (8" or 12").<br>Concrete strength was set to 4000psi and an average % of concrete flyash was assumed.<br>The wall envelopes consisting of plaster are modelled as consisting of Regular Gypsum 1/2" due to the unavailability of plaster as a material in Athena EIE.<br>The vapour barrier is assumed to be Polyethylene 6 mil.<br>For the external walls of the tower, the exterior envelope consists of 4.75" Norman Glazed Brick on 90% of the height of the wall, and 3.75" concrete cladding on 10% of the height of the wall. For the model to be inputted into Athena EIE, it is assumed that the exterior envelope consists of Standard Ontario Brick on 100% of the height of the wall. The glazing on the Norman Brick is modeled as Alkyd Solvent Based Paint in Athena EIE.<br>Doors have an actual size of 36"x7', but are modeled assuming they are of standard size in Athena EIE of 32"x7'. Windows are modeled as standard glazing with fixed aluminum framing, which is the closest estimation to the observed windows.<br>Typical Floor (TypFlr) values for measured wall length, number of windows, window area, and number |

| | | | |
|---|---|---|---|
| | | | of doors, were multiplied by 3 for EIE inputs to represent all typical floors (typical floor = 3rd, 4th, and 5th floors). |
| | Walls | 2.1.1 Wall_Cast-In-Place_W1_Ext_BrickClad_Basement_10'' | This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (453.73’) * [(10”)/8”]<br>= 567.16 feet |
| | | | |
| | | | |

| | | | |
|---|---|---|---|
| | | 2.1.2 Wall_Cast-In-Place_W1_Ext_BrickClad_Basement_11.75'' | This wall was reduced by a factor in order to fit the 12” thickness limitation of the Impact Estimator. This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/12”]<br>= (29’) * [(11.75”)/12”]<br>= 28.40 feet |
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| | | 2.1.3 Wall_Cast-In-Place_W1_Int_Basement_10" | This wall was increased by a factor in order to fit the 8" thickness limitation of the Impact Estimator. This was done by increaseing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8"]<br>= (157.75') * [(10")/8"]<br>= 197.19 feet |
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| | | 2.1.4 Wall_Cast-In-Place_W1_Int_Basement_8" | |
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| | | | |
| A32 Walls Above Grade | | | |
| | Walls | 2.1.5 Wall_Cast-In-Place_W2_Ext_BrickClad_GrndFlr_10" | This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by increaseing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (336.67’) * [(10”)/8”]<br>= 420.84 feet |
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| | | 2.1.6 Wall_Cast-In-Place_W2_Ext_BrickClad_GrndFlr_11.75" | This wall was reduced by a factor in order to fit the 12” thickness limitation of the Impact Estimator. This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/12”]<br>= (38.13’) * [(11.75”)/12”]<br>= 37.34 feet |
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| | | 2.1.7 Wall_Cast-In-Place-W2_Ext_GrndFlr_8" | |
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| | | 2.1.8 Wall_Cast-In-Place_W2_Ext_Grndflr_AdditionalWall | Additional wall section A1, B1 that is modeled as 4' high, 1' thick |
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| | | 2.1.13 Wall_Cast-In-Place_W3_Ext_BrickClad_TypeFlr_10'' | This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (281.83') * [(10”)/8”]<br>= 352.29 feet<br>Multiply by 3 (typical floor = floors 3,4,5);<br>= 352.39' * 3<br>= 1056.87 feet |
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|  |  | 2.1.14 Wall_Cast-In-Place_W3_Ext_BrickClad_TypFlr_7.5'' | This wall was reduced by a factor in order to fit the 8” thickness limitation of the Impact Estimator.  This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (32.92') * [(7.5”)/8”]<br>= 30.86 feet<br>Multiply by 3 (typical floor = floors 3,4,5);<br>= 30.86' * 3<br>= 92.58 feet |
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2.1.15 Wall_Cast-In-Place_W3_Ext_Brickclad_TypFlr_8"

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| | | 2.1.19 Wall_Cast-In-Place_W4_Ext_BrickClad_SecondFlr_10" | This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (280.08') * [(10”)/8”]<br>= 350.10 feet |
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|  |  | 2.1.20 Wall_Cast-In-Place_W4_Ext_BrickClad_SecondFlr_7.5 | This wall was reduced by a factor in order to fit the 8” thickness limitation of the Impact Estimator.  This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (194.53') * [(7.5”)/8”]<br>= 182.37 feet |
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2.1.21 Wall_Cast-In-Place_W4_Ext_BrickClad_SecondFlr_8"

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| | | 2.1.24 Wall_Cast-In-Place_W5_Ext_BrickClad_Penthouse_7.5" | This wall was reduced by a factor in order to fit the 8" thickness limitation of the Impact Estimator. This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8"]<br>= (33.17') * [(7.5")/8"]<br>= 31.10 feet |
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| | | 2.1.25 Wall_Cast-In-Place_W5_Ext_BrickClad_Penthouse_8" | |
| B11 Partitions | | | |

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| | Walls | 2.1.9 Wall_Cast-In-Place_W2_Int_Grndflr_10'' | This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator.  This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (91.67') * [(10”)/8”]<br>= 114.59 feet |
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|  |  | 2.1.10 Wall_Cast-In-Place_W2_Int_GrndFlr_6" | This wall was reduced by a factor in order to fit the 8” thickness limitation of the Impact Estimator.  This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (73.22') * [(6”)/8”]<br>= 54.92 feet |
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| | | 2.1.11 Wall_Cast-In-Place_W2_Int_GrndFlr_7.5'' | This wall was reduced by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (28.08') * [(7.5”)/8”]<br>= 26.33 feet |
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| | | 2.1.12 Wall_Cast-In-Place_W2_Int_GrndFlr_8'' | |
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|  |  | 2.1.16 Wall_Cast-In-Place_W3_Int_TypFlr_10" | This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (101.47') * [(10”)/8”]<br>= 126.84 feet<br>Multiply by 3 (typical floor = floors 3,4,5);<br>= 126.84' * 3<br>= 380.52 feet |
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|  |  | 2.1.17 Wall_Cast-In-Place_W3_Int_TypFlr_5.75'' | This wall was reduced by a factor in order to fit the 8" thickness limitation of the Impact Estimator. This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8"]<br>= (54.26') * [(5.75")/8"]<br>= 39.00 feet<br>Multiply by 3 (typical floor = floors 3,4,5);<br>= 39.00' * 3<br>= 117.00 feet |
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|  |  | 2.1.18 Wall_Cast-In-Place_W3_Int_TypFlr_8'' |  |
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| | | 2.1.22 Wall_Cast-In-Place_W4_Int_SecondFlr_10'' | This wall was increased by a factor in order to fit the 8" thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8"]<br>= (101.08') * [(10")/8"]<br>= 126.35 feet |
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|  |  | 2.1.23 Wall_Cast-In-Place_W4_Int_SecondFlr_8" |

HEBB Theatre Assumption

| **Element** | **Assembly Type** | **Assembly Name** | **Assumption** |
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| A11 Foundations |  |  |  |

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| Footing | 1.2.1 Footing_L01&02_Lobby | The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be under 19.7”. The measured length was maintain, thicknesses were set at 19” and the widths were increased using the following calculations;<br>= [(Cited Width) x (Cited Thickness)] / (19”/12)<br>= [(2’) x (24.5”/12)] / (19”/12)<br>= 2.58 feet |
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| | 1.2.2 Footing_L03a&05a_Lobby | |
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### 1.2.3 Footing_L03b_Lobby

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|  | 1.2.4 Footing_L04_Lobby | The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be under 19.7”.  The measured length was maintain, thicknesses were set at 19” and the widths were increased using the following calculations;<br>= [(Cited Width) x (Cited Thickness)] / (19”/12)<br>= [(2’) x (60”/12)] / (19”/12)<br>= 6.32 feet |
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|  | 1.2.5 Footing_L05b&14_Lobby |  |
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| 1.2.6 Footing_L06a_Lobby |
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| 1.2.7 Footing_L06b_Lobby |
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| 1.2.8 Footing_L08_Lobby_1'x1'6" |
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| | 1.2.9 Footing_L12_Lobby | The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be greater than 7.5”. The measured length was maintain, thicknesses were set at 7.5” and the widths were decreased using the following calculations;<br>= [(Cited Width) x (Cited Thickness)] / (7.5”/12)<br>= [(7.83’) x (6”/12)] / (7.5”/12)<br>= 6.26 feet |
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| | 1.2.10 Footing_LA_Lobby | |
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### 1.2.11 Footing_LB_Lobby

### 1.2.12 Footing_LC_Lobby

### 1.2.13 Footing_LD_Lobby

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| A21 Lowest Floor Construction | The Impact Estimator, SOG inputs are limited to being either a 4” or 8” thickness. Since the actual SOG thicknesses for the HEBB theatre were not exactly 4” or 8” thick, the areas measured in OnScreen required calculations to adjust the areas to accommodate this limitation.<br>The Impact Estimator limits the thickness of footings to be between 7.5” and 19.7” thick. As there are a number of cases where footing thicknesses are not within these limitations, their widths were adjusted accordingly to maintain the same volume of footing.<br>Concrete strength was set to 4000psi and an average % of concrete flyash was assumed.<br>Lastly, the concrete stairs were modelled as footings. |

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| | SOG | 1.1.1 SOG_5"_Lobby | The area of this slab had to be adjusted so that the thickness fit into the 8" thickness specified in the Impact Estimator. The following calculation was done in order to determine appropriate Length and Width (in feet) inputs for this slab;<br>= sqrt[((Measured Slab Area) x (Actual Slab Thickness))/(4”/12) ]<br>= sqrt[ (5,653.31 x (5”/12))/(4”/12) ]<br>= 84.06 feet |
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| A22 Upper Floor Construction | | | |

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| Stairs | 1.2.14 Stairs_Theatre | The thickness of the stairs was estimateded to be 24 inches based on the cross-section architectural drawings.<br>The width of this slab was adjusted to accommodate the Impact Estimator limitation of footing thicknesses to be under 19.7”.  The measured length was maintain, thicknesses were set at 19” and the widths were increased using the following calculations;<br>= [(Cited Width) x (Cited Thickness)] / (19”/12)<br>= [(65.5’) x (24”/12)] / (19”/12)<br>= 82.74 feet |
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| | Column<br>Beam | 3.1.1<br>Column_Beam_Concrete_Lobby | An average floor to floor height of 10.5' was used throughout lobby, as determined from architectural drawings;<br><br>= (8.5+9.5+7+9+12+17)/6 = 10.5' |
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|  | 3.1.2 Column_Beam_Concrete_Theatre | An average floor to floor height of 26' was used throughout theatre, as determined from architectural drawings;<br>= (19'+32.5'+36'+33'+30'+26'+21'+15'+19.5')/9 = 26' |

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| | Suspended Floor | 4.1.1 Floor_ConcreteSuspendedSlab_Theatre | The Impact Estimator calculated the thickness of the material based on floor width, span, concrete strength, concrete flyash content and live load. Concrete strength was set to 4000psi and an average % of concrete flyash was assumed.<br>As stated on the structural drawings, the live loads for floors are as follows: labs, classrooms, and theatre have specified live loads of 60psf; corridors, entrances, and stairs have specified live loads of 100psf. An average of these values of 75psf is used for EIE Inputs. |
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| A23 Roof Construction |  |  | The live load was assumed to be 45 psf instead of the specified 27 psf and the concrete strength was set to 4,000psi with average flyash content. All stated about roof envelope from architectural drawings is that it is comprised of 1" rigid insulation. For EIE Model, it is assumed to have a 4-Ply Built-up Asphalt Roof System - Inverted with Extruded Polystyrene, Glass Felt envelope material. Vapour barrier assumed to be polyethylene 6mil. |
|  | Suspended Slab | 5.1.1 Roof_ConcreteSuspendedSlab_Theatre |  |
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| A31 Walls Below Grade | | The length of the concrete cast-in-place walls needed adjusting to accommodate the wall thickness limitation in the Impact Estimator (8" or 12").<br>Concrete strength was set to 4000psi and an average % of concrete flyash was assumed.<br>The wall envelopes consisting of plaster are modelled as consisting of Regular Gypsum 1/2" due to the unavailability of plaster as a material in Athena EIE.<br>The vapour barrier is assumed to be Polyethylene 6 mil.<br>For the external wall of the theatre, the exterior envelope consists of 4.75" Norman Glazed Brick on 90% of the height of the wall, and 3.75" concrete cladding on 10% of the height of the wall. For the model to be inputted into Athena EIE, it is assumed that the exterior envelope consists of Standard Ontario Brick on 100% of the height of the wall. The glazing on the Norman Brick is modeled as Alkyd Solvent Based Paint in Athena EIE.<br>Doors are modeled as steel exterior doors, which is the closest estimation to the observed doors. The number and location of doors are as determined from site exploration.<br>Wall heights for the lobby determined from dimensioning of structural drawings and given elevations. |
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| A32 Walls Above Grade | | |
| | Walls | 2.1.1 Wall_Cast-In-Place_L01_Lobby_8'' |
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| | | 2.1.2 Wall_Cast-In-Place_L02_Lobby_8'' |
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2.1.3 Wall_Cast-In-Place_L03a_Lobby_8"

2.1.4 Wall_Cast-In-Place_L03b_Lobby_8"

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| | 2.1.5 Wall_Cast-In-Place_L04_Lobby_8'' | |
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| | 2.1.6 Wall_Cast-In-Place_L05_Lobby_1'8'' | This wall was increased by a factor in order to fit the 12” thickness limitation of the Impact Estimator.  This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/12”]<br>= (4.75’) * [(20”)/12”]<br>= 7.92 feet |

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| | 2.1.7 Wall_Cast-In-Place_L06_Lobby_1'8" | This wall was increased by a factor in order to fit the 12” thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/12”]<br>= (6.58’) * [(20”)/12”]<br>= 11.00 feet |

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| 2.1.8 Wall_Cast-In-Place_L07_Lobby_8'' |
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| | 2.1.9 Wall_Cast-In-Place_L08_Lobby_6'' | The height of this wall varies along its length; therefore, the average height of 12' is used.<br>This wall was reduced by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (24.81') * [(6”)/8”]<br>= 18.61 feet |
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| | 2.1.10 Wall_Cast-In-Place_L09-10_Lobby_8" | The height of this wall varies along its length; therefore, the average height of 12' is used. |
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| | 2.1.11 Wall_Cast-In-Place_L11_Lobby_10" | The height of this wall varies along its length; therefore, the average height of 12' is used.<br>This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (42.32') * [(10”)/8”]<br>= 52.90 feet |
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| | 2.1.12 Wall_Cast-In-Place_L12a_Lobby_8" | |
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2.1.13 Wall_Cast-In-Place_L12b_Lobby_8"

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| | 2.1.14 Wall_Cast-In-Place_L13_Lobby_10" | This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (27.50') * [(10”)/8”]<br>= 34.38 feet |
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| | 2.1.15 Wall_Cast-In-Place_L14_Lobby_11.75" | This wall was reduced by a factor in order to fit the 12” thickness limitation of the Impact Estimator. This was done by reducing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/12”]<br>= (89.57) * [(11.75”)/12”]<br>= 87.70 feet |
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| | 2.1.16 Wall_Cast-In-Place_W6_Ext_BrickClad_Theatre_8" | An average floor to floor height of 26' was used throughout theatre, as determined from architectural drawings;<br>= (19'+32.5'+36'+33'+30'+26'+21'+15'+19.5')/9 = 26' |
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B11 Partitions

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| Walls | 2.1.17 Wall_Cast-In-Place_W6_Int_Theatre_6" | An average floor to floor height of 26' was used throughout theatre, as determined from architectural drawings;<br>= (19'+32.5'+36'+33'+30'+26'+21'+15'+19.5')/9 = 26'<br>This wall was increased by a factor in order to fit the 8” thickness limitation of the Impact Estimator. This was done by increasing the length of the wall using the following equation;<br>= (Measured Length) * [(Cited Thickness)/8”]<br>= (51.75') * [(6”)/8”]<br>= 38.81 feet |
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| | 2.1.18 Wall_Cast_In_Place_W6_Int_Theatre_8" | An average floor to floor height of 26' was used throughout theatre, as determined from architectural drawings;<br>= (19'+32.5'+36'+33'+30'+26'+21'+15'+19.5')/9 = 26' |