UNIVERSITY OF TORONTO

OFFICE OF THE GOVERNING COUNCIL

FOR APPROVAL **PUBLIC** **OPEN SESSION**

TO: Academic Board

SPONSOR: Scott Mabury, Vice-President, Operations and Real Estate Partnerships
416-978-2031, scott.mabury@utoronto.ca

PRESENTER: See Sponsor

DATE: March 3, 2022 for March 10, 2022

AGENDA ITEM: 7

ITEM IDENTIFICATION:

Capital Project: *Report of the Project Planning Committee for the Galbraith Structural Testing Facility* - Project Scope and Sources of Funding

JURISDICTIONAL INFORMATION:

Pursuant to section 4.2.3. of the Committee's terms of Reference, "…the Committee considers reports of project planning committees and recommends to the Academic Board approval in principle of projects (i.e. space plan, site, overall cost and sources of funds) with a capital cost as specified in the *Policy on Capital Planning and Capital Projects*."

The *Policy on Capital Planning and Capital Projects* provides that capital projects with costs between $10 million and $50 million (Approval Level 2) on the St. George campus, will first be considered by the Planning & Budget Committee, which shall recommend approval to Academic Board. Such projects will be confirmed by the Executive Committee of the Governing Council on the recommendation of the Academic Board.

GOVERNANCE PATH:

A. Project Planning Report
1. Planning and Budget [for recommendation] (Feb 28, 2022)
2. **Academic Board [for approval] (March 10, 2022)**
3. Executive Committee [for confirmation] (March 22, 2022)

B. Execution of Project
1. Business Board [for approval] (March 15, 2022)

PREVIOUS ACTION TAKEN:

At the November 24, 2020 Capital Project and Space Allocation Committee (CaPS) Executive Committee meeting Terms of Reference as well as a request for fees to conduct a feasibility study were approved.

In early 2021 the project was awarded to the consultant team led by DIALOG, and the feasibility study was subsequently finalized August 2021. The feasibility study and associated project costing were used by the Department of Civil & Mineral Engineering to determine next steps.

On October 12, 2021 the CaPS Executive Committee approved a budget increase for consultant fees to continue and complete the design of the new Galbraith Structural Testing Facility.

HIGHLIGHTS:

The Structural Testing Laboratory in the Department of Civil & Mineral Engineering is among the top few testing facilities in North America and has received numerous awards for the quality of research performed. The main laboratory facility spans the basements of the Sandford Fleming and the Galbraith building and includes numerous ancillary facilities such as a concrete mixing laboratory, machine shop, welding bay and woodworking area.

Historically, the Structural testing facility at the University of Toronto was divided into two separate laboratories, the Mark Huggins Structures Laboratory in the Galbraith building and the Sandford Fleming Laboratory. These two testing facilities were joined in 2009 as part of a large renovation and equipment upgrade sponsored by CFI and ORF and worth more than $8 million.

The original Mark Huggins Structures Laboratory, constructed in 1960, provided the Department with one of the best such facilities in North America at that time. Experiments conducted in the laboratory have contributed significantly to the development of Canadian structural engineering codes and practice. The Mark Huggins Structures Laboratory was basically designed and equipped to test individual structural elements, (primarily individual beams and columns - i.e. bar-like specimens), under simple loading conditions.

The Sandford Fleming Structures Laboratory, which has approximately 700 m^2 of floor area and an 18 m x 12 m strong floor as well as a 5 m high by 5 m wide reaction wall, was constructed following a fire in 1977 and was officially opened in 1982. With the aid of an NSERC Major Installation Grant, this laboratory was then outfitted with "state-of-the-art" testing equipment for research on large scale structural specimens.

Based on the results of the feasibility study, the Department of Civil & Mineral Engineering would like to continue with the revitalization of their existing Structural Testing Facility located in the Galbraith building. The proposed work is part of a long-term initiative to design and build the world's first Adjustable Multi-Dimensional (AMD) Loading System in the Structural Testing Facilities at the University of Toronto. Extensive construction work, consisting of Project Areas, is planned as part of this project.

Two distinct project areas in the lab have been defined to assist in prioritizing design focus and to assist with cost containment (the third project area was removed from the project scope during the feasibility study due to cost constraints). Project Area #1 (now referred to as #1B) includes the installation of the new structurally isolated ultra-high-strength instrumented loading platform (a functional necessity for the lab to be realized), and Project Area #2 (now referred to as #2B) includes the relocation of existing Hydraulic Power Units (HPUs). The lab is approximately 667 nasm (709 m2 gsm).

Scope in Project Area 2B may be further reduced to help control costs.

Secondary Effects

Due to the scale of the excavation, vibration and noise during construction will have effect throughout the building which houses offices and classrooms. Recommend that excavation be limited to the summer period if possible or after hours.

The Structural Testing Facility in Galbraith Building will be closed during the entire period of construction, with testing and lab functions to be relocated to Sandford Fleming to allow testing to continue (during the construction period). The cost of this effect will be covered by CivMin and is outside of the scope of this project.

Equipment and lab materials will be relocated to Sanford Fleming, with potential needs for offsite storage. The cost of this effect will be covered by CivMin and is outside of the scope of this project.

Schedule

The proposed overall project schedule is as follows:

Project Milestone	**Anticipated Date**
CFI Funding announced	November 18, 2020
CaPS Exec: TOR and request to conduct feasibility study	November 24, 2020
RFP for Feasibility Study	January 2021
Feasibility Study Complete	August 2021
Provincial Funding Announcement (ORF) announced	September 2021
CaPS Exec: request for increase in design fees	October 1, 2021
Schematic Design and Design Development	October to November 2021
CaPS Exec: for full project approval	January to March 2022
Conclude Construction Documents / Permit	March 2022
Project Tender	April 2022
Construction Start	May 2022
Deadline to begin construction activities	May 22, 2022

RESOURCE IMPLICATIONS:

Discussion of overall costs and sources of funds can be found in the *in-camera* document for this project.

RECOMMENDATION:

Be it Resolved,

THAT subject to confirmation by the Executive Committee,

THAT the project scope of the Galbraith Structural Testing Facility, as identified in the *Report of the Project Planning Committee for the Galbraith Structural Testing Facility*, dated January 21, 2022, be approved in principle; and,

THAT the project totaling 667 net assignable square metres (nasms) (709 gross square metres (gsm)), be approved in principle, to be funded by the Canadian Foundation for Innovation (CFI) funding, the Ontario Research Fund (ORF), Dean's Office, Faculty of Applied Science and Engineering Operating Funds and, Civil and Mineral Engineering Operating Funds.

DOCUMENTATION PROVIDED:

- *Galbraith Structural Testing Facility Interim Project Planning Report* dated January 21, 2022

Galbraith Structural Testing Facility

Project Planning Report

January 21, 2022

I. Executive Summary

The Structural Testing Laboratory in the Department of Civil & Mineral Engineering (CivMin) is among the top few testing facilities in North America and has received numerous awards for the quality of research performed. The main laboratory facility spans the basements of the Sandford Fleming and the Galbraith building and includes numerous ancillary facilities such as a concrete mixing laboratory, machine shop, welding bay and woodworking area.

CivMin is planning to revitalize the existing Structural Testing Facility as it is unable to model entire complex infrastructure under extreme loading conditions due to limited capabilities in numerical modelling and experimental testing. The proposed research project will overcome these limitations by establishing a mega-scale multi-dimensional experimental facility that will enable testing of larger-scale specimens in numerous configurations under multi-directional loading conditions. The facility will be integrated within the UT-SIM simulation framework, which is a new open platform for numerical and hybrid (experimental-numerical) simulations. The proposed research and technology development activities will improve the understanding of how our built environment will be affected in the event of a natural disaster. The acquired expertise will form the basis for the next generation of resilient structural systems, design codes and guidelines so that the safety of our infrastructure and the well-being of all Canadians can be ensured for generations to come.

The University of Toronto engaged DIALOG's service to conduct a Feasibility Study report which proposed designs and related construction work for the loading platform and adjacent areas. Three distinct project areas in the lab have been defined to assist in prioritizing design focus and to assist with cost containment. Project Area #1includes the installation of the new structurally isolated ultra-high-strength instrumented loading platform (a functional necessity for the lab to be realized). Project Area #2 includes the relocation of existing Hydraulic Power Units (HPUs) and Project Area #3 includes the expansion and consolidation of structural laboratory space to include corridor 19K and the existing machine shop. While Project Areas #2and #3 would help the lab function in a more efficient manner, Project Area #3, or Project Areas #2 and #3 could be excluded from project scope to help contain costs. After initial feasibility study, an alternative exploration of the scope of Project Area 1 was requested, resulting in the revised area scope referred to as project area 1B and 2B. Project Area 2 & 3 is removed due to cost restrains, which is now outside of the base scope and estimate. There is no anticipated change in COU category for this lab renovation. The existing lab facility has a total nasm of 667, and the proposed space nasm will remain the same at project completion. The structural Testing Facility supports the activities of approximately 12 faculty members and employs four full-time staff in the facility and machine shop. The new equipment will require the addition of one net new staff member.

Secondary effects for this project include management of noise and vibration during excavation activities and the potential disruption to offices and classes in the area.

Canadian Foundation for Innovation (CFI) funding for this project was announced November 18, 2020 with the caveat that construction must start within 18 months (May 18, 2022 target). The current start of construction for this project is estimated at March 2022. The other primary funding source is the Ontario Research Fund (ORF) , approved of as of September 3, 2021.

For clarity, there are two primary components for this experimental facility: the Adjustable Multi-Dimensional (AMD) Loading System; and the Ultra-High-Strength Instrumented Loading Platform. This project concerns the design and renovation of the existing lab and installation of the new loading platform. The design, fabrication, and installation of the AMD will be a future project and is not included in the scope of this project. However, from a funding perspective, both of these elements (loading platform, and AMD) are within the scope of the CFI / ORF funding.

Table of Contents

II. Project Background

a) Membership

Constantin Christopoulos	Professor, Civil & Mineral Engineering
Brent Sleep	Chair, Civil & Mineral Engineering
Loreto Caprara	Director, Technical Services, Civil & Mineral Engineering
Tom Saint-Ivany	Director, Facilities & Infrastructure Planning, FASE
Laragh Halldorson	Manager, Project Development
Gordon Robins	Director, Utilities and Building Operations
Mary Byrne	Director, Property Management
Linda Liu	Planning Associate, University Planning (UPDC)
David Sasaki	Managing Director, University Planning (UPDC)

b) Terms of Reference

1. Review and identify the scope of work for: the new loading platform, the new underground hydraulic pump room, and the expansion of existing structural laboratory space.
2. Identity implications that the new platform and its dynamic nature may pose to the existing structural systems of the Galbraith Building.
3. Identify and conduct required destructive testing to better understand the existing conditions of the Galbraith Building.
4. Consult with Facility & Services to understand existing building / site infrastructure conditions and review any proposed utilities upgrades / improvements required to operate the new testing facility. Review any logistical requirements and access requirements required for the movement (and future maintenance and replacement) of equipment. Discuss how this work may be influenced by campus-wide infrastructure improvements currently being planned or implemented.
5. Identify sustainability opportunities where reasonable and appropriate in support of campus-wide initiatives.
6. Identify and address any barriers to accessibility where reasonable and appropriate.
7. Identify all secondary effects related to the project including impacts to the delivery of academic programs and/or research activities in the building / space during construction. Identify staging strategies where appropriate.
8. Determine other projects either taking place in the Galbraith Building or in the immediate vicinity that may impact this work, or that this project may impact in return.
9. Better understand any disturbances that this work may cause to other activities occurring in adjacent spaces during the construction period.
10. Identify a phasing plan for the project, if required.
11. Demonstrate that the proposed space program will be consistent with the Council of Ontario Universities (COU) space standards and the University of Toronto space standards.
12. Address site considerations (site servicing), as well as campus-wide planning directives as set out in the campus Master Plan / Secondary Plan / Urban Design Guidelines that respond to the broader University context.
13. Review and identify code requirements / issues for the proposed facility.
14. Review any heritage impacts that may result from this work.

15. Identify any existing equipment and moveable furnishing to be relocated and reused, and new equipment and moveable furnishing necessary for the project and their related costs.
16. Identify any security features or data requirements required for the new facility.
17. Develop the "Total Project Costs" (TPC) estimate for this capital project, including costs associated with secondary effects and sequencing / phasing of construction.
18. Identify all sources of funding for this capital project.
19. Identify anticipated operating costs once the facility is operational.
20. Interim Project Planning Report to be prepared at the conclusion of feasibility study for approval for design fees (summer 2021 anticipated).
21. Final Project Planning Report to be prepared for final project approval, anticipated by end of 2021.

c) Background Information

The Structural Testing Laboratory

The Structural Testing Laboratory in the Department of Civil & Mineral Engineering is among the top few testing facilities in North America and has received numerous awards for the quality of research performed. The main laboratory facility spans the basements of the Sandford Fleming and the Galbraith building and includes numerous ancillary facilities such as a concrete mixing laboratory, machine shop, welding bay and woodworking area.

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The Department of Civil & Mineral Engineering

The University of Toronto's Department of Civil & Mineral Engineering traces its roots to the Ontario School of Practical Science, which was established in 1876. The Department offers a dynamic compendium of research and academic programs with a mandate that spans a wide range of applications

in professional practice. Departmental programming encompasses the built environment and its infrastructure, structural engineering, transportation engineering and planning, environmental engineering, mining and geomechanics. Our department seeks to uphold and strengthen its position as a preeminent leader in education and research, and to continue to develop sustainable solutions for the global community across the spectrum from mineral engineering to urban infrastructure. The Department hosts 900 students in undergraduate and graduate research/professional degree programs. Our facilities total 8,000+ square meters of combined research/teaching/computational labs, offices, classrooms, and common-use/support spaces.

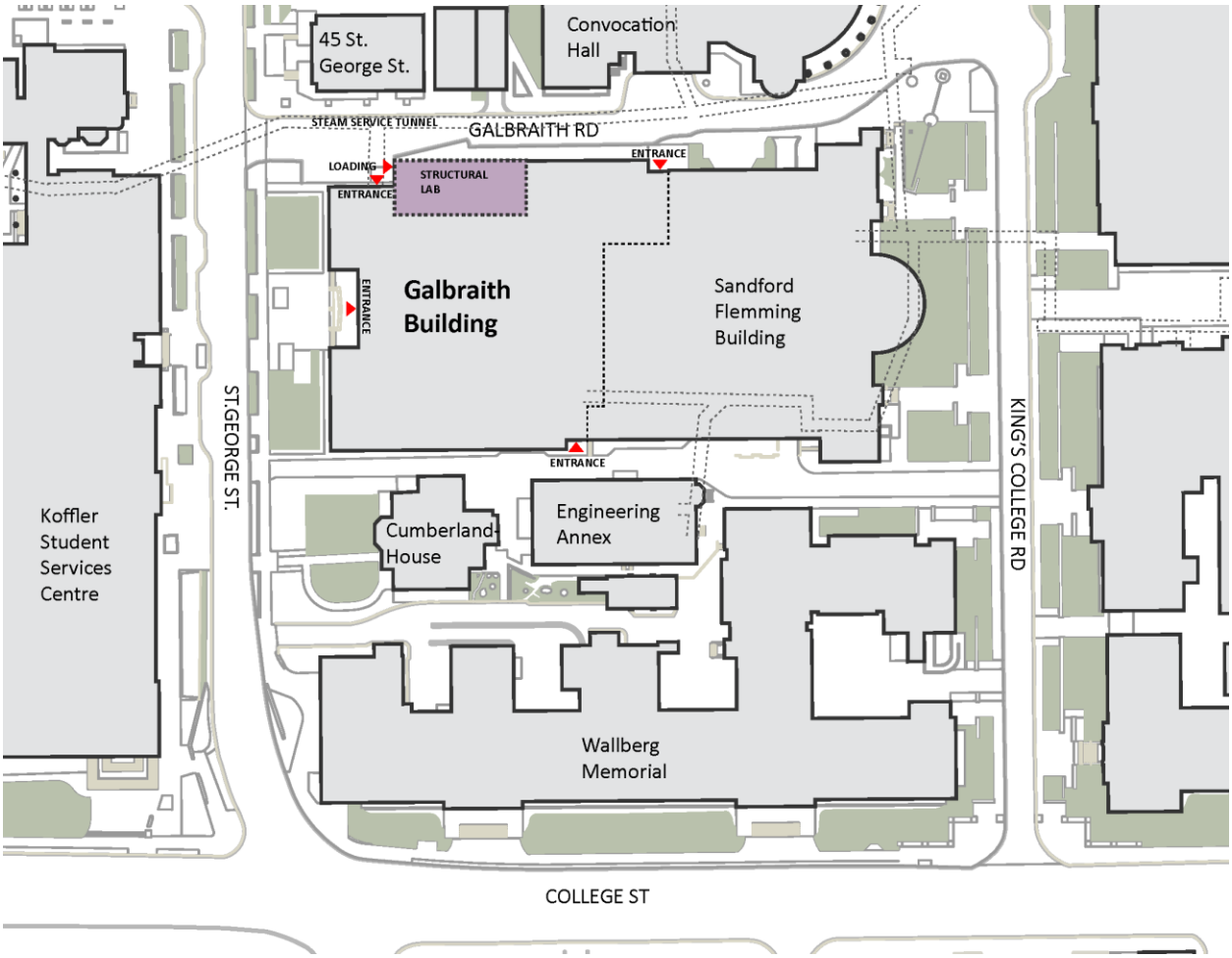
The Department of Civil & Mineral Engineering occupies four buildings at St. George campus and has a total footprint of approximately 8,118 nasm. CivMin is primarily housed in the Galbraith Building, followed by the Lassonde Mining Building, the Sandford Fleming Building, and the Haultain Building. As per the University space inventory, almost 45% of the Department of Civil & Mineral Engineering space types are dedicated to Research Lab space followed by Academic Department Offices and related space (39%). The table below provides a space break-down of these spaces by COU category.

Building Name	***Room Category***	***Subcategory***	***Subcategory Description***	***Area (nasms)***
Galbraith Building	1.0	**1.2**	Non-Tiered Classrooms	198.49
	3.0	**3.1**	Research Lab Space	1,951.93
		3.2	Research Lab Support Space	396.91
	4.0	**4.5**	Office Support Space	300.67
		4.4	Departmental Support Staff Office	250.90
		4.1	Academic Offices	527.94
		4.2	Research Office/Project Space	306.97
		4.3	Graduate Student Office	843.49
	11.0	**11.1**	Structured Formal Study Space	20.80
		11.2	Informal Study Space	29.06
	14.0	**14.1**	Student Office And Support Space	113.06
	2.0	**2.3**	Undergraduate Lab Support Space	60.26
		2.1	Scheduled Class Lab	311.89
			TOTAL nasm in Galbraith	**5,312.37**
Lassonde Mining Building	1.0	**1.2**	Non-Tiered Classrooms	68.24
	3.0	**3.1**	Research Lab Space	193.48
	4.0	**4.5**	Office Support Space	94.89
		4.4	Departmental Support Staff Office	15.57
		4.1	Academic Offices	111.69

		4.2	Research Office/Project Space	12.62
		4.3	Graduate Student Office	174.52
	14.0	**14.1**	Student Office And Support Space	39.38
		14.2	Recreational Facilities And Service	15.03
	2.0	**2.3**	Undergraduate Lab Support Space	29.09
		2.1	Scheduled Class Lab	383.09
			TOTAL nasm in Lassonde	**1,137.60**
Sandford Fleming Building	3.0	**3.1**	Research Lab Space	677.83
		3.2	Research Lab Support Space	394.82
	4.0	**4.5**	Office Support Space	169.61
		4.1	Academic Offices	97.27
		4.2	Research Office/Project Space	28.54
		4.3	Graduate Student Office	190.47
			TOTAL nasm in Sanford Fleming	**1,558.54**
Haultain Building	2.0	**2.1**	Scheduled Class Lab	**109.56**
Total				***8,118.07***

d) Existing Space

Existing Space: The Galbraith Building



The Galbraith Building is located at 35 St. George Street. The building was completed in 1960 with an interior connection to the Sandford Fleming Building constructed in 1982. The Faculty of Applied Science and Engineering is the main occupant of Galbraith Building. The majority of the spaces are classrooms and labs, as well as office space for the Department of Civil & Mineral Engineering and the Department of Electrical & Computer Engineering. See table below for a table that summarizes the major occupants in the building and their space footprint.

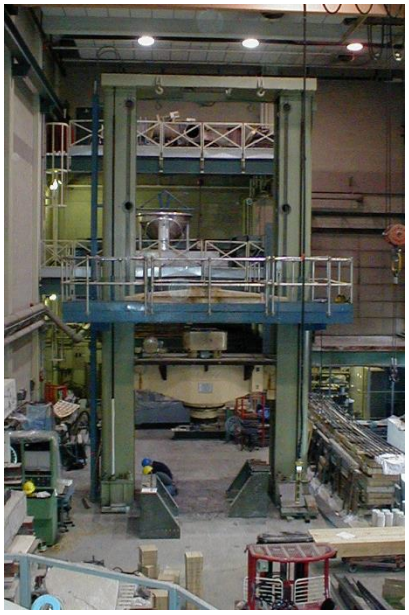
Department/ Occupant	area NASM	% of Total NASM
Central Admin - St. George - VP University Operations		
Learning Space Management Classroom Inventory	941.77	5.6%
Facilities and Services - St. George		
Building Services, Grounds & Trades	47.54	0.3%
Faculty of Applied Science and Engineering		
Civil & Mineral Engineering, Dept of	5,312.37	31.7%
Deans Off Applied Sci & Engineering	1,559.75	9.3%
Electrical & Computer Eng, Rogers Dept of	4,318.00	25.8%
Non-Assignable		
Non Assignable Space	4,566.74	27.3%
Total	**16,746.17**	**100.0%**

Existing Space: The Structural Testing Facility

The Structural Testing Facility is a collection of connected spaces on the north side of the Galbraith-Sanford Fleming building complex. The complex is centred on two large lab spaces in GB16 and SFB510 that have overall height clearance of three storeys from Basement to the top of the of the second storey. These spaces are connected via an integrated hallway GB25K. Both lab spaces have 10-ton cranes overhead bridge cranes and loading docks with garage door access at ground level from St George Street and Galbraith Rd.

EXISTING STRUCTURAL LAB (GB16 panorama – centre looking north)

The Project is centred around major modifications to infrastructure original to the building in GB16. GB16 has an existing strong floor for variable testing located in the north portion of the facility. A Baldwin 1.2 million pound hydraulic press and unique Shell Element Testing Equipment are currently located in the south portion of the facility. There is also an existing strong floor constructed around the Baldwin Testing Machine.

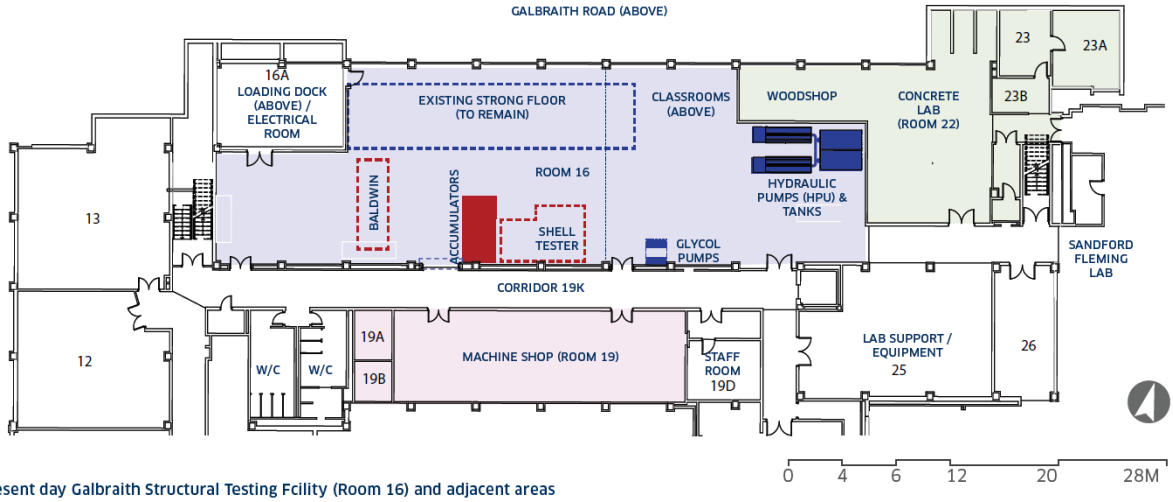


GB16 EXISTING EQUIPMENT (Left: Baldwin 1.2Mlbf hydraulic press; Right: Shell Element Tester)

A room inventory for the Galbraith side of the lab follows:

Room Number	COU Subcategory	Room Name	Area (nasm)
16	3.2	Mark Huggins Structures Laboratory	54.36
16	3.1	Mark Huggins Structures Laboratory	481.13
22	3.1	Wood Shop / Concrete Materials Lab	131.66
Structural Testing Facility Subtotal:			***667.15***
19	2.3	Machine Shop	32.15
19	3.2	Machine Shop	96.44
19B	3.2	Staff Change Room	7.26
19C	2.3	Tool Room	2.24
19C	3.2	Tool Room	6.71
19D	4.5	Lunch Room	25.11
23	3.2	Capping Room	16.23
23A	3.2	Moist Curing Room	24.91

23B	3.2	Equipment Room	9.78
24	3.2	Equipment Room	6.48
24A	3.2	Electrical Room (Non-Assignable)	2.87
25	2.1	Teaching Lab	114.14
26	3.2	Staff Office / Instrumentation Storage	35.74
Total			**1,046.31**



Present day Galbraith Structural Testing Fcility (Room 16) and adjacent areas

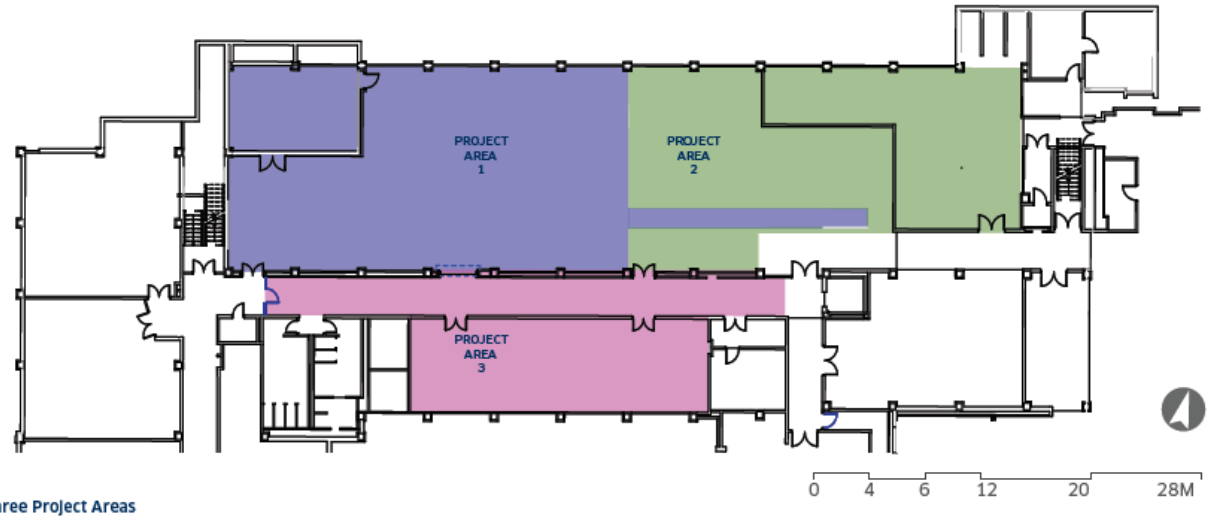
EXISTING FACILITY OVERVIEW

Existing Documentation

Available existing information (plans and space inventory) can be found in the appendix. CivMin is currently investigating documentation from previous projects implemented in the existing structural testing facility to assist the consultant team with an understanding of existing conditions. CivMin also has a full 3D Solidworks model of the testing facility.

Project Areas

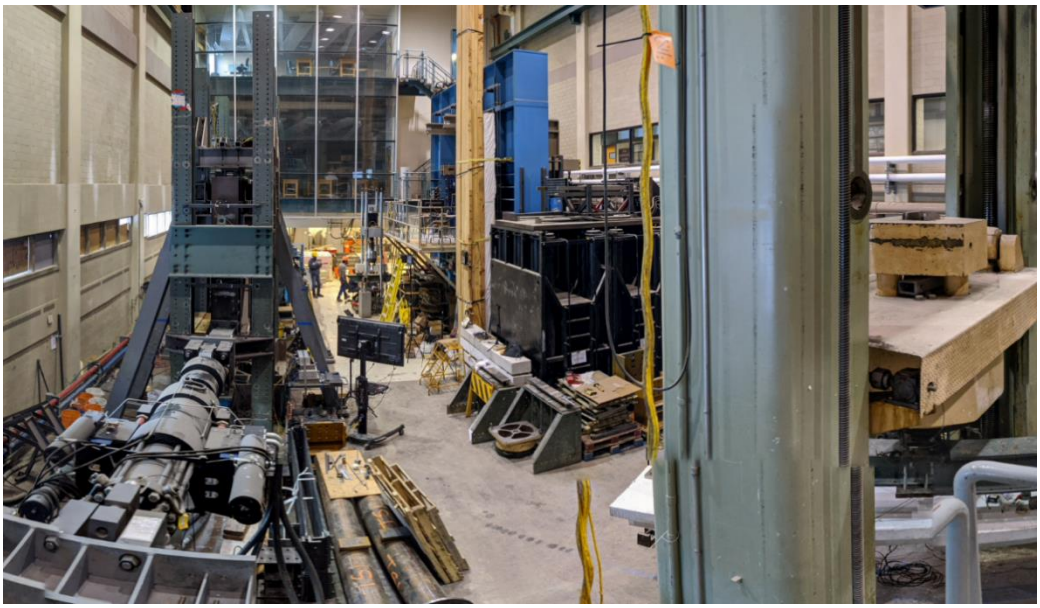
This section provides a summary of existing conditions in project areas that are described in detail in Section III c) of this report.



Three Project Areas

PROPOSED PROJECT AREA OVERVIEW (this project considers improvements to three project areas)

As was described in the previous section, the existing lab and its major components (existing strong floor, Baldwin Test Frame, and Shell Element Tester) are located in **Project Area #1B**. The boundary of project area one (approximately 535 nasm) was chosen because it encapsulates the extents of the new strong floor – the most critical component of the new lab. **Project Area #2B** (approximately 132 nasm) contains the existing Hydraulic Power Units (HPU) that were purchased in 2007. The HPU's service both the existing Galbraith Testing Facility and the adjacent Sandford Fleming Lab to the east. The departmental wood shop is currently housed in RM 22 located next to the HPUs. **Project Area #3** (approximately 129 nasm plus 114 m2 corridor) contains the Department Machine Shop (RM 19) which is currently located across the corridor in the south side of the Structural Testing Facility. The shop is outfitted with a variety of lathes, mills, drills, saws, and tooling. This shop supports testing programs in the Structural Testing facility, but is also used to support other research and teaching laboratories in the department. See below for photos of existing conditions.



EXISTING STRUCTURAL LAB (GB16 from loading dock looking east; Baldwin machine in foreground at right)

EXISTING STRUCTURAL LAB (GB16 from classrooms above)

EXISTING STRUCTURAL LAB (GB16 east panorama – inc. Hydraulic Pumps)

EXISTING MACHINE SHOP (GB19 looking east)

EXISTING HALLWAY 19K (looking west)

Occupant profile

The Structural Testing Facility houses over 10 million dollars of experimental equipment and supports the research activity of approximately 12 CivMin faculty members.

Typically, there are between 12 and 20 active projects in the facility. During peak summer research season, the facility may accommodate as many as 40 research-stream graduate students and work term students.

The Department employs 4 full time staff in the structural testing facilities and machine shop. Full time staff duties include operation of hydraulic machinery, instrumentation, and data acquisition equipment, lifting and material handling devices (cranes/forklifts), fabrication tools, and various tasks outside the scope of student experience/abilities. The planned procurement, construction, commissioning, and operation of the new equipment will require at least one net new FTE staff member.

III. Project Description

a) Vision Statement

The Department of Civil & Mineral Engineering (CivMin) is planning to revitalize their existing Structural Testing Facility. Current structural facilities are unable to model entire complex infrastructure under extreme loading conditions due to limited capabilities in numerical modelling and experimental testing. The proposed research project will overcome these limitations by establishing a mega-scale multi-dimensional experimental facility that will enable testing of larger-scale specimens in numerous configurations under multi-directional loading conditions. The facility will be integrated within the UT-SIM simulation framework, which is a new open platform for numerical and hybrid (experimental-numerical) simulations. The proposed research and technology development activities will improve the understanding of how our built environment will be affected in the event of a natural disaster. The acquired expertise will form the basis for the next generation of resilient structural systems, design codes and guidelines so that the safety of our infrastructure and the well-being of all Canadians can be ensured for generations to come.

b) Statement of Academic Plan

The planned infrastructure reinforces and supports divisional and departmental academic plan objectives. This unique infrastructure will provide opportunities to deliver transformative teaching and learning, ensure an outstanding student experience, and advance impactful research through creativity, multidisciplinary collaboration, and innovation.

One of the primary elements of The Faculty of Applied Science & Engineering's overall mission (as articulated in the 2017 – 2022 Academic Plan) is to lead in Transformative Teaching & Learning. The faculty will continue to strengthen highly regarded undergraduate and graduate programs and will strive to provide outstanding learning experiences. Its goal is to provide a wealth of opportunities that are multidisciplinary, collaborative and internationally focused.

The U of T Engineering research community is defined by its commitment to generate transformative knowledge, research excellence and global impact. Its strengths are leveraged to develop a compelling research vision with the mandate to enhance impact by leading research benefiting the Province of Ontario, Canada, and global society. An important role of the faculty is to educate and prepare the next generation of research leaders. The Department of Civil & Mineral Engineering's multi-disciplinary research themes attempt to bridge the gap from traditional Civil & Mineral engineering fields to ideas that are more representative of the issues that face our societies.

c) Overview of Project Scope

CivMin has prepared a concept design of the proposed facility that will serve as the basis for this project. Please refer to the Appendix for *Overview of Renovation Project for CFI/ORF Upgrade of Structural Testing Facilities*.

Early works to be completed by CivMin (not a part of this project):

- Initial preparation of the facility for construction by the Faculty of Applied Science and Engineering
- Shell element tester to be relocated over existing strong floor Equipment and materials to be relocated to the Structures Testing Facility Space in the Sandford Fleming Building to allow for construction activities to occur.
- Relocate the existing Accumulator Bank
- Decommissioning and extraction of the Baldwin Press frameCommissioning of existing hydraulic pumps and new piping immediately after relocation to resume SF STF operations.

Project Area 1B (Structural Test Lab RM 16) Scope:

-
- Expanded loading dock overhead door with provisions (structural, electrical) for future signage.
- Temporary shoring will be required along the south side of the electrical vault (along gridline 2, between grids D & F) as we will be undermining the south wall of the electrical vault
- Excavate the existing strong floors and other machine bases to accommodate the new strong floor.
- Allow for active dewatering and full monitoring of adjacent foundations during the excavation and foundation construction for any movement. Existing water table anticipated at 2m below the existing basement level.
- Cut down top of Baldwin foundation by 1524mm and replace with a crushed stone & sand cushion to avoid any rigid intermediate supports below the new strong floor.
- Fill the existing Baldwin Machine pit with lean mix concrete.
- Provide a new 100mm thick lean mix mud slab along base and all sloping bases.
- Construct new strong floor. The cross section of the new strong floor will be a smaller trapezoid on the west side, a rectangular shape above the existing Baldwin foundation, and a larger trapezoid on the east side.
- Provide reinforcing steel, cast-in anchorage and spreader beams within the new strong floor.
- Construct a new trench along the south side of the new strong floor and route hydraulics within this trench.

Project Area 2B(Hydraulic Pump Area & Wood Shop RM22) Scope:

- Relocation of the HPUs and surge tanks with in a acoustically mitigated enclosure to the north side of the expanded RM 16, and reroute power connection to the Sandford Fleming building
- Demolition of the four existing walls at the east side of the lab (to expose the woodwork shop RM 22)

The following 2B scope could be coordinated by Civ Min and not part of this project scope in the future to help control cost

- Construction of New Pump Room to house existing hydraulic pumps and surge tanks with appropriate mechanical and electrical services.
- New acoustic provisions for the existing glycol pumps.
- New heat/energy recovery ventilation unit for the new pump room
- Relocation of existing dust extractor and associated ductwork.

Project Area 3 (Expansion and Consolidation) Scope:

Project Area 3 will remain outside of the base project scope due to cost restrains. Post-Project Activities to be coordinated by CivMin (not a part of this project):

- Installation of high-pressure hydraulic lines

Installation of new AMD (materials and labour) once the construction of this project has concluded
Demolition and removal of existing second floor Mezzanine
A Note on Project Areas and Cost Containment

Three distinct project areas in the lab have been defined to assist in prioritizing design focus and to assist with cost containment. Project Area #1B includes the installation of the new structurally isolated ultra-high-strength instrumented loading platform (a functional necessity for the lab to be realized). Project Area #2B includes the relocation of existing Hydraulic Power Units (HPUs) and Project Area # 2 and #3 is excluded from the scope of this project due to cost restrains.

Special Equipment

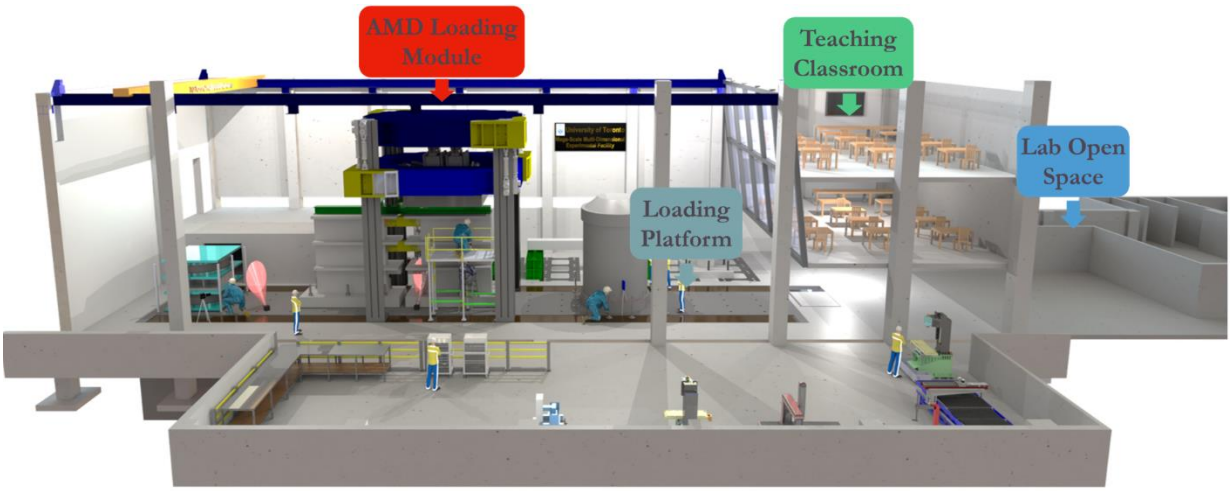
The proposed mega-scale multi-dimensional experimental facility will enable testing of larger-scale specimens in numerous configurations under multi-directional loading conditions. The facility will be integrated within the UT-SIM simulation framework, which is a new open platform for numerical and hybrid (experimental-numerical) simulations. Two key pieces of equipment for the proposed project are: (i) the Adjustable Multi-Dimensional (AMD) Loading System; and (ii) the Ultra-High-Strength Instrumented Loading Platform. Noting that the installation of the new loading platform is a part of this project, while the fabrication and installation of the AMD is a future project and not included in the scope of this project.

Adjustable Multi-Dimensional Loading System

The AMD Loading System is the central piece of the requested infrastructure, consisting of four 8m-high large steel braced columns and eight high-capacity actuators. Housed inside the steel columns will be steel posts on which two adjustable highly stiffened L-shaped actuator mounts, which can be moved independently in the vertical direction. The horizontal actuators will be installed on the L-shaped actuator mounts. For the vertical actuators, a highly stiffened movable reaction dome will be constructed, and the steel posts will be used to relocate the dome in the vertical direction. A hydraulic lifting and high-capacity locking mechanism will be used to rapidly move up and down and lock the L-shaped mounts as well as

the reaction dome to allow for versatile reconfiguration. The four steel posts will be used for lifting and supporting the weights of the L-shaped mounts and the reaction dome only. After locking occurs, the forces induced by the actuators will be transferred to the steel columns and ultimately transferred to the ground through an Ultra-High Strength Loading Platform. A 3m x 3m stiffened specimen mount will be used to connect the test specimens to the actuators. The members of the AMD modules have been sized based on detailed three-dimensional finite element analysis considering various worst-case loading scenarios.

A total of four horizontal and four vertical dynamic actuators (in the AMD module will be able to apply large loads to test specimens in all six degrees of freedom and will provide new levels of loading capacities when compared to the existing testing equipment around the world. The AMD module will allow full-scale specimens to be loaded under large multi-degree-of-freedom loads, with very large displacement capacities, combining versatility with adaptability. The AMD module will have 8 MN of static axial force and 3 MN of dynamic lateral force capacities in each perpendicular direction with a maximum displacement of ±400 mm laterally and ±250 mm vertically. By re-configuring the horizontal actuators vertically, the proposed system will be capable of applying 14 MN of direct axial load as well as 6 MN.m moments in each orthogonal direction simultaneously while maintaining an 8 MN axial load.



RENDERING OF NEW PLATFORM AND AMD LOADING MODULE

Ultra-High-Strength Instrumented Loading Platform

An ultra-high-strength loading platform measuring 30 m x 5 m x 4.5 m will be constructed to form the reaction basis for the large loads that will be applied to the test specimens. The platform is required to support the loads that test specimens are expected to undergo in the AMD modules. The platform will be made of ultra-high strength prestressed concrete. The AMD module and the specimens can be post-tensioned within this self-reacting loading platform. The platform will be hollow inside in order to allow access underneath it for post-tensioning purposes. The hollow portion will also be used for storage purposes. Only the top surface of the platform will be exposed; the remainder will be underground. Two

access points with helical steel stairs will be provided from the basement to this platform. Basic lighting will be installed, and air ventilation arrangements will be made so that up to three people can work underneath on three-hour shifts.

d) Space Requirements, Program and Functional Plan

Space Requirements / Space Program

From a COU perspective there is no change in use / category as the existing lab space will be revitalized. See table below that summarizes the COU categories for the space.

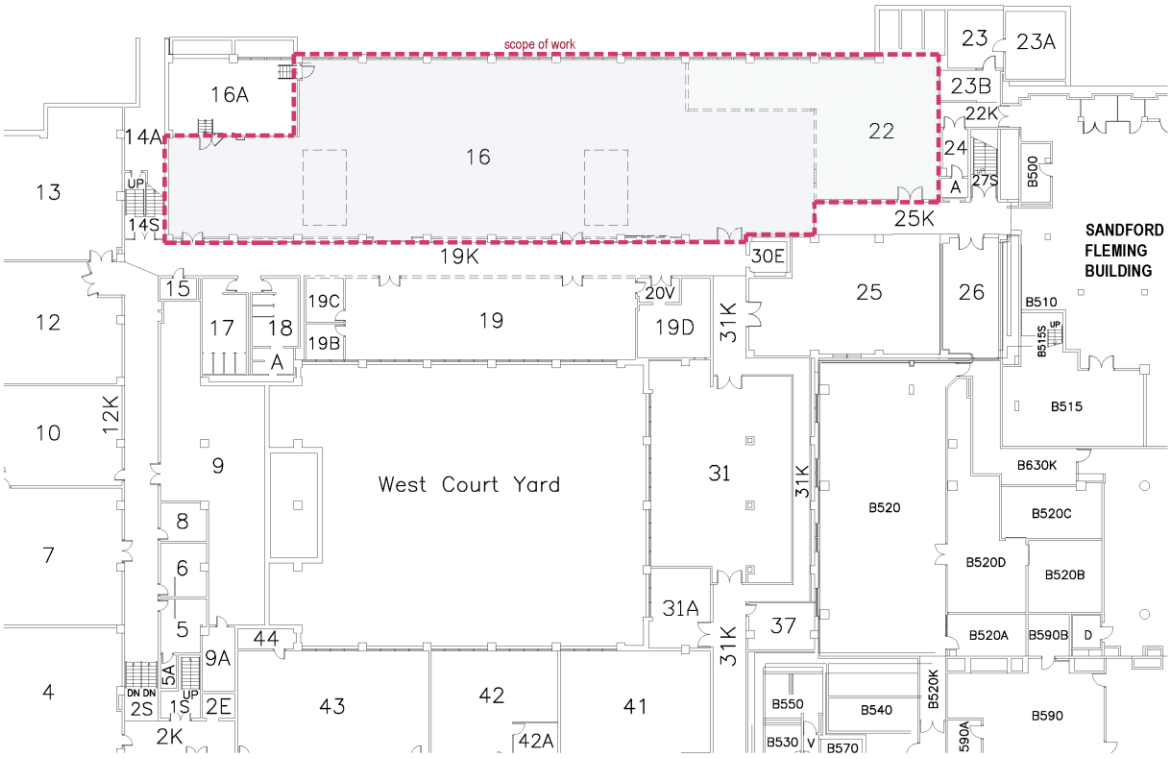
Proposed Space Program:

Room Code	Cou Subcategory	Room Name	Area (Nasm)
16	3.2	Mark Huggins Structures Lab	54.36
16	3.1	Mark Huggins Structures Lab	481.13
22	3.1	Wood Shop/Concrete Lab	131.66
Total			**667.15**

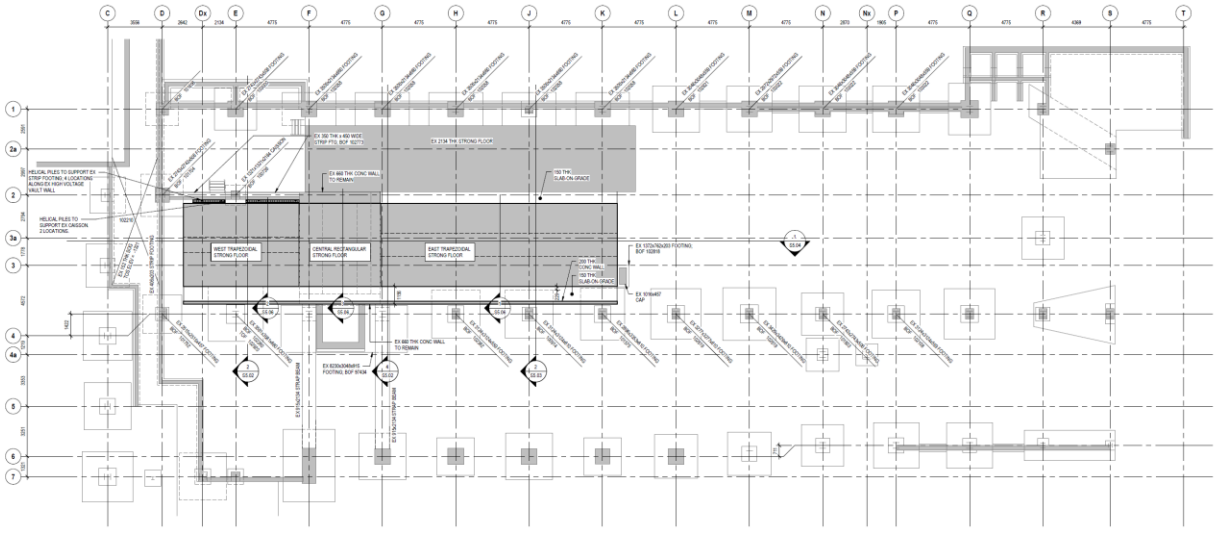
COU Comparison:

COU Category	Existing Nasm
3.0 Research Laboratory Space	**667.15**
3.1 Research Lab Space	612.79
3.2 Research Lab Support Space	54.36
Grand Total	**667.15**

Functional Plan



PLAN SHOWING SCOPE OF NEW LAB



PLAN SHOWING PROPOSED STRONG FLOOR

e) Building Considerations

Standards of construction

The project's design and construction are adhering to the University of Toronto's Facilities and Services and Capital Projects Design Standards to the greatest degree possible. Details can be found at:

https://www.fs.utoronto.ca/projects/design-standards-and-project-forms/

Sustainability design and energy conservation

The Sustainability Office confirmed that this project will be a minor renovation, and the project will meet the mandatory and prescriptive provisions of SB-10 Division 3 Chapter 2 "Additional Requirements to 2013 ANSI/ASHRAE/IES 90.1 for all improvements. Proposed design will meet U of T design standards, the proposed heat recovery makeup air handling systems will meet U of T's energy performance requirements. No upgrade of the existing mechanical systems is considered regarding energy performance.

Structural Considerations

The existing structural system of the Galbraith Building is comprised of precast and reinforced concrete slabs spanning between wide flange structural steel beams and girders for the four occupied floors and the roof. The beams and girders are supported on wide flange structural steel columns. The steel columns are typically founded on reinforced concrete piers and spread footings.

The primary structural concern for this project is the installation of the new strong floor which is anticipated to include demolition and shoring / underpinning of existing structural elements.

The revised structural scope for Project Area 1B consists of a single mass concrete strong floor element. The strong floor will measure 28.8 m long by 5.4 m wide and varies in thickness from 2 m to 4 m. The revised AMD strong floor will be composed of two trapezoidal segments and a rectangular segment in the centre. Helical piles remain for the existing grade beam along the electrical vault. The Baldwin Press removal, existing slab-on-grade removal, and existing strong floor foundation removal remain as part of project area 1B scope.

Elevators

There are no elevators proposed as a part of this project.

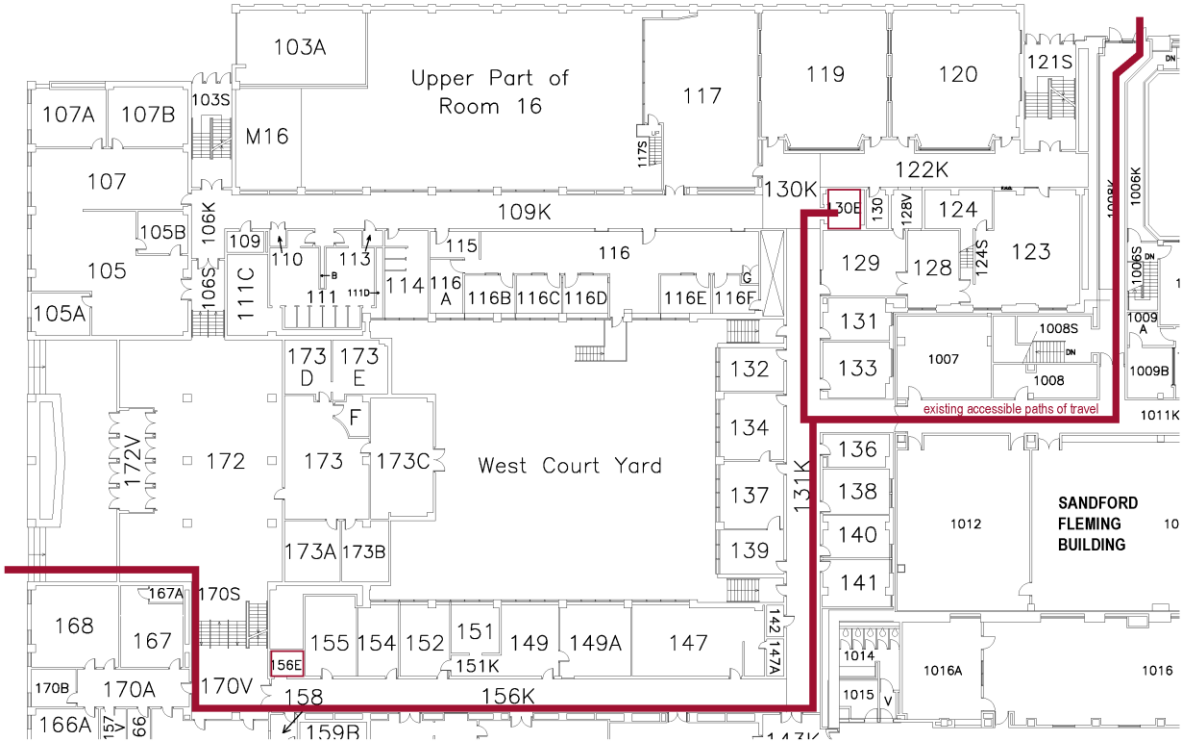
Accessibility

The Structural Testing Lab currently has two barrier-free paths of travel to gain access:

1. Through Sanford Fleming via Galbraith Raid; and,
2. From the Galbraith Building via St. the George Street entrance. The newly installed ramp into the building and a lift at an interior stair in the lobby makes this possible.

For additional information contact the University of Toronto's AODA Office.
http://aoda.hrandequity.utoronto.ca/

See below for plans that highlight the accessible paths of travel.



GALBRAITH GROUND FLOOR PLAN (showing accessible routes to the structural lab)

Signage, donor recognition

GB16 north wall, viewing gallery on 1st floor hallway. This is being defined through Advancement.

Signage is being considered for above the new loading dock door at a future time and is out of scope for this project.

Non-assignable space

No non-assignable spaces will be constructed as a part of this project. However, depending on extent of scope, there may be planned modifications to existing non-assignable spaces.

Mechanical

Many of the existing mechanical systems are original to the building and at the end of their service life, while alternations and additions to diverse mechanical systems took place in 2008 and 2018. The existing hydraulic system serving the existing strong floor was constructed in 2008.

Initial considerations raised by the feasibility study process:

- Both [temperature control] systems are suspended from the ceiling and are 4-pipe fan coil units with HWH and chilled water. Controls are pneumatic and located in room 16. A radiation system is located at the perimeter with HWH and pneumatic thermostats.
- Option for upgrading the existing fan coil units serving Lab 16, and Room 19 from pneumatic to DDC. Facilities & Services to discuss funding pending feasibility study.
- Long Term HVAC requirements pending DIALOG report regarding if existing HVAC meets code requirements for project area 1, 2, and 3.
- BAS compliance: Upgrades to controls of the building, DDC (Digital Direct Controls) to be on BAS system for sensory monitor.

The existing hydraulic distribution system will be extended by running new distribution piping in the new service trench along the south side of the new strong floor. New connection terminals will be installed at set intervals along the length of the new loading platform. The existing accumulator banks will be disassembled, placed in the new service trench and reconnected to the hydraulic system to suit the location of the new loading platform (see Figure 1 below) .The existing HVAC, plumbing and fire protection systems serving Room 16 will remain as is.

Electrical

The existing electrical service to the building need not be up-sized or revised for this renovation.

There exists a 4160 volt distribution from the Galbraith Roof Substation to a 600V distribution in the Structural Testing Facility.

Initial considerations raised by the feasibility process:

- While new equipment is being procured, it is hydraulically powered using existing electric pumps. The new loads in the space are minor compared to the legacy process equipment that is being maintained in the space. According to the draft feasibility study, it will be necessary to install a new electrical panel in GB16A to serve the new loads which include lighting, HVAC, and convenience receptacles.

- The project has included a provision for electrical panel monitoring.
- Modifications to legacy power distribution in the lab space is planned to be completed as new work. All modified distribution will be reworked to ensure that panels are not feeding equipment or spaces outside the lab.
- It is understood that Property Management/F&S is undertaking a building-wide LED retrofit program in the Galbraith building that will upgrade all existing light fixtures with higher-efficiency and possibly higher-output LED fixtures.
- Where lab equipment is being installed, there are provisions for emergency stop switches.

Please refer to Section 6 in the Feasibility Study for additional electrical considerations / details.

Data / Information Technology

Minor data network expansion may be included in scope of work to allow for project related connectivity.

Environmental Health and Safety

The Office of Environmental Health & Safety (EHS) at the University of Toronto facilitates and ensures that a safe environment is maintained for all on our campuses. The following is a list of initial considerations for this project:

- Management of hydraulic fluids / oils during the connect / disconnect of the Hydraulic Power Units (HPUs), noting that the hydraulic pumps need to be installed by Technical Standards and Safety Authority (TSSA) certified vendors
- A Pre-start Health and Safety Review is a best-practice, but may not be required for this facility
- Physical hazards – Standard Operating Procedures (SOPs) for lifting devices (cranes, forklift)
- Special considerations for venting or sewage traps for hazardous chemicals – the drainage pit located in room 22
- Safety design for receiving areas and loading docks

Building Code, Fire Protection, and Life Safety Systems

The current lab and adjacent spaces within the scope of this project are fully sprinklered, and the intent is that the existing fire alarm system will remain. Certain upgrades may be required to ensure the system complies to current regulations.

The commissioning of new equipment will involve specialized and documented procedures to be completed under the care of a professional engineer.

Designated Substances

The Hazardous Construction Materials Group and Environmental Health & Safety (EHS) at the University of Toronto are the primary groups consulted during a building construction project to investigate and identify (1) Designated Substances and (2) other site-specific hazardous materials present within the project area as per appropriate regulations and the Ontario Occupational Health and Safety Act (OHSA).

Asbestos-containing materials and fireproofing has been identified in the ceiling of corridor 19K. Consideration to be given to the approach of opening this space expanded lab space.

Destructive Testing, Inspections and Audits

Lessons learned from previous projects at the University promote early exploration via destructive testing where possible to help better understand existing conditions – especially for complex renovation projects in old buildings.

Perform destructive testing, early inspections, and audits where feasible.

Perform structural inspections and assess foundations to:

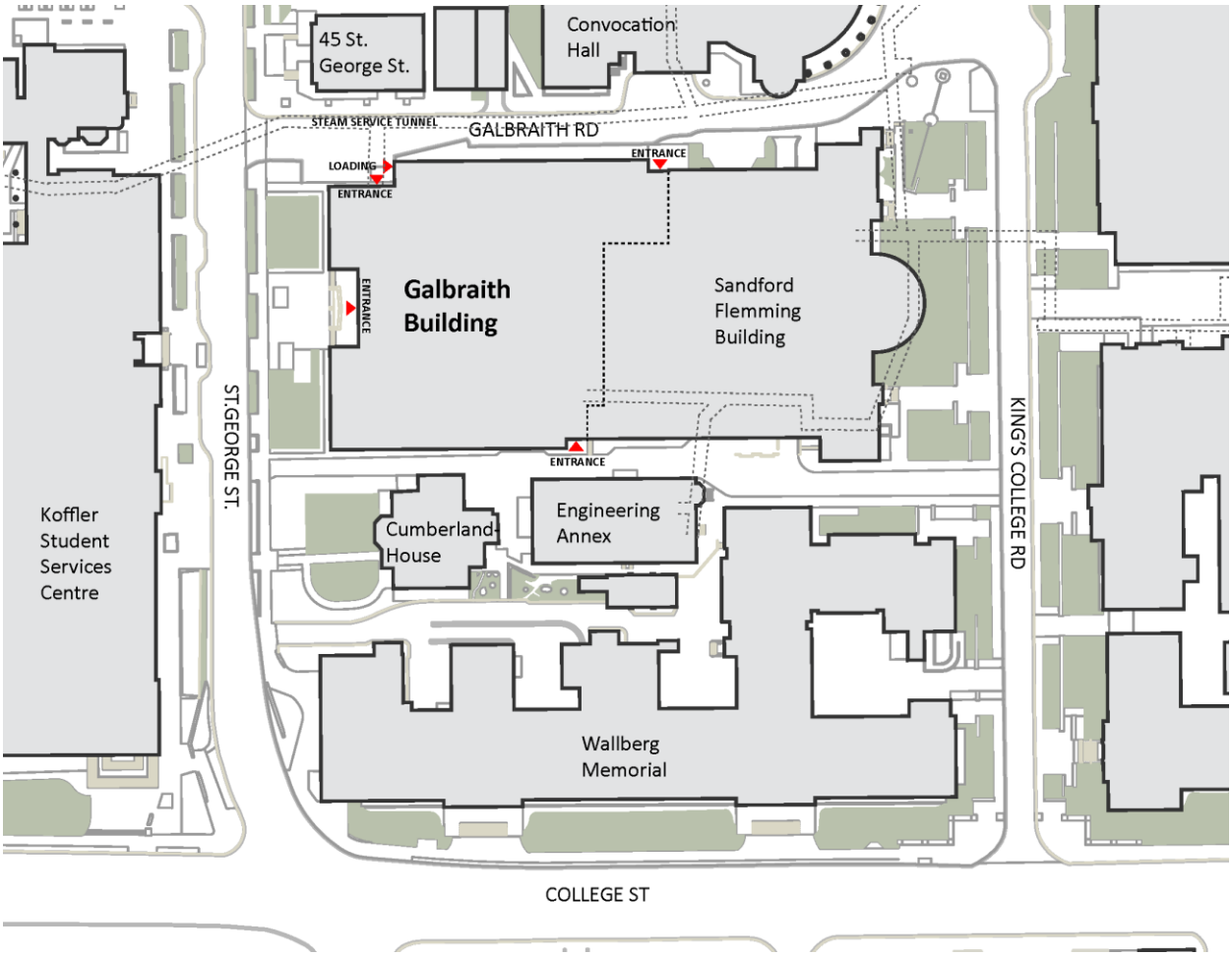
- identify load bearing structures;
- confirm depth and condition of existing foundations including mortar condition, composition / materiality of foundations, and surrounding materials (soil, garbage etc.)

Early consultation with Facilities & Services is advised to gather input on existing M&E systems.

f) Site Considerations

Site context

The Galbraith Building is located close to College and St. George a major gateway into the St. George Campus, and is attached to the Sanford Flemming Building to the east. It is bound by three roadways and is adjacent to the newly constructed Myhal Centre for Engineering Innovation & Entrepreneurship and Convocation Hall to the north.



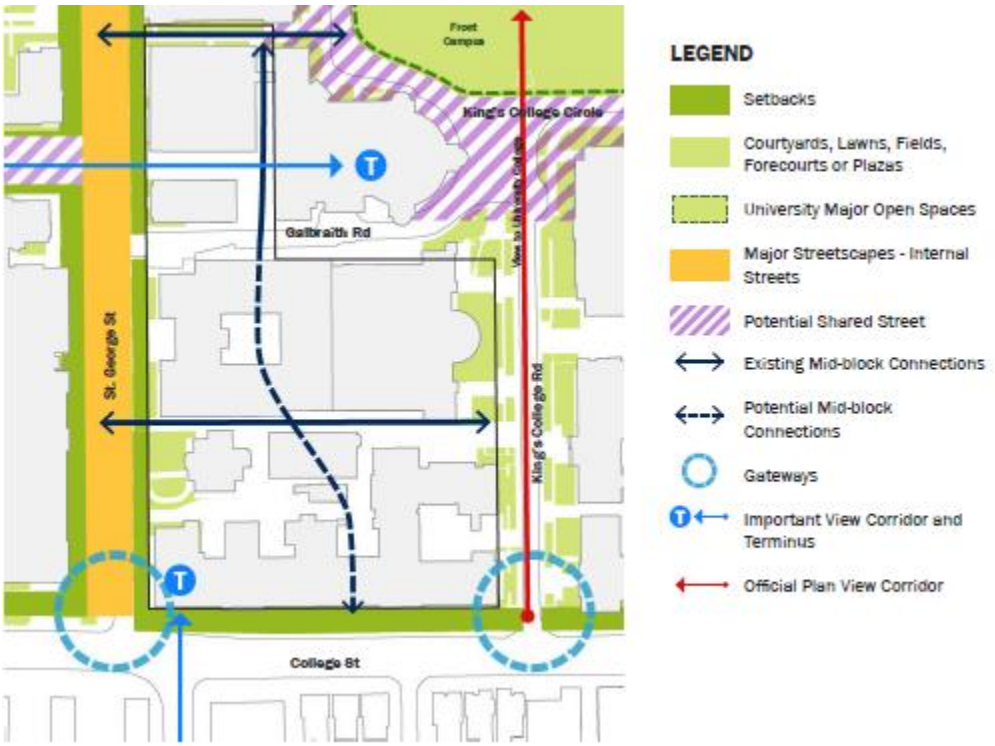
Master Plan

No impacts anticipated based on the 2011 St. George Master Plan.

Secondary Plan and Zoning regulations

No zoning or Secondary Plan impacts anticipated for this project.

As per the 2018 draft Secondary Plan and Urban Design Guidelines (under review by the City) the Galbraith Building is located on Block B in the southeast quadrant of campus. The diagram below highlights potential considerations for the block, and notes that the streetscape treatment of Kings' College Road should be extended to Galbraith Road to help emphasize pedestrian movement and sfaety while continuing to facilitate vehicular movement. Improvements such as these are not being considered as a part of this project.



Municipal Approvals

Anticipated approvals include a building permit application. No zoning variances anticipated at this time.

Environmental Issues, Regional Conservation, Ministry of the Environment

The scope of this project includes increased depth for the new strong floor and consideration for sump pumps to discharge ground water. Ground water extraction will require MOECC and City of Toronto approval.

Landscape and open space requirements

No landscape or open space improvements to be made as a part of this project.

Site access

The Galbraith Building can be accessed via Galbraith Road to the north, St. George Street to the west, and a narrow lane to the south. These roadways provide vehicular and pedestrian access to the four ground level entrances to the building as well as provide access for servicing and loading.

The facility is currently accessed by staff and students through a wired salto lock installation on a number of doors.

Site servicing

The loading dock for the Structural Testing Facility is accessed from Galbraith Road and is located at the west end of the lab. New loading door will be constructed to allow for a clear opening of at least 4.5m high to allow for the receipt for slightly oversized loads. Due to the proximity to the existing stair, this door will be fire-rated in order to meeting current building code requirements.

Heritage status

The Galbraith Building is not currently listed in the City of Toronto's Heritage Register. However, it is advised that the Galbraith Building will be listed in the future. As a result, a heritage consultant will be hired to the project team to lead early discussion with City Heritage.

Current design includes alterations on the north façade of the Galbraith building along Galbraith Road, with increasing the loading door opening as well as mechanical penetrations.

Soil conditions

Soil conditions under the proposed strong floor location of the structural testing lab to be verified during the feasibility study and design phase.

The hydrogeological studies for the Myhal Centre to the north of Galbraith have indicated a high-water table and contaminated with manganese. A discharge agreement will be required.

Geotechnical and hydrogeological investigations have been procured for this project and are underway.

Removal of existing site elements

No removal of this kind is anticipated for this project.

g) Campus Infrastructure Considerations

Utilities (electrical capacity, water, gas, steam lines)

No impacts from a campus utilities perspective are anticipated. Assumed that all existing utilities are adequate for new lab.

Noting that a steam service tunnel exists below Galbraith Road adjacent to the Galbraith Building in the event that excavation / construction activities need to occur exterior to the building.

Sewer and storm water management

No impacts anticipated.

Information Technology

No additional data infrastructure anticipated.

Vehicle Parking

No impacts to vehicle parking anticipated.

Bicycle parking

No impacts to bicycle parking anticipated.

h) Potential Impacts from Other Projects

There are currently no impacts anticipated at this time.

i) Secondary Effects

- Due to the scale of the excavation, vibration and noise during construction will have effect throughout the building which houses offices and classrooms. Recommend that excavation be limited to the summer period if possible or after hours.

- Structural Testing Facility in Galbraith Building will be closed during the entire period of construction, with testing and lab functions to be relocated to Sandford Fleming to allow testing to continue (during the construction period). The cost of this effect will be covered by CivMin and is outside of the scope of this project.
- Equipment and lab materials will be relocated to Sanford Fleming, with potential needs for offsite storage. The cost of this effect will be covered by CivMin and is outside of the scope of this project.

j) Schedule

Project Milestone	**Anticipated Date**
Submit to CaPS Exec (Cycle 3): TOR, Scope / TPC for feasibility	November 10, 2020
CaPS Exec Approval for TOR and Feasibility Study	November 24, 2020
CFI Funding news (*18 month time limit begins)	November 18, 2020
RFP for Feasibility Study	January 2021
Provincial Funding Announcement	September 2021
Feasibility Study Complete	August 2021
Feasibility Study Review Period	August/September 2021
CaPS Exec approval for full consulting fees	Oct 1, 2021
Schematic Design and Design Development Phases	October to November 2021
CaPS Exec for full project approval (Cycle 4)	January to March 2022
Conclude Construction Documents / Permit	March 2022
Project Tender	April 2022
Construction Start	May 2022

*The CFI funding opportunity requires that the project must start construction within 18 months of being notified. May 22, 2022 is the deadline to begin construction.

IV. Resource Implications

a) Total Project Cost Estimate

The total estimated cost for the project includes estimates or allowances for:

- construction costs (assuming a lump sum type of tender to qualified general contractors)
- contingencies
- taxes
- hazardous waste removal
    - decommission of hazardous substances
    - disposal costs for hazardous materials
    - release of area (hazardous materials) for unrestricted re-use
- secondary effects
- select demolition
- permits and insurance
- professional fees: architect, engineering consultants, project management.
- data terminations
- moving and staging, decommission of labs being vacated
- furniture and equipment
- miscellaneous costs [signage, other]
- commissioning
- testing and inspection
- donor recognition
- escalation
- financing costs during design & construction
- Note: this TPC does not include the construction (materials and labour) of the new AMD

b) Operating Costs

No impacts to operating costs anticipated.

c) Other Related Costs

No other costs identified at this time.

d) Funding Sources

This project will be funded by the following sources:

1. 40% Canada Foundation for Innovation (CFI)
2. 40% Ontario Research Fund (ORF)

3. 10% Dean's Office, Faculty of Applied Science and Engineering
4. 10% Civil and Mineral Engineering

V.APPENDICES:

1. Existing Floor Plans
2. Existing Space Inventory
3. *Overview of Renovation Project for CFI/ORF Upgrade of Structural Testing Facilities* dated November 2, 2020 and prepared by the Department of Civil & Mineral Engineering
4. Feasibility Report prepared by DIALOG dated August 24, 2021
5. Total Project Cost Estimate (on request to limited distribution)