UNIVERSITY OF TORONTO

OFFICE OF THE GOVERNING COUNCIL

**FOR RECOMMENDATION** **PUBLIC** **OPEN SESSION**

**TO:** Planning & Budget Committee

**SPONSOR:** Professor Scott Mabury, Vice President, University Operations
**CONTACT INFO:** 416-978-2031, scott.mabury@utoronto.ca

**PRESENTER:** Christine Burke, Director, Campus and Facilities Planning
**CONTACT INFO:** 416-978-4333, christine.e.burke@utoronto.ca

**DATE:** April 14, 2016 for May 11, 2016

**AGENDA ITEM:** 4

**ITEM IDENTIFICATION:**

Capital Project: Report of the Project Planning Committee for the McLennan Physical Laboratories Renovation – Undergraduate Labs Year 1

**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)."

Under the Policy on Capital Planning and Capital Projects, "…capital projects over $3 million and up to $10 million will be considered by the Planning and Budget Committee for projects at the St. George campus and by the respective Campus Affairs Committees and Campus Councils for projects at University of Toronto Mississauga and University of Toronto Scarborough and recommended to the Academic Board for consideration. It is expected that such projects will be placed on the Board's consent agenda and be confirmed by the Executive Committee of the Governing Council. Execution of such projects is approved by the Business Board."

**GOVERNANCE PATH:**

**A. Project Planning Report – Project Scope, Total Project Cost, and Sources of Funding**

1. **Planning and Budget [for recommendation] (May 11, 2016)**
2. Academic Board [for approval] (May 30, 2016)
3. Executive Committee [for confirmation] (June 14, 2016)

**B. Execution of the Project**

1. Business Board [for approval] (June 16, 2016)

**PREVIOUS ACTION TAKEN:**

The original discussion document for this project was created in August 28, 2013. It was then followed up with an updated document on January 29, 2014. The new document was a response to the request from the Faculty of Arts and Science for a more complete outline of renewal proposals for the U of T Undergraduate Experimental Physics program and the corresponding renovations of the labs located in the north wing of McLennan Physics (MP). In October 2014, a planning group was formed to generate a Project Planning Summary for the renovations of the Undergraduate area, first floor teaching labs. The report was provided to Project Development, University Planning, Design and Construction in April 2015 for the purpose of establishing a cost estimate. This cost estimate served to inform the group that the scale of the project necessitated a Level 2 governance approval.

The terms of reference for the project was approved by the CaPS Executive at the May 25, 2015 meeting.

In-between CaPS meeting approval for expenditure of consultant fees for the amount of $435,000 was approved on March 9, 2016.

**HIGHLIGHTS:**

The aim of the Physics Department is to create Canada’s best undergraduate Practical Physics program and ultimately recruit new generations of top physics students to the University of Toronto. This project addresses first year physics Practicals for the Physical Science stream, Physics Department and first year labs for Engineering. It also speaks to the challenges associated with the Practicals methodology concerning work space, storage, and equipment. The labs will serve the combined constituencies of:

- Physics students from FAS (65-75% usage)
- Engineering students from FASE (20-30% usage)
- Other students, outside groups and outreach (5-10% usage)

“Other" students include those in the distribution requirements and outreach activities, not physical science stream students. "Other" students also include those from high school outreach, camps, and potential others from enhanced activities particularly outside of the fall winter term. For example the Physics department would run a Science Camp, Math Camp, and other high school outreach activities in the new rooms on the first floor. The lab renewal would immediately improve the educational experience of both the first year Physics and Engineering students.

At the May 25, 2015 CaPS Executive Committee meeting, the expenditure of consultant fees to advance the design of the project was approved. Consultant selection will proceed prior to Executive Committee Confirmation in order to align with a September 2017 occupancy date.

Vision Statement and Academic Plan

The resulting Physics Practicals consist of weekly two-hour sessions promoting small-team, hands-on, guided discovery in Physics. The Practicals have replaced the bi-weekly lab plus weekly tutorial sessions previously used in these courses. The Practicals are delivered in three Practical Rooms; 125A, 125B & 125C. The plan for room 126 is to be used by PHY180 in the fall (Engineering) and by PHY205 "The Physics of Everyday Life" in the winter. PHY205 is a distribution requirement course for all students across the Faculty of Arts and Science that is very popular and oversubscribed. Currently the Practicals for this course run on the second floor of the Undergraduate wing scattered through many rooms. The new space on the first floor would allow the increase of the current enrolment cap of 200 and consolidate all activities into this space. Currently the department turns away about 100 students because of the restriction on the Practicals size.

This project will complete a renewal of the undergraduate labs located on the 1st and 2nd floors of the north wing of McLennan Physical Laboratories. Several areas have been identified for pedagogical and infrastructure renewal in the first year space. These include:

1. Space and equipment reflecting modern pedagogy
2. Improved integration of experimental, numerical and theoretical curriculum
3. A restructured Practicals experience that balances small team, collaborative, guided discovery with in-depth, independent experimental exploration.

Space Program and Scope of Work

The proposed project will result in 713 nasm of renovated space. The space program for the proposed renovation area consists of:

- An enhanced and enlarged teaching lab 126B
- A new enclosed teaching lab 126
- An improved and enlarged teaching lab 222
- Several drop-in study/work areas 225
- A more effective lab technician support and storage space 127
- A vestibule area outside classrooms 134 and 137 to segregate the traffic flow from the adjacent teaching labs and create a useful space for students to gather and have arranged electrical/data access at a built-in countertop 126K
- Short-term, standing only, work counters in common corridor 102K and 107K

| Room # | Room Type | NASM | Appendix # | Room Data Sheet |
|---|---|---|---|---|
| 125 | Drop-In Work/Study Area | 88 | 3c | RDS2 |
| 126 | Teaching Lab | 146 | 3c | RDS4 |
| 126B | Teaching Lab | 166 | 3d | RDS3 |
| 127 | Technician Workroom/Storage Room | 112 | 3e | RDS5 |
| 222 | Teaching Lab | 201 | 3f | RDS6 |
| 120K | Corridor/Open Work Space | N/A | 3c | RDS1 |
| 126K | Corridor/Open Work Space | N/A | 3c | RDS1 |
| 127K | Corridor/Open Work Space | N/A | 3d | RDS1 |
| | **TOTAL NASM** | **713** | | |

**Secondary Effects**

The renovations outlined in this project are proposed to occur from late December 2016 through to the end of August 2017. It is expected that classes can proceed as usual assuming some scheduling accommodations are made. Access to rooms 125 A, B and C must be maintained during scheduled classes throughout construction. Swing space for the lab technicians during the renovations will be required. After discussions with ACE rooms 101, 201 and 229 are preferred. . The following project parameters have been identified, and will require consideration:

- Rooms 134, 137, 102, 103, 202, 203:
  - Wait for the Fall 2016 exam period to finish before any demolition related to the project can start
  - ACE would need full use of the rooms until the end of the Winter 2016 term
- Rooms 135, 137:
  - Rooms are not needed during the Spring 2017 term
- Rooms 102 and 202:
  - The two associated classrooms, rooms 102 and 202 respectively, cannot schedule classes for students that require entry at the front of the room. This holds true during the construction period only. ACE will schedule classes accordingly.

The Department of Physics currently operates a drop-in centre in room 125 that provides academic assistance to physics students. This will have to be relocated during the renovations, created by partitioning MP200. This must be completed before the start of classes in January 2017, and can be constructed when there are no classes, either in late December or late August 2016.

**Schedule**

The proposed schedule is as follows:

| | |
|---|---|
| CaPS Exec Approval | 29 February, 2016 |
| Consultant Selection | May 2016 |
| Executive Committee Confirmation | 14 June, 2016 |
| Tender | mid-October 2016 |
| Award | late November 2016 |
| Site Vacancy/Clean-up | December 2016 |
| Construction Start | January 2017 |
| Substantial Completion | August 2017 |
| Occupancy | September 2017 |

Disruptions to the existing occupants are to be expected during the course of construction; however, every effort must be made by the general contractor team to minimize such disruptions through construction scheduling and carefully considered access and implementation strategies.

The schedule assumes all municipal approvals may be achieved within the timelines.

**FINANCIAL IMPLICATIONS:**

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

**RECOMMENDATIONS:**

Be It Recommended to the Academic Board:

1. THAT the Report of the Project Planning Committee for the University of Toronto McLennan Physical Laboratories Renovation – Undergraduate Labs Year 1, dated April 7, 2016, be approved in principle, and,

2. THAT the project scope of the McLennan Physics Laboratories Renovation – Undergraduate Labs Year 1 totalling 713 net assignable square metres (nasm) be approved in principle, to be funded by operating funds from the following: Faculty of Arts & Science Operating Funds, Department of Physics Operating Funds, and Faculty of Applied Science & Engineering Operating Funds.

**DOCUMENTATION PROVIDED:**

- Report of the Project Planning Committee for the University of Toronto McLennan Physical Laboratoies Renovation – Undergraduate Labs Year 1, dated April 7, 2016.

# Report of the Project Planning Committee
## for the
# University of Toronto
# McLennan Physical Laboratories Renovation - Undergraduate Labs Year 1

April 7, 2016

University of Toronto
Infrastructure Planning, Faculty of Arts & Science
Campus & Facilities Planning

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## Executive Summary

The aim of the Physics Department is to create Canada's best undergraduate Practical Physics program and ultimately recruit new generations of top physics students to the University of Toronto. This project addresses first year physics practicals for the Physical Science stream, Physics Department and first year labs for Engineering. It also speaks to the challenges associated with the practicals methodology concerning work space, storage, and equipment. The labs will serve the combined constituencies of:

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"Other" students include those in the distribution requirements and outreach activities, not physical science stream students. "Other" students also include those from high school outreach, camps, and potential others from enhanced activities particularly outside of the fall winter term. For example the Physics department would run a Science Camp, Math Camp, and other high school outreach activities in the new rooms on the first floor. The lab renewal would immediately improve the educational experience of both the first year Physics and Engineering students.

This project will complete a renewal of the undergraduate labs located on the 1st and 2$^{nd}$ floors of the north wing of McLennan Physical Laboratories, affecting approximately 700 nasm of space. Several areas have been identified for pedagogical and infrastructure renewal in the first year space. These include:

1. Space and equipment reflecting modern pedagogy
2. Improved integration of experimental, numerical and theoretical curriculum
3. A restructured Practicals experience that balances small team, collaborative, guided discovery with in-depth, independent experimental exploration.

The terms of reference for the project was approved by the CaPS Executive at the May 25, 2015 meeting. In-between CaPS meeting approval for expenditure of consultant fees for the amount of $435,000 was approved on March 9, 2016.

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# I. Project Background

## a) Membership

Stephen Julian, Chair, Department of Physics
Sabine Stanley, Associate Chair, Undergraduate, Department of Physics
Jason Harlow, Senior Lecturer, Department of Physics
Peter Hurley, CAO, Department of Physics
Alex Cabaj, undergraduate student, President of PASU, Department of Physics
Jason Foster, Senior Lecturer, Faculty of Applied Science & Engineering (FASE)
Jay Pratt, (Committee Chair), Professor, Vice-Dean Research and Infrastructure, Faculty of Arts and Science (FAS)
Kim McLean, Chief Administrative Officer, FAS
Lucy Chung, Director of Infrastructure Planning, FAS
Dan Derkach, IIT, FAS
George Phelps, Director, Project Development, University Planning, Design & Construction (UPDC)
Christine Burke, Director, Campus and Facilities Planning, UPDC
Patricia Piwowar, Planner, Campus and Facilities Planning (Secretary), UPDC
Gordon Robins, Director of Utilities and Building Operations, Facilities and Services (F&S)

## b) Terms of Reference

1. Make recommendations for a detailed space program and functional layout to accommodate the needs of students in the core courses planned to take place in the space, including accounting for Arts and Science physics student enrolment trends and needs of technologists serving the courses.
2. Demonstrate that the proposed space program is consistent with the Council of Ontario Universities (COU) space standards and University of Toronto space standards.
3. Identify all secondary effects, including staging of existing site occupants and impact on the delivery of academic programs during construction.
4. Identify all equipment and moveable furnishings necessary to the project and their estimated costs.
5. Identify all data, networking and communications requirements and their related costs.
6. Identify all security, occupational health and safety and accessibility requirements and their related costs.
7. Determine a total project cost estimate [TPC] for the capital cost including a projected increase to the annual operating cost.
8. Identify all sources of funding for the capital project and any increased operating costs once the project is complete.
9. Report by December 2015.

## c) Background Information

The project builds on the pioneering and highly successful 2007-2009 renewal of the first year Introductory Physics courses and labs for students in the Life Science stream.

The renewal for students in the Life Science stream focused on:

1) Thorough pedagogical integration of the theoretical and experimental curriculum in the courses
2) Strategically chosen experimental activities (Practicals) keyed on pedagogical goals
3) Modernization of equipment and lab space to reflect best pedagogical practice
4) Introduction of computers into the curriculum for data acquisition, experimental analysis, and modeling of physical systems

The resulting Physics Practicals consist of weekly two-hour sessions promoting small-team, hands-on, guided discovery in Physics. The Practicals have replaced the bi-weekly lab plus weekly tutorial sessions previously used in these courses. The Practicals are delivered in three Practical Rooms; 125A, 125B & 125C, see FIGURE 1 & 2. The construction and equipment were funded by the Student Experience Fund and other sources at a cost of approximately $1.7M over 2007-2009.

The plan for room 126 is to be used by PHY180 in the fall (Engineering) and by PHY205 "The Physics of Everyday Life" in the winter. PHY205 is a distribution requirement course for all students across the Faculty of Arts and Science that is very popular and oversubscribed. Currently the Practicals for this course run on the second floor of the Undergraduate wing scattered through many rooms. The new space on the first floor would allow the increase of the current enrolment cap of 200 and consolidate all activities into this space. Currently the department turns away about 100 students because of the restriction on the Practicals size. Accommodating the PHY205 students will not require a change to the layout for this central room (126).

According to measured learning outcomes, student surveys, and professional accolades, the Physics Practicals are a huge success, see FIGURE 3. Increasingly, the Practical Rooms are sought after by other courses and outside groups as well. Largely this renewal has mainly served the Life Science stream students who were in the most critical need at the time. Based on the success with the Life Science Stream, the project proposal is to make a commensurate investment in Physical Science stream students, including students in Physics Specialists and Majors, joint Specialist programs, and Applied Science and Engineering.

The original discussion document for this project was created in August 28, 2013. It was then followed up with an updated document on January 29, 2014. This version was prepared by Stephen Julian (Chair of Physics), Paul Kushner (Associate Chair for Undergraduate Studies) and the Working Group on Undergraduate Laboratory Renewal (WGUL), Department of Physics. The new document was a response to the request from the Faculty of Arts and Science for a more complete outline of renewal proposals for the U of T Undergraduate Experimental Physics program and the corresponding renovations of the labs located in the north wing of McLennan Physics (MP). WGUL met several times between the Fall of 2013 and early 2014.

In October 2014, a planning group was formed to generate a Project Planning Summary for the renovations of the Undergraduate area, first floor teaching labs. This group included Stephen Julian (Chair of Physics), Paul Kushner (Associate Chair for Undergraduate Studies), Peter Hurley (CAO, Physics), and Jen McDonald (A&S Infrastructure Planning). The report was provided to Project Development in April 2015 for the purpose of establishing a cost estimate. This cost estimate served to inform the group that the scale of the project necessitated a Level 2 governance approval.

The terms of reference for the project were approved by the CaPS Executive Committee at the May 25, 2015 meeting.

In the fall of 2015, Sabine Stanley took over the role of Chair for Undergraduate Studies from Paul Kushner and a meeting was held to review the project status with her and the WGUL.

The first PPR Committee meeting took place on November 10, 2015. A second was scheduled for mid-December but later deemed unnecessary since the report was largely completed.

The student member as well as the member from the Faculty of Applied Science & Engineering was unable to attend the committee meetings but the Chair & CAO from the Department from Physics met with them separately in early December 2015 to consult on progress to date. They reviewed the planning document, and discussed in detail how Engineering Science would be affected and how the experience of FAS Physics undergrads would be improved.

The FASE representative suggested that a reconfigurable room be considered as well as the possibility of integrating PHY180 with other first-year Engineering Science courses. The preferred model for these labs would facilitate a group working around a table with access to a screen at one end. There would be capacity for every student to project their work on the screen within the group and for the instructor to broadcast that image to all the screens in the lab. There would be the potential to reconfigure the room by moving the tables that are set against the screen (much like a peninsula). The Director of Planning & Infrastructure at FASE confirms that this is in line with the labs currently being built at their new building, the Centre for Engineering Innovation & Entrepreneurship (CEIE).

The student representative was satisfied with the proposed plans.

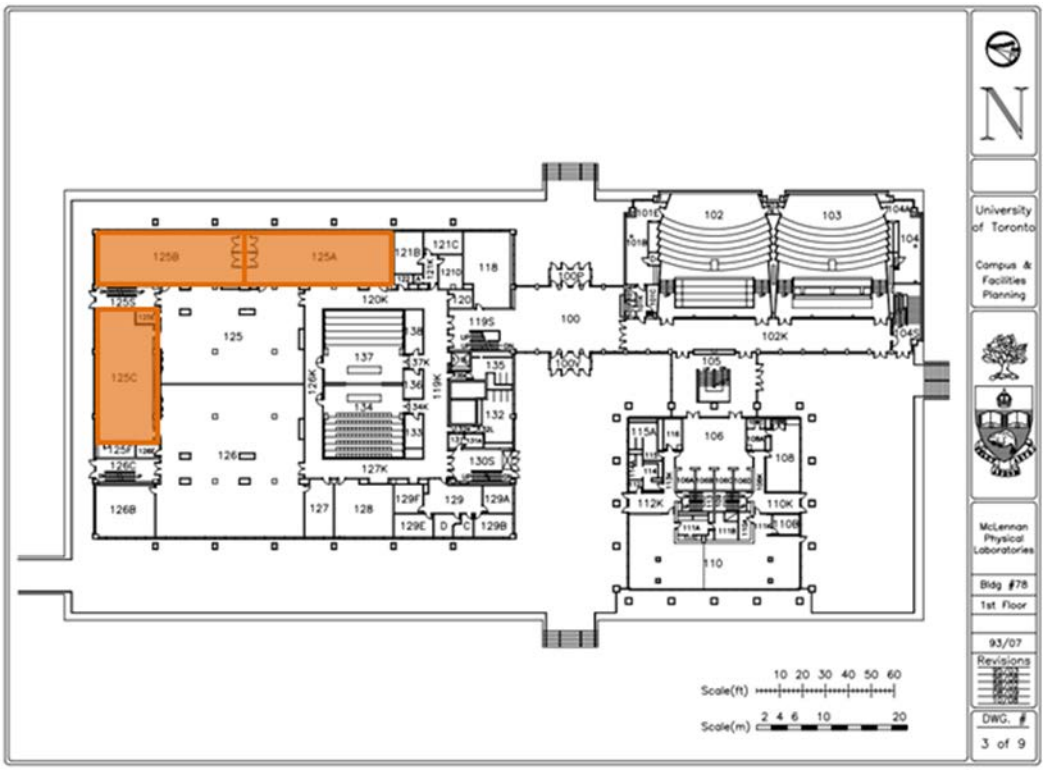


**FIGURE 1 – Recently renovated Practical Labs 125A, B & C**

**FIGURE 2 – Photo of updated Practical Labs**

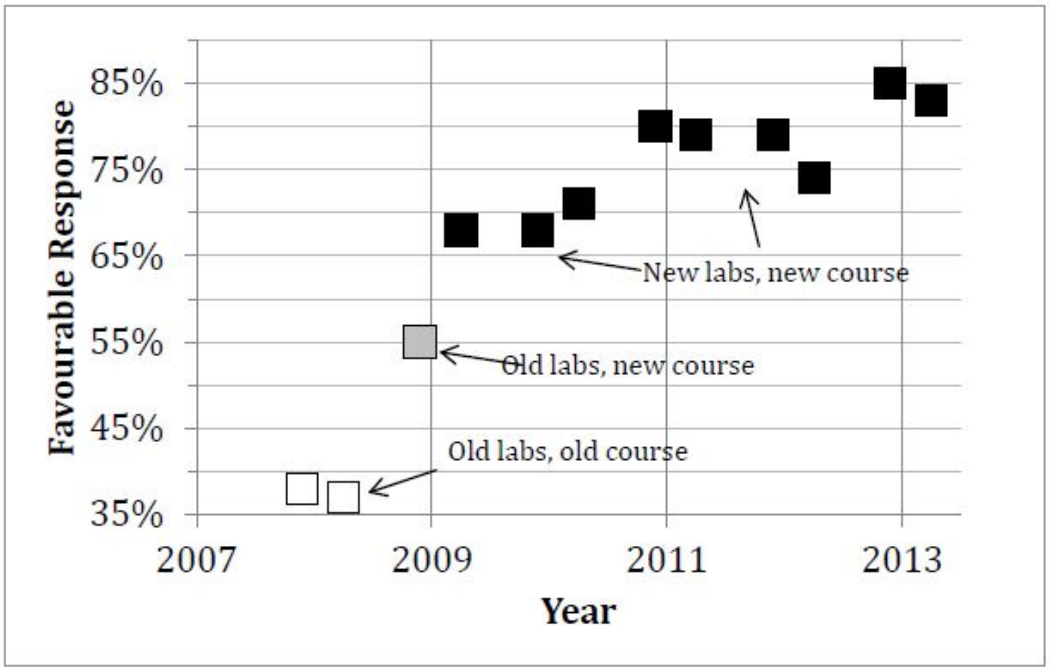


**FIGURE 3 - Results of Student Satisfaction Questionnaires from 2007 – 2013**

Percentage of favorable responses in November and March 2007-2013 to student satisfaction questions in the first year Life Science Stream Physics Labs.

Fall 2009 the course changed from the year-long PHY138Y/110Y structure (white squares) to semester based PHY131H1/PHY132H1S structure (grey square); the change to Practical rooms was in transition.

Winter 2009 the Practical Rooms were fully operational (black squares).

The questionnaire, which changed somewhat from the lab renewal in 2009 to after the lab renewal, surveyed overall student satisfaction and effectiveness of the labs. The 30-40% favorable response rating before 2009 was typical of several years of student surveys in this group. They are qualitatively different from student satisfaction rates with the new Practical Rooms and methodology. The growing satisfaction over 2009-2013 reflects increasingly effective use of the rooms and Practicals methodology.

## d) Statement of Academic Plan

The most recent planning documents for the Department of Physics come from a UTQAP review in 2013, and a Faculty of Arts and Science faculty-wide planning exercise in 2010.

In the UTQAP review, the first-year undergraduate laboratories were discussed in the Department Self-Study, where the success of the "Practicals/Laboratorials" format in our Physics for Life Sciences courses, PHY131/132, was used to motivate extending this to our introductory courses for physical scientist students, PHY151/152:

> "The advanced stream courses, PHY151F and PHY152S, are delivered with three hours of lecture per week (rather than the usual Toronto standard of two). These courses actually cover fewer topics than PHY131/132, but in significantly greater detail. The laboratory and tutorial components of these courses follow more traditional approaches than the Practicals, in which the laboratory component is largely independent of the lecture material. While the success of the Practicals in PHY131/132 clearly indicates that this is a promising direction for PHY151/152, the current Practical rooms do not have sufficient capacity to accommodate these additional students. A major goal for the next several years is to secure the funding to build additional Practical rooms, as well as to develop the appropriate material for these more advanced courses."

The UTQAP External Review Report endorsed this, and also noted our efforts to modernize the upper-year labs, which speaks to our second-floor renovation plans. The italics are those of the Reviewers:

> "The introduction of Physics Practicals [in PHY131/132] required the design and renovation of new space to accommodate small group learning assisted by computer-assisted experiments. This new facility is innovative and in keeping with modern pedagogical best practices. *The first year course for physics specialists would benefit from the creation of similar facilities.* Initiatives are underway to incorporate computation into all programs, to develop new biophysics courses, and to modernize upper year labs."

The Administrative Response from the Dean of the Faculty of Arts and Science has these renovations as an explicit goal:

> "*Upgrading first year Practicals for physics specialists to match physics for life sciences labs:*

<u>Short-term response:</u>

- The Department has carried out a pilot project on weekly "laboratorials" for PHY151/PHY152, the courses for physics specialists. Over the course of this summer, the Department will roll these out fully. Renovations to room 126 in the McLennan Physical building are underway to create a suitable temporary space for the laboratorials.

Intermediate-term response:

- "The space being created in MP126 is temporary. The Department has set aside some infrastructure funds and is working with the Dean's Office to move forward on a more permanent renovation.
- The Department will monitor the impact of the laboratorials and renovations for the undergraduate program."

The PHY151/152 labs currently share a large space on the first floor of the undergraduate wing of McLennan Physics with PHY180, which is our introductory physics course for Engineering Science. Renovation of the PHY151/152 space necessitates renovation of the PHY180 space, and of the adjoining tech space where equipment for the practicals is constructed and repaired.

Class sizes in PHY180 have also grown substantially, and the renovation will help us to accommodate the additional students, as well as give them an improved laboratory experience. The new layout will, for example, allow the students to work more effectively in pairs. The PHY180 laboratory space will be used by PHY180 only in the fall; the same space will be used by PHY205 in the spring.

PHY205, "The Physics of Everyday Life", is a breadth course offered by the Department of Physics. Enrolment is capped at two sections of 200 students, and it is typically oversubscribed by about 100. In contrast to typical physics courses for non-scientists which rely on lectures and memorization of key principles/facts, PHY205 instead provides non-science students with an opportunity to more fully understand physical principles through hands-on experiments and demonstrations. Students learn by doing, rather than by being told. This experiential learning approach to teaching a non-science cohort is important in order to give future tax payers/members of the public a deeper insight and appreciation of what scientists do.

On the second floor, MP222 serves a number of classes: as overflow for our very popular fourth-year computational physics class, for example, but its primary use is for a second-year laboratory class, PHY224, "Practical Physics 1". This course has grown by 50% since 2010, and is currently near capacity. The renovation of this room has two goals:

1) to increase class size in PHY224 by: increasing the size of the room by removing two non-load-bearing walls; using narrower desks; and installing under-floor wiring, and
2) to improve the experience of the students by fixing a very noisy HVAC system that makes teaching in MP222 very challenging: it is currently difficult to even talk in that room without turning off the HVAC.

Finally, turning to the proposed modifications of our Advanced Lab, this was addressed in the Department of Physics 2010 plan:

> "c) significant improvement of our upper year laboratories: These upper year labs are in many cases indistinguishable from research in terms of student experience, but in addition to suffering from antiquated equipment, the upper year labs have also fallen behind, especially in the areas of computerized data acquisition and because of

modernization of our pedagogical approach. The new biological physics initiative is also presently very poorly supported in the lab and Practical courses."

The Department of Physics has been working towards installing more modern experimental apparatus in the upper-year labs. However, the comparatively minor upgrades of this laboratory space envisioned in this renovation are also a required step towards the goal of modernizing these courses.

In summary, the first floor renovation starts from a change in pedagogy for PHY151/152 (physics for physical scientists), that was endorsed in the 2013 UTQAP review of the Department of Physics. The PHY151/152 renovation requires renovation of the adjoining lab space for PHY180 (Engineering Science) and the nearby technical preparation room, and these further renovations will bring pedagogical benefits to PHY180 and to PHY205 (a breadth course currently taken by 400 non-science students per year). The second-floor renovation of MP222 was not emphasized in our planning documents, but it is justified by recent enrolment growth in PHY224 and a noisy HVAC system that negatively impacts teaching in that room. Finally, the Advanced Lab renovations were envisioned in our 2010 plan and, together with upgrades to the experiments themselves, will lead to enhanced experience in this, our flagship laboratory for Physics Specialists, and Engineering Science students in the Engineering Physics stream.

### e) Space Requirements

<u>COU Comparison Analysis:</u>

The COU Analysis follows. It was undertaken using up to date changes in Space Factors as outlined in the May 2015 COU report, "Inventory of Physical Facilities of Ontario Universities 2013-14". Refer to Appendix 5 for calculation details.

| Use (COU Category) | Existing Inventory (NASM) | COU Generated (NASM) | +/- (NASM) | % COU |
|---|---|---|---|---|
| Teaching Labs & Support Spaces (2.0) | 2540 | 3160 | -621 | 80% |

The proposed renovation will increase lab utilization rates. The teaching lab on the first floor (rm 126) would allow the increase of the current enrolment cap of 200 and consolidate all activities into one space - currently the department turns away approx. 100 students because of the restriction on the Practicals size.

<u>Teaching Lab Utilization:</u>

Utilization of the teaching labs in this project largely meets or exceeds COU space guidelines. Seat occupancy is well over 75% as noted.

The COU space guideline for Category 2: LABORATORY – UNDERGRADUATE is as follows:

*"Space guidelines for teaching laboratories include a room utilization of 18 hours per week and 75% seat occupancy when in use."*

**Existing - Fall 2015/Winter 2016**

| Room # | Room Type | NASM | Total Scheduled Weekly hours-Fall | Total Scheduled Weekly hours-Winter |
|---|---|---|---|---|
| 125A | Teaching Lab | 134 | 28 | 26 |
| 125B | Teaching Lab | 135 | 28 | 26 |
| 125C | Teaching Lab | 122 | 16 | 16 |
| 126B | Teaching Lab (temp storage) | 54 | n/a | n/a |
| 126EAST | Teaching Lab | 150 | 12 | 0 |
| 126WEST | Teaching Lab | 136 | 24 | 22 |
| 222 | Teaching Lab | 139 | 26 | 22 |
| 218 | Teaching Lab | 29 | 21 | 18 |

# II. Project Description

## a) Vision Statement

The aim of the Physics Department is to create Canada's best undergraduate Practical Physics program and ultimately recruit new generations of top physics students to the University of Toronto. This project addresses first year physics Practicals for the Physical Science stream, Physics Department and first year labs for Engineering. It also speaks to the challenges associated with the Practicals methodology concerning work space, storage, and equipment. The labs will serve the combined constituencies of:

- Physics students from FAS (65-75% usage)
- Engineering students from FASE (20-30% usage)
- Other students, outside groups and outreach (5-10% usage)

The project will create 3 new Practical Teaching Labs, rooms 126, 126B and 222, with a capacity of 40, 68, 66 and people respectively. It will also include an open area Drop-in Work/Study Space for students, room 125, and a renovated Technician Workroom/Storage Room, room 127. There will also be several new open work spaces throughout the main corridors 120K, 126K and 127K.

The Practical Teaching Labs, rooms 126, 126B and 222, must be equipped with a teaching station, a ceiling speaker system, a projection screen located at the front of the room, a printer and a projector all networked with switch control to project the work in any of the learning pod computers or the front projection screen. Each practical lab must be equipped with a lab sink and lab benching station, discretely located away from the learning pods. Each learning Pod must have solid resistant pod tables, with at least 2 m from the wall to their far end, with a white board viewed by a webcam. Each Teaching Station must have a switch control to the digital projector, both fixed and wireless microphones, sound system, and recording capability.

The open concept Drop-in Work/Study Space, room 125, requires wireless access, conveniently located power outlets and flexible furniture (chairs, tables and mobile whiteboard). Some privacy is to be created through use of fixed frosted glass partitions.
The Technician Workroom/Storage Room, room 127, will be renovated and expanded to accommodate the various storage needs, work areas and ancillary needs.

Standing height counter, bench seating and work counters will be incorporated throughout the common corridors 120K, 126K and 127K to allow for short-term work spaces while not impeding the flow of traffic.

For specific details, please refer to the Room Data Sheets (Appendix 4).

### b) Space Program and Functional Plan

The space program for the proposed renovation area consists of:

- An enhanced and enlarged teaching lab 126B
- A new enclosed teaching lab 126
- An improved and enlarged teaching lab 222
- Several drop-in study/work areas 225
- A more effective lab technician support and storage space 127
- A vestibule area outside classrooms 134 and 137 to segregate the traffic flow from the adjacent teaching labs and create a useful space for students to gather and have arranged electrical/data access at a built-in countertop 126K
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| 126 | Teaching Lab | 146 | 3c | RDS4 |
| 126B | Teaching Lab | 166 | 3d | RDS3 |
| 127 | Technician Workroom/Storage Room | 112 | 3e | RDS5 |
| 222 | Teaching Lab | 201 | 3f | RDS6 |
| 120K | Corridor/Open Work Space | N/A | 3c | RDS1 |
| 126K | Corridor/Open Work Space | N/A | 3c | RDS1 |
| 127K | Corridor/Open Work Space | N/A | 3d | RDS1 |
| | **TOTAL NASM** | **713** | | |

### c) Building Considerations

The existing 126 area was divided into two areas in 2014 to create separate teaching spaces as a temporary measure ahead of the larger project. This was completed using a drywall partition; however there are no doors or windows and this wall may/may not need to be altered in the new

layout. The west side has an open concrete waffle-slab ceiling, drop down electrical boxes from the ceiling for power to the existing tables and suspended lighting. The tables were ordered to be movable and can therefore be reused in the new plan.
The east side has an open concrete waffle-slab ceiling, drop down electrical boxes from the ceiling for power to the existing tables and suspended lighting. The tables in this area are to be disposed of unless the department has another use for them. The corridor between these two spaces has a drop T-bar ceiling.

The department would also like to explore the possibility of making one or both sets of exit doors on the North ends of the corridors (marked 1 & 2 on Appendix 3a Test Fit - 1st Floor) into entrance doors.

Standards of Construction

The renovated space must feel comfortable, airy, light and student friendly. Equally important, the building must be functional and robust with durable materials suitable to laboratories that can be easily maintained. The University of Toronto's Facilities and Services and Capital Projects Design Standards apply to the design of all projects. As well, the University of Toronto Environmental Health and Safety group provides information and resources to ensure that environmentally responsible, safe and healthy work, research and study environments are provided and maintained, http://www.ehs.utoronto.ca/Page11.aspx.

Building Components and Systems

The project will likely be a mix of moderate and extensive renovation. The building components and systems to be considered for the project include but are not limited to: HVAC, electrical power, communication, wireless connectivity, lighting, personal security and fire protection. The project will strive to make use of the existing services and infrastructure reconfigured to the new plans where possible; however, some renewal may need to be undertaken to address limitations and provide enhancements to properly service the re-purposed spaces.

Accessibility

Planning principles related to Accessibility are identified in the 2011 St. George campus master plan:

"The University's buildings, landscape and grounds must accommodate a diverse population in an open and inclusive campus. The campus environment should adhere to the principles of universal design with all new construction on campus."

The University of Toronto is committed to ensure that its buildings and services are accessible to persons with disabilities. Compliance with the University's Barrier Free Accessibility Design Standards is required for all new construction and renovation projects at the St. George campus. Neither the ODA nor the University require full adherence to the standard. For renovation projects, particularly of older buildings, there may be some recommendations that are very difficult or impossible to implement. Design teams must provide written explanation in the event of non-compliance. Accessibility amendments to the Ontario Building Code were made effective January 1,

2015. The amended requirements apply to new projects, major retrofits, common space and circulation areas, and change in use.

Sustainability design and energy conservation (LEED)

The University's Design Standard Part 1, Section 5 (Environmental Design Standard) contains a draft revision (December 14, 2011) that recommends using CaGBC's LEED 2009 Silver certification as a minimum target for new construction and major renovations. Thus, the project's design and construction should be driven by sustainable initiatives as appropriate and feasible in terms of design, construction and operation. In particular, innovative and alternative choices, should be considered when decisions are made about design, processes and products that influence resource use (e.g., energy, water, materials) and other environmental impacts (e.g., indoor air quality, lighting, waste management).

Existing Building Conditions

Any renovation to an existing building must comply with the appropriate Building Codes, Safety Acts and applicable By-Laws.

### d) Site Considerations

Asbestos abatement is included in the project scope.

### e) Campus Infrastructure Considerations

The proposed project will not result in additional load to existing campus infrastructure.

### f) Secondary Effects

The renovations outlined in this project are proposed to occur from late December 2016 through to the end of August 2017. It is expected that classes can proceed as usual assuming some scheduling accommodations are made. Access to rooms 125 A, B and C must be maintained during scheduled classes throughout construction. Swing space for the lab technicians during the renovations will be required. After discussions with ACE rooms 101, 201 and 229 are preferred. The following project parameters have been identified, and will require consideration:

- Rooms 134, 137, 102, 103, 202, 203:
    - Wait for the Fall 2016 exam period to finish before any demolition related to the project can start
    - ACE would need full use of the rooms until the end of the Winter 2016 term
- Rooms 134 and 137:
    - Rooms are not needed during the Spring 2017 term

- Rooms 102 and 202:
    - The two associated classrooms, rooms 102 and 202 respectively, cannot schedule classes for students that require entry at the front of the room. This holds true during the construction period only. ACE will schedule classes accordingly.

The Department of Physics currently operates a drop-in center in room 125 that provides academic assistance to physics students. This will have to be relocated during the renovations, created by partitioning MP200. This must be completed before the start of classes in January 2017, and can be constructed when there are no classes, either in late December or late August 2016.

### g) Schedule

The following is a summary of the project milestones for the proposed project.

| | |
|---|---|
| CaPS Exec Approval | 29 February, 2016 |
| Consultant Selection | May 2016 |
| Executive Committee Confirmation | 14 June, 2016 |
| Tender | mid-October |
| Award | late November 2016 |
| Site Vacancy/Clean-up | December 2016 |
| Construction Start | January 2017 |
| Substantial Completion | August 2017 |
| Occupancy | September 2017 |

Disruptions to the existing occupants are to be expected during the course of construction; however, every effort must be made by the general contractor team to minimize such disruptions through construction scheduling and carefully considered access and implementation strategies.

The schedule assumes all municipal approvals may be achieved within the timelines.

## III. Resource Implications

### a) Total Project Cost Estimate

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

- construction costs
- contingencies
- taxes
- hazardous materials
- secondary effects
- demolition
- permits and insurance
- professional fees, architect, engineer, misc. consultants, project management

- computer and telephone terminations
- moving and staging
- furniture and equipment
- miscellaneous costs [signage, security, other]
- commissioning
- escalation

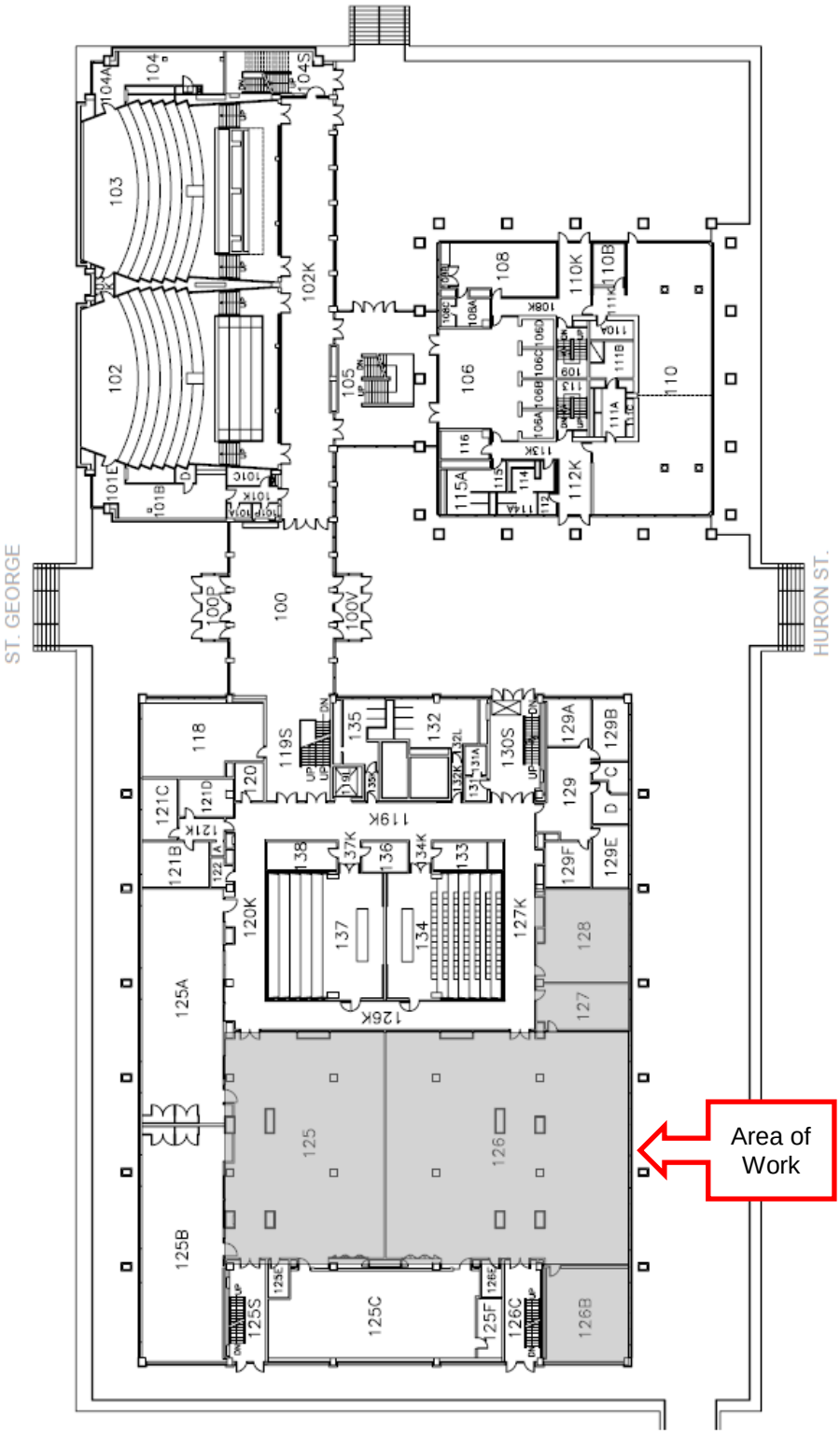
**b) Operating Costs**

2015/16 annual operating costs for the McLennan Physics Building is estimated to be $290.00/ net assignable square meters, including utilities, maintenance and cleaning. No additional operating costs are anticipated as a result of the proposed renovation.

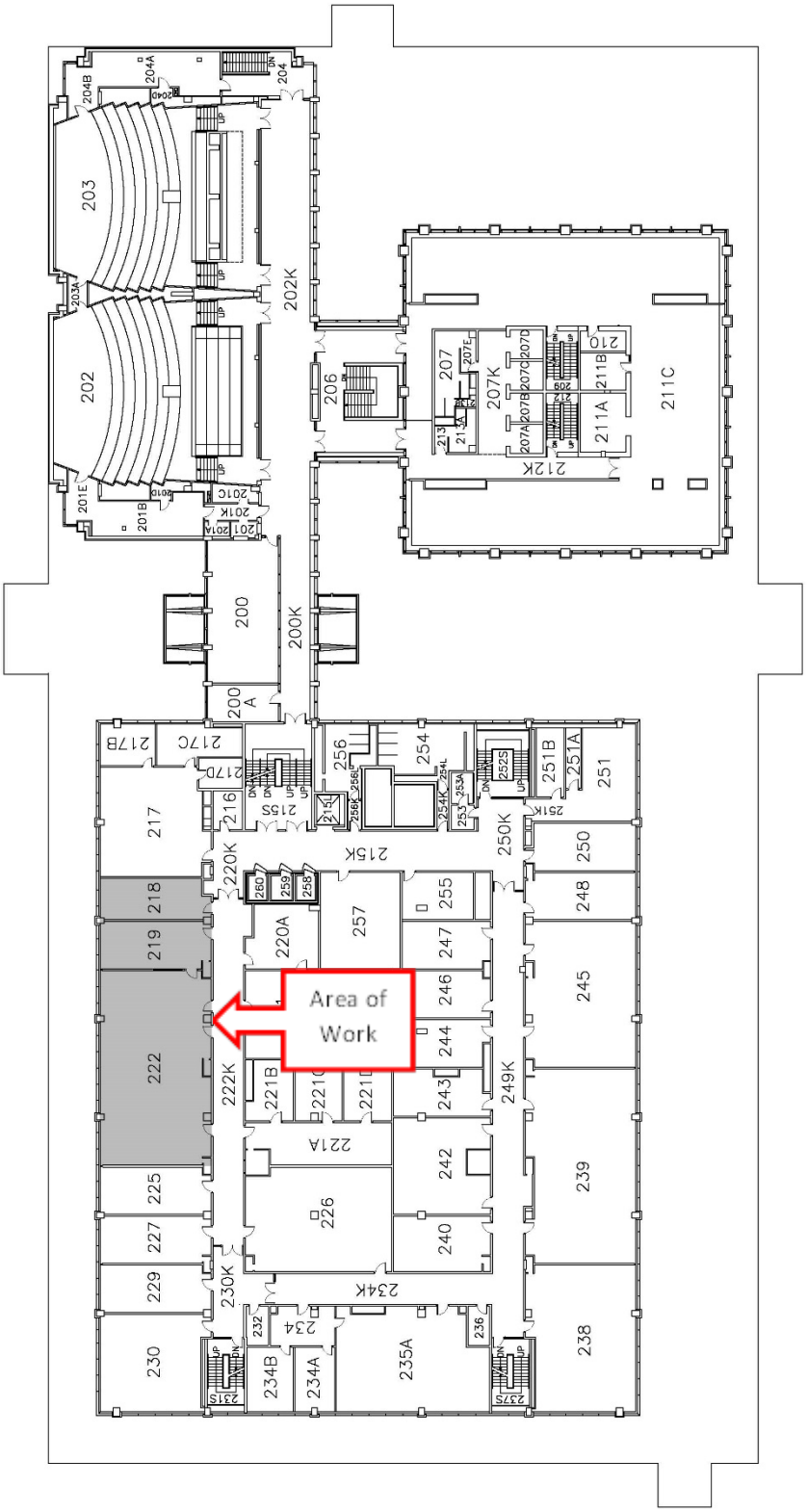
**c) Funding Sources**

The project will be funded by Faculty of Arts & Science Operating Funds, Department of Physics Operating Funds and Faculty of Applied Science & Engineering Operating Funds.

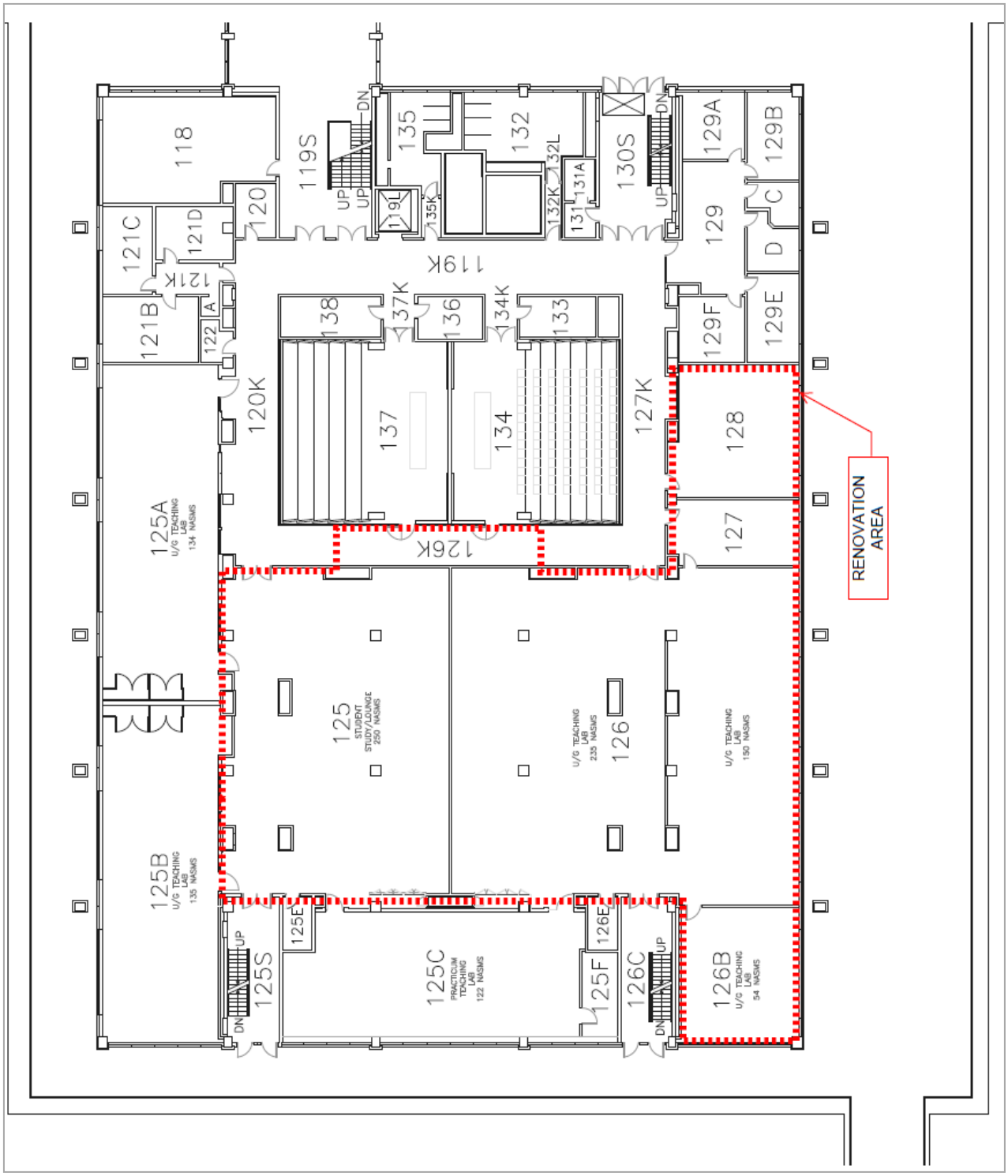
## APPENDIX 1a: Key Plan/Area of Work – 1st Floor



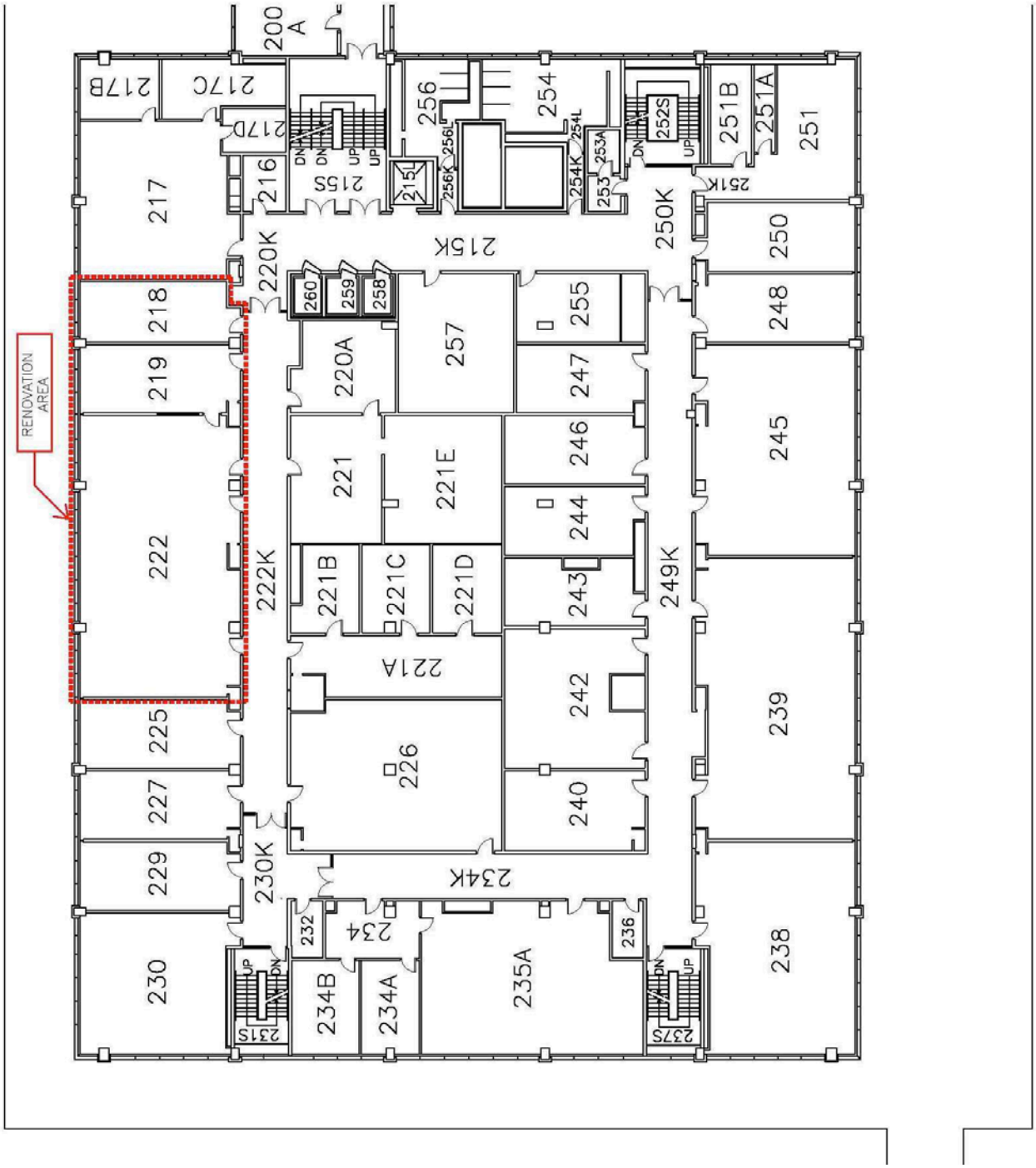
## APPENDIX 1b: Key Plan/Area of Work – 2nd Floor



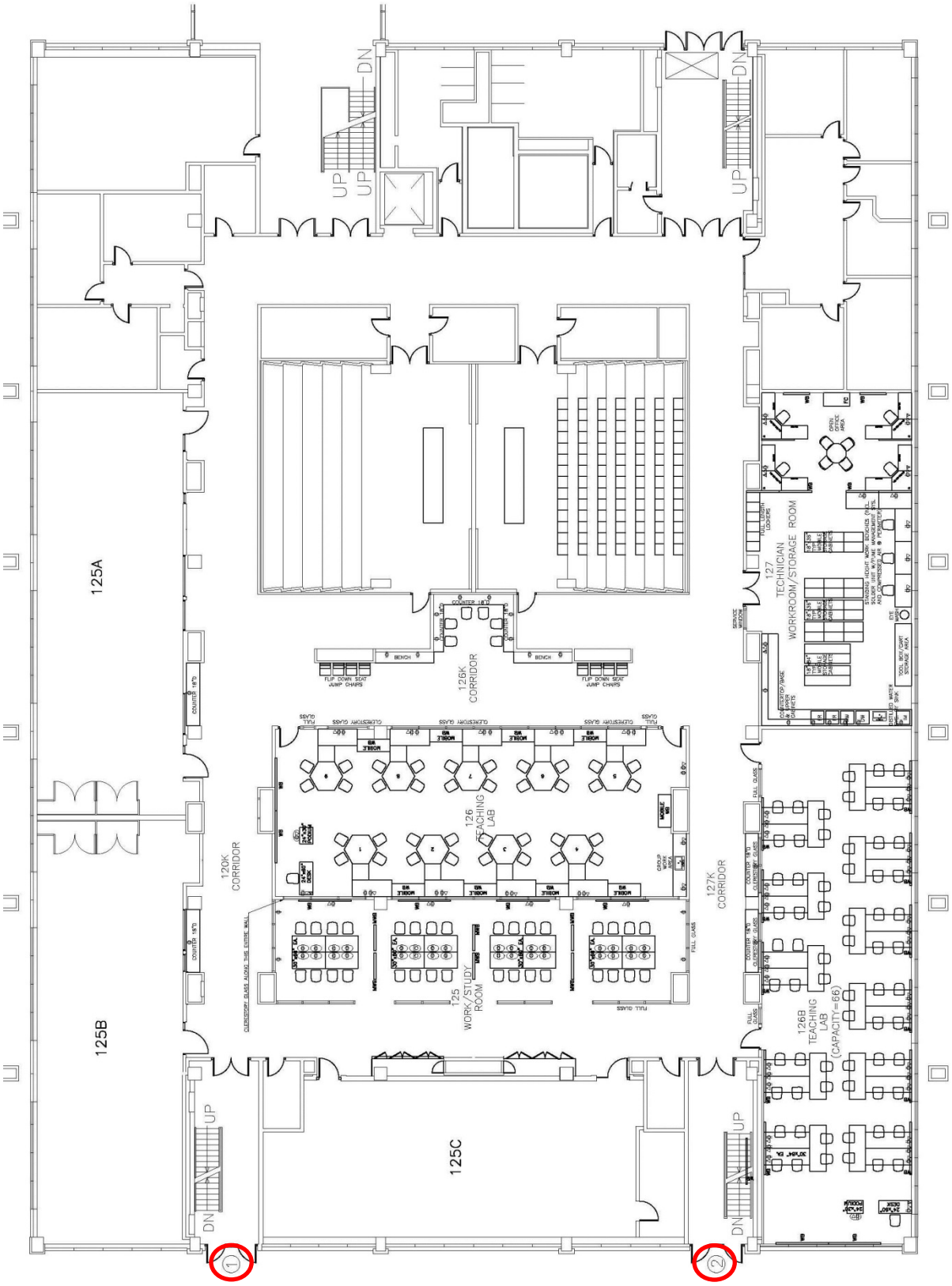
## APPENDIX 2a: Existing Plan Diagram – 1st Floor



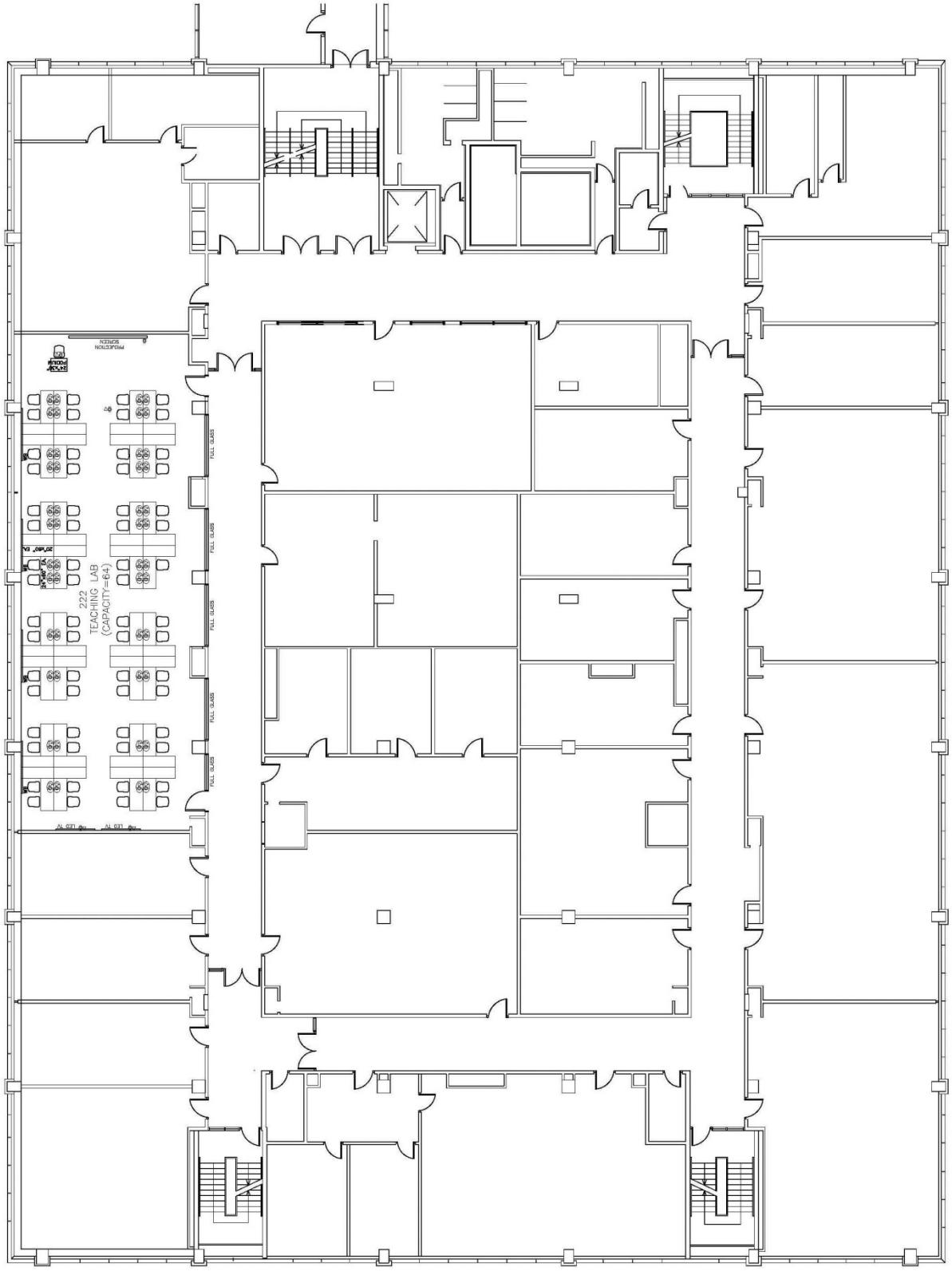
**APPENDIX 2b: Existing Plan Diagram – 2nd Floor**



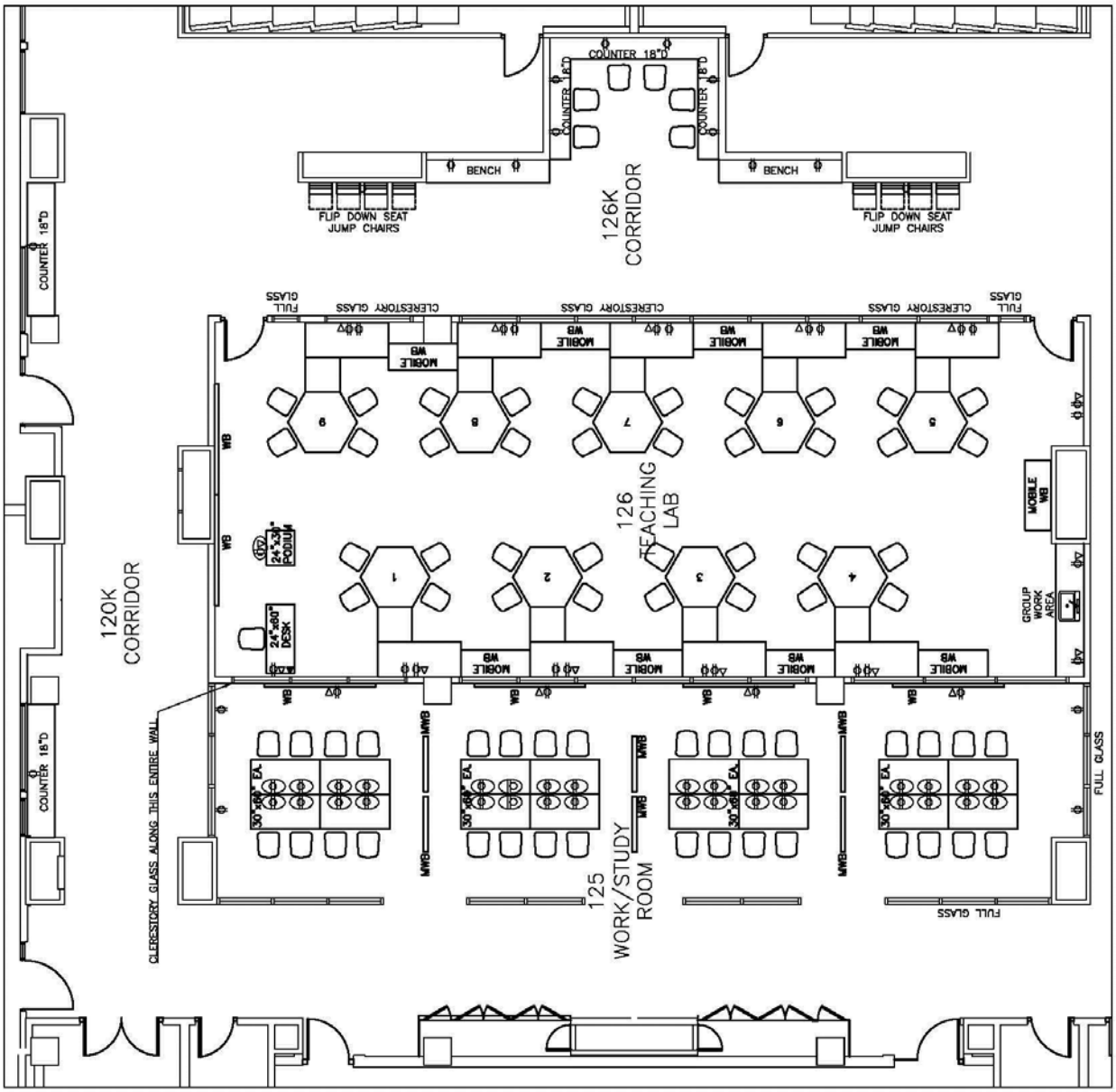
## APPENDIX 3a: Test Fit – 1st Floor



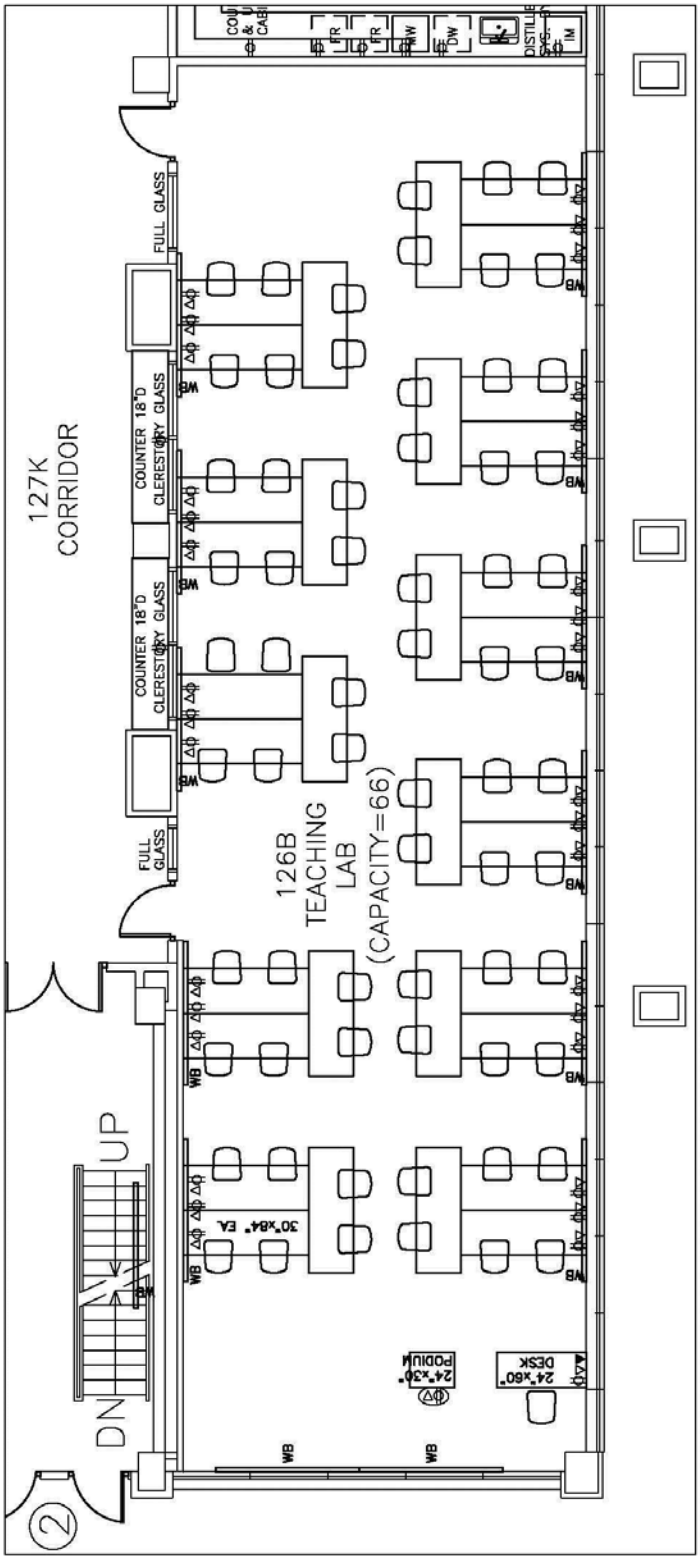
## APPENDIX 3b: Test Fit – 2nd Floor



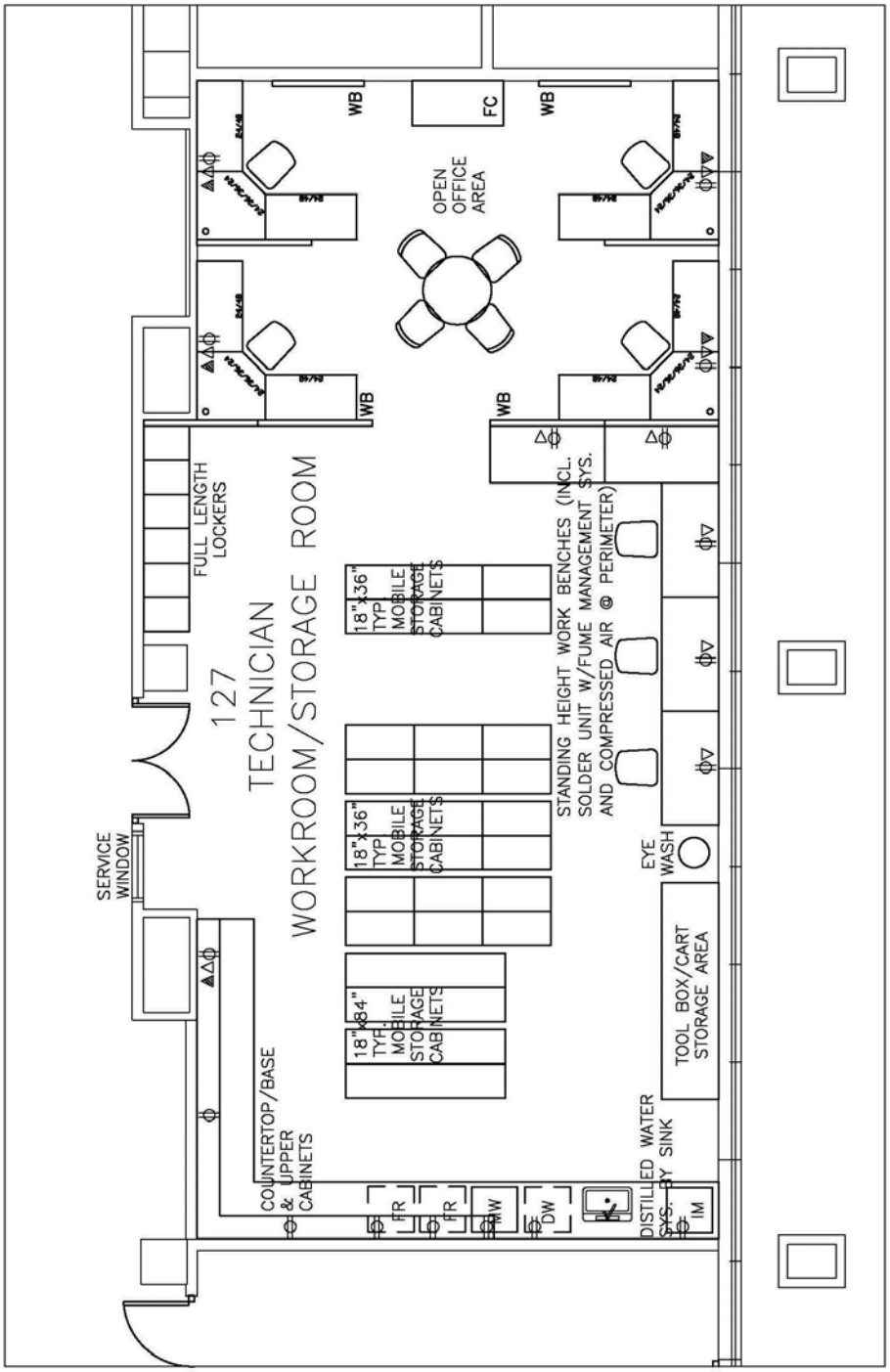
**APPENDIX 3c: Proposed Plan – Rooms 125 & 126 and Corridor 120K & 126K**



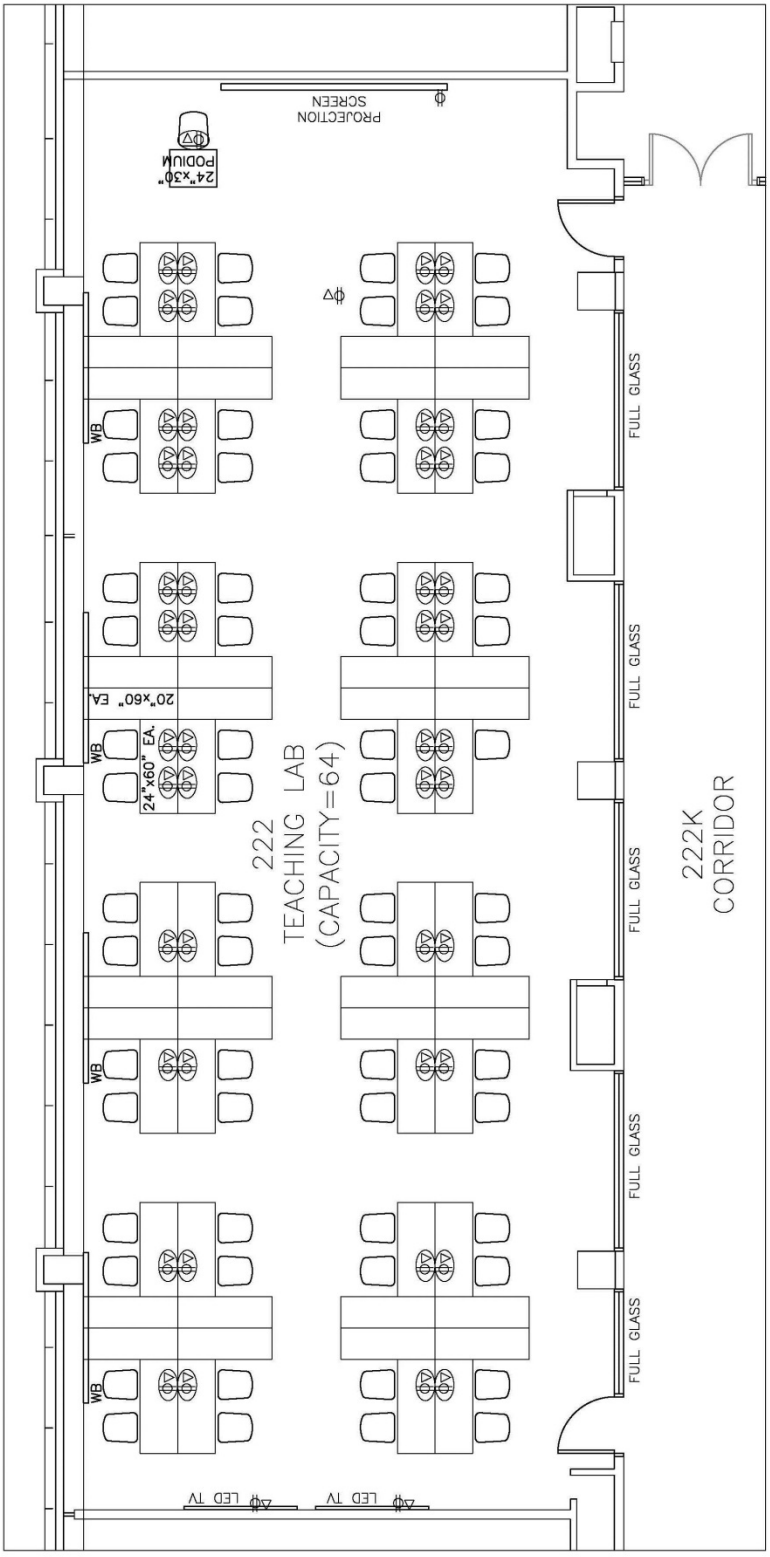
**APPENDIX 3d: Proposed Plan – Room 126B and Corridor 127K**



**APPENDIX 3e: Proposed Plan – Room 127**



**APPENDIX 3f: Proposed Plan – Room 222**



## APPENDIX 4: Room Data Sheets

### ROOM DATA SHEET #1 – Vestibule/Corridor Area

***SECTION A:***
**ROOM NAME:** MP120K, MP126K & MP127K
**Rooms Required:** N/A
**NASM required:**

***SECTION B:***

A. **Space Purpose and Type of Activity:** Area of separation for overflow from classrooms adjacent to teaching labs, as well as a gathering area for quick laptop/electronic device use that is not encroaching on the corridor.
B. **Number of Occupants, Resident:** 0
C. **Number of Occupants, Transient**: 32
D. **Space Relationships:**
   **Adjacent to:** Undergrad Laboratories
   **Close to:** Classrooms
   **Separate from:**
E. **Visual Relationships:**
F. **Communications:**
   **Voice:**
   **Data:** wireless access points, as required for traffic
   **Audio Video:**
G. **Furniture and Equipment, Fixed:** *(where applicable, please enter approx. sizes, model (for equipment), and quantities)*
   - 2 x 8'-11"Lx20"D Benches
   - Approx. 62'-0" linear feet of counter top
   - 6 x fixed base swivel stools
   - 8 flip down chairs – JumpSeat Wall, by Sedia Systems
H. **Furniture and Equipment, Moveable:** *(where applicable, please enter approx. sizes, model (for equipment), and quantities)*

**SECTION C:**

I. **Lighting Requirements:**

J. **Power Requirements:**
   - 16 x wall mounted duplex receptacles
K. **Building Services Requirements:**
   - **Special Systems:**

M. **HVAC:**

N. **Plumbing:**

O. **Special Finishes:**
   - VCT tile flooring
P. **Special Requirements & Other Considerations:**

Q. **Safety & Security Considerations:**

McLennan Physical Laboratories Renovation - Undergraduate Labs Year 1: Room 120K, 126K & 127K Page **1** of **1**

**ROOM DATA SHEET #2 Drop-In Work/Study Space**

***SECTION A:***
**ROOM NAME:** MP125
**Rooms Required:** 1
**NASM Required:** 88

***SECTION B:***

**A. Space Purpose and Type of Activity:** Space for student study and collaboration

**B. Number of Occupants, Resident:** 0

**C. Number of Occupants, Transient**: 32+

**D. Space Relationships:**

**Adjacent to:** Undergrad Laboratories
**Close to:** Classrooms
**Separate from:**

**E. Visual Relationships:**

**F. Communications:**

**Voice:**
**Data:** wireless access points as required for 30-40 users; 4 wall mounted data ports
**Audio Video:**

**G. Furniture and Equipment, Fixed:** ***(where applicable, please enter approx. sizes, model (for equipment), and quantities)***

- 4 x 8'Wx4'H frosted glass whiteboards

**Furniture and Equipment, Moveable:** ***(where applicable, please enter approx. sizes, model (for equipment), and quantities)***

- 16 x 30"x60" mobile tables
- 32 x armless task chairs on castors
- 6 x mobile glass whiteboards (4'Wx6'H)

**SECTION C:**

**H. Lighting Requirements:**

- Retain existing lighting where possible (standard hanging florescent fixtures), re-lamp and clean

**I. Power Requirements:**

- Recessed floor monuments for power/data to tables, required to be recessed to allow movement of the furniture
- 8 x perimeter wall mounted duplex receptacles
- 32 x duplex receptacles in floor monuments

**K. Building Services Requirements:**

- **Special Systems:**
  - ½ wall glazing on north wall, approx. 40'Lx10"H, four sections
  - ½ wall glazing on east wall, approx. 12'Lx10"H (to close in)
  - ½ wall glazing on west wall, approx. 12'Lx10"H, (to close in)
  - Clerestory glazing in south wall
  - Note – walls to be discussed with architect

**M. HVAC:**

- Ensure ventilation is adequate for occupancy of room, including equipment

**N. Plumbing:**

**O. Special Finishes:**

- VCT tile flooring
- Signage to match existing

**P. Special Requirements & Other Considerations:**

**Q. Safety & Security Considerations:**

- Lever door handle with key lock cylinder

**ROOM DATA SHEET #3 Teaching Lab**

***SECTION A:***
**ROOM NAME:** MP126 B
**Rooms Required:** 1
**NASM Required:** 166

***SECTION B:***

**A. Space Purpose and Type of Activity:** Teaching Lab

**B. Number of Occupants, Resident:** 0

**C. Number of Occupants, Transient**: 68

**D. Space Relationships:**

**Adjacent to:**
**Close to:** Technician workroom
**Separate from:**

**E. Visual Relationships:**

**F. Communications:**

**Voice:** 1 x voice connection at instructor desk
**Data:**
- 33 x Ethernet ports perimeter wall mounted
- 2 x Ethernet ports at instructor podium in recessed floor monument
- 2 x Ethernet ports at instructor desk

**Audio Video:**
- Projector & projector screen
- PA system similar to room MP126W

**G. Furniture and Equipment, Fixed:** *(where applicable, please enter approx. sizes, model (for equipment), and quantities)*
- 11 x 8'Wx4'H frosted glass whiteboards
- 2 x 8'Wx4'H frosted glass whiteboards

**H. Furniture and Equipment, Moveable:** *(where applicable, please enter approx. sizes, model (for equipment), and quantities)*
- 33 x rectangular tables (standing height) 30"x84" ea.
- 66 x armless stools, vinyl finish
- 1 x instructor task chair
- 1 x 24"x60" instructor desk
- 1 x instructor podium

**SECTION C:**

**I. Lighting Requirements:**
- Retain existing lighting where possible (standard hanging florescent fixtures), re-lamp and clean where necessary

**J. Power Requirements:**
- 33 x perimeter wall mounted duplex receptacles
- 2 x duplex receptacle in recessed floor monument at instructor podium
- 1 x duplex receptacle at instructor desk

**K. Building Services Requirements:**
- **Special Systems:**

**M. HVAC:**
- Ensure ventilation is adequate for occupancy of room, including equipment

**N. Plumbing:**

**O. Special Finishes:**

- New VCT tile flooring
- 2 new entrance doors, full glass with aluminum frames, automatic
- 2 full length sidelights adjacent to doors (approx. 2'-6" ea.)
- Approx. 20' linear feet of clerestory glass to be installed at the top of the east wall
- Signage to match existing
- New window blinds for existing windows on west wall (approx. 76 linear feet & approx. floor to ceiling ~12'H)

**P. Special Requirements & Other Considerations:**

**Q. Safety & Security Considerations:**

- Mortise lever door handle
- Electronic entry, to match MP125A

**ROOM DATA SHEET #4 Teaching Lab**

***SECTION A:***
**ROOM NAME:** MP126
**Rooms Required:** 1
**NASM Required:** 146

***SECTION B:***
**A. Space Purpose and Type of Activity:** Practical Physics space 1) integration of theoretical and experimental course content, 2) strategically chosen experimental activities keyed on pedagogical goals, 3) use of computers for data acquisition, experimental analysis, and modeling of physical systems, and 4) modernization of equipment and lab space

**B. Number of Occupants, Resident:**

**C. Number of Occupants, Transient**: 40

**D. Space Relationships:**

**Adjacent to:** Drop-In Work/Study Space
**Close to:** Classrooms
**Separate from:**

**E. Visual Relationships:**

**F. Communications:**

**Voice:** 1 x voice connection at instructor desk
**Data:**

- 18 Ethernet ports at pods
- 2X Ethernet ports at instructor podium in recessed floor monument

(If podium is located next to instructor desk, data ports may not need to be floor mounted)

- 2X Ethernet ports at instructor desk

**Audio Video:**

- Projector & projector screen

(If podium is located next to instructor desk, data ports may not need to be floor mounted)

- PA system similar to room MP126W

**G. Furniture and Equipment, Fixed:** ***(where applicable, please enter approx. sizes, model (for equipment), and quantities)***

- Approx. 10' linear countertop with base cabinets
- 2 x 8'Wx4'H frosted glass whiteboards

**H. Furniture and Equipment, Moveable:** ***(where applicable, please enter 1pprox.. sizes, model (for equipment), and quantities)***

- 9 x 'pod' style desks @ standing height, to be in 1 piece that have a shape similar to the assembly in room MP126w, which is made up of:
  - 1 x hexagon table (5'x4', w/ 30" edge)
  - 1 x square table (30"x30")
  - 1 x rectangular table (30"x72")
- 9 x mobile glass whiteboards (5'Wx6'H)
- 36 x armless stools, vinyl finish
- 1 x 24"x60" instructor desk
- 1 x task chair for instructor desk
- 1 x instructor podium (located adjacent to instructor desk)

**SECTION C:**

**I. Lighting Requirements:**

- Retain existing lighting where possible (standard hanging florescent fixtures), re-lamp and clean where necessary

**J. Power Requirements:**

- 18 x duplex receptacles at pods
- 1 x duplex receptacle at instructor desk
- 1 x duplex receptacle in recessed floor monument at instructor podium

**K. Building Services Requirements:**

- **Special Systems:**

**M. HVAC:**

- Ensure adequate ventilation for the capacity of the room, including equipment

**N. Plumbing:**

- Sink required on south wall

**O. Special Finishes:**

- New VCT tile flooring
- 2 new entrance doors, full glass with aluminum frames, automatic
- 2 full length sidelights adjacent to doors
- Approx. 40 linear feet of clerestory glass on the south wall (glazing to be start above pod height)
- Approx. 40 linear feet of clerestory glass on the north wall
- Signage to match existing

**P. Special Requirements & Other Considerations:**

**Q. Safety & Security Considerations:**

- Mortise lever door handle
- Electronic entry, to match MP125A

**ROOM DATA SHEET #5 Technician/Storage Space**

***SECTION A:***
**ROOM NAME:** MP127
**Rooms Required:** 1
**NASM Required:** 112

***SECTION B:***

**A. Space Purpose and Type of Activity:**

**B. Number of Occupants, Resident:** 4

**C. Number of Occupants, Transient:**

**D. Space Relationships:**

**Adjacent to:** Teaching Labs

**Close to:**

**Separate from:**

**E. Visual Relationships:**

**F. Communications:**

**Voice:**

- 4 voice connections for desk area
- 1 voice connection near the entrance

**Data:**

- 4 Ethernet ports for desk area
- 5 at the workbenches
- 1 near the entrance

**Audio Video:**

**G. Furniture and Equipment, Fixed:** *(where applicable, please enter approx. sizes, model (for equipment), and quantities)*

- 5 x workbenches @ 30"Dx60"W (standing height) w/anti-static tops
- Approx. 37 linear feet of countertop w/base/upper cabinets
- 6 x full height lockers
- 4 large mobile storage cabinets with shelves @ 18"Dx84"Wx78"H
- 24 small mobile storage cabinets with pull out drawers @ 18"Dx36"Wx78"H
- 4 x open concept workstations with privacy panels
- 2 x 4'x4' whiteboards
- 2 x under-counter refrigerators
- 1 x microwave
- 1 x dishwasher
- 1 x ice machine
- 1 x distilled water system
- Solder unit w/ fume management
- Compressed air at perimeter for workbenches

**H. Furniture and Equipment, Moveable:** *(where applicable, please enter approx. sizes, model (for equipment), and quantities)*

- 1 x 36"Dia. meeting table
- 4 x task chairs for desk work
- 4 x armless side chairs for meeting table
- 3 x stools for work bench area
- 3 x task lights for workbenches
- 1 x 4 drawer filing cabinet

**SECTION C:**

**I. Lighting Requirements:**

- Retain existing lighting where possible (standard hanging florescent fixtures), re-lamp and clean where necessary

**J. Power Requirements:**

- 4 duplex receptacles for desk area
- 4 receptacles for counter area (with increased power where required for equipment)
- 5 receptacles for workbench area (with increased power where required for equipment)

**K. Building Services Requirements:**

- **Special Systems:**
  - Solder system for workbenches
  - Compressed air at workbenches

**M. HVAC:**

- Ventilation system for solder station

**N. Plumbing:**

- Sink required on north wall
- Distilled water system to be installed above sink
- Eyewash station to be installed near workbenches

**O. Special Finishes:**

- New VCT tile flooring
- 2 new entrance doors, full glass with aluminum frames
- Service window with secure closure on corridor wall near north end
- Signage to match existing

**P. Special Requirements & Other Considerations:**

**Q. Safety & Security Considerations:**

- Lever mortise handles w/key lock cylinders, with two levels of keys (i.e. Technicians would have master, TA's would carry a sub-master)

**ROOM DATA SHEET #6 Teaching Lab**

***SECTION A:***
**ROOM NAME:** MP222
**Rooms Required:** 1
**NASM Required:** 201

***SECTION B:***

**A. Space Purpose and Type of Activity:** Teaching Lab

**B. Number of Occupants, Resident:** 0

**C. Number of Occupants, Transient**: 66

**D. Space Relationships:**

**Adjacent to:** MP217: a student union room; MP225: a practical physics/lab room
**Close to:** Practical physics rooms/labs
**Separate from:**

**E. Visual Relationships:**

**F. Communications:**

**Voice:**
**Data:**
- 32 x Ethernet ports in recessed floor monument at pods
- 2 x Ethernet ports at instructor podium in recessed floor monument

**Audio Video:**
- Projector & projector screen
- PA system similar to room MP126W

**G. Furniture and Equipment, Fixed:** ***(where applicable, please enter approx. sizes, model (for equipment), and quantities)***
- 4 x 8'Wx4'H frosted glass whiteboards on east wall
- Full height frosted glass walls on west, approximately 45' linear feet (to be used as a whiteboard)

**H. Furniture and Equipment, Moveable:** ***(where applicable, please enter approx. sizes, model (for equipment), and quantities)***
- 32 x rectangular workstations (desk height) – 1 2'x5' table and 1 20"x5' table with removable couplings
- 64 x armless stools, vinyl finish
- 1 x armless instructor stool
- 1 x instructor podium

**SECTION C:**

**I. Lighting Requirements:**
- Retain existing lighting where possible (standard hanging florescent fixtures), re-lamp and clean where necessary

**J. Power Requirements:**
- 32 x duplex receptacles in recessed floor monument at workstations
- 2 x duplex receptacle in recessed floor monument at instructor podium

**K. Building Services Requirements:**
- **Special Systems:**

**M. HVAC:**
- Ensure ventilation is adequate for occupancy of room, including equipment

**N. Plumbing:**

**O. Special Finishes:**

- New VCT tile flooring
- 2 new entrance doors, full glass with aluminum frames, automatic
- 2 full length sidelights adjacent to doors
- Approx. 45' linear feet of full height frosted glass to be installed on west wall (to be used as whiteboard inside lab)
- Signage to match existing
- New automatic roller shade window blinds for existing windows on east wall (approx. 76 linear feet & approx. 5' aff to ceiling ~12'H)

**P. Special Requirements & Other Considerations:**

**Q. Safety & Security Considerations:**

- Mortise lever door handle
- Electronic entry, to match MP125A

## APPENDIX 5: Space Requirements As Measured By COU Space Standards, 2013-14

| Space Requirements As Measured By COU Space Standards | | | | | |
|---|---|---|---|---|---|
| **DEPARTMENT NAME: Department of Physics** | | | **DATE:** | Feb. 2016 | |
| | Input Measure | Space Factor | Generated Space | Inventory | % I / G |
| **TEACHING/RESEARCH/ACADEMIC SUPPORT** | | | | | |
| CLASSROOMS | | | | | |
| **Total FTE Students** | | 1.23 | 0.00 | 170 | |
| CLASS LABS | | | | | |
| Lab Contact Hours W | 0.00 | 0.8 | 0.00 | 0.00 | |
| **Lab Contact Hours X** | 5,267.00 | 0.6 | 3,160.20 | 2,539.59 | |
| Lab Contact Hours Y | 0.00 | 0.5 | 0.00 | 0.00 | |
| Lab Contact Hours Z | 0.00 | 0.3 | 0.00 | 0.00 | |
| Unclassified | | | | | |
| **Total Class Lab** | 5,267.00 | | 3,160.20 | 2,539.59 | 80.4 |
| RESEARCH LABS | | | | | |
| **Research Disciplines A** | 150.50 | 45.0 | 6,772.50 | 3,920.91 | |
| Research Disciplines B | | 30.0 | 0.00 | 0.00 | |
| Research Disciplines C | | 20.0 | 0.00 | 0.00 | |
| Research Disciplines D | | 10.0 | 0.00 | 0.00 | |
| Research Disciplines E | | 1.0 | 0.00 | 0.00 | |
| Unclassified | | | | | |
| **Total Research** | 150.50 | | 6,772.50 | 3,920.91 | 57.9 |
| OFFICE - ACADEMIC | | | | | |
| Total FTE Faculty | 45.00 | 12.0 | 540.00 | 1,234.27 | 228.6 |
| Research Appointments | 31.00 | 12.0 | 372.00 | 750.26 | 201.7 |
| Total FTE Grads | 180.00 | 3.0 | 540.00 | 1,223.77 | 226.6 |
| Total FTE Non-Acd Staff | 43.00 | 12.0 | 516.00 | 497.53 | 96.4 |
| Office Service | 1,968.00 | 0.25 | 492.00 | 636.52 | 129.4 |
| **Total Academic Office** | | | 2,460.00 | 4,342.35 | 176.5 |
| OFFICE - ADMINISTRATIVE | | | | | |
| Total FTE Non-Acd Staff | 0.00 | 12.0 | 0.00 | 0.00 | |
| Office Service | 0.00 | 0.5 | 0.00 | 0.00 | |
| Total Admin. Office | | | 0.00 | 0.00 | 0.0 |
| **Total Office - Academic & Administrative** | | | 2,460.00 | 4,342.35 | 176.5 |
| LIBRARY FACILITIES & CAMPUS STUDY SPACE | | | | | |
| **Study (Total FTE Students)** | 0.00 | 0.6 | 0.00 | 238.41 | #DIV/0! |
| Traditional Static Shelving Space | | 0.005 | 0.00 | | |
| Mobile Compact Shelving | | 0.004 | 0.00 | | |
| Super High Density | | 0.0035 | 0.00 | | |
| **Total Stack** | 0.00 | | 0.00 | 242.32 | #DIV/0! |
| **Library Support** | 0.00 | 0.25 | 0.00 | 37.63 | #DIV/0! |
| **Total Library Facilities & Campus Study Space** | | | 0.00 | 518.36 | #DIV/0! |
| **SUB-TOTAL: TEACHING/RESEARCH/ACAD SUPPORT** | | | **12393** | **11492** | **92.7** |
| **OTHER SPACE** | | | | | |
| RECREATION / ATHLETICS | | | | | |
| Under 4,000 FTE Enrol. | 0.00 | | | | |
| 4,000-8,000 Enrol. | 0.00 | | | | |
| Total FTE Students | 0.00 | 0.9 | 0.00 | | |
| Total P.E./Athletics | | | 0.00 | 0.00 | |
| MAINTENANCE SHOPS | | | | | |
| Total NASM Inv. (exc. 16.0) | 0.00 | 0.015 | 0.00 | 0.00 | |
| STUDENT AND CENTRAL SERVICES | | | | | |
| Total FTE Students | 0.00 | 1.5 | 0.00 | 496.13 | |
| **SUB-TOTAL: OTHER SPACE** | | | **0.00** | **496.13** | |
| **TOTAL FORMULA AREAS** | | | **12392.70** | **11987.82** | **96.7** |

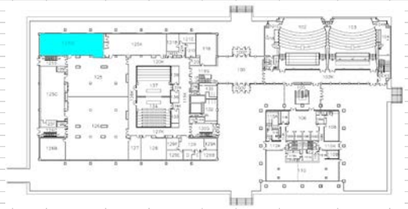
# APPENDIX 6: Teaching Laboratories Utilization (page 1 of 4)

**Physics Classroom Usage Analysis - February 2016**
**Teaching Lab - PHY Fall (Page 1 of 2)**
**Schedules (Page 1 of 4)**

| | | | |
|---|---|---|---|
| | Scheduled Class Times | E | =Enrolment |
| | Engineering Class Times | (H) | =Total Hours |
| | TA Training | | |
| | Additional Bookings + Labs | | |

Rm MP125B - Classroom
Capacity = 36 Nasms = 135.15
Total Scheduled Weekly hrs = 28
Total Additional Weekly hrs = 0

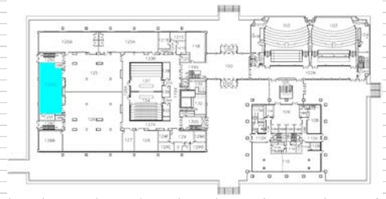
| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY113H1 (2) E=36 | | PHY113H1 (2) E=32 | PHY113H1 (2) E=32 |
| 11 | | | | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 |
| 12 | | | | | |
| 1 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 |
| 2 | | | | | |
| 3 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | PHY113H1 (2) E=36 | | |
| 8 | | | | | |
| 9 | | | | | |



No Photo Available (Similar to 125C & 125A)

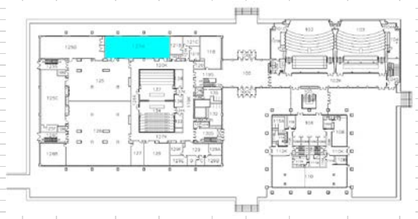
Rm MP125C - Classroom
Capacity = 36 Nasms = 122.19
Total Scheduled Weekly hrs = 16
Total Additional Weekly hrs = 3

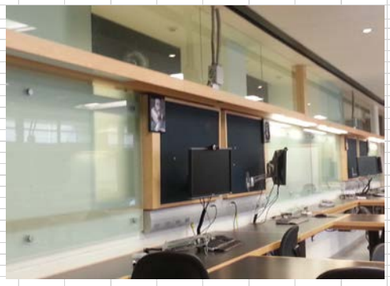
| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | PHY111 TA (1) | |
| 10 | | PHY113H1 (2) E=36 | | | PHY112H1 (2) E=36 |
| 11 | | | | | |
| 12 | | | | | |
| 1 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | | |
| 2 | | | | | PHY112H1 (2) E=36 |
| 3 | PHY113H1 (2) E=36 | | | PHY112 TA (1) | |
| 4 | | PHY113H1 (2) E=36 | PHY131 TA (1) | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |



Rm MP125A - Classroom
Capacity = 36 Nasms = 133.92
Total Scheduled Weekly hrs = 28
Total Additional Weekly hrs = 0

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY113H1 (2) E=36 | | PHY113H1 (2) E=34 | PHY113H1 (2) E=34 |
| 11 | | | | | |
| 12 | | | | PHY113H1 (2) E=34 | PHY113H1 (2) E=34 |
| 1 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | | |
| 2 | | | | PHY113H1 (2) E=36 | BPHY113H1 (2) E=36 |
| 3 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | PHY113H1 (2) E=36 | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | PHY113H1 (2) E=36 | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |

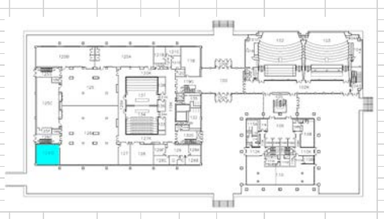




Rm MP126B - Classroom
Capacity = 10 Nasms = 53.68
Total Scheduled Weekly hrs=
Total Additional Weekly hrs=

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |

This has been used for lab work, but is temporarily a storeroom

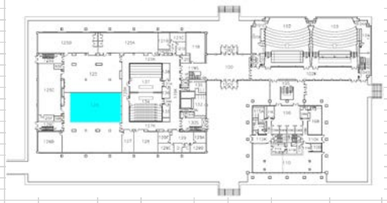


No Photo Available

Previously used as a dark space for experiments, but recent switch to a different pedagogy, so now used for storage until renovations are completed

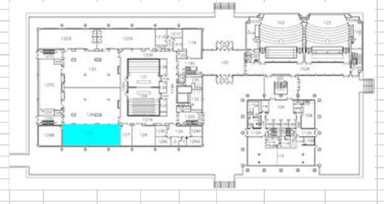
Rm MP126 (East) - Classroom
Capacity = 50 Nasms = 150.13
Total Scheduled Weekly hrs = 12
Total Additional Weekly hrs = 0

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY180 Engineering (3) E=41.5 classes alternate weekly 41/42 | PHY180 Engineering (3) E=41.5 classes alternate weekly 41/42 | | PHY180 Engineering (3) E=41.5 classes alternate weekly 39/44 |
| 11 | | | | | |
| 12 | | | | | |
| 1 | | PHY180 Engineering (3) E=41.5 classes alternate weekly 41/42 | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |



Rm MP126w (West) - Classroom
Capacity = 50 Nasms = 136.32
Total Scheduled Weekly hr s= 24
Total Additional Weekly hrs = 0

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY151H1 (3) E=34 | PHY151H1 (3) E=34 | PHY151H1 (3) E=34 | PHY151H1 (3) E=33 |
| 11 | | | | | |
| 12 | | | | | |
| 1 | | PHY151H1 (3) E=34 | | PHY151H1 (3) E=34 | |
| 2 | | | PHY151H1 (3) E=34 | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | PHY151H1 (3) E=32 | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |



## APPENDIX 6: Teaching Laboratories Utilization (page 2 of 4)

**Physics Classroom Usage Analysis - February 2016**
**Teaching Lab - PHY Fall (Page 2 of 2)**
**Schedules (Page 2 of 4)**

| | | | |
|---|---|---|---|
| | Scheduled Class Times | E | =Enrolment |
| | Engineering Class Times | (H) | =Total Hours |
| | TA Training | | |
| | Additional Bookings + Labs | | |

Rm MP222 - Classroom
Capacity = 60 Nasms = 138.56
Total Scheduled Weekly hrs = 26
Total Additional Weekly hrs = 0

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY224H1 (3) E=65 | PHY293 Engineering (3) | PHY224H1 (3) E=65 | |
| 11 | | | | | PHY224H1 (3) E=65 |
| 12 | | | | | |
| 1 | PHY385H1 (2) E=29 | PHY224H1 (3) E=66 | PHY293 Engineering (3) | PHY224H1 (3) E=66 | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | PHY224H1 (3) E=65 | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |

Rm MP218 - Classroom
Capacity = 8 Nasms = 28.60
Total Scheduled Weekly hrs = 21
Total Additional Weekly hrs = 21

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY224H1 (3) E=8 | PHY293 (3) Engineering E=8 | PHY224H1 (3) E=8 | |
| 11 | | | | | PHY224H1 (3) E=8 |
| 12 | | | | | |
| 1 | | PHY224H1 (3) E=8 | PHY293 (3) Engineering E=8 | PHY224H1 (3) E=8 | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |

No Picture Available

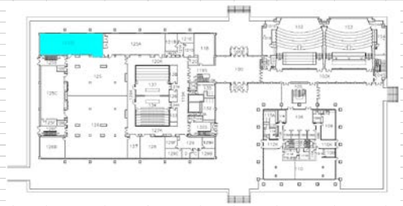
# APPENDIX 6: Teaching Laboratories Utilization (page 3 of 4)

**Physics Classroom Usage Analysis - February 2016**
**Teaching Lab - PHY Winter (Page 1 of 2)**
**Schedules (Page 3 of 4)**

| | | | |
|---|---|---|---|
| | Scheduled Class Times | E | =Enrolment |
| | Engineering Class Times | (H) | =Total Hours |
| | TA Training | | |
| | Additional Bookings + Labs | | |

Rm MP125B - Classroom
Capacity = 36 Nasms = 135.15
Total Scheduled Weekly hrs = 26
Total Additional Weekly hrs = 0

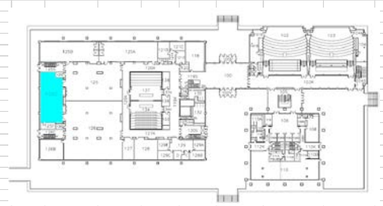
| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | | | | |
| 11 | | PHY132H1 (2) E=0 | | PHY132H1 (2) E=0 | PHY132H1 (2) E=35 |
| 12 | | PHY132H1 (2) E=20 | | PHY132H1 (2) E=25 | PHY132H1 (2) E=20 |
| 1 | PHY132H1 (2) E=32 | | PHY132 H1 (2) E=32 | | |
| 2 | | | | PHY132H1 (2) E=30 | |
| 3 | PHY132H1 (2) E=25 | PHY132H1 (2) E=23 | PHY132H1 (2) E=27 | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | PHY132H1 (2) E=0 | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |



No Photo Available (Similar to 125C & 125A)

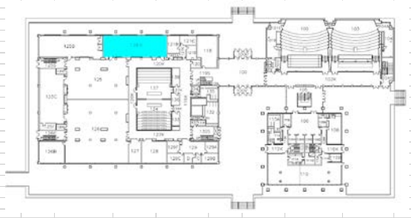
Rm MP125C - Classroom
Capacity = 36 Nasms = 122.19
Total Scheduled Weekly hrs = 16
Total Additional Weekly hrs = 10

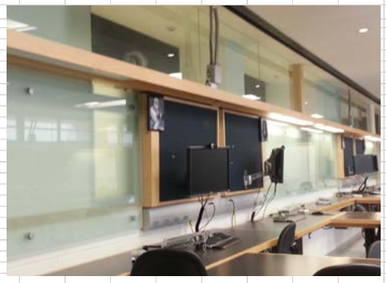
| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | TA training for PHY132 (2) | | PHY131H1 (2) E=28 | PHY131H1 (2) E=36 |
| 11 | | | TA Training for PHY131 (1) | | |
| 12 | ENV237H1 (2) E=17 | | | PHY131H1 (2) E=37 | PHY131H1 (2) E=29 |
| 1 | | | | | |
| 2 | | | PHY131H1 (2) E=36 | PHY131H1 (2) E=38 | PHY131H1 (2) E=33 |
| 3 | | | | | |
| 4 | | TA training for PHY132 (2) | | | |
| 5 | Pilot Course Capstone Learning Community (2) | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |



Rm MP125A - Classroom
Capacity = 36 Nasms = 133.92
Total Scheduled Weekly hrs = 26
Total Additional Weekly hrs = 0

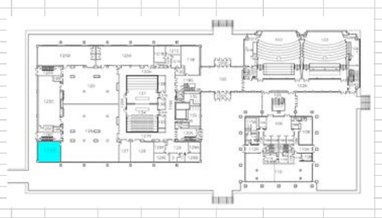
| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY132H1 (2) E=36 | | PHY132H1 (2) E=29 | PHY132H1 (2) E=35 |
| 11 | | PHY132H1 (2) E=20 | | PHY132H1 (2) E=25 | PHY132H1 (2) E=20 |
| 12 | PHY132H1 (2) E=32 | | PHY132 H1 (2) E=32 | | |
| 1 | | | | PHY132H1 (2) E=30 | |
| 2 | PHY132H1 (2) E=25 | PHY132H1 (2) E=23 | PHY132H1 (2) E=27 | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | PHY132H1 (2) E=25 | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |





Rm MP126B - Classroom
This has been used for lab work, but is temporarily a storeroom
Capacity = 10 Nasms = 53.68
Total Scheduled Weekly hrs=
Total Additional Weekly hrs=

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |

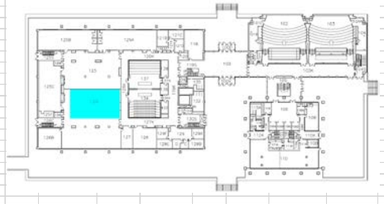


No Photo Available

Previously used as a dark space for experiments, but recent switch to a different pedagory, so now used for storage until renovations are completed

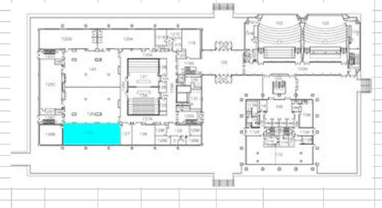
Rm MP126 (East) - Classroom
Capacity = 50 Nasms = 150.13
Total Scheduled Weekly hrs=
Total Additional Weekly hrs=

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | | | | |
| 11 | PHY131 Overflow | | PHY131 Overflow | | |
| 12 | | | | | |
| 1 | PHY 152 Overflow | | PHY 152 Overflow | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |



Rm MP126 (West) - Classroom
Capacity = 50 Nasms = 136.32
Total Scheduled Weekly hrs = 21
Total Additional Weekly hrs = 0

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY152H1 (3) E=21 | PHY152H1 (3) E=23 | PHY152H1 (3) E=31 | |
| 11 | | | | | |
| 12 | | | | | |
| 1 | | PHY152H1 (3) E=32 | | PHY152H1 (3) E=27 | |
| 2 | | | PHY152H1 (3) E=36 | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | PHY152H1 (3) E=29 | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |



Overflow is for oversubscribed lectures - this normally is not needed after a few weeks (student withdrawals)

# APPENDIX 6: Teaching Laboratories Utilization (page 4 of 4)

**Physics Classroom Usage Analysis - February 2016**
**Teaching Lab - PHY Winter (Page 2 of 2)**
**Schedules (Page 4 of 4)**

| | | | |
|---|---|---|---|
| | Scheduled Class Times | E | =Enrolment |
| | Engineering Class Times | (H) | =Total Hours |
| | TA Training | | |
| | Additional Bookings + Labs | | |

Rm MP222 - Classroom
Capacity = 60 Nasms = 138.56
Total Scheduled Weekly hrs = 22
Total Additional Weekly hrs = 0

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | PHY294 Engineering (3) E= 50 classes alternate weekly 50/50 | | |
| 10 | | PHY324H1 (3) E=44 | | PHY324H1 (3) E=47 | PHY205H1 (1) E=88 |
| 11 | | | | | |
| 12 | | | | | PHY205H1 (1) E=104 |
| 1 | | | | | |
| 2 | | PHY324H1 L0201 (3) E=58 | PHY294 Engineering (3) E= 50 classes alternate weekly 50/50 | PHY324H1 (3) E=58 | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | PHY205H1 (1) E=100 | | PHY205H1 (1) E=84 | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |

*enrolment in certain sections of these courses are above room capacity as the students rotate into other rooms for experiments post-instruction time

Rm MP218 - Classroom
Capacity = 8 Nasms = 28.60
Total Scheduled Weekly hrs = 18
Total Additional Weekly hrs = 0

| | M | T | W | R | F |
|---|---|---|---|---|---|
| 9 | | | | | |
| 10 | | PHY324H1 L0201 (3) E=8 | PHY294 Engineering (3) E=8 | PHY324H1 L0201 (3) E=8 | |
| 11 | | | | | |
| 12 | | | | | |
| 1 | | | | | |
| 2 | | PHY324H1 L0201 (3) E=8 | PHY294 Engineering (3) E=8 | PHY324H1 L0201 (3) E=8 | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |

No Picture Available