MSKTD

Purdue University College of Engineering

EE-MSEE Study

October 31st, 2014

PURDUE UNIVERSITY

MSKTD & Associates, Inc.

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Scope and Objectives

Project Scope and Objectives:

Scope

The scope of the project was described as a programming and schematic design exercise to try to reconfigure all of the current faculty offices, instructional and research ECE labs, administration spaces, graduate assistant offices, student space, conference and meeting rooms and general classrooms located on all of the floors into more efficient labs with better functionality/flexibility to accommodate the future growth of the departments. Our task was to create a new building space plan which expands on the lessons learned from the Grissom Building Renovation. We believe that by designing this new space, the College of Engineering will have a building that provides better classroom layout for current teaching and learning environments, better long term flexibility of space, enhanced handicapped access to the building's entrances and internal circulation, more robust mechanical, plumbing, electrical and technology infrastructure, a more efficient layout of departmental labs and support space which will enhance and make these labs work for today's students now and well into the future.

Location

The Electrical Engineering building renovation project comprises nearly 140,000 gross square feet. The project includes the original building (of which the actual construction date and drawings are not fully known by this author but assumed to be in the late 1920's or early 1930's), the multiple additions and renovations over the next 20 to 30 years and a large building addition called the Duncan Annex. This portion of the building was built on in the 1940's. Our study includes all space inside the Electrical Engineering Building, the Duncan Annex as well as portions of the ECE departments which happen to be located inside the MSEE building next door. Although our study report does not directly show all of those conversations, diagrams and space needs analysis, we did spend a portion of time assessing those areas to make sure that the program of spaces considered proximities and relationships in the final analysis. Although not all of these space needs could be met, we did provide many solutions for increasing spatial relationships that worked better and more efficient use of resources.

One must keep in mind that part of this overall project was to study an area described as the "DL2" Lab space. This early study involved multiple instructional labs located on the ground floor. The directive by Purdue University for this early pull-ahead project was to try to renovate a portion of instruction lab area that had been closed off due to an event that created space that was no longer available to students and faculty. After much review and discussion in April and May of this year, it was determined the most optimal location for these labs was basically in the same location but with different orientation and access. This decision was made after spending time reviewing the current building support functions and the configuration and layout of the existing structure of the building. It became apparent that the current location was fairly well suited for that type of lab space.

This renovation does not come with some restrictions. Current use of Classroom 129 must remain operational the entire time the renovations project is being undertaken except for various times during the year when the students are not in session such as summer, fall and winter breaks and other major holidays and vacation periods as set by the University.

Evaluation

We looked at the building from various perspectives and these were the major criteria we utilized:

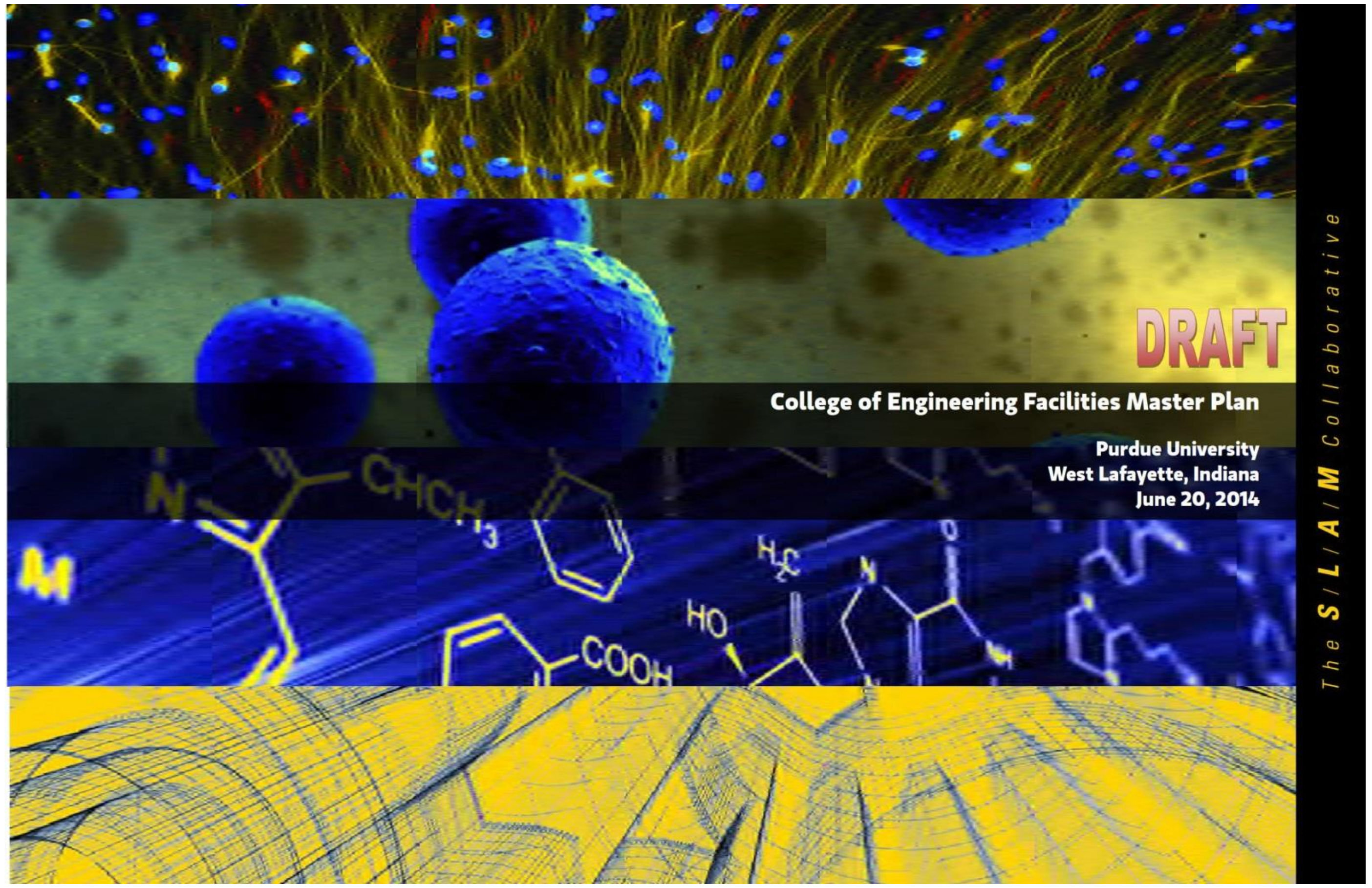
- <u>Infrastructure</u>
  - Analysis of the buildings super structure shows this building was designed originally for multiple educational uses. Offices, classrooms and lab functions use were planned when the building was built. One thing that was not considered in the early designs was flexibility.
  - The building envelope (walls, doors, windows and roof) generally are in good shape except for special locations which are not providing ADA access or natural light into some spaces. This project will not modify the building walls or roof. The existing windows generally will remain. Some of the interior windows might be replaced and new windows will be added to the Duncan Annex for lighting many spaces inside that portion of the EE building. Exterior doors will be replaced as needed for new access and upgrades as needed.
  - Elevators will be repaired if they remain or removed if no longer functioning the spaces served. A new elevator core is being added to better service many inaccessible areas inside the Duncan Annex as well as the EE building.
  - Review of the electrical service shows we can remove much of the existing internal power and lighting panels and upgrade the services with no primary service upgrades. The existing building has more than enough power for current and future needs. Current code requires new lighting and power panels as well as arc flash upgrades. The new panel upgrades will reinforce the need for new building lighting and power as well. Refer to the electrical portions of this report for more detail on this subject.
  - The mechanical systems reveal a bit more difficult solution in which to solve the heating and cooling conditions for the building. We feel that providing all new mechanical systems are necessary for this aging facility. The current systems are old, inefficient and not properly designed due to various renovations and additions over the years. New technology in systems design will provide better efficiency as well as performance for the buildings occupants. Refer to the mechanical portion of this report for more detail on this subject.
  - Plumbing systems will be replaced to better serve the occupants of the building. These improvements will provide better access to restrooms, better lab support as well as other necessary potable water services.
  - Telecommunications inside this building will also a bit more difficult to resolve. Existing telecommunication closets located inside EE are old and not developed to provide adequate services for the EE renovation into the future. We are therefore recommending that new BDF and IDF rooms be constructed within the building to provide data and video service for this major renovation. The new infrastructure will be strategically located for future growth and expansion.

Master Plan

Master Plan:

The following images represent a few pages from the SLAM Master Plan Document dated June 20, 2014. The first page is a general statement of the purpose of the facility master plan. Obvious to this project is the fulfillment of supporting the strategic growth initiative of the College of Engineering along with renewal and replacement of the physical facilities within the EE building.

The additional pages from the Master Plan documents show various options for the Electrical Engineering Building. All options show ECE instructional labs, classrooms and faculty remaining inside the building supporting the core mission of the College of Engineering.



Introduction

COLLEGE OF ENGINEERING

VISION

"We will be known for our impact on the world."

MISSION

"To advance engineering learning, discovery, and engagement in fulfillment of the Land Grant promise and the evolving responsibility of a global university."

GOALS

- **GRADUATES EFFECTIVE IN A GLOBAL CONTEXT**

  Purdue Engineers will be prepared for leadership roles in responding to the global technological, economic, and societal challenges of the 21st century

- **RESEARCH OF GLOBAL SIGNIFICANCE**

  We will focus our talent and facilities on research with great potential for expanding the boundaries of science and technology and addressing the global challenges and opportunities of the 21st century

- **EMPOWERING OUR PEOPLE, ENRICHING OUR CULTURE**

  We will create a leadership culture and environment where the people of Purdue Engineering can dream their boldest dreams and collaborate in a place where those dreams can become reality

Introduction

Purdue University's College of Engineering is among the largest and most highly ranked in the United States and is committed to leveraging its strength in undergraduate education, to further expanding and strengthening its faculty, to increasing its excellence in research and growing creative discovery, to improving the quality of its graduate programs, to completing improvements to its facilities and environment, and to continuing its deep commitment to increasing diversity among its students and faculty. The College is comprised of thirteen academic schools and divisions and nine programs. Engineering is crucial to innovation, economic development, jobs creation and to addressing the grand challenges facing our world in the 21st century. And the College is accelerating the speed at which it progresses to bring itself from excellence to preeminence.

In 2009, the College of Engineering announced its strategic plan, *Extraordinary People, Global Impact*. This plan sets aside business as usual and calls on the creativity and drive of its people—faculty, students, staff, alumni, and friends—pursuing individual passions and shared goals to make Purdue Engineering *known for its impact on the world.*

Since 2009, some remarkable and game-changing opportunities for strategic growth and expansion have occurred:

- In 2012, Purdue's Board of Trustees endorsed a five-year plan for a landmark investment in the College of Engineering, prompted by significant growth in its undergraduate and graduate enrollments and in its research enterprise, and spurred by the national call for the U.S. to graduate 10,000 more engineers a year. The College expects to increase the size of its faculty by 30% and staff by 28% by 2017.
- In 2013, President Mitch Daniels launched the Purdue Moves initiatives, a set of big ideas that will drive innovation, achievement, and growth across the University and differentiate Purdue as one of the true STEM capitals of higher education. A key Purdue Move is the expansion of the College of Engineering—a move that builds on and broadens the College's strategic plan.
- Growth on this scale is an opportunity for transformational change and must be supported by appropriate physical resources to accommodate personnel, instructional, research, and collaboration activities. In 2013 the College commissioned The S/L/A/M Collaborative to develop a facilities master plan to align the College's physical resources with its Strategic Plan.

Current College of Engineering space associated with the West Lafayette campus is located on the core academic North Campus, on the South Campus, and off-campus and is comprised of approximately 950,000 net square feet. Certain initiatives including the Active Learning Center (classrooms), Innovation Design Center (student organization space), Zucrow Test Cell Facility, and Jischke Addition are already underway and informed the master plan space program

Existing space varies in quality depending on building and status of renewal activity. Space as currently occupied is highly utilized and does not allow for growth or expansion of individual worksettings, instruction, research, and collaboration.

Master Plan Objectives

The purpose of the facilities master plan is to:

- Create a comprehensive physical facilities plan to support the College's Strategic Plan and to align with the University Campus Plan
- Define the physical resources required to sustain and advance the College's mission, goals, objectives, and priorities
- Identify the College's immediate needs and establish a long-term strategy for additions to and renewal and/or replacement of physical facilities.
- Identify a long-term physical vision for the College, reflective of its position as one of the best colleges of engineering in the nation and the world
- Provide the College with a sense of place that proclaims its purpose, distinction, and domain

The facilities master plan specifically studies and resolves the following issues:

- Determine individual group current space needs and projected over a 10-year timeframe
- Accommodate the current program of space requirements and projected growth
- Establish appropriate space assignments and a consistency in space quality.
- Understand and develop existing building condition assessments in order to assure the best and highest use for existing facilities.
- Understand space use and optimize utilization of available space
- Maintain strategic and/or desired adjacencies
- Maintain strategic and/or desired north, south, and off-campus locations
- Enable classrooms upgrades
- Provide space for unknown future initiatives and/or aspirational growth
- Develop a prioritized plan for major renovations and new construction projects with appropriate phasing, costs, and schedules for integration into Purdue's ongoing capital planning budget process

Project Description

This document provides a facilities master plan to:

- Accommodate the addition of 107 faculty (28% growth), 100 staff (30% growth), 300 paid graduate students, and 500-600 unpaid graduate students in 5 years
- Improve the quality of outdated instructional and research space.
- Provide worksettings and research space for personnel growth, and to increase efficiency of space utilization.

Growth in personnel is anticipated to be completed by the fall of 2017 with facility alignment completed in 2021. The master plan also takes longer range growth into account by identifying opportunities for additional growth of physical resources.

This study defines programmatic space needs, assesses existing conditions, defines planning criteria, looks at conceptual planning options, develops the selected master plan option, and develops a budget and schedule model. This master plan meets the anticipated needs of the College of Engineering through continued use of existing space, new construction and remodeling/repurposing of existing space. The study identifies needs that can be accommodated in repurposed space and those that can only be met by construction of new space. The study has taken into account prioritized needs and has developed phasing strategies for implementation.

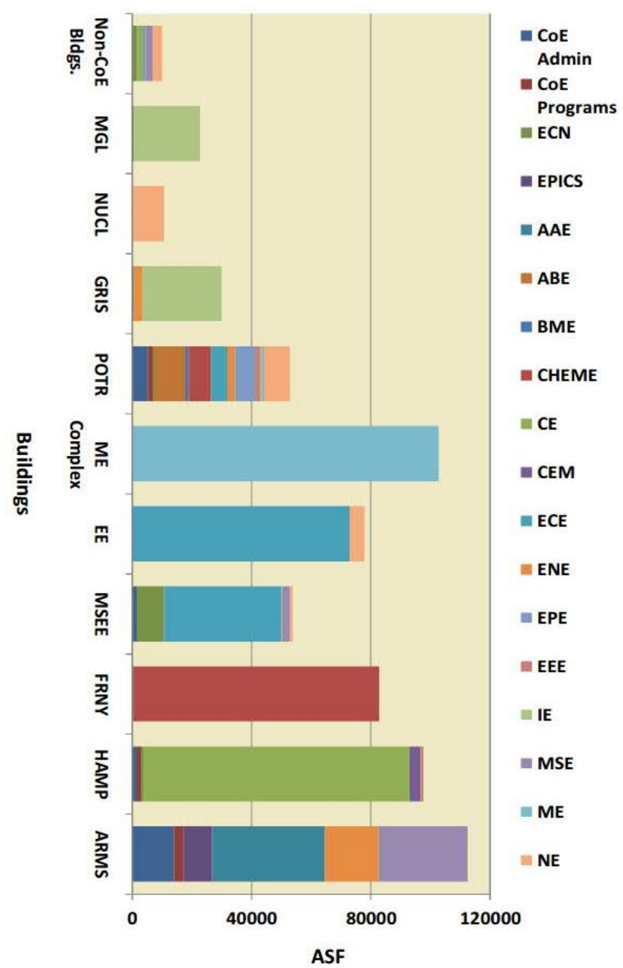


Chart 1.3.a showing CoE space in North Campus buildings

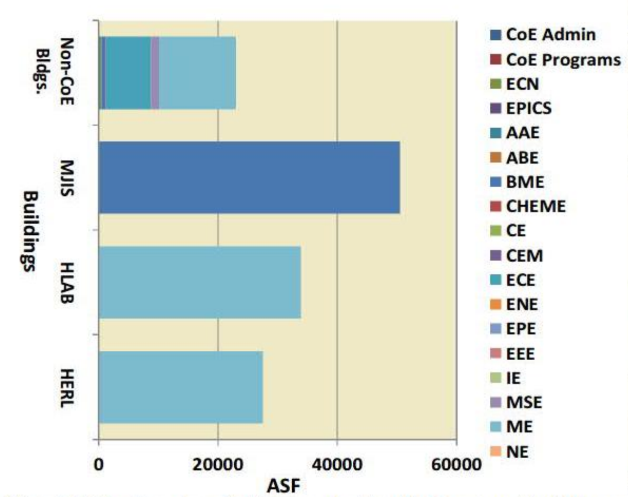
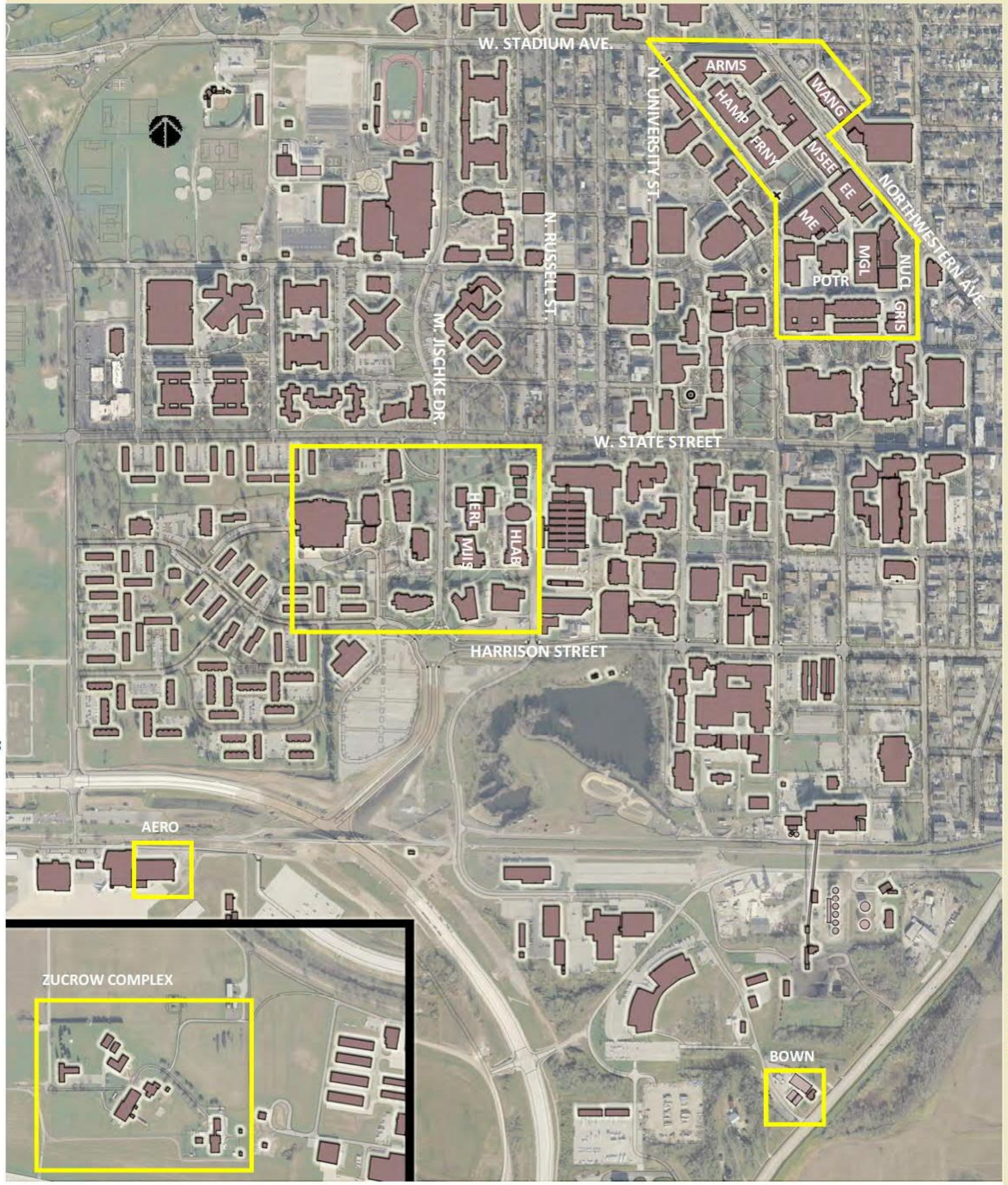


Chart 1.3.b showing CoE space in South Campus buildings

Aerial view of campus:

Existing College of Engineering facilities are located within the highlighted areas.



The College of Engineering is comprised of the following Schools, Divisions, Programs, and Units

- Dean's Office
- Engineering Computer Network
- Engineering Projects in Community Service
- Global Engineering Program
- Honors Program
- Minority Engineering Program
- Office of Future Engineers
- Office of Professional Practice Programs
- Women in Engineering Program
- System of Systems
- School of Aeronautics and Astronautics
- School of Agricultural & Biological Engineering
- Weldon School of Biomedical Engineering
- School of Chemical Engineering
- Lyles School of Civil Engineering
- Divisions of Constriction Engineering & Management
- School of Electrical & Computer Engineering
- School of Engineering Education
- School of Engineering Professional Education
- Division of Environmental & Ecological Engineering
- School of Industrial Engineering
- School of Materials Engineering
- School of Mechanical Engineering
- School of Nuclear Engineering

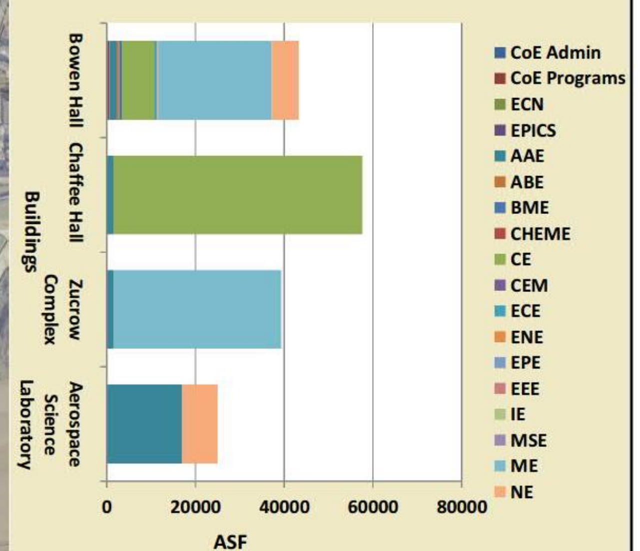


Chart 1.3.c showing CoE space in Off-Campus buildings

The S/L/A/M Collaborative

Executive Summary

Introduction

INTRODUCTION

Goals and Objectives

A program of space requirements has been developed to accommodate the needs of the College of Engineering through the year 2017. The goal of the space program is to document the types, quantity, and quality of spaces that are required to accommodate the activities that will meet the Strategic Plan of the College. Through meetings with the Core Committee, Steering Committee, representatives of the College of Engineering Schools and Divisions, the Facilities Department, and other stakeholders a clear understanding of what the facility master plan program should provide was developed.

The resulting program encompasses a broad vision for facilities, both new and existing, that:

- Meets current and future needs and provides space to grow
- Develops a sense of community and place
- Creates collaborative facilities that catalyze people
- Enables organization of space on an interdisciplinary and synergistic basis rather than only departmental
- Develops a "road map" for future capital growth that can be phased as funding becomes available

Space needs are both quantitative and qualitative. Quantitative space needs are perhaps the easiest to understand as these address accommodating anticipated growth and achieving parity of space among all users in alignment with Purdue University space guidelines. Qualitative space requirements address the need to create an experiential, integrated, and collaborative learning and research environment that have a tremendous impact on productivity and success in learning and research at the College of Engineering.

Thus, the facility master plan program has been developed to accomplish the following.

- Provide appropriate office and office support space for the anticipated number of personnel
- Create a state-of-the-art teaching and learning environment including:
  - Experiential teaching lab spaces
  - Large teaching spaces
  - Opportunities for informal learning
  - Enable inter– and trans-disciplinary learning
  - Student project space
  - Access to more equipment and instrumentation
- Create a state-of-the-art research environment including:
  - Appropriate heating, ventilation, air conditioning, electrical, and plumbing systems
  - Grouping of disciplines regardless of department
  - Flexible research and support spaces to accommodate evolving research targets, group sizes, and equipment and instrumentation.
  - Core and specialized support facilities that are consolidated and avoid duplication where appropriate
- Incorporate state-of-the-art technology:
  - Increased data usage and storage space to enable collaborations
  - Enabling use of technology to share knowledge beyond Purdue borders
- Create collaboration and interaction environments:
  - Opportunities for spontaneous interactions
  - Space for student/faculty and student/grad/post-doc engagement
  - Surge office and social space for visitors that is not isolated
- Enhance Purdue's close relationship with state and industry partners:
  - Space to meet specific industry needs
  - Space for after-hours courses and meetings
- Create a community with a sense of place that proclaims the stature of the College of Engineering and that:
  - Provides compelling and exciting space
  - Enhances faculty and student recruitment
  - Provides clarity, wayfinding, and organization
  - Fosters transparency and accessibility
  - Creates density and buzz
  - Puts science on display

And finally, the facility master plan program for the College of Engineering must align with the Campus Master Plan in order to add to a cohesive and comprehensible campus.

Program Development Process and Methodology

The program was developed based on Purdue space guidelines, scientific requirements, utilization, and the requirement to create community and enhance interaction. All of these were informed by the Core Committee, Steering Committee, Departmental, and other stakeholder meetings.

Purdue space guidelines delineate the amount of space allocated for an individual worksetting for each category of personnel. Office support space and collaboration space is added to achieve a state-of-the-art workplace.

Space Program

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING (ECE)

Personnel Change

- 23% faculty and staff increases to support the College's growth initiative
- 25% faculty increase
- 23% increase of staff

Table 2.34.a -Personnel summary by position

Space Type	PERSONNEL – ALL CAMPUSES: Total Number of Existing Personnel	Projected Growth	Total Master Plan Personnel
Offices	679	157	836
Dean			
Academic Department Head	1		1
Academic Associate Head	3		3
Tenured/TT Faculty	77	20	97
Adjuncts or Joint Appointments	4		4
Visiting Scholars (7% total of above)	20		20
Research or Visiting Faculty	4		4
Instructor or Lecturer		3	3
Emeritus/Emeritas Office	3		3
Post-Doctoral Assistants - Workstation	14	2	16
Grad - Thesis*	507	126	633
Professional Staff - Office			
Development	3		3
UG Director/Advisors/Coordinators	4	2	6
Grad	4	1	5
Business Manager	1		1
Business Staff	9	1	10
ECN-IT Staff			
Admin/Operations Staff - Workstation			
Admin Assist to Faculty	1		1
Secretary to Faculty	8	1	9
Development Admin	1		1
UG Receptionist	1		1
Grad Secretary	1		1
Staff			
Building Services	1		1
Mail Services	1		1
Web	2		2
Computing Services	1		1
UG Lab Techs	4	1	5
Shops	3		3
Teaching	1		1

Table 2.34.b—North Campus master plan space program

Space Type	EXISTING: OFF- CAMPUS Area	OFF- CAMPUS Worksettings or Seats	SOUTH CAMPUS Area	SOUTH CAMPUS Worksettings or Seats	NORTH CAMPUS Area	NORTH CAMPUS Worksettings or Seats	TOTAL: TOTAL EXISTING AREA (NSF)	TOTAL EXISTING WORKSETTINGS	MASTER PLAN FOR NORTH CAMPUS FUNCTIONS – Worksettings: Located on North Campus	North Campus Adjustment / Growth	Total Worksettings	Required Seats – Instr.: Teaching Lab Seats	Collaboration: Personnel Collaboration	Student Collaboration	Res.: Research seats	Master Plan Program – cap.: Seats	per room: NSF / Seat	NSF / station or Room	TOTALS: No. of stations or Rooms	Total Area (NSF)	Comments
Offices	0	0	7,598	126	43,985	418	51,583	544	436	265	701				370.5					32,698	
Academic Department Head					711	1		1	1		1				1			180	1	180	
Academic Associate Head						3			3		3				3			150	3	450	
Tenured/TT Faculty			2,187	14	13,265	63		77	63	20	83				69			120	83	9,960	96 existing - 13 vacant
Adjuncts or Joint Appointments			316	3	227	1		4	1		1				1			60	1	60	
Visiting Scholars (7% total of above)									20		20				20			746	1	746	
Research or Visiting Faculty			159	1	282	3		4	3		3				3			60	3	180	
Instructor or Lecturer									0	3	3							120	3	360	
Emeritus/Emeritas Office					556	3		3	3		3							120	1	120	
Post-Doctoral Assistants - Workstation			479	12	326	2		14	2	2	4				4			90	4	360	
Grad - Thesis*			3,921	94	17,956	303		397	303	236	539				269.5			40	377	15,092	* MP provides grad desks at ratio of .7 desk/grad
Professional Staff - Office			536	2	3,605	2		4	2	2	4										
Development																		120	3	360	
UG Director/Advisors/Coordinators																		120	3	360	
Grad																		120	6	720	
Business Manager						1		1	1		1							120	5	600	
Business Staff						9		9	9		9							120	1	120	
Admin/Operations Staff - Workstation					905	27		27													
Admin Assist to Faculty									1		1							90	1	90	
Secretary to Faculty									8	1	9							120	9	1,080	
Development Admin									1		1							90	1	90	
UG Receptionist									1		1							90	1	90	
Grad Secretary									1		1							120	1	120	
Staff																					
Building Services									1		1							120	1	120	
Mail Services									1		1							90	1	90	
Web									2		2							120	2	240	
Computing Services									1		1							120	1	120	
UG Lab Techs									4	1	5							120	5	600	
Shops									3		3							90	3	270	
Teaching									1		1							120	1	120	
Office Support					3,137		3,137													1,800	
Department Reception																		300	1	300	
Files/Storage																		300	2	600	
Admin Workroom																		300	1	300	
Business Workroom																		300	1	300	
Academic Advising																		300	1	300	
Research Labs & Support	0				34,717		34,717								370.5	395				52,367	
Experimental																278	200	55,575	1	55,575	
Relocate to Flex Lab																24	230.2			-5,524	
Specialized Shared Support	600				4,260		4,860													5,600	
Shops					1,979													3,000	1	3,000	
Instrument Room																		400	1	400	
Export Control Space																		400	1	400	
Central Storage	600				2,371															1,800	

Table 2.33.b—North Campus master plan space program

Space Type	EXISTING: OFF- CAMPUS Area	OFF- CAMPUS Worksettings or Seats	SOUTH CAMPUS Area	SOUTH CAMPUS Worksettings or Seats	NORTH CAMPUS Area	NORTH CAMPUS Worksettings or Seats	TOTAL: TOTAL EXISTING AREA (NSF)	TOTAL EXISTING WORKSETTINGS	MASTER PLAN FOR NORTH CAMPUS FUNCTIONS: Worksettings: Located on North Campus	North Campus Adjustment / Growth	Total Worksettings	Required Seats: Instr. Teaching Lab Seats	Collaboration: Personnel Collaboration	Student Collaboration	Res. Research seats	Master Plan Program: cap. Seats	per room: NSF / Seat	NSF / station or Room	TOTALS: No. of stations or Rooms	Total Area (NSF)	Comments
Teaching Labs & Support	**0**				**20,935**		**20,935**					**673**							23	**26,109**	
ASIC Design Lab, CMOS VLSI Design Lab												20				20	50	1,000	1	1,000	POTR 360
Computer Design and Prototyping (UNIX)												24				24	50	1,200	1	1,031	EE 069
Video & Image Systems Engineering Lab												24				24	50	1,200	1	1,200	MSEE 190
Digital Systems Senior Design Project												36				12	50	600	3	2,412	EE 061, 063, 064
Electro and Fiber Optics Lab												12				12	50	600	1	502	MSEE 016
Digital Logic Design Lab												48				24	50	1,200	2	2,400	EE 065 / grow to 2
Digital Systems Courses												0				16	50	800	0	0	EE 058, in research lab
Electronic Devices & Design Lab												24				24	50	1,200	1	1,200	EE 167
Electronics Measurements Teaching Lab												60				30	50	1,500	2	1,660	EE 161, EE 163
Elec. Circ. & Sys. Sys. Sim. & Ctrl. Lab												18				18	50	900	1	980	EE 165
Microwave Meas. & Simulation Lab												0				8	75	600	0	0	EE289, held in research lab
Electromagnetic Motion Devices Lab												16				16	50	800	1	610	EE 057
Microprocessor Systems & Interfacing												24				24	50	1,200	1	981	EE 067
Modern Filter Design												10				10	75	750	1	319	EE 056
Senior Design Lab												70				35	50	1,750	2	2,364	EE 159, EE160
Vertically Integrated Proj. - Soph.,Jr, & Sr												15				16	75	1,200	1	997	MSEE 140
HP Digital Collaborative Classroom												48				48	30	1,440	1	1,316	MSEE 184
SW for Embedded Sys. Embedded Sys.												20				20	30	600	1	693	EE 217
Linux Adv. C Comp. Lab, Op. Sys. Eng. Lab												60				30	30	900	2	1,865	EE 206/207
Flex Teaching Labs												120				30	30	900	4	3,600	ability to combine / divide
Flex Lab - Computer Lab												24				24	30	720	1	720	
Teaching Support - 1%																		259	1	259	
Collaboration Space	**0**				**10,225**		**10,225**		**0**		**0**		**348**	**296**						**10,929**	
Personnel Collaboration																					153 seats existing
Presentation Conference Room													40			40	25	1,000	1	1,000	In Wang
Conference Room					639								48			24	25	600	2	1,200	
Conference Room					3,084								64			16	25	400	4	1,600	Assume 1 in Wang
TA Consult/Help/Advising Rooms					1,251								48			4	25	100	12	1,200	
Mediascapes													60			6	25	150	10	1,500	
Break/Coffee Bar					237								40			10	25	250	4	1,000	
Open Lab - Grad Project Space													48			12	50	600	4	2,400	
Student Collaboration																					138 seats existing
Open Lab - Undergrad Project Space					754									48		24	50	1,200	2	2,400	
Open Lab - Computer D-CL Terminals					2,296									72		72	30	2,160	1	1,729	MSEE 189
Student Organizations					238									36		12	25	300	3	900	3 student orgs
Group Study (quiet)					830									40		4	25	100	10	1,000	
Break-out / Commons Undergrad					1,064									100		100	25	2,500	1	2,500	lounge, coffee
ELEC AND COMPUTER ENG TOTAL	**600**	**0**	**7,598**	**126**	**117,259**	**418**	**125,457**	**544**	**436**	**265**	**701**	**673**	**348**	**296**	**741**					**129,502**	

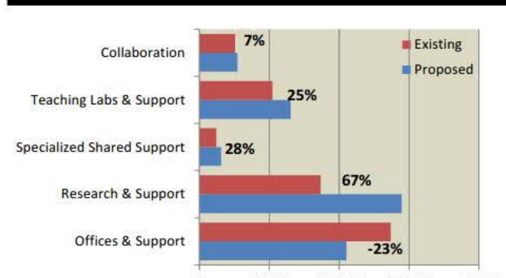


Chart 2.33.b -Change in program space type

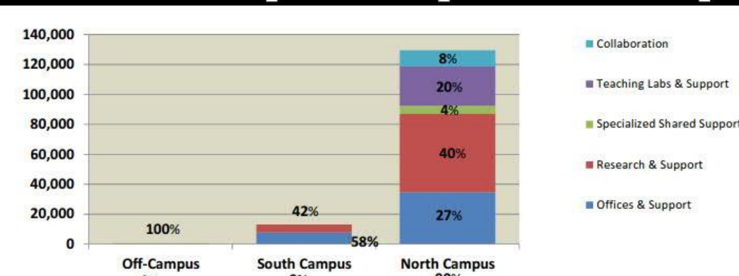


Chart 2.33.a -Program summary by location and space type

Teaching Labs and Support

The current facilities are overcrowded and more space will be required to add new teaching labs and student work space to support growing student populations.

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING (ECE)

Space Program

The Electrical Engineering graduate program is ranked 10th in the nation and the Computer Engineering graduate program is ranked 9th in the nation. Areas of research include:

- Automatic Controls
- Biomedical Imaging & Sensing
- Communications, Networking, Signal & Image Processing
- Computer Engineering
- Education
- Power & Energy Systems
- Fields & Optics
- Microelectronics & Nanotechnology
- VSLU & Circuit Design

Space Drivers

- To efficiently accommodate faculty and staff growth
- To support growing student enrollment

Program Changes

Offices and Support

There has been an overall reduction of space in this category despite personnel growth. New space standards help to minimize the growth in this category

Research Labs and Support

Experimental research labs include:

- Automatic Controls
- Microelectronics & Nanotechnology
- Fields & Optics
- Computer Engineering
- CNSIP Communications Networking: Signal & Image Processing
- Dry Computations Research Labs include:
- Biomedical Imaging & Sensing
- VSLI & Circuit Design
- Power & Energy Devices and Systems

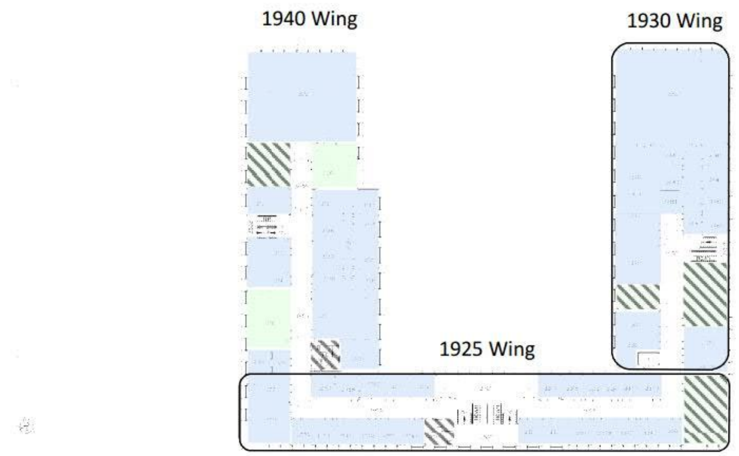
Total required research space exceeds the available space on the North Campus. Therefore, some research will be located in the South Campus Flex Lab. It is recommended that the research best served by intra-disciplinary actives should be at the Flex Lab.

Table 2.33.a -Program summary by location and space type

	MP Total: Off-Campus	South Campus	North Campus	Total
Offices	0	7,598	32,698	40,296
Office Support	0	0	1,800	1,800
Research Labs & Support	0	5,524	52,367	57,891
Specialized Shared Support	600	0	5,600	6,200
Teaching Labs & Support	0	0	26,109	26,109
Collaboration Space	0	0	10,929	10,929
ELEC AND COMPUTER ENG TOTAL	**600**	**13,122**	**129,502**	**143,224**

The S/L/A/M Collaborative

Master Plan Program



Third Floor Plan

Existing Space Use

- Office
- Research
- Instructional
- Collaboration
- Poor Quality / Poor Use

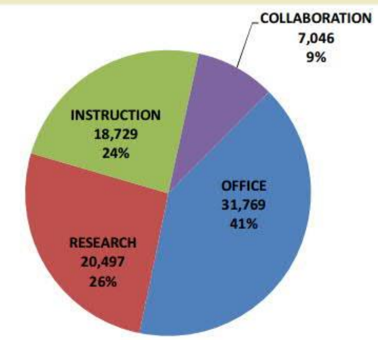


Chart 3.9 -Distribution of ASF by space type

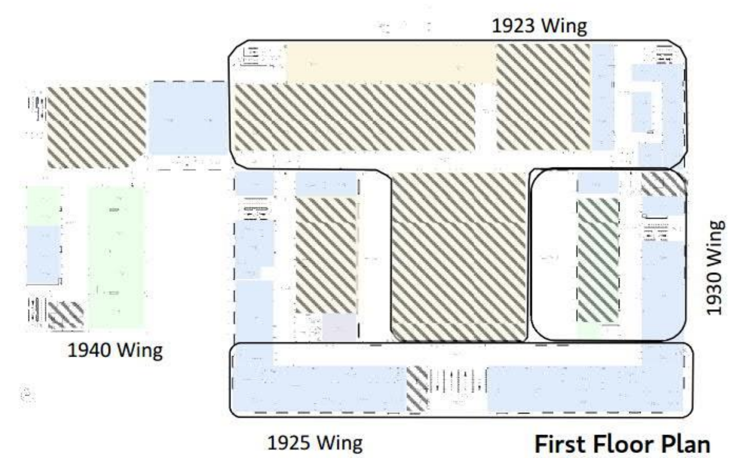
The Electrical Engineering building was built in four phases. The first wing was completed in 1923 and the first addition was completed in 1925. The second was completed in 1930 and the final addition was completed in 1940. In 1962 a nuclear reactor was installed in the basement of the last building addition. The building houses the School of Electrical and Computer Engineering, Nuclear Engineering, and Engineering Computer Network. Also located in the building are many SMAS classrooms including a large 468-seat auditorium.

Electrical Engineering Building (EE)

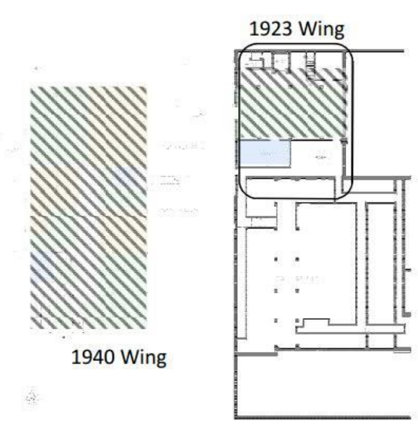
Constructed:	1923 Additions in 1925, 1930, and 1940
Structural System:	Concrete
Building efficiency:	49.8%
Highest and best use:	Technical (Research & Instructional)
Repair & Rehabilitation Level:	4
Current Replacement Value:	$59,073,718
Deferred Maintenance Value:	$17,672,092
Facility Condition Index:	0.30

Second Floor Plan

Ground Floor Plan



First Floor Plan



Basement Plan

Legend
- ◎ Poor
- ◒ Fair
- ● Good

Building	Functionality						Environment			Infrastructure				
	Adjacencies	Appropriate Use	Research Space	Instruction Space	Support Space	Wayfinding	Finishes	Amenities	Accessibility	HVAC	Electrical Systems	Roof	Windows/ Doors	Elevator
Electrical Engineering														
EE Wing 0 - 1923												◎	◎	◒
First Floor Plan	◒	◒	◎	◎	◒	◎	◎	◎	◎	◎	◎			
Ground Floor Plan	◒	◒	◎	◒	◒	◎	◎	◎	◎	◎	◎			
Basement Plan	◒	◒	◎	◎	◎	◎	◎	◎	◎	◎	◎			
EE Wing 1 - 1925												◎	◎	◒
Third Floor Plan	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒			
Second Floor Plan	◎	◎	◎	◎	◎	◒	◎	◎	◎	◎	◎			
First Floor Plan	◒	◒			◒	◒	◒	◒	◒	◒	◒			
Ground Floor Plan	◒	◒	◒		◒	◒	◒	◒	◒	◒	◒			
EE Wing 2 - 1930												◎	◎	◒
Third Floor Plan	◒	◒	◎		◒	◒	◒	◒	◒	◒	◒			
Second Floor Plan	◒	◒	◎		◒	◒	◒	◒	◒	◒	◒			
First Floor Plan	◒	◒	◎		◒	◒	◒	◒	◒	◒	◒			
Ground Floor Plan	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒			
EE Wing 3 - 1940-Duncan Annex												◎	◎	◎
Third Floor Plan	◒	◒	◎		◒	◒	◒	◒	◒	◒	◒			
Second Floor Plan	◒	◒	◎	◎	◒	◒	◒	◒	◎	◒	◒			
First Floor Plan	◒	◒	◎	◎	◒	◒	◒	◒	◎	◒	◒			
Ground Floor Plan	◒	◒	◎	◎	◒	◒	◒	◒	◎	◒	◒			
Basement Plan	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎			

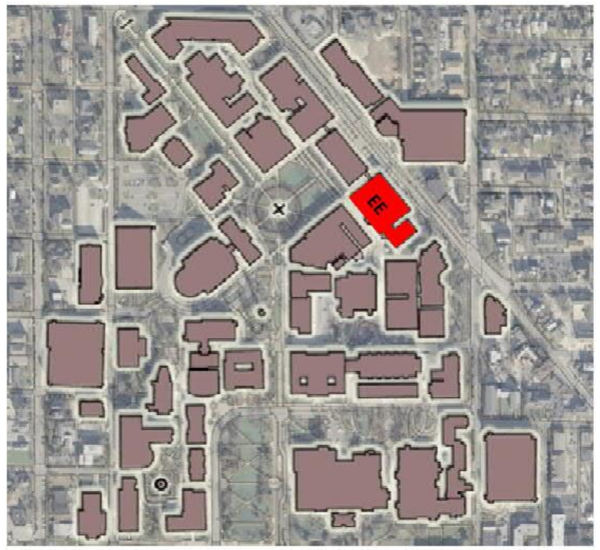
Table 3.9 -EE existing space analysis

Building & Site Evaluation

The S/L/A/M Collaborative

Renovation Plans

ELECTRICAL ENGINEERING BUILDING

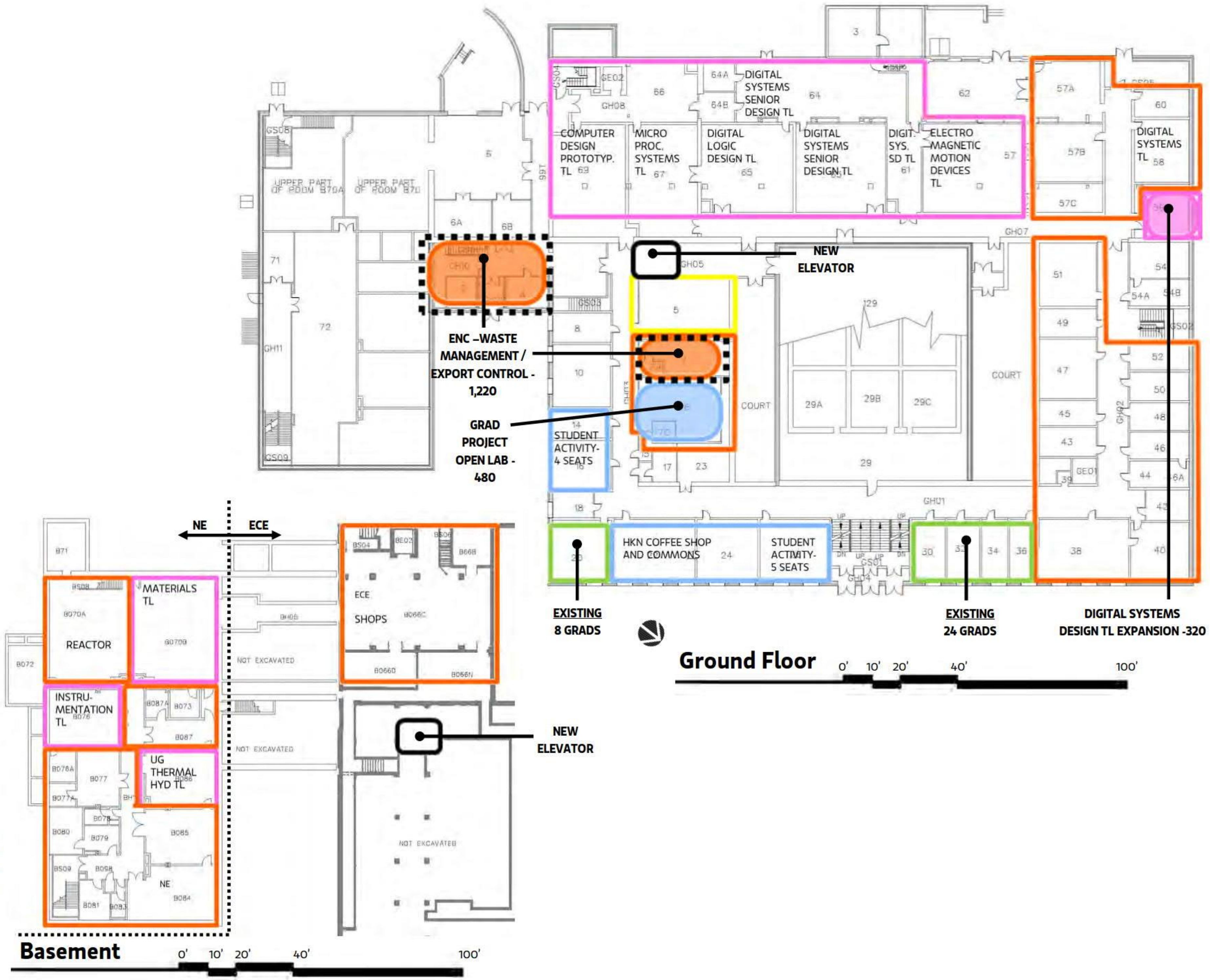


The location of the Electrical Engineering building (EE) is indicated in red above. The floor plans at the right indicate the existing uses and the areas envisioned for renovation or reassignment for new uses.

Figure 4.52

EXISTING USE	PROPOSED USE
OFFICE & SUPPORT	OFFICES
TEACHING LABS	WORK STATIONS
RESEARCH LABS	TEACHING LABS
COLLABORATION	RESEARCH SPACE
SMAS CLASSROOM	COLLABORATION
* SMAS TABLET ARM-CHAIR CLASSROOM	CLASSROOMS

Existing uses are indicated by rectangular edged shapes around the space. Proposed uses are indicated by the shaded oval or curved edge shapes. Room names and approximate square footages identify the proposed use of the space. The type of space is indicated by the color of the shape.



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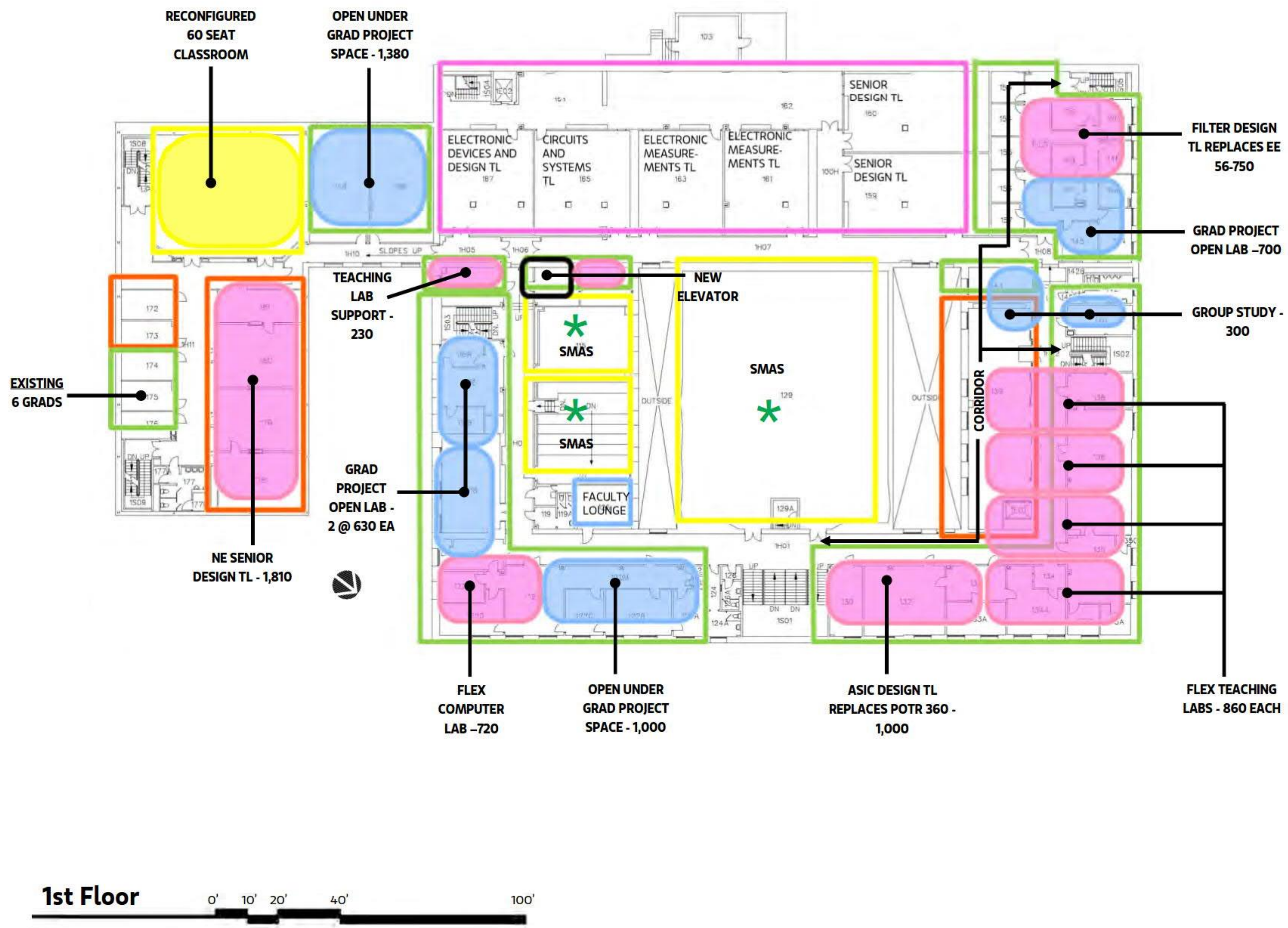


ELECTRICAL ENGINEERING BUILDING

The EE currently houses:

- School of Electrical and Computer Engineering (ECE)
- School of Nuclear Engineering (NE)

Final proposed occupants

- School of Electrical and Computer Engineering (ECE)
- School of Nuclear Engineering (NE)
- School of Mechanical Engineering (ME)

The master plan envisions that EE will house portions of ECE, NE, and ME. As is currently the case the majority of the space in EE will be devoted to ECE with NE occupying the basement level of the Dunkin Annex. In addition an office suite to accommodate ME growth will be developed on the 2nd floor. The most significant change within the building is the repurposing of first floor office and research space to teaching labs and open project labs. The ECE offices currently located on the first floor will relocate to MSEE. Most research space on the 1st floor as well as some on the 3rd floor will relocate to the south campus Flex Lab. Some ground floor space adjacent to the loading dock will be allocated to ECN for their waste management and export control activities.

Efficiency renovations on the 2nd and 3rd floor will introduce collaboration space to the office areas on these floors and improve efficiency particularly in the graduate student areas of the 3rd floor.

Total Renovation = 39,250sf

Research Displaced = 4,400sf

The floor plans on these pages illustrate one possible arrangement of spaces to achieve the goals of the master plan and the College of Engineering Strategic Plan. As the Master Plan is implemented the types and locations of spaces may change from what is indicated. These plans are useful as a test fit to match the programmatic requirements to space that may be required in the buildings of the North Campus. The quantity of space that will need to become available as well as the extent of renovation required to realize the Strategic Plan can be estimated. By determining the required quantity of renovation an estimate of cost can be developed.

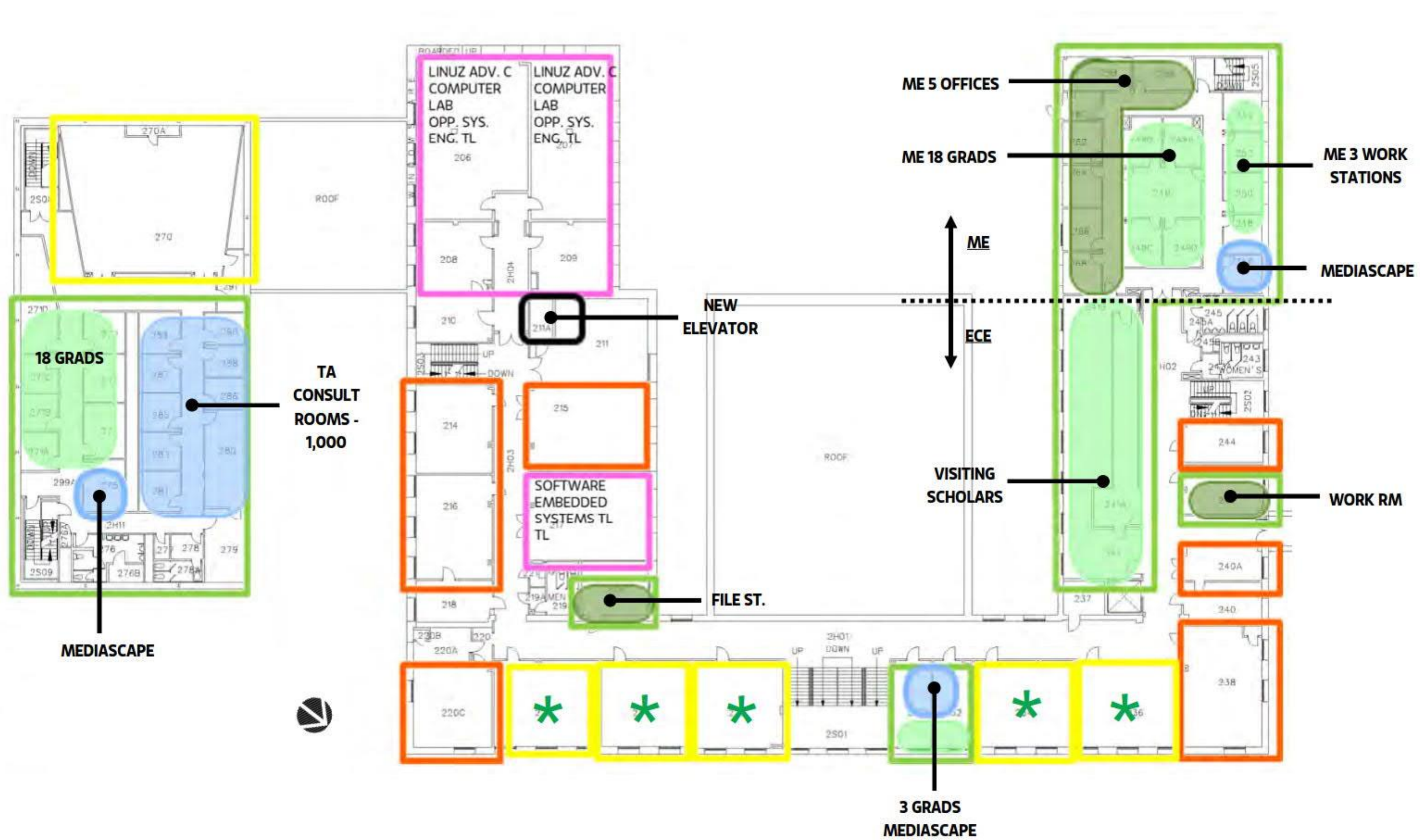
The S/L/A/M Collaborative

Renovation Plans

ELECTRICAL ENGINEERING BUILDING

	OFFICES	RESEARCH LABS AND SUPPORT	TEACHING LABS AND SUPPORT	COLLABORATION	Total
EE - Existing	**31,558**	**20,497**	**18,729**	**7,046**	**77,830**
ECE	31,244	17,624	16,852	7,046	**72,766**
NE	314	2,873	1,877		**5,064**
EE- Proposed	**20,812**	**20,526**	**19,864**	**5,979**	**67,181**
ECE	17,498	17,653	17,987	5,979	**59,117**
ME	3,000				**3,000**
NE	314	2,873	1,877		**5,064**

Table 4.54 –Space Type Summary



EXISTING USE

- OFFICE & SUPPORT
- TEACHING LABS
- RESEARCH LABS
- COLLABORATION
- SMAS CLASSROOM
- * SMAS TABLET ARM-CHAIR CLASSROOM

PROPOSED USE

- OFFICES
- WORK STATIONS
- TEACHING LABS
- RESEARCH SPACE
- COLLABORATION
- CLASSROOMS

Existing uses are indicated by rectangular edged shapes around the space. Proposed uses are indicated by the shaded oval or curved edge shapes. Room names and approximate square footages identify the proposed use of the space. The type of space is indicated by the color of the shape.

2nd Floor 0' 0' 20' 40' 100'

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3rd Floor 0' 10' 20' 40' 100'

ELECTRICAL AND COMPUTER ENGINEERING		
Teaching Labs & Support	**Status**	**Room**
Computer Design and Prototyping (UNIX)	Moved to new location on EE ground floor	EE 069
Digital Systems Senior Design Project	Existing to Remain	EE 061, 063, 064
Digital Logic Design Lab	Existing to Remain and additional lab on EE ground floor	EE 065 / grow to 2
Digital Systems Courses	Existing to Remain	held in research lab
Electronic Devices & Design Lab	Moved to new location on EE 1st floor	EE 167
Electronics Measurements Teaching Lab	Existing to Remain	EE 161, EE 163
Electronic Circuits & Systems, Systems Simulation and Control Lab	Existing to Remain	EE 165
Microwave Measurements and Simulation Lab		held in research lab
Electromagnetic Motion Devices Lab	Existing to Remain	EE 057
Microprocessor Systems and Interfacing	Existing to Remain	EE 067
Modern Filter Design	Existing to Remain	EE 056
Senior Design Lab	Existing To Remain	EE 159, EE160
Software for Embedded Systems, Embedded Systems	Existing to Remain	EE 217
Linux Advanced C Computer Lab, Operating Systems Engineering Lab	Existing to Remain	EE 206/207

Table 4.55 –Teaching Lab Locations Summary

Planning

The S/L/A/M Collaborative

Renovation Plans

ELECTRICAL ENGINEERING BUILDING - PHASING DIAGRAM

Phase 1 –Completed 2015

Prerequisite:	GRIS renovation to make available swing space in WANG
Vacated Space:	12,800 ASF
Renovation:	12,800 ASF
Renovation Value:	$6,100,000

Phase 2–completed 2018

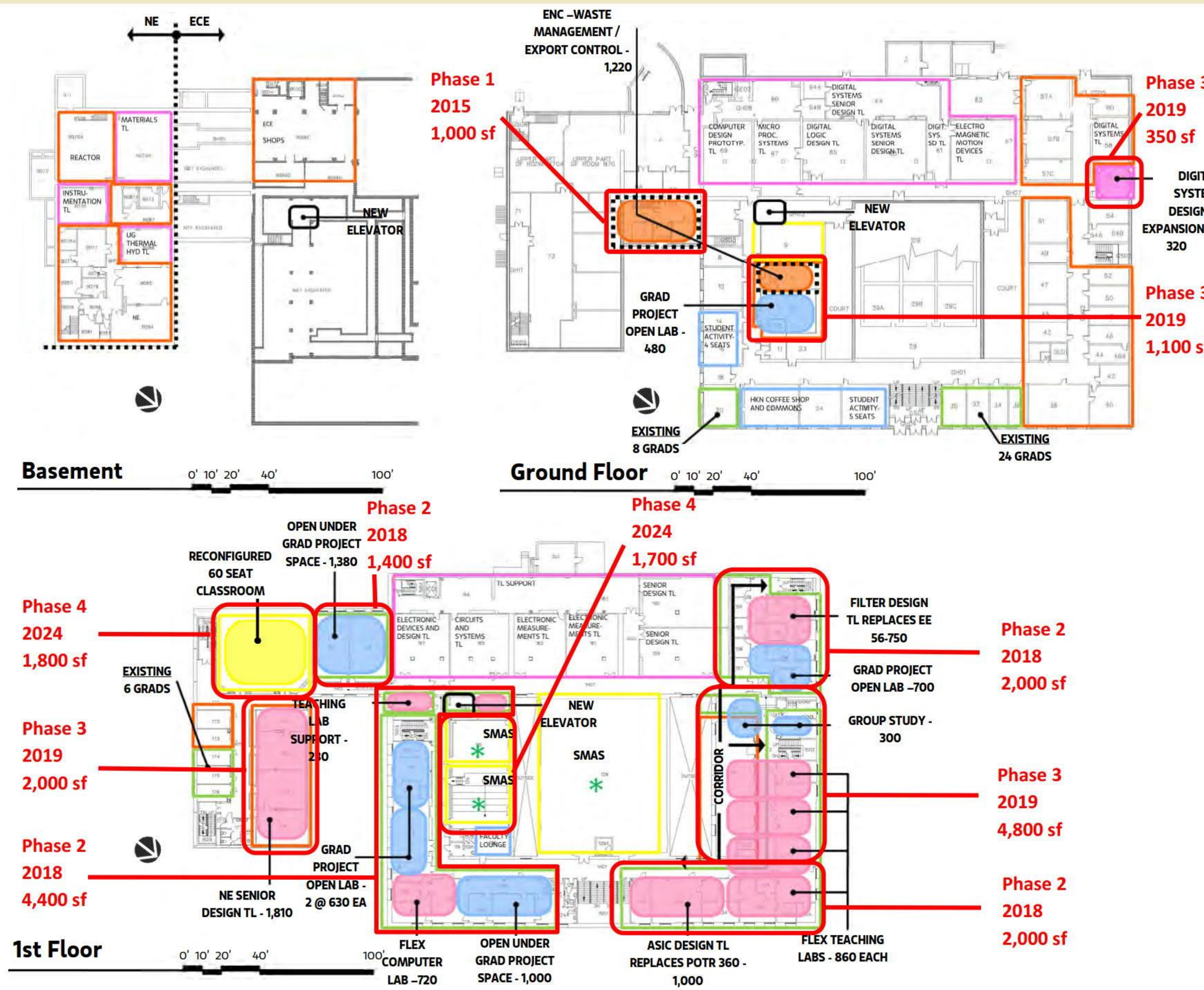
Prerequisite:	Move research to Flex Lab
Vacated Space:	9,800 ASF
Renovation:	9,800 ASF
Renovation Value:	$5,100,000

Phase 3–completed 2019

Prerequisite:	New Classroom building complete
Vacated Space:	10,400 ASF
Renovation:	10,400 ASF
Renovation Value:	$5,700,000

Phase 4–completed 2024

Prerequisite:	New Classroom building complete
Vacated Space:	6,250 ASF
Renovation:	6,250 ASF
Renovation Value:	$4,500,000



EXISTING USE	PROPOSED USE
OFFICE & SUPPORT	OFFICES
TEACHING LABS	WORK STATIONS
RESEARCH LABS	TEACHING LABS
COLLABORATION	RESEARCH SPACE
SMAS CLASSROOM	COLLABORATION
SMAS TABLET ARM-CHAIR CLASSROOM	CLASSROOMS

Existing uses are indicated by rectangular edged shapes around the space. Proposed uses are indicated by the shaded oval or curved edge shapes. Room names and approximate square footages identify the proposed use of the space. The type of space is indicated by the color of the shape.

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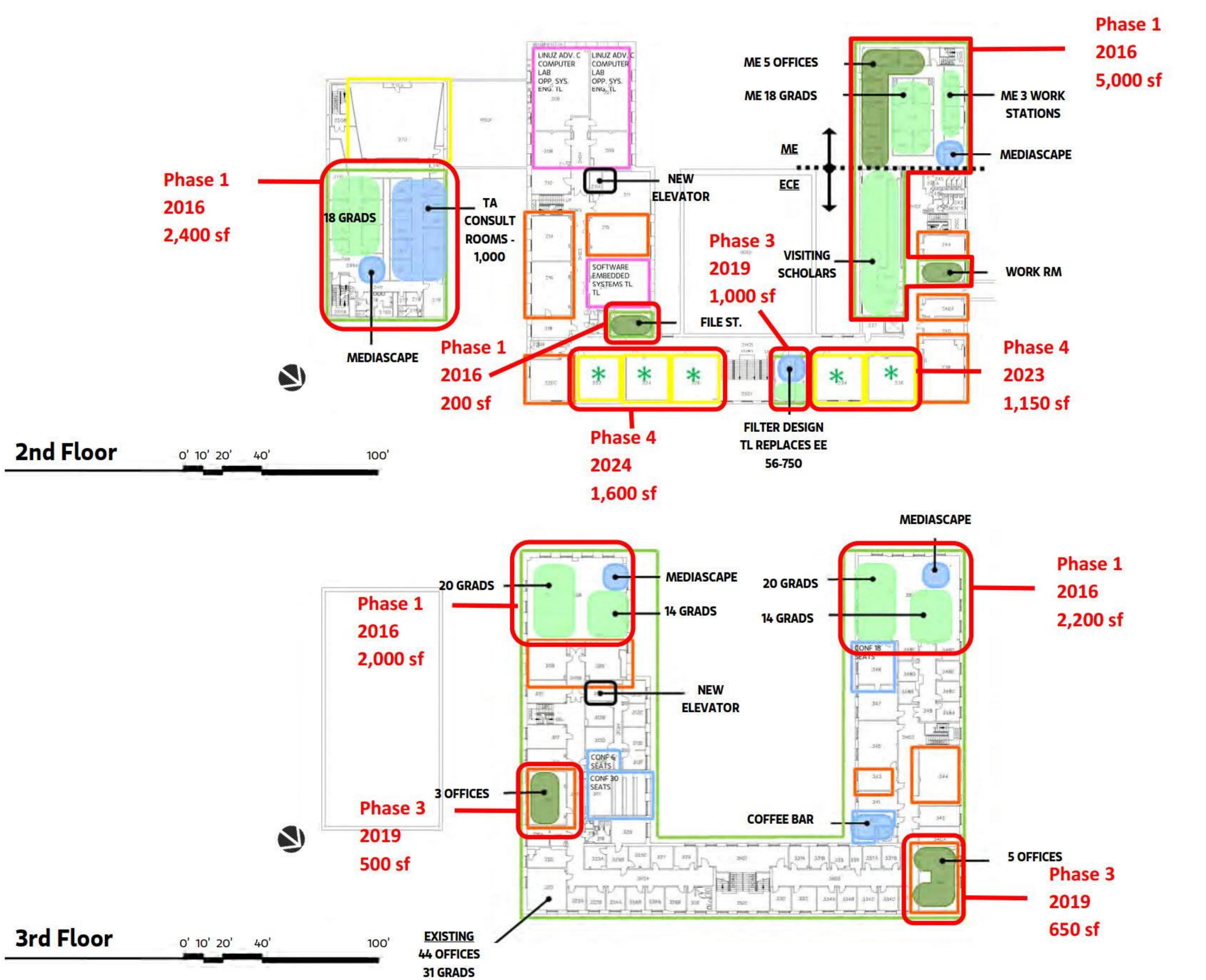


ELECTRICAL ENGINEERING BUILDING - PHASING DIAGRAM

Phase 1—Complete 2016

Renovations of office space on the 2nd and 3rd floors to improve efficiency and introduce collaboration space can begin as soon as swing space is available in WANG. This swing space is expected to become available in the fall of 2015 when the renovation of the GRIS building is complete and IE moves from the swing space into GRIS. While not specifically related to other renovation activities in EE, allocation of space near the loading dock for ECN waste management and export control during Phase 1 would be timed to align with ECN move to the third floor of MSEE.

Phase 2—Complete 2018

Phase 2 is contingent on completion of the renovation of the 1st floor of MSEE and the move of existing EE offices on the first floor of EE to the first floor of MSEE. This move will free up much of the 1st floor of EE which can then be remodeled for instructional space. Spaces anticipated are Open Project Labs, a Flex Computer Lab, and a Filter Design teaching lab to replace EE056 which is undersized. A Flex Teaching Lab of approximately 860 sf would be developed in the northeast corner of the 1st floor. When nearby research space is vacated during Phase 3, additional Flex Teaching Lab spaces can be generated that will abut the Flex Lab built out during Phase 2.

Phase 3—Complete 2019

Phase 3 renovations are dependent on the completion of a new research Flex Lab to be located South of State Street. The Flex Lab is anticipated to be ready for occupancy in 2018. Once this building is available research programs on the Ground, 1st, and 3rd floors of EE can move to the new Flex Lab and this space can be remodeled for other uses. Research space and an associated server room in 007 and 007B can be remodeled into additional open project space and additional ECN waste Management / Export control space. Research space on the 1st floor can be developed into additional Flex Teaching Labs that can abut the Flex Lab developed during Phase 2. Research space on the 1st floor of the Dunkin Annex can be developed into Senior Design teaching lab for NE. Vacating research on the 3rd floor will generate room for additional faculty offices.

Phase 4—Complete 2024

The new classroom building anticipated by the master plan will provide classroom seats to replace rooms 115, 117, 222, 224, 226, 234, and 236. Once this new building is in service these classrooms can be repurposed to new uses in a fourth phase of renovation.

The S/L/A/M Collaborative

Planning

Cost and Time Line

Cost Estimate Methodology

Cost estimates have been developed using Purdue Construction Cost Estimating Planning Index data adjusted to the 3rd quarter 2013. Total costs for each renovated building have been weighted depending on the condition of the building being renovated and the extend of infrastructure upgrades that can be expected. ARMS has been weighted at 50% of new construction cost. EE, HAMP, MSEE, HAMP, and RAIL have been weighted at 75% of new construction. POTR, and all proposed new buildings have been weighted at 100%

All costs include a 30% mark up to cover soft costs including fees, contingency, and fit up. All costs have been escalated at 4% per year.

Time Line Explanation

Costs for each building have been broken down by Phase and indicated in the year in which they can be expected to be accrued. Total costs for each year are indicated on the right-most column. Total costs per building are listed at the bottom of the table on the facing page

Sequential activities are indicated by like colors. Activities that rely on the completion of the Flex Lab and the found space that will result are colored Olive. Activities that rely on the relocation of research on the 3rd floor of MSEE are colored gold. Activities that rely on the completion of the new Classroom building are light blue.

		ALC	ARMS	EE	FRNY	GRIS	HAMP	NUCL	ME	MSEE	POTR	RAIL	WANG	South Campus Flex Lab	Classroom Bldg	Total Cost per Year
2014	Activity	JTRP to WANG 4th				IE moves to WANG Renovation begins				Design 3rd flr for ECN, Design 1st for ECE	EPE, ENE to WANG - IE from GRIS		IE from GRIS, EPE from POTR, ENE from ARMS, ECE from EE, JTRP from ENAD	Predesign		
	Cost															
2015	Activity	Demo ENAD HPN Start Construction		ECE swings 100 to 115 seats to WANG, Efficiency Renovations	Construction	Occupy - IE from WANG & POTR, EEE from POTR			Design Renovations for ME	3rd flr research to TBD, Renovate for ECN - ECE swings to WANG, Efficiency renovation Base.	IE to GRIS, EEE to GRIS		IE to GRIS, ECE from EE & MSEE	Design		
	Cost			2,440,000		11,700,000				6,000,000				6,170,000		**26,310,000**
2016	Activity	Construction		Design 1st flr teaching labs, ECE swings back from WANG - Phase 1 Complete	Occupied by ChE		Design renovations for CE		ME swings to WANG, Efficiency Renovations - Phase 1 Complete	ECN to MSEE 3rd flr, Renovate 1st ECE Office and stud. Ctr. - Phase 1 Complete	Predesign	Efficiency renovations - Phase 1 Complete	ECE to EE, ME from ME	Construction		
	Cost			3,660,000					12,200,000	9,000,000		1,200,000		37,020,000		**63,080,000**
2017	Activity	Construction	Artisan Lab to IDC, Renovations for EPICS, AAE - Phase 1 Complete	ECE 1st flr to MSEE 1st flr - Renovate for ECE Teaching Labs			CE swing to WANG Efficiency Renovations G, 1st, & 4th		ME swings back from WANG	ECE from EE occupies 1st flr - Phase 2 Complete	Design Renovated POTR		ME to ME, CE from HAMP	Construction		
	Cost		1,500,000	2,040,000			1,260,000			16,600,000				55,530,000		**76,930,000**
2018	Activity	Occupy - Libraries move from HAMP, POTR	Research to FLEX Lab, Renovations for AAE - Phase 2 Complete	Research to Flex Lab, Renovate for ECE Teaching Labs - Phase 2 Complete			Research to Flex Lab, Libraries to ALC, REM to TBD, Renovate for CE growth - Phase 1 Complete	Predesign, Research to Flex Lab	Research to Flex Lab, Renovate for ME teaching Labs, Classrooms, growth		BME to TBD, Libraries to ALC, Research to FLEX Lab, EEE 10 seats & OPP 10 seats to WANG		OPP, EEE from POTR	Occupy -		
	Cost		1,800,000	3,060,000			2,940,000		9,000,000					24,680,000		**41,480,000**

Time Line Key

(green)	Activity related to completion of the South Campus Flex Lab
(orange)	Activity related to the completion of renovations in MSEE
(light blue)	Activity related to the completion of a Classroom Building

		ALC	ARMS	EE	FRNY	GRIS	HAMP	NUCL	ME	MSEE	POTR	RAIL	WANG	South Campus Flex Lab	Classroom Bldg	Total Cost per Year
2019	**Activity**		Design renovations	Renovation for Flex Teaching Labs on 1st floor - Phase 3 Complete			Occupy - CE / JTRP from WANG - Phase 2 Complete	Design new NUCL building, NE to WANG - Demo NUCL	Occupy teaching labs & Classrooms - Phase 2 Complete		Under Renovation		CE / JTRP to HAMP			
	Cost			5,700,000			14,000,000	3,145,000	6,000,000		59,760,000					**88,605,000**
2020	**Activity**		Programs & ENE to POTR, Renovate for MSE, AAE, EPICS growth - Phase 3 Complete				GEP, Honors to POTR - Phase 3 Complete	Construction			Occupy - ENE, Programs from ARMS, EEE from GRIS, GEP Honors from HAMP		OPP to POTR, NE from NUCL		Predesign	
	Cost		5,100,000				3,300,000	18,870,000			14,940,000					**42,210,000**
2021	**Activity**		Occupy EPICS, MSE, AAE, Renovate for EPICS Computer Lab - Phase 4 Complete					Construction					ENE Research growth		Design -	
	Cost		600,000					31,450,000							1,446,825	**33,496,825**
2022	**Activity**							Occupy - IE from MGL S., SOS, NE from WANG					NE to new NUCL building		Construction	
	Cost							9,435,000							14,910,000	**24,345,000**
2023	**Activity**			Design classroom back fill			Design classroom back fill		Design classroom back fill	Design classroom back fill					Construction	
	Cost														22,365,000	**22,365,000**
2024	**Activity**			Back fill SMAS Classrms - Phase 4 Complete			Back fill SMAS Classrms - Phase 4 Complete		Back fill SMAS Classrms - Phase 3 Complete	Back fill SMAS Classrms - Phase 3 Complete					Occupy - SMAS	
	Cost			4,500,000			3,300,000		4,200,000	1,500,000					9,940,000	**23,440,000**
	Total Cost per Building	**0**	**9,000,000**	**21,400,000**	**0**	**11,700,000**	**24,800,000**	**62,900,000**	**31,400,000**	**33,100,000**	**74,700,000**	**1,200,000**	**0**	**123,400,000**	**48,661,825**	**442,261,825**

Existing Plans

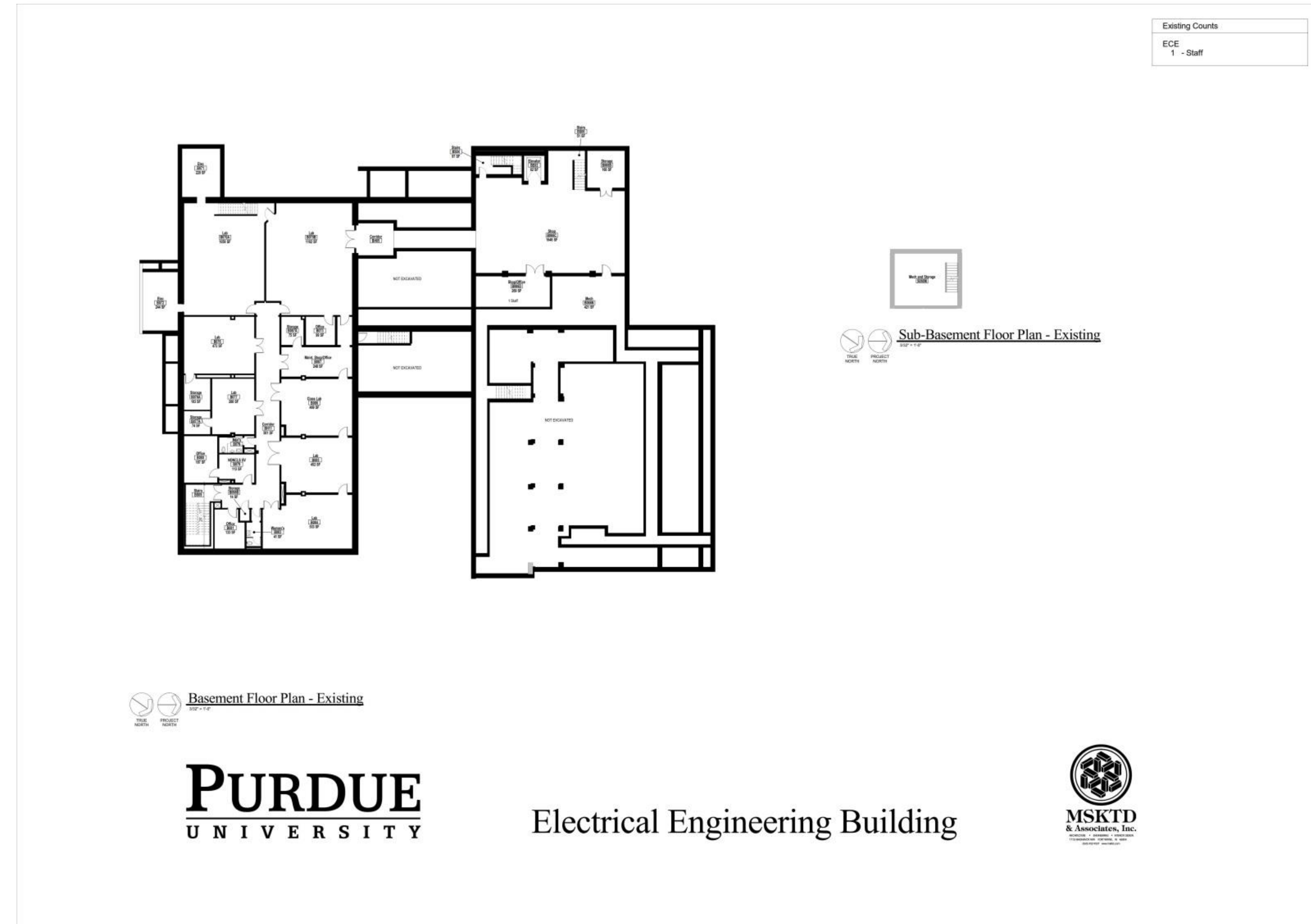
Existing Plan Description:

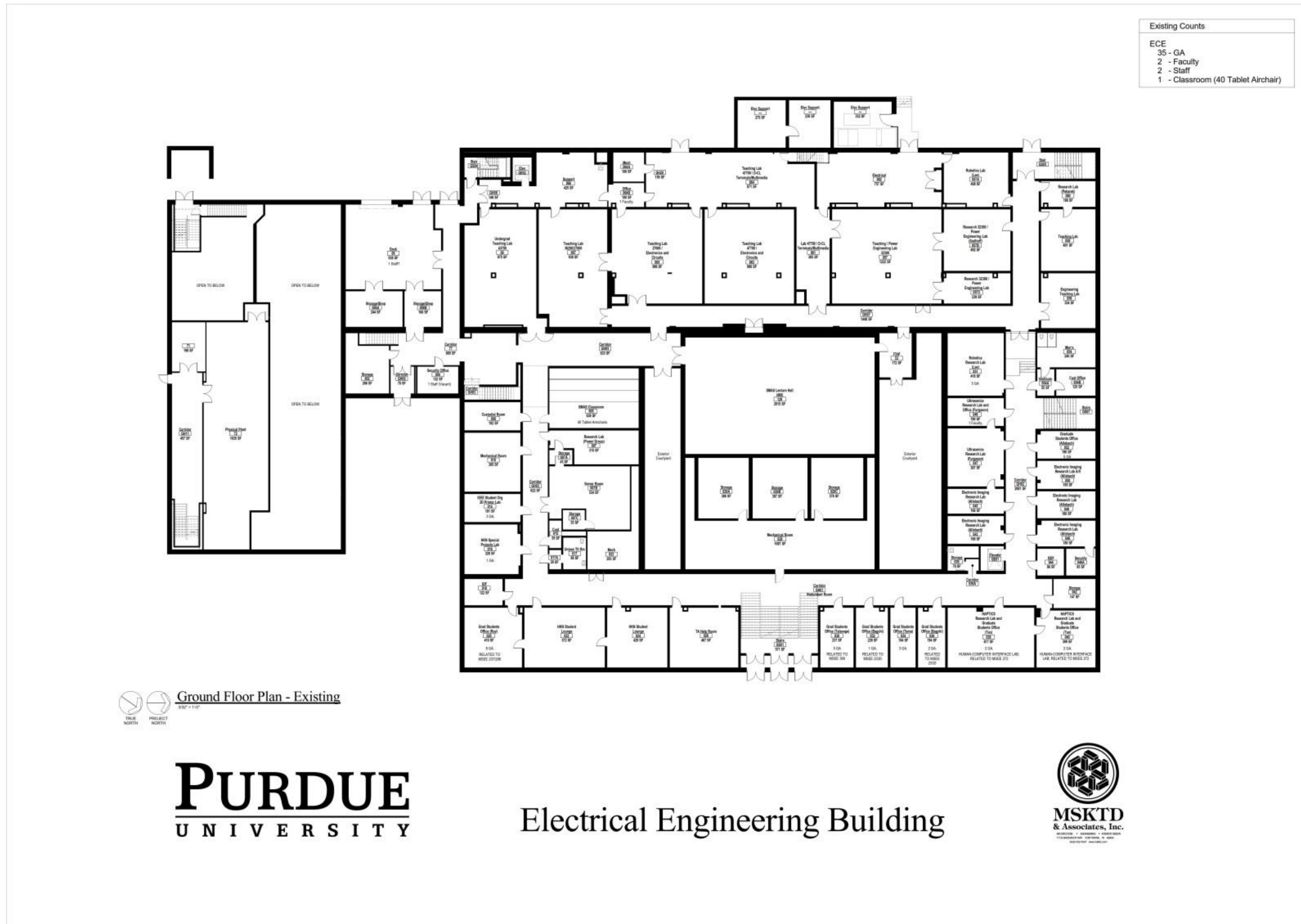
This project encompasses an area completely within the Electrical Engineering building. We do not intend to include some minor spaces in the basement and sub-basement of the building, the area defined as nuclear engineering and other remote mechanical, plumbing and electrical chase spaces. All of the areas omitted from the renovation amount to a very small portion of the whole.

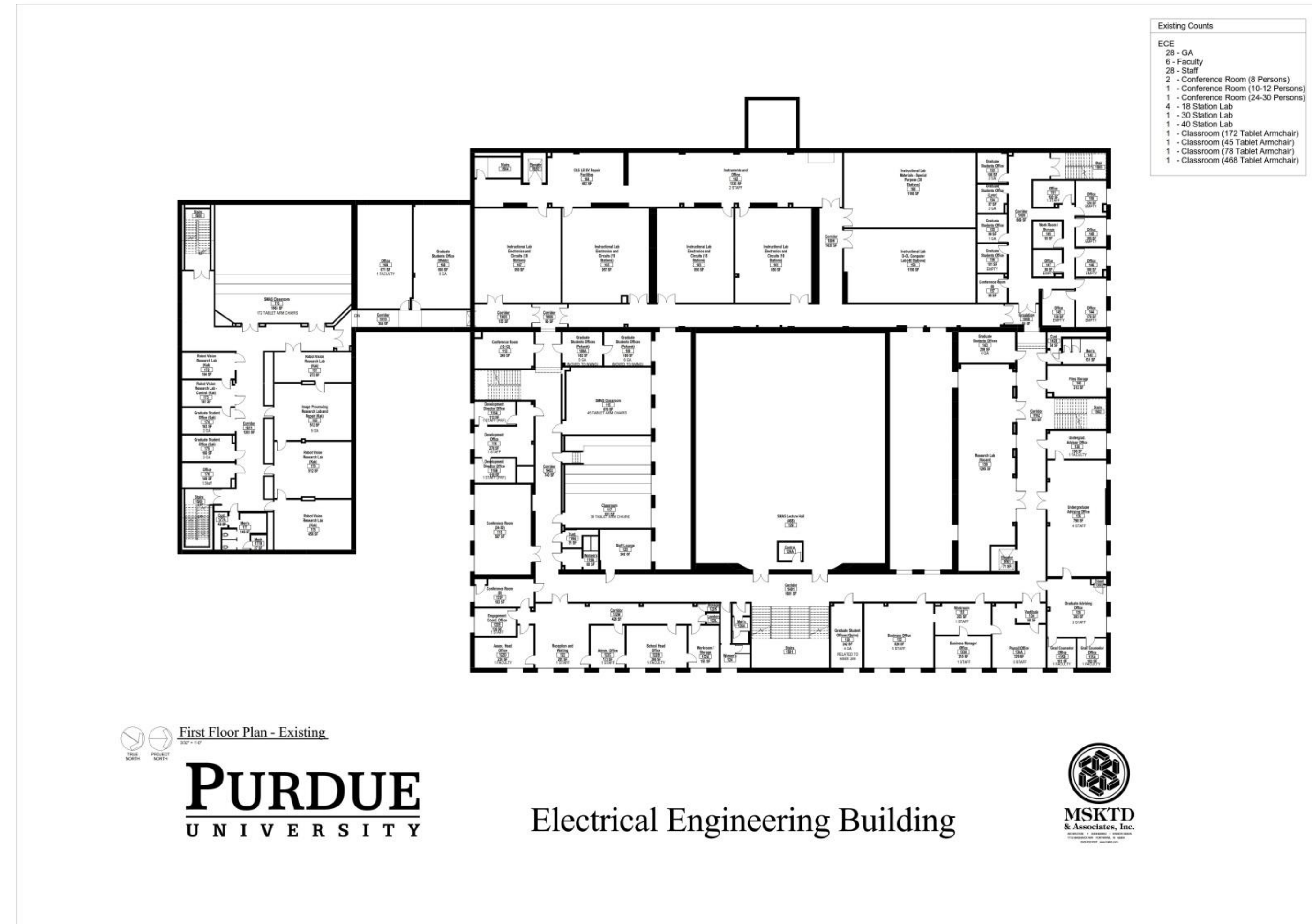
The total gross square footage of the renovated space is approximately 159,660 GSF, with the following breakdown by floor.

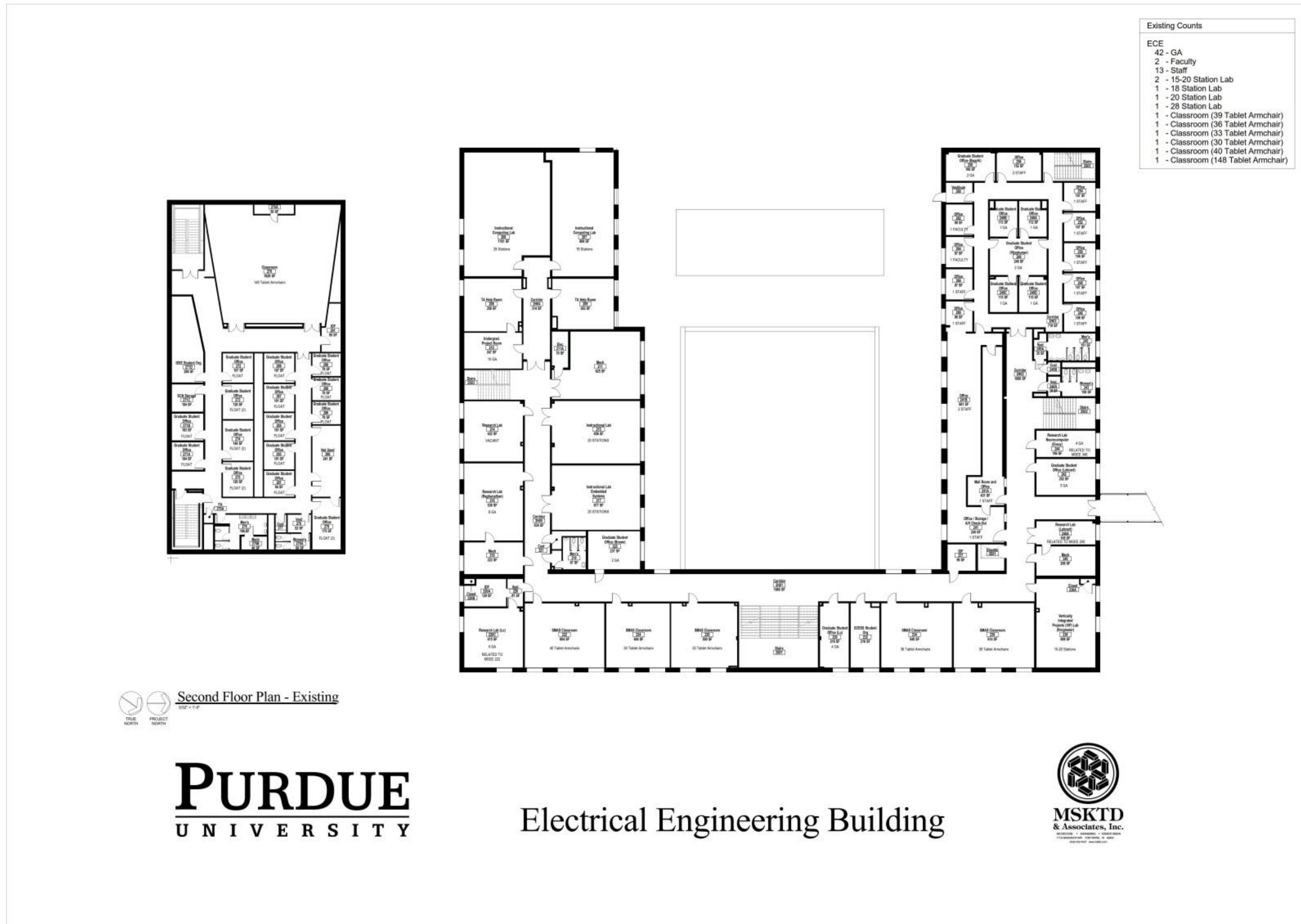
Basement ....2,275 GSF
Ground Floor .... 49, 065 GSF
First Floor ....49, 685 GSF
Second Floor..............................34, 370 GSF
Third Floor ....24, 265 GSF

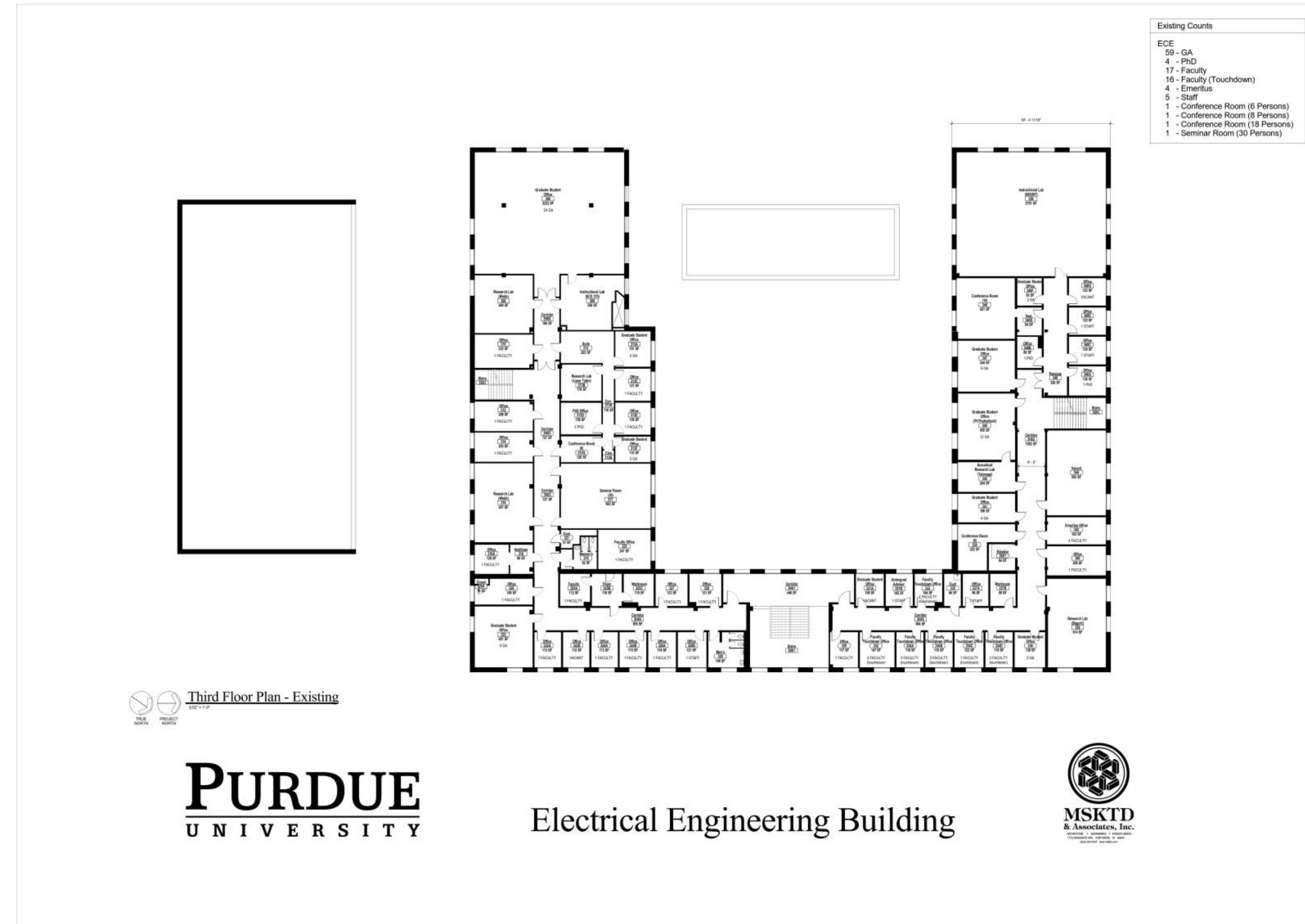
As a brief summary, we are showing approximately 40,917 NSF of Office space, including Conference and smaller meeting spaces; 11,790 NSF of Research, Project Labs, Student Organizations and Data Server Room, and 20,813 NSF of Instructional Labs. These calculations do not include support, toilet rooms or circulation.




Existing Counts
ECE
35 - GA
2 - Faculty
2 - Staff
1 - Classroom (40 Tablet Airchair)
Ground Floor Plan - Existing
PURDUE
UNIVERSITY
Electrical Engineering Building
MSKTD
& Associates, Inc.


Existing Counts
ECE
28 - GA
6 - Faculty
28 - Staff
2 - Conference Room (8 Persons)
1 - Conference Room (10-12 Persons)
1 - Conference Room (24-30 Persons)
4 - 18 Station Lab
1 - 30 Station Lab
1 - 40 Station Lab
1 - Classroom (172 Tablet Armchair)
1 - Classroom (45 Tablet Armchair)
1 - Classroom (78 Tablet Armchair)
1 - Classroom (468 Tablet Armchair)
First Floor Plan - Existing
PURDUE
UNIVERSITY
Electrical Engineering Building
MSKTD
& Associates, Inc.


Existing Counts
ECE
42 - GA
2 - Faculty
13 - Staff
2 - 15-20 Station Lab
1 - 18 Station Lab
1 - 20 Station Lab
1 - 28 Station Lab
1 - Classroom (39 Tablet Armchair)
1 - Classroom (36 Tablet Armchair)
1 - Classroom (33 Tablet Armchair)
1 - Classroom (30 Tablet Armchair)
1 - Classroom (40 Tablet Armchair)
1 - Classroom (148 Tablet Armchair)
Second Floor Plan - Existing
PURDUE
UNIVERSITY
Electrical Engineering Building
MSKTD
& Associates, Inc.


Existing Counts
ECE
59 - GA
4 - PhD
17 - Faculty
16 - Faculty (Touchdown)
4 - Emeritus
5 - Staff
1 - Conference Room (6 Persons)
1 - Conference Room (8 Persons)
1 - Conference Room (18 Persons)
1 - Seminar Room (30 Persons)
Third Floor Plan - Existing
PURDUE
UNIVERSITY
Electrical Engineering Building
MSKTD
& Associates, Inc.

PROGRAM OF EE AND MSEE

The following sheets are standard forms used by architects and engineers to quantify and describe the programmed spaces in a typical project. These sheets attempt to identify the current room names, room numbers, area or assignable square footage of the room, departmental use, current staff assigned to the space and comments regarding the space usage. There are generally other qualities of the space that are needed during early programming and design. We therefore ask general spatial relationship location and does the room have any special needs that would be out of the normal so that placement of the room in the building can be accommodated.

Once we move to the next step, more detailed individual room data sheets will be required in order to build and develop the program for all designers to utilize.

PROGRAM SUMMARY OF STAFF AND SPACE COUNTS						Note: Does not include DL2 or Nuclear Eng
EXISTING				Current Count	Current Staff Count	
GRADUATE ASSISTANTS					200	Sub Basement and Basement = 0 Ground = 39 First Floor = 38 Second Floor = 64 Third Floor = 59
COLLEGE/DEPARTMENT STAFF						Sub Basement and Basement = 1 Ground = 1 First Floor = 28 Second Floor = 11 Third Floor = 5
TEACHING FACULTY					31	Sub Basement and Basement = 0 Ground = 1 First Floor = 10 Second Floor = 3 Third Floor = 17
CONFERENCE ROOMS				7		1 @ 12, 1 @ 24-30, 3 @ 8, 1 @ 6, 1 @ 18
PROPOSED				Projected Count	Projected Staff Count using +30%	
GRADUATE ASSISTANTS					260	
COLLEGE/DEPARTMENT STAFF					60	
TEACHING FACULTY					40	
CONFERENCE ROOMS				8 to 10		
ECE COLLEGE ADMINISTRATION						PROJECTING RELOCATION OF 24 STAFF MEMBERS, 5 FACULTY, STORAGE AND ONE CONFERENCE ROOM

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power…
SUB BASEMENT									
Stairs	SS06	52 SF	General			Stairs from Maintenance Shop			
Mechanical and Storage	S066M	362 SF	General			Elevator Pump room and Storage			

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BASEMENT									
Elevator	BE02	63 SF	General			ELEVATOR			
Corridor	BH05	306 SF	General			RAMP TO SHOP			
Corridor	BH11	651S	General			CORRIDOR - FROM B070A TO B084			
Stairs	BS04	112 SF	General			STAIRS N.W.			
Stairs	BS06	52 SF	General			STAIRS TO SUB BASM'T			
Stairs	BS08	64 SF	General			STAIRS S.W. CORNER			
Stairs	BS09	192 SF	General			STAIRS S.E. CORNER			
Storage	B066B	169 SF	ECE	ECE		Storage	EE	DL2, INST LAB SUPPORT	
Shop	B066C	1666 SF	ECE	ECE		Maintenance Shop	EE	DL2, INST LAB SUPPORT	
Shop	B066D	286 SF	ECE	ECE		Model Shop	EE	DL2, INST LAB SUPPORT	
Office	B066D	32 SF	ECE	ECE	1 S	Supervisor - C. Harrington	EE	DL2, INST LAB SUPPORT	
Mechanical	B066N	425 SF	General			MECHANICAL EQUIPMENT			
LAB	B070A	954 SF	Nucl Engr	Nucl Engr		Reactor	EE		
LAB	B070B	953 SF	Nucl Engr	Nucl Engr		Teaching Lab	EE		
Electrical	B071	215 SF	General			TRANSFORMER VAULT			
Electrical	B072	240 SF	General			TRANSFORMER VAULT			

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BASEMENT									
Office	B073	90 SF	Nucl Engr	Nucl Engr			EE		
LAB	B076	468 SF	Nucl Engr	Nucl Engr		Instrumentation Lab	EE		
Storage	B076A	95 SF	Nucl Engr	Nucl Engr		Radioactive Material Storage	EE		
LAB	B077	266 SF	Nucl Engr	Nucl Engr		FUEL PROCESSING LAB	EE		
Storage	B077A	72 SF	Nucl Engr	Nucl Engr		Radioactive Material Storage	EE		
Men's	B078	60 SF	General			Men's Restroom - 1WC,1U,1L			
NONCLS SV	B079	120 SF	Nucl Engr	Nucl Engr		Emergency Support Center - N. Satvat	EE		
Office	B080	184 SF	Nucl Engr	Nucl Engr	1 F	R. Bean	EE		
Office	B081	126 SF	Nucl Engr	Nucl Engr			EE		
Custodial	B082	13 SF	General			Custodial Closet			
Women's	B083	51 SF	General			Women's Restroom - 1WC, 1L			
LAB	B084	516 SF	Nucl Engr	Nucl Engr		SUBCRITICAL ASSEMBLY	EE		
LAB	B085	456 SF	Nucl Engr	Nucl Engr		Multi-Phase Flow Research Lab	EE		
CLASS LAB	B086	456 SF	Nucl Engr	Nucl Engr		Undergrad Thermal Hydraulics Lab	EE		
Maint. Shop	B087	120 SF	Nucl Engr	Nucl Engr		Maintenance Shop	EE		
Office	B087	120 SF	Nucl Engr	Nucl Engr		Graduate Assistants	EE		
Office	B087A	68 SF	Nucl Engr	Nucl Engr		Office	EE		

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GROUND FLOOR									
Elevator	GE01	75 SF	General			ELEVATOR			
Elevator	GE02	72 SF	General			ELEVATOR			
Corridor	GH01	1780 SF	General			CORRIDOR - FROM 018 TO 042			
Corridor	GH02	835 SF	General			CORRIDOR - FROM 044 TO 054			
Corridor	GH03	650 SF	General			CORRIDOR - FROM 005 TO 016			
Corridor	GH04	82 SF	General			VESTIBULE - EAST			
Corridor	GH05	582 SF	General			CORRIDOR BY 005			
Corridor	GH07	1500 SF	General			CORRIDOR - FROM 057A TO 67			
Corridor	GH08	243 SF	General			CORRIDOR BY 066			
Corridor	GH10	965 SF	General			HALLWAY BY LOADING DOCK			
Corridor	GH11	460 SF	General			CORRIDOR - DUNCAN SE			
Stairs	GS01	607 SF	General			STAIRWAY - EAST ENTRY			
Stairs	GS02	224 SF	General			CORRIDOR+STAIRS - NORTH			
Stairs	GS03	102 SF	General			STAIRS - BY 008			
Stairs	GS04	120 SF	General			STAIRWAY BY 066			
Stairs	GS05	252 SF	General			CORRIDOR+STAIR - NORTHWEST			
Stairs	GS06	39 SF	General			STAIRWAY - DOWN FROM 064			
Stairs	GS07	52 SF	General			STAIRWAY TO NUCL			
Stairs	GS08	198 SF	General			STAIRWAY - DUNCAN SOUTHWEST			
Stairs	GS09	109 SF	General			STAIRWAY - DUNCAN SE			
Storage	002	269 SF	ECE	ECE		Storage	MSEE	MAIN ADMIN OFFICE	
Electrical	003	458 SF	General			TRANSFORMER ROOM			
Storage	004	144 SF	ECE	ECE					
CLASSROOM	005	635 SF	SMAS	SMAS	40 TAC	Theater Seating			

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GROUND FLOOR									
Receiving Dock	006	969 SF	General			RECEIVING AREA			
Shop	006A	249 SF	ECE	ECE	1 S	Maintenance Shop	EE		
Shop	006B	170 SF	ECE	ECE		Storage	EE		
Storage	007	373 SF	ECE	ECE					
Storage	007A	48 SF	ECE	ECE					
Server Room	B007	484 SF	ECE	ECE		Computer Room			
Storage for Server Room	007C	46 SF	ECN	ECE		Storage managed by ECN			
Custodial	008	232 SF	General			Custodial Room			
Mechanical	010	410 SF	General			air conditioning equipment			
3d PRINTER LAB	014	199 SF	ECE	ECE	3 GA	Student Activity/Organizations - IEEE			
Custodial	015	40 SF	General			Custodial Closet			
HKN Special Proj LAB	016	325 SF	ECE	ECE	1 GA	Student Activity - HKN Shop			
Unisex RR	017	118 SF	General			Unisex Restroom - 1WC,1U,1L-HCA			
Electrical	018	126 SF	General	ITAP		TELECOMMUNICATIONS CLOSET-IDF			
"Scifres" Office	020	426 SF	ECE	ECE	6 - 8 GA	Roy - Graduate Assistants	MSEE		
Student Lounge	022	584 SF	ECE	ECE		HKN Coffee Shop			
Mechanical	023	233 SF	General			MECHANICAL EQUIPMENT			
Student Commons Space	024	480 SF	ECE	ECE		HKN Commons			
HELP ROOM	026	497 SF	ECE	ECE		Help Room for EE 201			
Mechanical	029	950 SF	General			VENTILATION FANS			
Storage	029A	331 SF	ECE	ECE		Storage			
Storage	029B	331 SF	ECE	ECE		Storage			
Storage	029C	331 SF	ECE	ECE		Storage			
Mechanical	029D	50 SF	General			COMPRESSOR			

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GROUND FLOOR									
Office	030	274 SF	ECE	ECE	4 - 5 GA	TALAVAGE- Graduate Assistants	MSEE	TALVAGE	
Office	032	249 SF	ECE	ECE	1 GA	Graduate Assistant for 323 LAB		BAGCHI	
Office	034	209 SF	ECE	ECE	3 GA	Graduate Assistants			
Office	036	209 SF	ECE	ECE	2 GA	BAGCHI - Graduate Assistants		BAGCHI	
LAB	038	660 SF	ECE	ECE	2 - 4 GA	HAPTICS - CPT Network Center - Tan	MSEE? RM 272	TAN	
Storage	039	81 SF	ECE	ECE					
Entry	039A	17 SF	ECE	ECE		ENTRANCE TO CHEM STOR.			
LAB	040	426 SF	ECE	ECE	2 GA	HAPTICS - CPT Network Center - Tan	MSEE? RM 272	TAN	
Storage	042	126 SF	ECE	ECE		Storage		ALLEBACH	
LAB	043	191 SF	ECE	ECE		Electronic Imaging - Allebach	MSEE? RM 350	ALLEBACH	
Electrical	044	95 SF	General	ITAP		TELECOMMUNICATIONS CLOSET-BDF			
LAB	045	191 SF	ECE	ECE		Electronic Imaging - Allebach	MSEE? RM 350	ALLEBACH	
LAB	046	186 SF	ECE	ECE		Electronic Imaging - Allebach	MSEE? RM 350	ALLEBACH	
SECURITY ROOM	046A	118 SF	ECE	ECE		Storage Room Camera Head End	MSEE? RM 350	ALLEBACH	
LAB	047	400 SF	ECE	ECE		Ultrasonics Lab - Furgason		FURGASON	
LAB	048	186 SF	ECE	ECE		Electronic Imaging - Allebach	MSEE? RM 350	ALLEBACH	
LAB	049	50 SF	ECE	ECE		Ultrasonics Lab - Furgason		FURGASON	
Office	049	150 SF	ECE	ECE	1 F	E. Furgason		FURGASON	
LAB	050	186 SF	ECE	ECE		Electronic Imaging - Allebach	MSEE? RM 350	ALLEBACH	
LAB	051	406 SF	ECE	ECE	5 GA	Research - Lee			
Office	052	203 SF	ECE	ECE	5 GA	Allebach Graduate Assistants	MSEE? RM 350	ALLEBACH	
Men's	054	250 SF	General			Men's Restroom - 2WC,3U,2L			
Men's	054A	45 SF	General			Men's Restroom Entrance			
Custodial	054B	66 SF	General			Custodial Closet			

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GROUND FLOOR									
CLASS LAB	056	319 SF	ECE	ECE	DL2	Engineering Teaching Lab			
CLASS LAB	057	609 SF	ECE	ECE	DL2	Teaching Lab			
LAB	057	610 SF	ECE	ECE	DL2	Power Engineering Lab			
CLASS LAB	057A	546 SF	ECE	ECE	DL2	Robotics Lab - Lee			
LAB	057B	492 SF	ECE	ECE	DL2	Power Engineering Lab - Sudhoff			
LAB	057C	264 SF	ECE	ECE	DL2	Power Engineering Lab			
CLASS LAB	058	405 SF	ECE	ECE	DL2	Lab - M. Johnson			
LAB	060	162 SF	ECE	ECE	DL2	Research - Pekarek			
LAB	061	352 SF	ECE	ECE	DL2	D-CL Terminals/Multimedia			
Electrical	062	734 SF	General			ELECTRICAL EQUIPMENT			
CLASS LAB	063	1010 SF	ECE	ECE	DL2	ELECTRONICS+CIRCUITS			
CLASS LAB	064	1050 SF	ECE	ECE	DL2	D-CL Terminals/Multimedia			
Mechanical	064A	98 SF	General			AIR CONDITIONING CONTROL			
Office	064B	110 SF	ECE	ECE	1 S	J. Bougher			
CLASS LAB	065	994 SF	ECE	ECE	DL2	Electronics + Circuits Lab			
Storage	066	450 SF	ECE	ECE		Storage			
CLS LB SV	067	981 SF	ECE	ECE	DL2	Lab Workroom			
CLASS LAB	069	1031 SF	ECE	ECE	DL2	UNDERGRAD TEACHING LAB			
Electrical	071	188 SF	General			PANEL CIRCUITS			
Mechanical	072	1704 SF	General			air conditioning equipment			

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FIRST FLOOR									
Elevator	1E01	75 SF	General			ELEVATOR SHAFT			
Elevator	1E02	72 SF	General			ELEVATOR			
Corridor	1H01	1764 SF	General			FRONT HALL			
Corridor	1H02	816 SF	General			WEST HALL			
Corridor	1H03	736 SF	General			EAST HALL			
Corridor	1H05	135 SF	General			CORRIDOR NEAR 167			
Corridor	1H06	85 SF	General			CORRIDOR FROM 165 TO 167			
Corridor	1H07	1426 SF	General			CORRIDOR - FROM 157 TO 165			
Corridor	1H08	88 SF	General			CORRIDOR NEAR 145			
Corridor	1H09	596 SF	General			CORRIDOR-FROM 144-151-157			
Corridor	1H10	254 SF	General			CORRIDOR(RAMP)-FROM 168 TO 170			
Corridor	1H11	1215 SF	General			CORRIDOR - FROM 170 TO 199U			
Stairs	1S01	607 SF	General			FRONT STAIRS			
Stairs	1S02	224 SF	General			WEST STAIRS			
Stairs	1S03	204 SF	General			EAST STAIRS			
Stairs	1S04	300 SF	General			CORRIDOR+STAIR BY 164			
Stairs	1S05	145 SF	General			STAIRWAY - NORTHWEST			
Stairs	1S08	198 SF	General			DUNC ANX SOUTH STAIRS			
Stairs	1S09	210 SF	General			DUNC ANX NORTH STAIRS			
Electrical	103	264 SF	General			Switchgear Room			
Office	109	186 SF	ECE	ECE	6 GA	GRADUATE ASSISTANTS		S. Pekarek	
Office	109A	186 SF	ECE	ECE	5 GA	Graduate Assistants		S. Pekarek	
CONFERENCE	112	231 SF	ECE	ECE		Conference Room for 10 - 12			
CLASSROOM	115	675 SF	SMAS	SMAS	45 TAC	45 Tablet Arm Chairs			

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FIRST FLOOR									
Office	116	284 SF	ECE	ECE	1 S	K. Mouldoon + Student	MSEE	MAIN ADMIN OFFICE	
Office	116A	107 SF	PRF Devlpmnt	ECE	1 S	Development Director - A. McIntyre	MSEE	MAIN ADMIN OFFICE	
Office	116B	104 SF	PRF Devlpmnt	ECE	1 S	Development Director - B. Silotto	MSEE	MAIN ADMIN OFFICE	
CLASSROOM	117	975 SF	SMAS	SMAS	78 TAC	78 Tablet Arm Chairs			
CONFERENCE	118	559 SF	ECE	ECE		Conference Room for 24 - 30		MAIN ADMIN OFFICE	
Women's	119	46 SF	General			Women's Restroom Entrance			
Women's	119A	59 SF	General			Women's Restroom - 2WC, 1L			
Custodial	120	40 SF	General			Custodial Closet			
Office	122	274 SF	ECE	ECE	1 S	Secretary - D. Starewich	MSEE	MAIN ADMIN OFFICE	
Storage	122A	155 SF	ECE	ECE		Storage	MSEE	MAIN ADMIN OFFICE	
Office	122B	298 SF	ECE	ECE	1 F	R. Balakrishnan	MSEE	MAIN ADMIN OFFICE	
Office	122C	169 SF	ECE	ECE	1 S	K. Jurss	MSEE	MAIN ADMIN OFFICE	
Office	122D	227 SF	ECE	ECE	1 F	Assoc Dept Head - M. Melloch	MSEE	MAIN ADMIN OFFICE	
Office	122E	132 SF	ECE	ECE	1 S	M. Kissinger	MSEE	MAIN ADMIN OFFICE	
CONFERENCE	122F	200 SF	ECE	ECE		Conference Room for 8	MSEE	MAIN ADMIN OFFICE	
Storage	122K	12 SF	ECE	ECE		STORAGE	MSEE	MAIN ADMIN OFFICE	
	122L	17 SF	ECE	ECE		LAVATORY			
Corridor	122M	448 SF	ECE	ECE		Internal Corridor	MSEE	MAIN ADMIN OFFICE	
Women's	124	49 SF	ECE	ECE		Women's Restroom Entrance			
Women's	124A	84 SF	ECE	ECE		Women's Restroom - 1WC,1L			
Lounge	125	237 SF	ECE	ECE		Faculty/Staff Lounge	MSEE	MAIN ADMIN OFFICE	
Men's	126	26 SF	ECE	ECE		Men's Restroom Entrance			
Men's	126A	110 SF	ECE	ECE		Men's Restroom - 1WC,1L			
CLASSROOM	129	2476 SF	SMAS	SMAS	468 TAC	468 Tablet Arm Chairs			

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FIRST FLOOR									
Corridor	129A	174 SF	General			Vestibule between GH07 and EE129			
Office	130	228 SF	ECE	ECE	4 GA	Quinn - Graduate Assistants	MSEE? - RM 268		
Office	132	558 SF	ECE	ECE	5 S	Account Clerks	MSEE	MAIN ADMIN OFFICE	
OFF SERV	133	203 SF	ECE	ECE	1 S	Office Service	MSEE	MAIN ADMIN OFFICE	
Office	133A	194 SF	ECE	ECE	1 S	Business Mgr - B. Goodrick	MSEE	MAIN ADMIN OFFICE	
Entrance and Waiting	134	70 SF	ECE	ECE		134A Entrance + Waiting	MSEE	MAIN ADMIN OFFICE	
Office	134A	322 SF	ECE	ECE	3 S	Account Clerks	MSEE	MAIN ADMIN OFFICE	
Graduate Office	135	430 SF	ECE	ECE	3 S	Counseling - M. Golden + M. Wagner + D. Bowman	MSEE	MAIN ADMIN OFFICE	
Office	135A	96 SF	ECE	ECE	1 F	Grad Counselor - C. Ong	MSEE	MAIN ADMIN OFFICE	
Office	135B	96 SF	ECE	ECE	1 F	Grad Counselor - S. Midkiff	MSEE	MAIN ADMIN OFFICE	
Closet	135C	33 SF	ECE	ECE		Closet	MSEE	MAIN ADMIN OFFICE	
Office	136	782 SF	ECE	ECE	4 S	A. Rainwater + C. Glotzbach + C. Quillen + L. Wilson	MSEE	MAIN ADMIN OFFICE	
Counseling Office	138	221 SF	ECE	ECE	1 F	J. Gray	MSEE	MAIN ADMIN OFFICE	
LAB	139	1310 SF	ECE	ECE		DL2 Instructional 500/600 Lab			
Files	140	195 SF	ECE	ECE		FILES	MSEE?	Linhed Rm 135	
Men's	142	134 SF	General			Men's Restroom - 2WC,3U,3L			
Men's	142A	24 SF	General			Men's Restroom Entrance			
Custodial	142B	44 SF	General			Custodial Closet			
Office	143	217 SF	ECE	ECE	4 GA	Graduate Assistants		Power Group - Wang	
Office	144	175 SF	ECE	ECE	1 F	O. Wasynczuk		Power Group - Wang	
Office	145	143 SF	ECE	ECE	1 S	L. Campbell		Power Group - Wang	
Office	146	105 SF	ECE	ECE	1 F	M. Saeedifard		Power Group - Wang	
Office	147	99 SF	ECE	ECE	2 GA	Graduate Assistants		Power Group - Wang	
Office	148	104 SF	ECE	ECE	1 F	S. Pekarek		Power Group - Wang	

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FIRST FLOOR									
Storage	149	99 SF	ECE	ECE		Storage + Copier		Power Group - Wang	
Office	150	128 SF	ECE	ECE	1 F	S. Sudhoff		Power Group - Wang	
Office	151	122 SF	ECE	ECE	1 S	B. Robinson (Instructional)			
Office	153	106 SF	ECE	ECE	1 GA	Graduate Assistants			
Office	154	106 SF	ECE	ECE	1 GA	Graduate Assistants			
Office	155	106 SF	ECE	ECE		Graduate Assistants			
Office	156	106 SF	ECE	ECE		Graduate Assistants			
CONFERENCE	157	106 SF	ECE	ECE		Conference Room for 8			
CLASS LAB	159	1182 SF	ECE	ECE	40 STATIONS	D-CL Computer Lab		INSTRUCTIONAL	
CLASS LAB	160	1182 SF	ECE	ECE	30 STATIONS	MATERIALS-SPECIAL PURPOSE LAB		INSTRUCTIONAL	
CLASS LAB	161	827 SF	ECE	ECE	18 STATIONS	ELECTRONICS+CIRCUITS		INSTRUCTIONAL	
Instruments	162	1134 SF	ECE	ECE		Electronic Repair + Storage		INSTRUCTIONAL	
Office	162	126 SF	ECE	ECE	2 S	D. Azpell		INSTRUCTIONAL	
CLASS LAB	163	833 SF	ECE	ECE	18 STATIONS	ELECTRONICS+CIRCUITS		INSTRUCTIONAL	
CLS LB SV	164	464 SF	ECE	ECE		REPAIR FACILITY		INSTRUCTIONAL	
CLASS LAB	165	980 SF	ECE	ECE	18 STATIONS	ELECTRONICS+CIRCUITS		INSTRUCTIONAL	
CLASS LAB	167	942 SF	ECE	ECE	18 STATIONS	Electronics + Circuits Lab		INSTRUCTIONAL	
Office	168	704 SF	ECE	ECE	6 GA	Graduate Assistants - KAK		KAK	
Office	169	673 SF	ECE	ECE	1 F	Kak - ROBOTICS		KAK	
CLASSROOM	170	1830 SF	SMAS	SMAS	172 TAC	172 Tablet Arm Chairs			
LAB	172	154 SF	ECE	ECE		ROBOT VISION LAB - KAK		KAK	
CONTROL	173	154 SF	ECE	ECE		ROBOT VISION LAB - KAK		KAK	
Office	174	154 SF	ECE	ECE	2 GA	Graduate Assistants		KAK	
Office	175	154 SF	ECE	ECE	2 GA	Graduate Assistants		KAK	

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FIRST FLOOR									
Office	176	145 SF	ECE	ECE	1 S	H. Medeiros		KAK	
Men's	177	144 SF	General			Men's Restroom - 2WC,2U,3L-HCA			
Custodial	177A	24 SF	General			Custodial Closet			
MECHANICAL	177B	35 SF	General			MECHANICAL			
LAB	178	487 SF	ECE	ECE		Robot Vision Lab-Kak		KAK	
LAB	179	525 SF	ECE	ECE		Robot Vision Lab-Kak		KAK	
LAB	180	457 SF	ECE	ECE	5 GA	Image Processing - Kak		KAK	
Repair Area	180	62 SF	ECE	ECE		Electronics Repair		KAK	
LAB	181	280 SF	ECE	ECE		Robot Vision Lab-Kak		KAK	

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SECOND FLOOR									
Elevator	2E01	75 SF	General			ELEVATOR			
Corridor	2H01	1770 SF	General			MAIN HALLWAY			
Corridor	2H02	1848 SF	General			WEST HALLWAY			
Corridor	2H03	646 SF	General			east corridor from 211 to 219			
Corridor	2H04	299 SF	General			corridor from 206 to 210			
Corridor	2H10	508 SF	General			HALLWAY BY RM 270			
Corridor	2H11	692 SF	General			CORRIDOR THRU LSS OFFICES			
Stairs	2S01	607 SF	General			FRONT STAIRS			
Stairs	2S02	224 SF	General			NORTHWEST STAIRS			

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power…
SECOND FLOOR									
Stairs	2S03	204 SF	General			SOUTHEAST STAIRS			
Stairs	2S05	152 SF	General			CORNER STAIRS			
Stairs	2S08	198 SF	General			DUNC ANX SOUTH STAIRS			
Stairs	2S09	198 SF	General			DUNC ANX NORTH STAIRS			
CLASS LAB	206	1065 SF	ECE	ECE	28 STATIONS	Teaching Lab		INSTRUCTIONAL	
CLASS LAB	207	800 SF	ECE	ECE	18 STATIONS	Teaching Lab		INSTRUCTIONAL	
HELP ROOM	208	372 SF	ECE	ECE		Help Room		INSTRUCTIONAL	
HELP ROOM	209	382 SF	ECE	ECE		Help Room		INSTRUCTIONAL	
Under Grad Project Room	210	216 SF	ECE	ECE	10 GA				
Mechanical	211	584 SF	General	Gen Building		mechanical room			
Electrical	211A	65 SF	General	Gen Building		electrical room			
	214	447 SF	ECE	ECE					
CLASS LAB	215	672 SF	ECE	ECE	20 STATIONS	Class Lab		INSTRUCTIONAL	
LAB	216	529 SF	ECE	ECE	6 GA	Research Lab - V. Raghunathan			
CLASS LAB	217	693 SF	ECE	ECE	15 - 20 STATIONS	Embedded Systems Lab		INSTRUCTIONAL	
MECHANICAL	218	214 SF	General			air conditioning equipment			
Men's	219	113 SF	General			Men's Restroom - 2WC,1U,1L			
Men's	219A	36 SF	General			Men's Restroom Entrance			
Entry to LAB	220	44 SF	ECE	ECE		Entry to LU Lab	MSEE? - RM 222		
Electrical	220A	121 SF	General	ITAP		TELECOMMUNICATIONS CLOSET-IDF			
Mechanical	220B	10 SF	General			MECHANICAL CLOSET			
LAB	220C	398 SF	ECE	ECE	5 GA	Research - Lu	MSEE? - RM 222		
Custodial	221	20 SF	General			Custodial Closet			
CLASSROOM	222	591 SF	SMAS	SMAS	40 TAC	Tablet Arm Chairs			

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power…
SECOND FLOOR									
CLASSROOM	224	500 SF	SMAS	SMAS	30 TAC	Tablet Arm Chairs			
Office	225	239 SF	ECE	ECE	2 GA	BROWN Graduate Assistants	MSEE? - RM 326A		
CLASSROOM	226	506 SF	SMAS	SMAS	33 TAC	Tablet Arm Chairs			
Office	230	226 SF	ECE	ECE	2 GA	Graduate Assistants		ECESS	
HELP ROOM	232	222 SF	ECE	ECE	1 - 2 UGA'S	Under Grad Assistants			
CLASSROOM	234	552 SF	SMAS	SMAS	36 TAC	Tablet Arm Chairs			
CLASSROOM	236	589 SF	SMAS	SMAS	39 TAC	Tablet Arm Chairs			
Electrical	237	90 SF	General	ITAP		TELECOMMUNICATIONS CLOSET-IDF			
VIP LAB	238	605 SF	ECE	Prvst Rsv Ac	15-20 STATIONS	On Loan: Research Lab - JVK		KROGMEIER	
MECHANICAL	240	195 SF	General			air conditioning equipment			
LAB	240A	171 SF	ECE	ECE		RESEARCH - LEHNERT	MSEE? - RM 240		
Office	241	294 SF	ECE	ECE	2 S	S. Devault + N. Cope			
CLS LB SV	241	686 SF	ECE	ECE		Audio Visual Room			
Mail Room	241A	302 SF	ECE	ECE		Mail Room			
Office	241A	101 SF	ECE	ECE	1 S	W. Crabill			
Office	242	255 SF	ECE	ECE	3 GA	Graduate Assistants			
Women's	243	95 SF	General			Women's Restroom - 2WC, 2L			
Women's	243A	28 SF	General			Women's Restroom Entrance			
LAB	244	200 SF	ECE	ECE	4 GA	Neurocomputer-Ersoy	MSEE? - RM 346		
Men's	245	147 SF	General			Men's Restroom - 3WC,3U,2L			
Men's	245A	36 SF	General			Men's Restroom Entrance			
Custodial	245B	16 SF	General			Custodial Closet			
Office	246	102 SF	ECE	ECE	1 S	M. Swabey	DL2 TEAM	INSTRUCTIONAL	
Office	248	102 SF	ECE	ECE	1 S	M. Johnson	DL2 TEAM	INSTRUCTIONAL	

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power…
SECOND FLOOR									
Office	249	256 SF	ECE	ECE	2 GA	Research Office - Vijaykumar	EE - RM 320		
Office	249A	126 SF	ECE	ECE	1 GA	Research Office - Vijaykumar	EE - RM 320		
Office	249B	126 SF	ECE	ECE	1 GA	Research Office - Vijaykumar	EE - RM 320		
Office	249C	129 SF	ECE	ECE	1 GA	Research Office - Vijaykumar	EE - RM 320		
Office	249D	129 SF	ECE	ECE	1 GA	Research Office - Vijaykumar	EE - RM 320		
Office	250	102 SF	ECE	ECE	1 S	J. Lax			
Office	252	102 SF	ECE	ECE	1 S	G. Hadley	DL2 TEAM	INSTRUCTIONAL	
Office	254	102 SF	ECE	ECE	1 F	J. Park		KAK	
Office	256	141 SF	ECE	ECE	2 S	A. Ault, T. Wild	DL2 TEAM	KROGMEIER	
Office	258	157 SF	ECE	ECE	2 GA	Research Office - Bagchi		BAGCHI	
Corridor	260	73 SF	General			WALK WAY TO ROOF			
Office	262	110 SF	ECE	ECE	1 F	Meyer			Video Faculty
Office	264	108 SF	ECE	ECE	1 F	J. Nyenhuis	MSEE or EE - Flexible		
Office	266	108 SF	ECE	ECE	1 S	A. Hughes	Close to Mail Room		
Office	268	108 SF	ECE	ECE	1 S	M. Erickson	Close to Mail Room		
CLASSROOM	270	1472 SF	SMAS	SMAS	148 TAC	Tablet Arm Chairs			
Projection Booth	270A	64 SF	SMAS	SMAS		Projection Booth			
Office	271A	98 SF	ECE	ECE	1 GA	FLOAT			
Office	271B	98 SF	ECE	ECE	1 GA	FLOAT			
ECN Storage	271C	98 SF	ECN	ECE		Computer Support - LONG TERM			
IEEE Student Space	271D	230 SF	ECE	ECE		Student Activity			
Office	272	108 SF	ECE	ECE	1 GA	FLOAT			
Office	273	128 SF	ECE	ECE	2 GA	FLOAT			
Office	274	146 SF	ECE	ECE	2 GA	FLOAT			

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power…
SECOND FLOOR									
Office	275	139 SF	ECE	ECE	2 GA	FLOAT			
Men's	276	167 SF	General			Men's Restroom - 2WC,2U,3L-HCA			
Electrical FA Room	276A	8 SF	General			FIRE ALARM PANEL CLOSET			
MECHANICAL	276B	36 SF	General			MECHANICAL			
Custodial	277	24 SF	General			Custodial Closet			
Women's	278	116 SF	General			Women's Restroom - 2WC, 1L			
Office	279	187 SF	ECE	ECE	2 GA	FLOAT			
Office	280	238 SF	ECE	ECE	3 GA	FLOAT			
Office	281	107 SF	ECE	ECE	1 GA	FLOAT			
Office	283	101 SF	ECE	ECE	1 GA	FLOAT			
Office	285	101 SF	ECE	ECE	1 GA	FLOAT			
Office	286	78 SF	ECE	ECE	1 GA	FLOAT			
Office	287	101 SF	ECE	ECE	1 GA	FLOAT			
Office	288	81 SF	ECE	ECE	1 GA	FLOAT			
Office	289	109 SF	ECE	ECE	1 GA	FLOAT			
Office	290	78 SF	ECE	ECE	1 GA	FLOAT			
Electrical	291	100 SF	General	ITAP		TELECOMMUNICATIONS CLOSET-IDF			

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power…
THIRD FLOOR									
Elevator	3E01	75 SF	General			ELEVATOR			
Corridor	3H01	617 SF	General			FRONT HALL			
Corridor	3H02	702 SF	General			WEST HALLWAY			
Corridor	3H03	449 SF	General			EAST HALLWAY			
Corridor	3H04	844 SF	General			EAST HALLWAY			
Corridor	3H05	844 SF	General			EAST HALLWAY			
Corridor	3H06	180 SF	General			EAST HALLWAY			
Stairs	3S01	607 SF	General			FRONT STAIRS			
Stairs	3S02	224 SF	General			WEST STAIRS			
Stairs	3S03	204 SF	General			EAST STAIRS			
Office	306	2081 SF	ECE/VLSI	ECE	24 GA	Graduate Assistants			
LAB	308	400 SF	ECE	ECE		Research Lab WEBB			
LAB	309	452 SF	ECE	ECE		ECE 270 LAB		INSTRUCTIONAL	
Office	310	221 SF	ECE	ECE	1 F	S. Midkiff			
Office	312	216 SF	ECE	ECE	1 F	R. Pierret			
Entry to Suite	313	290 SF	ECE	ECE		Internal Corridor			
Office	313A	130 SF	ECE	ECE	2 GA	Graduate Assistants		Given and Siskind	
Research	313B	170 SF	ECE	ECE		Laser Table		Given and Siskind	
Office	313C	133 SF	ECE	ECE	1 F	R. Givan		Given and Siskind	
Office	313D	158 SF	ECE	ECE	2 PHd	Post Docs		Given and Siskind	
Office	313E	132 SF	ECE	ECE	1 F	J. Siskind		Given and Siskind	
Office	313F	108 SF	ECE	ECE	2 GA	Graduate Assistants			
CONFERENCE	313G	130 SF	ECE	ECE		Conference Room for 6			
Closet	313H	23 SF	ECE	ECE		CLOSET			

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power...
THIRD FLOOR									
Office	314	214 SF	ECE	ECE	1 F	K. Webb			
LAB	316	536 SF	ECE	ECE		Research - Webb			
CONF AND SEMINAR	317	637 SF	ECE	ECE	30 SEATS	VIDEO-CONFERENCING ROOM			
Office	318	77 SF	ECE	ECE		M. Melloch			
Office	318A	109 SF	ECE	ECE	1 F	M. Melloch			
REST ROOM	319	93 SF	General			Women's Restroom - 2WC, 1L			
REST ROOM	319A	26 SF	General			Women's Restroom Entrance			
Office	320	180 SF	ECE	ECE	1 F	T. Vijaykumar			
BLDG SERV	321	20 SF	General			Custodial Closet			
Office	322	409 SF	ECE	ECE	3- 5 GA	Graduate Assistants			
Office	322A	119 SF	ECE	ECE	1 F	S. Rao			
Office	322B	119 SF	ECE	ECE					
Office	324A	119 SF	ECE	ECE	1 F	M. Kulkarni			
Office	324B	119 SF	ECE	ECE	1 F	F. Lynn			
Office	325	239 SF	ECE	ECE	1 F	R. Eigenmann			
Office	325A	116 SF	ECE	ECE	1 F	J. Gray		???	
OFF SERV	325B	118 SF	ECE	ECE		Entry Foyer			
OFF SERV	325C	122 SF	ECE	ECE		COPY ROOM			
Office	326A	119 SF	ECE	ECE	1 F	C. Brown			
Office	326B	124 SF	ECE	ECE	1 S	Secretary - W. Thompson			
Office	327	121 SF	ECE	ECE	1 F	M. Thottethodi			
REST ROOM	328	124 SF	General			Men's Restroom - 2WC,1U,1L			
Office	329	121 SF	ECE	ECE	1 F	S. Bagchi			
Office	330	121 SF	ECE	ECE	1 F	Barja ???			

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power…
THIRD FLOOR									
Office	331A	105 SF	ECE	ECE	Visiting Fac.				
Office	331B	105 SF	ECE	ECE	1 S	Y. Wang	MSEE	MAIN ADMIN OFFICE	
Office	332	172 SF	ECE	ECE	4 F touchdown	E. Narimanov + D. Peroulis + P. Bermel + B. Ziaie			
Office	333	105 SF	ECE	ECE	2 F touchdown	Z. Chen + A. Botasseva			
Office	334A	121 SF	ECE	ECE	3 F touchdown	M. Capano + J. Cooper + J. Appenzeller			
Office	334B	121 SF	ECE	ECE	3 F touchdown	D. Janes + S. Mohammadi + E. Narimanov			
Office	334C	125 SF	ECE	ECE	1 F touchdown	M. Lundstrom			
Office	334D	125 SF	ECE	ECE	3 F touchdown	A. Alam + G. Klimeck + P. Ye			
Custodial	335	69 SF	General			Custodial Closet			
Office	336	121 SF	ECE	ECE	2 GA	Graduate Assistants - P. Ye			
Office	337A	105 SF	ECE	ECE	1 S	Undergrad Council Hire??			
COPY WORK RM	337B	105 SF	ECE	ECE		copy room			
LAB	338	631 SF	ECE	ECE		Research Lab - Bagchi			
CONFERENCE	339	219 SF	ECE	ECE		Conference room for 8			
Office	340	235 SF	ECE	ECE	1 F	A. Kak			
Office	341	201 SF	ECE	ECE					
Office	342	201 SF	ECE	ECE	4 F	Emeriti Faculty			
LAB	343	201 SF	ECE	ECE		Research - Talavage			Acoustic Chamber
	344	596 SF	ECE	ECE		VACANT			
Office	345	480 SF	ECE	ECE	12 GA	Graduate Assistants			
Office	347	360 SF	ECE	ECE	6 GA	Graduate Assistants RAO			
Corridor	348	306 SF	ECE	ECE		Internal Corridor			
Office	348A	119 SF	ECE	ECE	1 PHd	Office			
Office	348B	103 SF	ECE	ECE	1 PHd	Office			

Room Name	Room Number	Area SF	Department Using Space	Department assigned space	Current Staff Count	Comments	Space location: Pick either MSEE or EE	Relationship of this space to others: Pick either a department, faculty or N/A	Does this space have special room needs: example would be, Fume Hood, Sink, 220V power…
THIRD FLOOR									
Office	348C	120 SF	Ntwk Cmp Nan	ECE	1 S	R. DeSutter	Move to POTTER		HUB - Zero
CONFERENCE	348D	435 SF	ECE	ECE		Conference Room for 18			
CONF SERV	348D	95 SF	ECE	ECE		Conference Room Entrance + Coffee Bar			
Office	348E	120 SF	Ntwk Cmp Nan	ECE	1 S	J. Cychosz	Move to POTTER		
Office	348F	100 SF	ECE	ECE	2 GA	Office			
Office	348G	100 SF	ECE	ECE		VACANT			
LAB for Moved Rm 60/65	350	2132 SF	ECE	ECE		Instructional Lab for Swaby and Johnson			

NARRATIVES OF SYSTEMS
(Existing and Proposed)

Architectural Narrative

Electrical Engineering Building

The Electrical Engineering building was built in various times over the years. The original building was built in the 1930's with additions in the 1940's and significant remodeling in the 1960's. Currently, a majority of the building interior space is vintage 1960's construction with some improvements architecturally to satisfy educational changes over the last few decades. Recent renovations have occurred within some of the SMAS classrooms and some of the office and lab spaces as well. Refer to the existing plans for room names with dates indicating the year renovations happened recently. There are portions of the corridors that contain original exposed building walls.

The current interior spaces appear to be in generally good shape but dated. The materials on many portions of the floor, glued on ceiling tiles, paint and possibly fireproofing might contain some asbestos contamination. We feel that Purdue should reserve costs for abatement and removal of these finishes.

Almost all of the walls, floors and ceilings will be either rebuilt for the new programming or refinished as part of the new construction. We intend to put a new anti-static floor material down in the lab spaces, new VCT or other current flooring for the offices and classrooms, provide new wall base and wall paint on the vertical surfaces and install all new lay in ceilings in most of the public labs, offices, corridors and conference or support spaces. Back of house or storage/utility spaces will be upgraded with new sealed concrete, painted cmu block walls and exposed ceilings.

The current exterior light shafts that penetrate deep inside the building will be covered with skylights to permit natural light inside the building yet filled in on the lower levels for classroom surge space and pedestrian circulation areas. These will be infilled with a new concrete floor and structure. We intend to do a small infill between the Duncan Annex and the EE building to permit better access between these buildings. The infill will also include a new elevator and stairs reconstruction for better exiting. We will also be adding exterior curtain walls in the Duncan Annex for natural lighting inside these areas of building which have never seen day lighting….this will permit office functions to operate properly.

Many areas inside the building will have improved circulation routes which will meet code requirements. Other codes improvements include building fire separations, fire alarm and sprinkler upgrades, security system upgrades as well as other various improvements. Refer to the code study for more detailed information.

Doors and hardware, special construction like white boards, projection screens, etc. and other construction systems will be standard commercial grade which meet or exceed Purdue building standards. We envision some unique wall and overhead door separation techniques to allow flexible lab solutions. We also envision a lot of systems furniture designs similar to those being used inside Wang and Grissom Halls for the College of Engineering. These new systems are cost effective, efficient and reinforce many healthy learning benefits which include improved day-lighting to better learning communities to more student and faculty collaboration.

Structural Narrative

Electrical Engineering Building

The original Electrical Engineering building was built in the 1930's with multiple additions in the 1940's and significant remodeling in the 1960's. All of the additions and remodels created various structural modifications. These building modifications would be best described as gymnastics in order to accommodate the various level changes, loading and attempts to maintain existing structures from the original construction or previous additions. The majority of the building is a combination of steel superstructure columns and beams with load bearing block walls and concrete floors over various metal deck. There appears to be portions of the building with some form of fire protective covering systems and some block cmu construction providing some rating. The exterior walls in the EE building are generally punched window openings with block and brick construction for the exterior veneer.

Duncan Annex Building

The Duncan Annex building was built on as basically an independent structure with a connection on the first floor. No elevator or stairs permit complete connectivity between the Duncan Annex and the EE building. We are attempting to correct some of the circulation deficiencies in this renovation. We are also infilling some of the floor areas within Duncan as well as adding floor and walls to upper levels to accommodate connectivity.

One major change to the Duncan Annex is the addition of windows on the exterior of the building. We will attempt to provide vertical curtain wall window systems on various elevations to introduce natural daylighting into the building. This will make the space inside more usable for office functions.

Mechanical Narrative

Existing HVAC Systems:

DUNCAN ANNEX

For the purposes of this study, the spaces connecting the Duncan Annex to the EE Building will be referred to as the connector bridge, and will be discussed in the Duncan Annex portion of this study.

The Duncan Annex is currently being served by eight (8) major systems and various radiators and unit heaters. These systems currently utilize chilled water provided from chilled water pumps in room 92 on the ground floor for cooling. Chilled water is pumped throughout the annex from these pumps to provide cooling for the building. Campus steam is piped throughout the annex to provide heating to the area via steam coils in the existing air handling units; as well as radiators, convectors, and unit heaters located in smaller support spaces, corridors, and stairwells. Current HVAC systems in the building are controlled with pneumatic actuators supplied with compressed air from a pair of compressors located in the basement, room B66N.

Refer to the *Electrical Engineering Building and Duncan Annex Existing Zoning Plan* for an illustration of HVAC equipment locations and building zoning of the existing buildings.

Basement

The basement of the Duncan Annex is currently served by four (4) indoor air handling units located in room 72 on the ground floor of the Duncan Annex, and a few steam unit heaters throughout the floor. These units are labeled ACB-32, ACG- 5, ACG-6, and ACG-8. The basement of the Duncan Annex is currently occupied by the Nuclear Engineering Department and contains a small demonstration reactor. The support rooms around the reactor room are served by ACG- 5, ACG-6, and ACG-8. The reactor room itself is served by a small fan coil unit, ACB-32. Due to the safety implications of removing services from this area, steam and chilled water will remain in service for this area at all times. These units are not planned for demolition. ACG-5 is a single zone unit which serves room B84. ACG-8 is also a single zone unit which serves room B86. ACG-6 is a multi-zone unit which serves most of the remainder of the floor. Return air is ducted through the high bay overhead back to the units.

Ground Floor

The ground floor of the Duncan Annex is currently served by only unit heaters. The spaces in the basement are of a high bay construction and extend up into the ground floor. This floor is mainly mechanical and electrical space to house utilities for the annex.

First Floor

The first floor of the Annex is served by three (3) air handling units. The east portion of the floor is predominantly offices and small classrooms. This area is served by a multi-zone unit labeled ACG-7 located in room 72 on the ground floor of the annex. Return air is ducted back to the unit via plenum return above the ceiling passing air to a return duct which then goes back down to the first floor. One of the larger spaces, room 179, is served by a fan coil unit above the ceiling. This fan coil unit is labeled AC1-35. The large lecture hall, room 170, on the west end of the floor is served by ACA-28 located in the attic of the annex. ACA-28 is a multi-zone unit with 2 zones. One for the lecture hall on the first floor, and the other serves the lecture hall on the second floor. Air is returned to ACA-28 via duct in a chase on either side of the lecture hall.

Second Floor

The second floor of the annex is served by two (2) units. The large lecture hall on the west end of the annex is also served by ACA-28 and the offices occupying the rest of the floor are served by a multi-zone unit labeled ACA-27. Both of these units are located in the attic of the Duncan Annex. The return for these units is ducted back to the attic.

Perimeter Radiation

Exterior walls of the first and second floors of the annex have steam radiators placed around the perimeter providing supplemental heat.

Restroom Exhaust

There is currently a stack of restrooms and janitors closets in the southeast corner of each floor adjacent to the stairwell. This stack is served by an exhaust fan located in the attic of the annex.

EE BUILDING

The EE Building is currently being served by twenty two (22) major systems and various radiators, convectors, and unit heaters. These systems currently utilize chilled water provided from chilled water pumps in room 64A for cooling. Chilled water is pumped throughout the building from these pumps to provide cooling for the building. Campus steam is piped throughout the building to provide heating to the area via steam coils in the existing air handling units; as well as radiators, convectors, and unit heaters located in smaller support spaces, corridors, and stairwells. Current HVAC systems in the building are controlled with pneumatic actuators supplied with compressed air from a pair of compressors located in the basement, room B66N.

Refer to the *Electrical Engineering Building and Duncan Annex Existing Zoning Plan* for an illustration of HVAC equipment locations and building zoning of the existing buildings.

Basement

The basement of the EE building houses the entrance of campus steam and includes a small maintenance/machine shop area (Rooms B006C, B006C, and B006N). This area is currently served by a small unit labeled ACB-1. ACB-1 is located B66N along with the building air compressors, steam entrance, and other mechanical equipment.

Ground Floor

The ground floor of the building is served by eight (8) air handlers as well as many fan coil units and perimeter steam radiation.

West Wing (DL2)

The West Wing is currently being served by three (3) major systems and various radiators, convectors, and unit heaters.

The south half of the DL2 area, as well as the south area of the first floor directly above DL2 are served by a multi-zone unit labeled ACP-21. ACP-21 is located in the penthouse above the first floor. Humidification is provided with steam absorption manifolds also supplied from campus steam. A duct for each zone of the multi-zone unit penetrates the roof of the first floor to distribute air to the appropriate zone. Where zones located on the ground floor are supplied by ACP-21, the zone duct branch passes through a chase between Labs 163 and 165 on the first floor, down to the ground floor. Each zone has its own thermostat to control the zone dampers in the unit in order to satisfy the zone load. The area is currently zoned such that each lab/support area has its own thermostat. Air is returned from the spaces to the adjacent corridor via either a louver in the door or a return grille located in the wall of the space. In large part, air is returned via the corridor. Return air is then passed through a return grille located low in the wall in the corridor between labs 65 and 67 on the ground floor, and outside the door to lab 165 on the first floor. These grilles then pass return air through a chase back to the penthouse where a return fan draws air back into ACP-21. Outdoor air is pulled through a set of louvers on the west wall of the penthouse then mixed with the return air and fed into the unit. ACP-21 supplies more air than is returned giving the zone a positive pressurization.

The north half of the DL2 area and first floor directly above are fed from a second multi-zone unit labeled ACP-22, also located in the penthouse. ACP-22 operates in the same manner as ACP-21. Where zones on the ground floor are supplied by ACP-22, zone duct branches pass through a chase between lab 161 and room 100H on the first floor and down to the ground floor. Air for these spaces is then returned through the adjacent corridor via return grills. The return chases for ACP-22 are located between labs 61 and 63 on the ground floor, and just outside the door lab 161 on the first floor. A return fan in the penthouse then returns air to be mixed with outdoor air in the same configuration as ACP-22. Pneumatic controls are also utilized for ACP-22 in the same fashion as ACP-21. ACP-22 also uses a steam absorption manifold to provide humidification.

Rooms 56 and 58 on the ground floor are conditioned with unit ACG-38, located above the ceiling in room 56. This unit returns air via return grilles located in the ceiling of the rooms being served. Cooling is provided by chilled water and heating is provided by campus steam.

Classroom 5 is currently served by ACG-31 located above the ceiling in the adjacent corridor.

Room 7 is served from a small unit above the ceiling in that room.

Room 79 currently houses data racks with a very high heat load density. There is a dedicated unit to serve this space, ACG-30, located next door in room 23. Due to the nature of air distribution in data server rooms, the ceiling above this space is very congested with ductwork. Both the supply and return to the space is hard ducted.

Lecture hall 129 is currently served unit ACG-2 located in the mechanical room on the ground floor under the east end of the lecture hall. This mechanical room also houses the potable water entrance for the building. Fresh air is taken in from a louver on the north end of the mechanical room adjacent to the north light well. Supply air is ducted into the lecture then returned from the east end of the room.

There is a small unit above the ceiling in room 38. This unit is labeled ACG-41. ACG-41 serves only room 38. Supply air is ducted to diffusers. Air is returned via plenum above the ceiling.
The remainder of the floor is cooled by numerous fan coil units located above the ceilings in individual rooms. These spaces are heated via steam radiators located above the ceilings. There is also perimeter steam radiation under the windows in exterior spaces and throughout the corridors.

<u>First Floor</u>
The first floor of the building is served by six (6) air handlers as well as many fan coil units and perimeter steam radiation.

The south half of the west wing is served by a multi-zone unit labeled ACP-21. ACP-21 is located in the penthouse above the first floor. A duct for each zone of the multi-zone unit penetrates the roof of the first floor to distribute air to the appropriate zone. Each zone has its own thermostat to control the zone dampers in the unit in order to satisfy the zone load. The area is currently zoned such that each lab/support area has its own thermostat. Air is returned from the spaces to the adjacent corridor via either a louver in the door or a return grille located in the wall of the space. In large part, air is returned via the corridor. Return air is then passed through a return grille located low in the wall in the corridor outside the door to lab 165 on the first floor. These grilles then pass return air through a chase back to the penthouse where a return fan draws air back into ACP-21. Outdoor air is pulled through a set of louvers on the southwest wall of the penthouse then mixed with the return air and fed into the unit. Economizer relief air from the unit is relieved through a louver in the penthouse wall. ACP-21 supplies more air than is returned giving the zone a positive pressurization. ACP-21 also serves a portion of the ground floor.

The north half of the DL2 area and first floor directly above are fed from a second multi-zone unit labeled ACP-22, also located in the penthouse. ACP-22 operates in the same manner as ACP-21. Air for these spaces is then returned through the adjacent corridor via return grills. The return chases for ACP-22 are located just outside the door lab 161 on the first floor. A return fan in the penthouse then returns air to be mixed with outdoor air in the same configuration as ACP-22. Economizer relief air from the unit is relieved through a louver in the penthouse wall. Pneumatic controls are also utilized for ACP-22 in the same fashion as ACP-21. ACP-22 also uses a steam absorption manifold to provide humidification. ACP-22 also serves a portion of the ground floor.

The north end of the west wing is served by multi-zone unit ACP-23 located in the penthouse above the first floor. This unit operates in the same manner as ACP-21 and ACP-22. Air is ducted through a duct chase along the roof out of the north end of the penthouse. Supply air is fed to both the first and second floors. Return air is passed via a plenum above the ceilings back to return duct that runs through the same chase as the supply and is returned to the unit in the chase. A return fan then returns air to the unit. Economizer relief air from the unit is relieved through a louver in the penthouse wall.

The south wing of the floor is served by ACG-3, located on the ground floor. This unit is ducted through the floor to provide air from the unit on the ground floor to the spaces on the first floor. Return air is then ducted back to the unit. There is a chase located between rooms 116 and 118 that allow the supply and return air ductwork to pass. Each room on the zone is currently controlled by a space mounted thermostat.

Lab 139 is being served by a Liebert CRAC unit labeled AC1-9. This unit is used to serve only Lab 139. Supply air is ducted throughout the room. Air is returned to the unit directly from the space.

Office 136 is conditioned with AC1-10, which is located above the ceiling. Supply air is ducted throughout the room and returned via a ducted return grille.

The remainder of the floor is cooled by numerous fan coil units located above the ceilings in individual rooms. These spaces are heated via steam radiators located above the ceilings. There is also perimeter steam radiation under the windows in exterior spaces and throughout the corridors.

<u>Second Floor</u>
The second floor of the building is served by five (5) air handlers as well as many fan coil units and perimeter steam radiation.

The southwest corner of the building is currently served by AC2-11 located in room 211. This unit is a newer Haakan unit. Supply air is ducted east and west tight to the structure utilizing a VAV system. This system has 7 VAVs that serve the zone. Reheat is provided to the branches via a steam reheat coil cut into the ductwork. Supply air is then distributed to diffusers located in rooms in the south portion of the floor. Return air is then ducted back to the unit via a return fan. This unit utilizes digital controls in a standalone mode. It is not connected to the pneumatic control system utilized in the rest of the building.

The southeast portion of the floor is served by unit AC2-13. AC2-13 is located in room 218. This unit is also ducted above the ceiling to provide supply and return air paths to rooms served by the unit. Each room being served by this unit has its own thermostats for space temperature control.

The northeast portion of the floor is a mirror of the southeast portion of the floor. There is an air handling unit in room 240 labeled AC2-20. This unit is ducted above the ceilings tight to structure to provide supply air to the northeast portion of the floor. Return air is ducted back to the air handling unit. Each space in the zone has its own thermostat for space temperature control.

The office on the south wall of the north wing is served by a vertical air handling unit located in the southwest corner of room 241B. Supply air is ducted throughout the area tight to the structure. Air is then returned via a duct also running above the ceiling.

The northwest portion of the floor is served by unit ACP-23 as described in the previous first floor section.

Unlike the previous floor, the second floor is not served by fan coil units located above ceilings. It is, however, served by perimeter steam radiation on the perimeter walls like the previous floor.

Third Floor

The third floor is served by four (4) air handling units, all located in the attic. These units are all dual duct VVT systems. Supply and return ductwork mains have been run in the attic. Each office has a zone box located in the attic which is controlled by a thermostat located in the space. With very few exceptions, the entire floor is served by these air handlers. ACA-24 serves the central portion of the south wing. ACA-25 serves room 317. ACA-26 serves the north and east wings as well as rooms 308 and 309. ACA-44 is dedicated to room 306.

The remainder of the floor is cooled by numerous fan coil units located above the ceilings in individual rooms. These spaces are heated via steam radiators located above the ceilings. There is also perimeter steam radiation under the windows in exterior spaces and throughout the corridors.

Restroom Exhaust Systems

Currently, there are 2 stacks of restrooms in the EE building. One stack is located in the southeast corner of the building; the other is located in the north wing of the building. Each stack of restrooms has an adjacent janitor's closet . Each of these stacks is served by an exhaust fan located on the roof.

Existing Plumbing Systems:

Currently, the existing plumbing systems serving the building (sanitary, vent and domestic water) are galvanized steel. Domestic hot and cold water are distributed throughout the building above the ceiling on all floors. Domestic hot water is made via a steam to hot water heat exchanger located in the basement of the building in room B66N.

The building restrooms are configured in 3 stacks. Each floor has 3 restrooms which are located above the restroom on the floor below and below the restroom on the floor above. A stack of restrooms is located in the southeast corner of the Duncan Annex near the stairwell. A second stack is located on the interior side of the corridor in the southeast corner of the main building. The third, and final, stack is located on the exterior wall in the center of the north wing of the main building. There a few hand sinks located throughout the building.

The existing domestic water and fire protection service for the Duncan annex is located in the west end of mechanical room 72. The existing domestic water and fire protection service for the main building enters the building in the north end of mechanical room 29.

Existing Compressed Air System:

The building is currently provided with compressed via a pair of Quincy compressors located in basement in room B66N. Compressed air is piped from the compressor throughout the building above the ceiling.

Wet Pipe Sprinkler System

The EE building is currently served by a wet pipe sprinkler system. The water supply for the system is in mechanical room 29 under the lecture hall. Backflow preventer devices and water service enters the building underground through a tunnel under the north wall of the room in the east corner.

The Duncan Annex is also served by a wet pipe sprinkler system. The water supply for the system is in physical plant room 72 which also houses ACG-5, ACG-6, ACG-7, and ACG-8. Backflow preventer devices and water service enters the building underground through a tunnel under the west wall of the room.

Current Observations:

DUNCAN ANNEX

The units serving the basement of the Duncan Annex, ACG-5, ACG-6, ACG-8 and ACB-32, appear to have been installed during the 1957 Duncan renovation. These units appear to be functional and are not planned for replacement due to being part of the nuclear lab support facilities.

The units serving the rest of the Duncan Annex, ACG-7, AC1-35, ACA-27, and ACA-28 were also installed in the 1957 renovation. These units have exceeded their useful life expectancy and are not a good fit for the reprogramming of the building. The existing ductwork has deteriorated over the life of the system, and the insulation liner that was laminated to the inside of the duct has crumbled and peeled away from the sheet metal. In several locations evidence of debris from the deterioration of the liner can be seen where it has been blown out of supply diffusers serving spaces in the system. Engineers from Purdue's Physical Facilities Department have indicated that any existing ductwork should not be re-used, but should be disconnected and removed from the building.

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The current HVAC systems have been modified and renovated several times over the life of the building. The Haakan unit located in room 211, AC2-11 was installed in 2010 and is in very good condition. It is recommended that this unit remain in service with modifications to utilize hot water heating in lieu of steam. The rest of the systems have exceeded the life expectancy of the equipment and require a large degree of effort to maintain and keep in operation.

AC2-11 is a newer unit, but will require upgrades in order to utilize hot water for heating instead of steam. Likewise, the duct coils installed downstream of the VAV units will require replacement to allow the use of hot water.

The existing ductwork has deteriorated over the life of the system, and the insulation liner that was laminated to the inside of the duct has crumbled and peeled away from the sheet metal. In several locations evidence of debris from the deterioration of the liner can be seen where it has been blown out of supply diffusers serving spaces in the system. Engineers from Purdue's Physical Facilities Department have indicated that any existing ductwork should not be re-used, but should be disconnected and removed from the building.

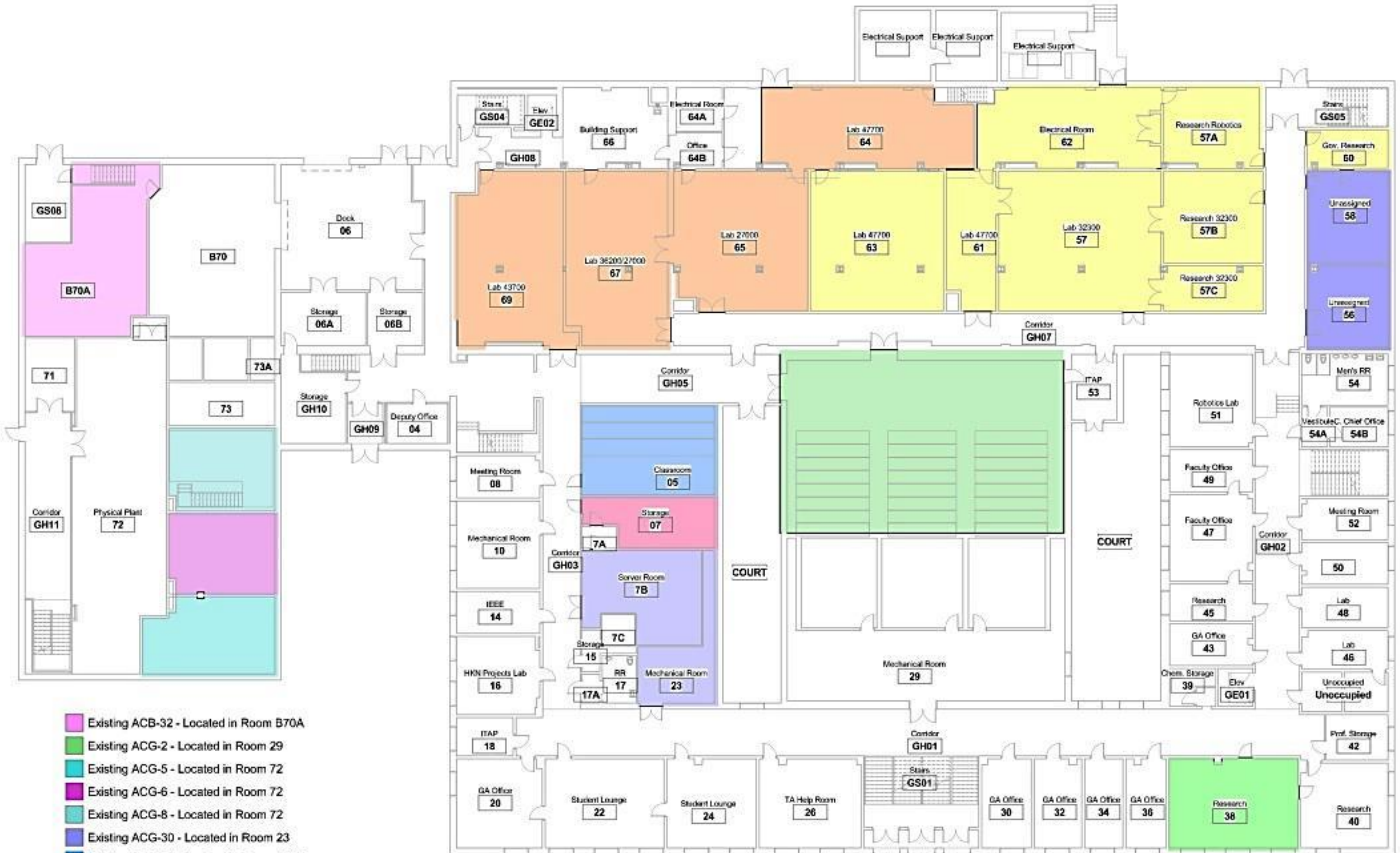
Currently, there are several units serving multiple floors. The preference of the University would be to serve spaces in the same floor with an air handler, and not multiple floors from a single unit.

The existing HVAC systems are controlled by a pneumatic system. There are several pneumatic thermostats and a handful of pneumatic humidistats installed throughout the building. These devices require annual maintenance to keep them calibrated, and can lead to inadequate control if not serviced annually. Purdue's Physical Facilities Department has also requested that any new units installed be equipped with modern digital controls and electric actuators.

The existing air handling units throughout the building are currently using campus chilled water to provide cooling and campus steam to provide heating. Purdue would like to continue to use chilled water for cooling, but would like to use hot water for heating in lieu of steam. This would require the installation of a steam to hot water heat exchanger and pump system to provide a heating source to any new air handling units and variable air volume (VAV) boxes installed in the building. Currently, the building load seems to be satisfied with the existing system capacities, but 10% additional capacity would be beneficial to future programming changes that would add additional load to the systems. This would make the systems more flexible to the future uses of the space.

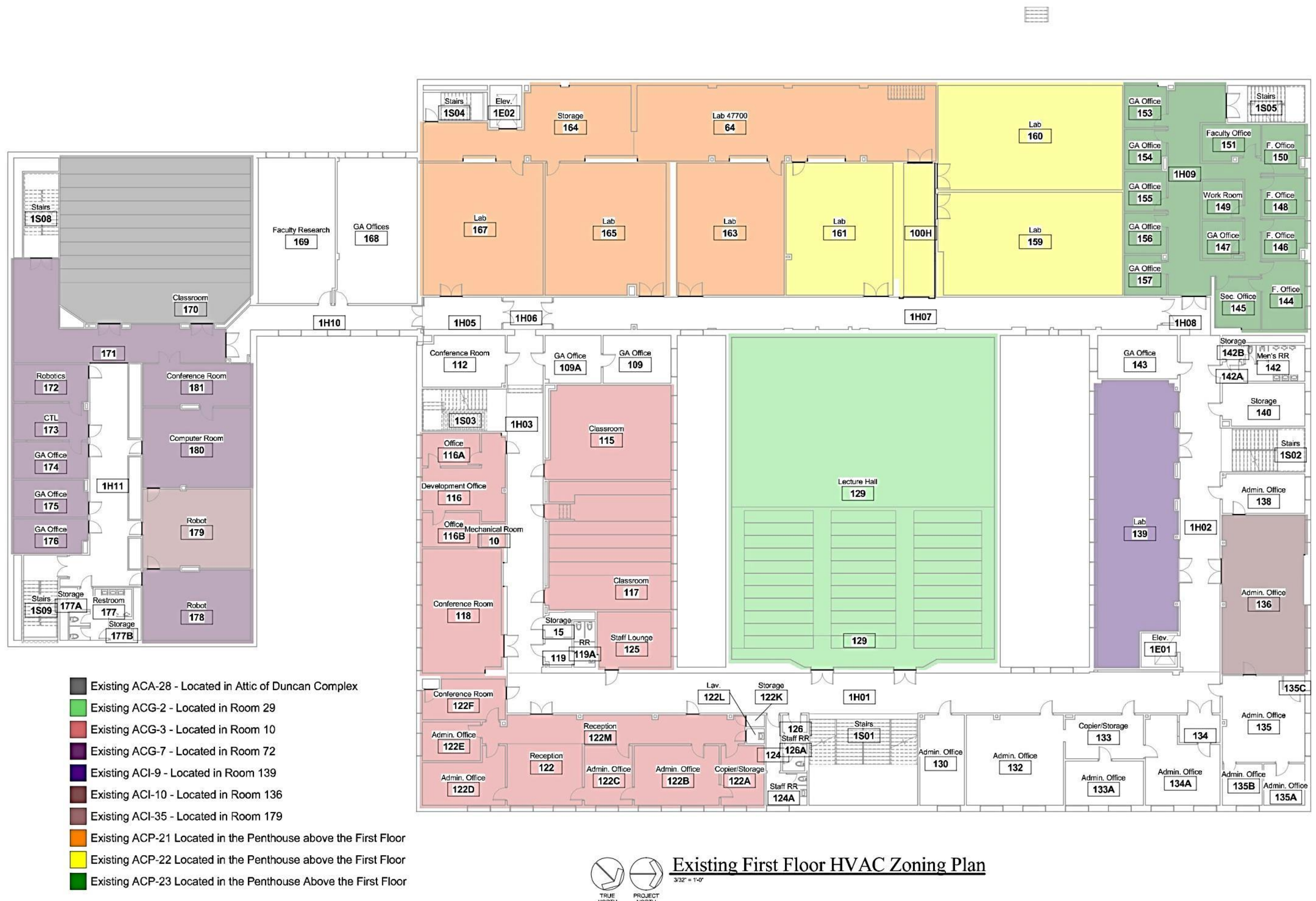
Using the corridor as a return plenum is no longer allowed by code. When new air handling units are installed, the return will have to be through grilles in the ceiling of spaces then ducted through the chases back to the respective units.
The plumbing piping has deteriorated over the years and is in poor condition. The physical facilities staff has requested that the domestic, sanitary, and storm piping be replaced.

Existing Basement HVAC Zoning Plan



- Existing ACB-32 - Located in Room B70A
- Existing ACG-2 - Located in Room 29
- Existing ACG-5 - Located in Room 72
- Existing ACG-6 - Located in Room 72
- Existing ACG-8 - Located in Room 72
- Existing ACG-30 - Located in Room 23
- Existing ACG-31 - Located in Room GH03
- Existing ACG-38 Located in Room 56
- Existing ACG-40 - Located in Room 7
- Existing ACG-41 - Located in Room 38
- Existing ACP-21 Located in the Penthouse above the First Floor
- Existing ACP-22 Located in the Penthouse above the First Floor

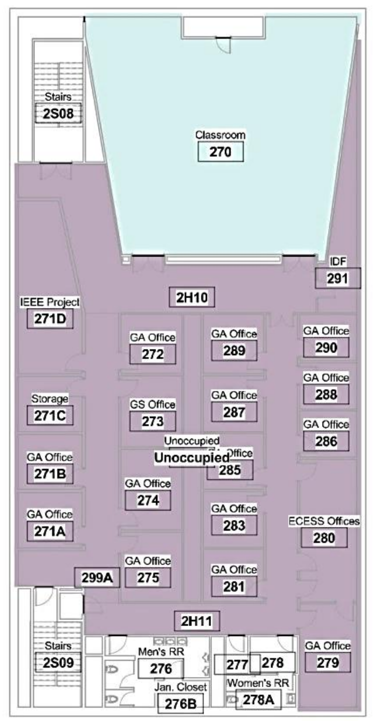
Existing Ground Floor HVAC Zoning Plan



Existing First Floor HVAC Zoning Plan

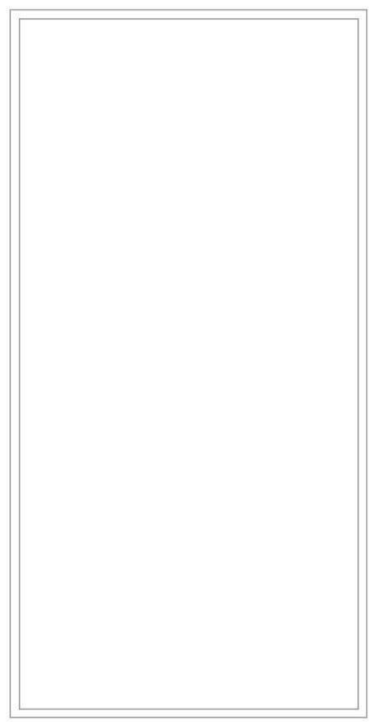
3/32" = 1'-0"

PURDUE UNIVERSITY



- Existing AC2-11 - Located in Room 211
- Existing AC2-13 - Located in Room 218
- Existing AC2-20 - Located in Room 240
- Existing AC2-43 - Located in Room 241B
- Existing ACA-27 - Located in Attic of Duncan Complex
- Existing ACA-28 - Located in Attic of Duncan Complex
- Existing ACP-23 Located in the Penthouse Above the First Floor

Existing Second Floor HVAC Zoning Plan



- Existing AC2-43 - Located in Room 241E
- Existing ACA-25 - Located in Attic
- Existing ACA-26 - Located in Attic
- Existing ACA-44 - Located in Attic

Existing Third Floor HVAC Zoning Plan

3/32" = 1'-0"

Proposed New Systems:

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HVAC Systems:
The approach to this renovation for the Duncan Annex includes a unique challenge with the nuclear engineering labs in the basement. Throughout this renovation process, utilities for these spaces are NOT to be interrupted or disconnected. For this reason, it is intended that the basement not be renovated. ACG-5, ACG-6, and ACG-8 are intended to remain in place. These units are located in Physical Plant Room 72 on the ground floor. Supply and return air are ducted through chases to and from the basement. It is intended to leave these air handlers in place and operating as they currently exist. This would mean leaving steam service in place for these units only. In approaching the rest of the building, it is recommended to completely disconnect and remove any piping and ductwork providing utilities to the ground, first, and second floor of the annex.

Refer to the *Electrical Engineering building and Duncan Annex New Zoning Plan* for an illustration of HVAC equipment locations and Building zoning of the proposed new buildings floor plan.

Refer to the *Electrical Engineering Building and Duncan Annex New HVAC Zone Schedule* for an estimation of HVAC capacities and air flows for the proposed new buildings floor plan.

New HVAC equipment would all be VAV systems with chilled water to provide cooling and hot water to provide heating. All chilled water piping in the building is to be replaced, except that continuous service to the reactor space must be maintained. Because the main chilled water supply and return piping runs through the reactor space, careful coordination will be required to allow access to this space. Because the building currently uses steam, a new steam to hot water heat exchanger would be set in the basement near the steam entrance in room B066N. This heat exchanger package would be complete with all equipment required to provide a closed loop heating hot water hydronic system for the two buildings. Included in this package would be base mounted circulating pumps, pump trim, expansion tank, air separator, make-up water connection, bypass chemical feeder, strainers, etc. A complete piping system would be routed throughout the building for use by air handlers, unit heaters, and fin tube radiation for heating of the building. Both the heating hot water and chilled water systems would have variable speed pumps, with a redundant backup pump. The pump interface will be designed and specified per the applicable Purdue standard.

Ground Floor
ACG-7, currently serving parts of the first floor of the annex would be removed along with its associated ductwork, piping, and accessories. A new air handler would be set in its place to serve the remodeled area of the first floor. The high bay rooms in the basement, B084, B085, and B086 are scheduled to have floors installed to separate the high bay portion of the room and the basement level in order to add the floor space of these rooms to the ground floor. The new air handler set in place of existing ACG-7 is shown as New ACG-3. ACG-3 would be an approximately 7.6 ton unit at a nominal 3,050 CFM to serve all of the ground floor of the annex minus the new ECN Server Room 093. This system shall utilize VAV control with hot water reheat coils. The supply air would use medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller. Return air shall then be ducted back to the unit via the same chase through which the supply duct passes.

The new ECN Server Room 093 would be served by a 10 ton, 4,000 CFM CRAC unit ACG-4 located in the room. The unit would accept room return and supply air would be ducted throughout the room to provide appropriate air flow. Due to the nature of server rooms, this unit would likely be cooling only and not require a heating hot water coil. The new CRAC unit would be provided with 2 cooling coils. One would be a chilled water coil fed from campus chilled water. The other would either be a refrigerant coil fed from a new air cooled condensing unit, or a water coil fed from city water backup.

First Floor
The two units existing in the annex attic, ACA-27 and ACA-28, are to be removed. A new air handler labeled ACA-12 would be placed in the west end of the annex attic, and utilize chilled water and heating hot water to serve the first floor of the annex. This replacement will require modification of the existing steel platform in the attic. It will also likely require the removal of part of the roof in order to remove old equipment and install new equipment. ACA-12 would have a capacity of approximately 30.4 tons at a nominal 12,150 CFM. Air would be ducted to the first floor via a chase passing through the second floor of the annex. This system shall utilize VAV control with hot water reheat coils. The supply air would use medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller. Return air shall then be ducted back to the unit via a return fan. Economizer air would then be relieved through a relief hood located on the roof of the annex. This relief hood would be on a curb with hinged curb cap.

Second Floor
A new air handler labeled ACA-16 would also be placed in the annex attic to serve the second floor of the annex. ACA-16 would be placed in the east end of the attic. This replacement will also require modification of the existing steel platform in the attic. It will also likely require the removal of part of the roof in order to remove old equipment and install new equipment. It is recommended that new ACA-12 and ACA-16 be installed at the same time that existing ACA-27 and ACA-28 are removed to minimize impact to the roof and time the structure is open. ACA-16 would have a capacity of approximately 30.8 tons at a nominal 12,320 CFM. Air would be ducted to the second floor from the attic of the annex. This system shall utilize VAV control with hot water reheat coils. The supply air would use medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller. Return air shall then be ducted back to the unit via a return fan. Economizer air would then be relieved through a relief hood located on the roof of the annex. This relief hood would be on a curb with hinged curb cap.

Perimeter Radiation Heat:
Spaces on the ground, first and second floors with exterior walls will have radiant heat along the exterior walls. This heat will be provided by fin tube radiators using hot water from the heating hot water system. Each zone will be served by a separate control valve.

Exhaust Systems:
The new restroom stacks and custodian closets will be exhausted with a common exhauster for each stack. This exhauster will be located in the attic of the building with a hood on the roof with roof curb and hinged curb cap. Exhaust fans are not planned to be on the roof in order to relieve maintenance staff of the requirement to work on the roof to maintain the fans. The hoods will have power actuated dampers interlocked with the fans. These fans will also be monitored by the BAS.

Plumbing Systems:
Due to the age and condition of the existing plumbing systems, as well as the reconfiguration of the floor plan; the existing domestic, sanitary, storm, and fire protection systems will need to be completely removed from the building. New domestic and sanitary systems will be installed to serve the new restroom layouts. A new sprinkler system will be installed to provide adequate coverage to the annex. This new sprinkler system will be designed and installed to meet the requirements of the universities requirements. This will include but not be limited to a new fire alarm system and interface with the new BAS. New storm piping will be run to provide adequate drainage for the building.

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It is recommended to completely disconnect and remove any piping and ductwork providing utilities to all floors in the existing EE building, with the exception of ACG-2 serving the lecture hall. This unit and all of its ductwork, piping, and accessories shall remain in service. All existing ductwork, chilled water piping, steam piping, domestic water piping, sanitary piping, and storm piping should be removed in its entirety and replaced.

A new steam to water shell and tube heat exchanger would be set in the basement near the steam entrance in room B066N with a pumping system as described above. New chilled water piping and heating hot water piping would be routed throughout the building to serve all new air handling equipment and finned tube radiation.

Refer to the *Electrical Engineering building and Duncan Annex New Zoning Plan* for an illustration of HVAC equipment locations and Building zoning of the proposed new buildings floor plan.

Refer to the *Electrical Engineering Building and Duncan Annex New HVAC Zone Schedule* for an estimation of HVAC capacities and air flows for the proposed new buildings floor plan.

Basement
Mechanical Room B066N currently houses a small air handler unit labeled ACB-1. This air handler would be replaced with a new air handler utilizing heating hot water for heating in lieu of steam, as well as chilled water for cooling. With an estimated 8.8 tons at 3,500 CFM, this new unit would also be labeled ACB-1. The new air handling unit would utilize VAV control with hot water reheat coils. The supply air would use medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller. Return air shall then be ducted back to the unit. As an alternate, this unit could be selected as a constant volume machine with the stat located in ECE Shop B066D. The rest of the area served by this unit would be shop area. The VAV for this shop area could be omitted at the university's discretion.

Ground Floor
The new approach to conditioning the ground floor includes 4 HVAC zones. One of these zones, serving Lecture Hall 129, is an existing zone and will remain in operation throughout the renovation. Temporary power, chilled water, steam, outside air, and relief air will need to be provided. The lecture hall is currently served by a large air handling unit labeled ACG-2. This air handling unit is located in Mechanical Room 029 under the east end of the hall. Currently ACG-2 uses chilled water for cooling and steam for heating. Steam piping will need to be maintained to the unit in order for the unit to continue providing heat to the lecture hall. It is recommended that a heating hot water branch be run to Mechanical Room 029 and valved and capped. This will allow the steam coil to be replaced with a hot water coil at a future date. It is currently planned for the existing light wells on the north and south sides of the lecture hall to be filled and converted to interior space. ACG-2 currently draws its outdoor ventilation air from the north light well and also relieves economizer air via a duct to the roof through the south light well. This will require the inclusion of a duct chase to route outdoor air and relief air when the light wells are filled in.

The other three zones on the floor will be new zones served by new air handling units. The first of these three zones is the DL2 area. The DL2 area is currently served by two multi-zone air handling units (ACP-21, ACP-22) with two return fans as described in the existing systems section above. Room 56 is currently served by a small air handler labeled ACG-38 located above the ceiling in room 56. ACP-21 and ACP-22, located in the penthouse above the first floor, use the campus chilled water and steam to provide heating. The existing ducting and diffusers will be removed entirely from the DL2 area and the area on the first floor directly above the DL2 area serving multi-zone units ACB-21 and ACB-22 as well as. The two existing multi-zone air handlers and their associated duct and return fans located within the penthouse will also need to be removed. This existing penthouse has a very low roof making it difficult to remove air handlers and replace them while keeping the penthouse intact. It is recommended that the penthouse itself be removed from the building. Either a new penthouse should be built or a screen wall should be erected around new air handlers installed in this area. A new VAV air handling unit that uses building chilled water and hot water will be used and located within the penthouse and placed in about the same location as the air handlers that were removed. This air handler will be dedicated for use in the DL2 area and be ducted down to the ground floor through the first floor via a chase. This air handler unit would be labeled ACP-7. ACP-7 would have a cooling capacity of about 42.2 tons at 16,900 CFM. The return air path would be reworked such that air passes through the plenum above the ceiling and is then ducted up through the return chase(s) back to the AHU via a return fan. This removes the corridor from the return path. Outdoor and relief air would be ducted through a louver in the wall of the penthouse.

The second new zone would serve the south wing of the ground floor. The area is currently served by 3 units, ACG-30, ACG-31, and ACG-40. These units will be removed completely. New ACG-9 would be located in the existing Mechanical Room 010 to replace existing ACG-3 which serves portions of the first floor above. At 29.8 tons and 11,900 CFM, ACG-9 would draw outdoor air from a louver located in the south exterior wall of the room. Supply air would be ducted throughout the area. This system shall utilize VAV control with hot water reheat coils. The supply air would use medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller. Return air shall then be ducted back to the unit via a return fan. Relief air would be ducted through a louver in the exterior wall of the mechanical room.

Like the south wing, the north wing would be served by a new VAV air handling unit. This unit would be labeled ACA-10 and be located in the attic of the EE building. ACA-10 would provide 31.9 tons of cooling at a nominal 12,760 CFM. Air would be ducted to the ground floor via a chase passing through the second and third floors of the light wells being filled in. This system shall utilize VAV control with hot water reheat coils. The supply air would use medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller. Return air shall then be ducted back to the unit via the same chase as the supply air via a return fan. Outdoor and relief air would be ducted through a hood in the roof of the attic.

First Floor
Like the ground floor, the new approach to conditioning the first floor includes 4 HVAC zones. One of these is the zone, serving Lecture Hall 129.

The other three zones on the floor will be new zones served by new air handling units. The first of these three zones is the first floor above the DL2 area. This area is also served by ACP-21 and ACP-22 which are scheduled for demolition. A second VAV air handling unit, ACP-13, which uses building chilled water and hot water will be used and located within the penthouse and placed near ACP-7. This air handler will be dedicated to serving the first floor above the DL2 area. Supply air will be ducted down to the first floor through the roof. ACP-13 would have a cooling capacity of about 45.6 tons at 18,220 CFM. The return air path would be reworked such that air passes through the plenum above the ceiling and is then ducted up through the roof back to the AHU via a return fan. This removes the corridor from the return path. Outdoor and relief air would be ducted through a louver in the wall of the penthouse.

The second new zone would serve the south wing of the first floor. The area is currently served by ACG-3, located in Mechanical Room 10 on the ground floor. This unit will be removed completely to make room for ACG-9 as described above. The zone will now be served by new air handling unit ACA-14 located in the attic of the building. ACA-14, 30.5 tons and 12,190 CFM, shall utilize VAV control with hot water reheat coils. The supply air would use medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Supply and return air would be ducted through a chase from the attic down to the first floor via a chase located in the existing south light well which is to be enclosed. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller.

Like the south wing, the north wing would be served by a new VAV air handling unit. This unit would be labeled ACA-15 and be located in the attic of the EE building. ACA-15 would provide 32.0 tons of cooling at a nominal 12,800 CFM. Air would be ducted to the first floor via a chase passing through the second and third floors of the light wells being filled in. This chase would also be the chase passing ductwork for ACA-10 to the ground floor. ACA-15 shall utilize VAV control with hot water reheat coils. The supply air would use medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller. Return air shall then be ducted back to the unit via the same chase as the supply air.

<u>Second Floor</u>

The second floor will be served by 3 HVAC zones. The southwest portion of the floor is currently served by AC2-11, which shall remain. This is a newer unit that still has several years of serviceable life remaining. Although the unit is new, it will still need to be retrofitted to use heating hot water. Currently the unit has a steam coil to provide heating. This coil will need to be replaced with a coil sized to provide heating using hot water. The VAV system currently uses steam coils that are cut into the branch ductwork to provide reheat. Likewise, these coils will have to be removed and replaced with hot water coils.

The southeast section of the second floor will be served by a new HVAC zone. Currently this area is served by an AC2-13 located in Mechanical Room 218 in the south wing of the second floor. AC2-13 will be removed and the floor space will be absorbed by the college. The zone will now be served by AC2-17 located in Mechanical Room 211 next to AC2-11. AC2-17 will have a capacity of 21.1 tons at a nominal 8,430 CFM. Outdoor air will be taken from a louver in the north, exterior wall of the room. Using a VAV system, supply air will be ducted throughout the zone and returned to the new unit. Supply duct will be medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller.

The northeast section of the second floor will be served by a second new HVAC zone. Currently this area is served by an AC2-20 and AC2-43. AC2-20 is located in Mechanical Room 240 and AC2-43 is located in room 241B. Both of these units will be removed and the floor space will be absorbed by the college. The zone will now be served by ACA-18 located in the attic. ACA-18 will have a capacity of 36.8 tons at a nominal 14,730 CFM. Using a VAV system, supply air will be ducted throughout the zone and returned to the new unit via a duct chase located in the existing north light well. Supply duct will be medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller.

<u>Third Floor</u>

The third floor will be served from 3 completely new zones. Each zone will be served by an air handler located in the attic above. The south wing will be served by ACA-19, the east wing by ACA-20, and the north wing by ACA-21. These units will have capacities of 27.6 tons at 11,050 CFM, 19.6 tons at 7,820 CFM, and 31.2 tons at 12,470 CFM respectively. Each of these will have a VAV system with supply air ducted throughout the zone and returned to the new unit via a duct main located in the attic. Supply duct will be medium pressure ductwork up to the VAV boxes, and low pressure duct in the run outs to diffusers. Each space would be served by its own individual VAV. The system will have digital controls tied into a new building automation system (BAS). In the event of loss of communication with the BAS, the unit shall be capable of operating in a standalone mode utilizing programming in a hard wired local controller.

<u>IDF/BDF and Electrical Rooms</u>

Each floor of the EE building will have 2 IDF rooms and 2 electrical closets. Each one of these rooms will be served by a cooling only fan coil unit. Cooling will be provided with chilled water with a city water backup. Giving each one of these rooms a fan coil unit allows them to be separated from the VAV systems serving the zone surrounding the rooms. This separation will allow the VAV systems to go into an unoccupied mode where the associated air handler can be shut down to conserve energy. Should these rooms be put on the VAV system, the air handlers would be required to run 24/7.

<u>North Wing Elevator Shaft</u>

A gravity ventilator hood will be installed in the roof above the elevator shaft with a duct connecting the shaft and the hood. The hood will have a roof curb and hinged cap. This ventilator will not have a damper and shall be open at all times.

<u>Perimeter Radiation Heat:</u>

Spaces on the ground, first, second and third floors with exterior walls will have radiant heat along the exterior walls. This heat will be provided by fin tube radiators using hot water from the heating hot water system. Each zone will use a separate control valve.

<u>Exhaust Systems:</u>

The new restroom stacks and custodian closets will be exhausted with a common exhauster for each stack. This exhauster will be located in the attic of the building with a hood on the roof with roof curb and hinged curb cap. Exhaust fans are not planned to be on the roof in order to relieve maintenance staff of the requirement to work on the roof to maintain the fans. The hoods will have power actuated dampers interlocked with the fans. These fans will also be monitored by the BAS.

A new exhaust hood for local area capture would be installed in rooms EE65 and EE69. This hood would be activated via a manual on/off toggle switch located on the wall in close proximity to the hood. The hood could be exhausted by either an inline fan exhausting through an exterior wall through a louver, or by an exterior wall mounted fan. An inline fan would allow a cleaner appearance to the exterior of the building, but could be a potential source of noise above the ceiling. A wall mounted fan would potentially produce less noise in the space, but would be very visible on what is otherwise a very clean exterior wall.

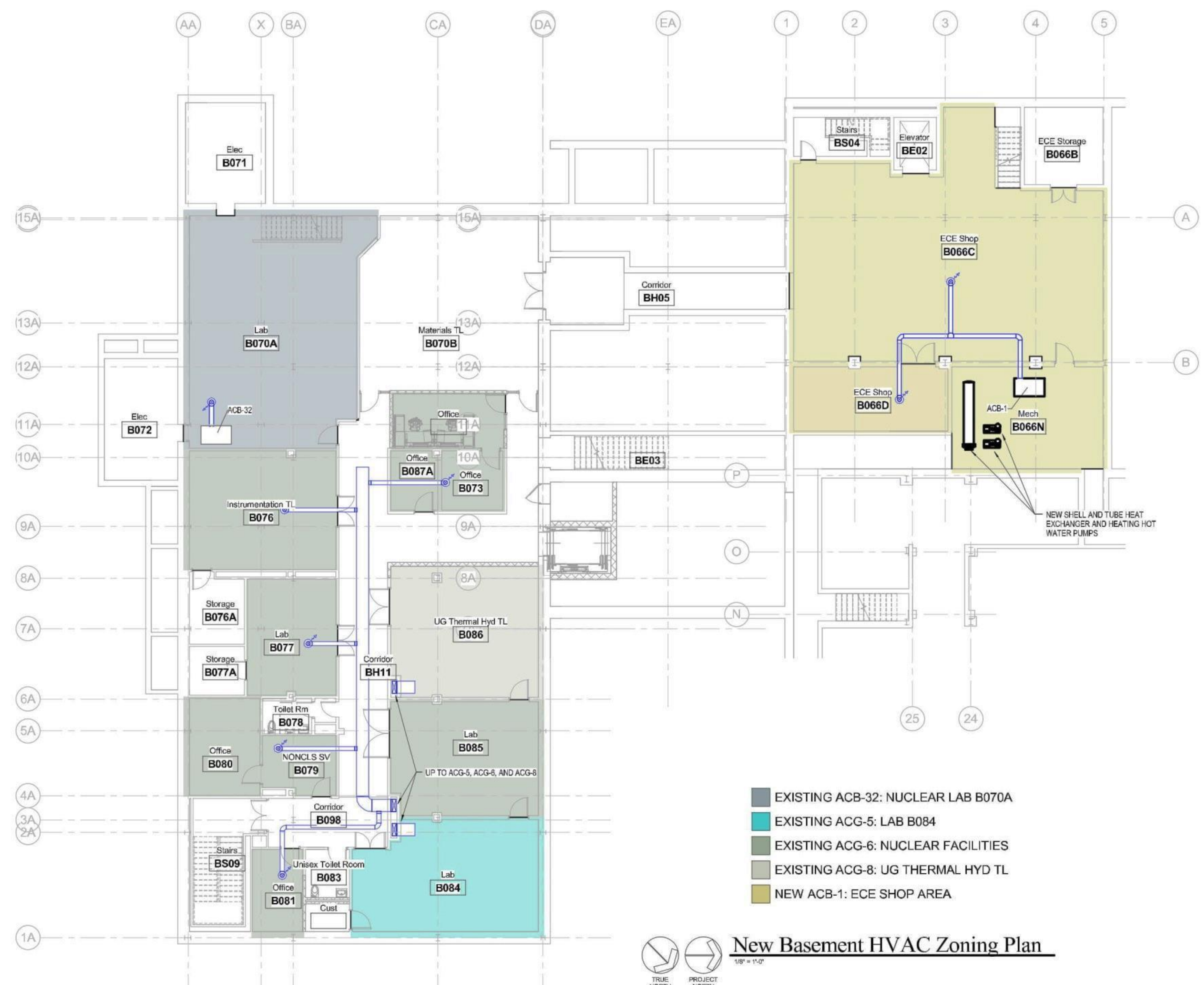
Plumbing Systems:

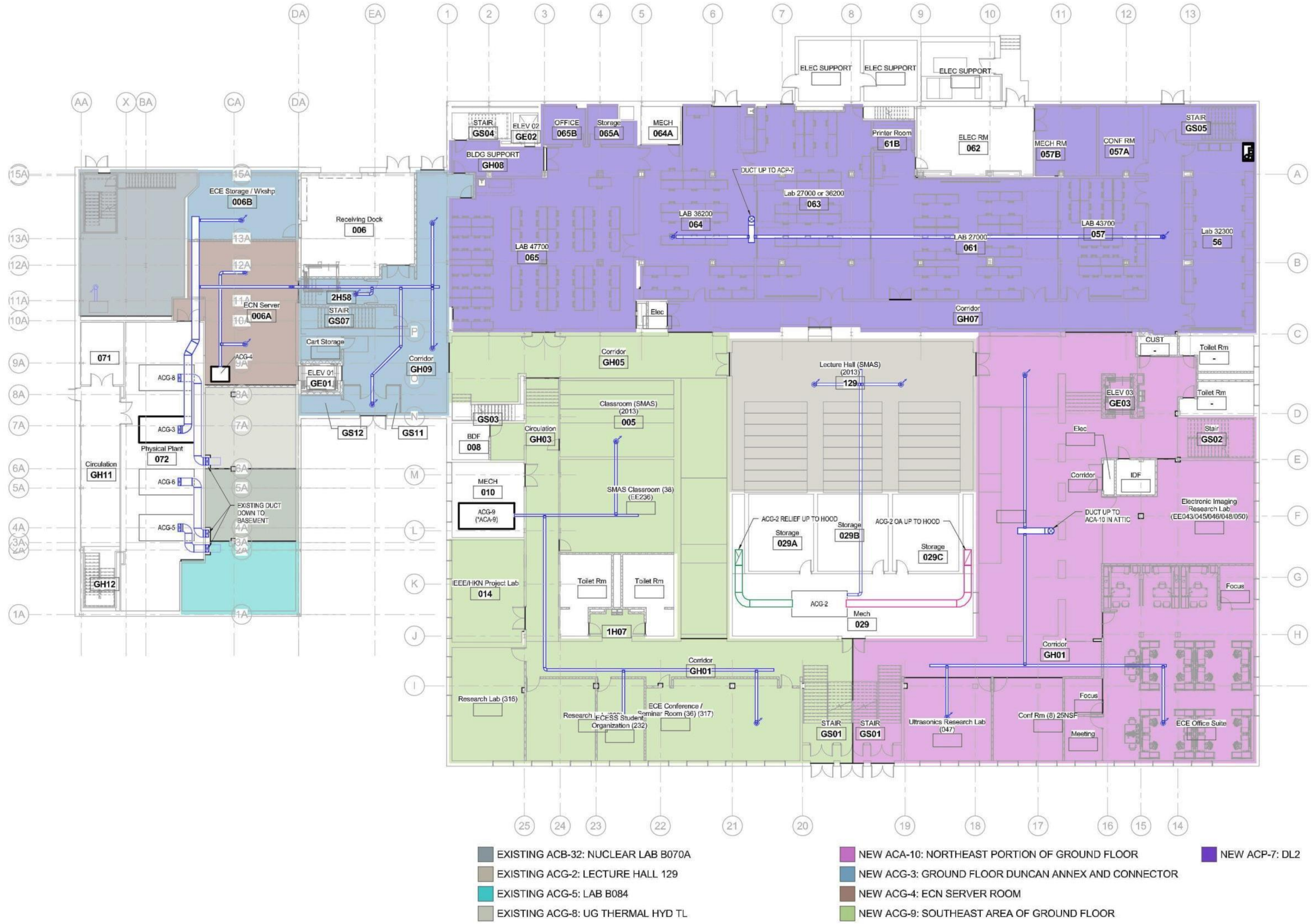
Due to the age and condition of the existing plumbing systems, as well as the reconfiguration of the floor plan; the existing domestic water, sanitary, storm, and fire protection systems will need to be completely removed from the building. New domestic and sanitary systems will be installed to serve the new restroom layouts. A new sprinkler system will be installed to provide adequate coverage to the annex. This new sprinkler system will be designed and installed to meet the requirements of the universities requirements. This will include but not be limited to a new fire alarm system and interface with the new BAS. New storm piping will be run to provide adequate drainage for the building.

A new stainless steel sink would be installed in rooms EE65 and EE69. The existing slab would have to be saw cut and new under-slab sanitary piping would be routed back to the existing sanitary system at it closest point. This point is likely located in the west corner of new storage room STG 99W where the sink for existing room 66 is being removed. Domestic hot and cold utilities would be extended to these new sinks. There currently is both domestic hot and cold piping running above the ceiling in the DL2 area. Sanitary vent for these sinks would be routed above the ceiling and tied into the vent line currently serving the sink being removed from existing room 66. These new sinks would have chemical interceptors installed at the request of the university.

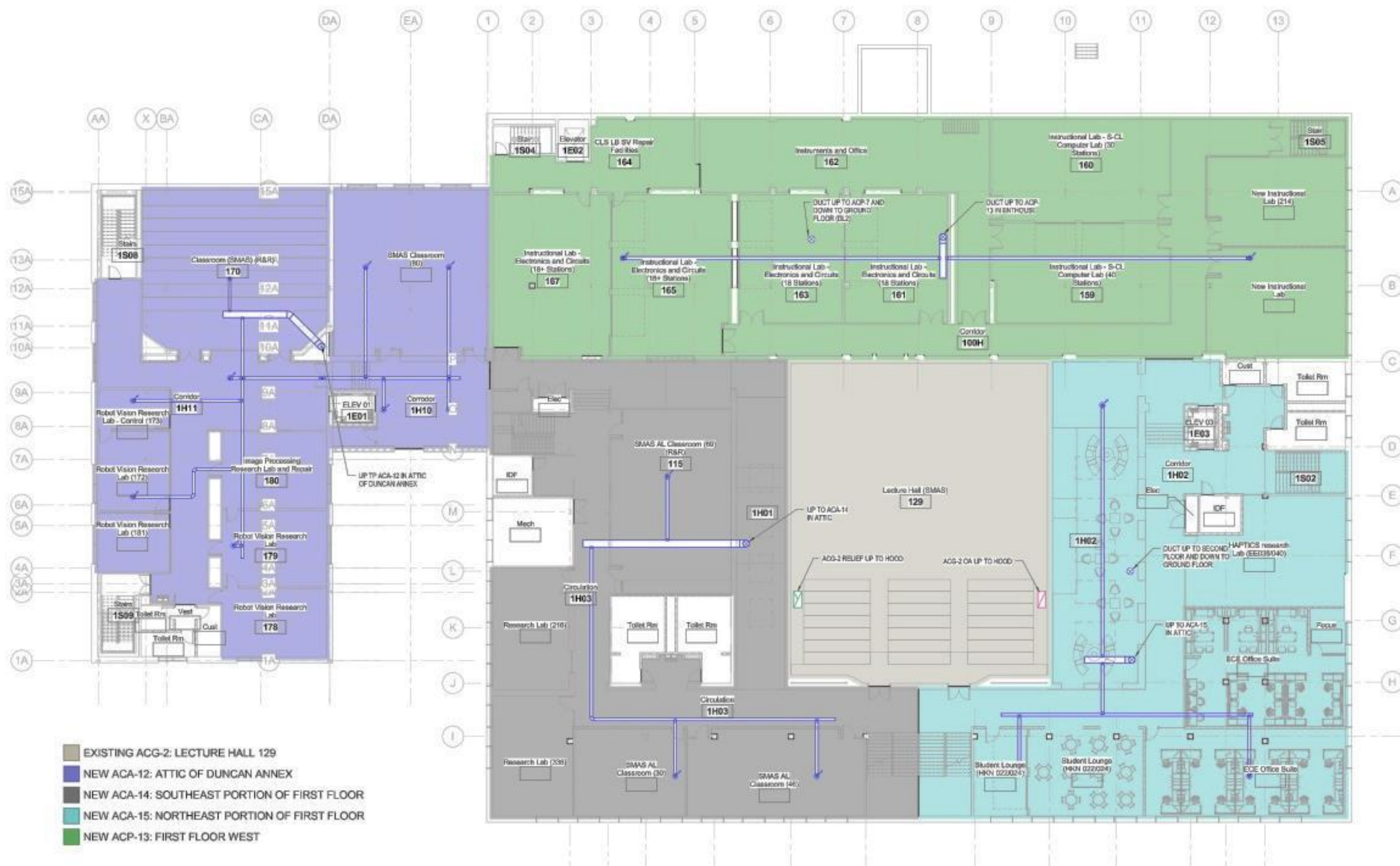
Compressed Air:

The existing compressed air serving the building would be extended into EE63, EE65, EE69, and EE99U.

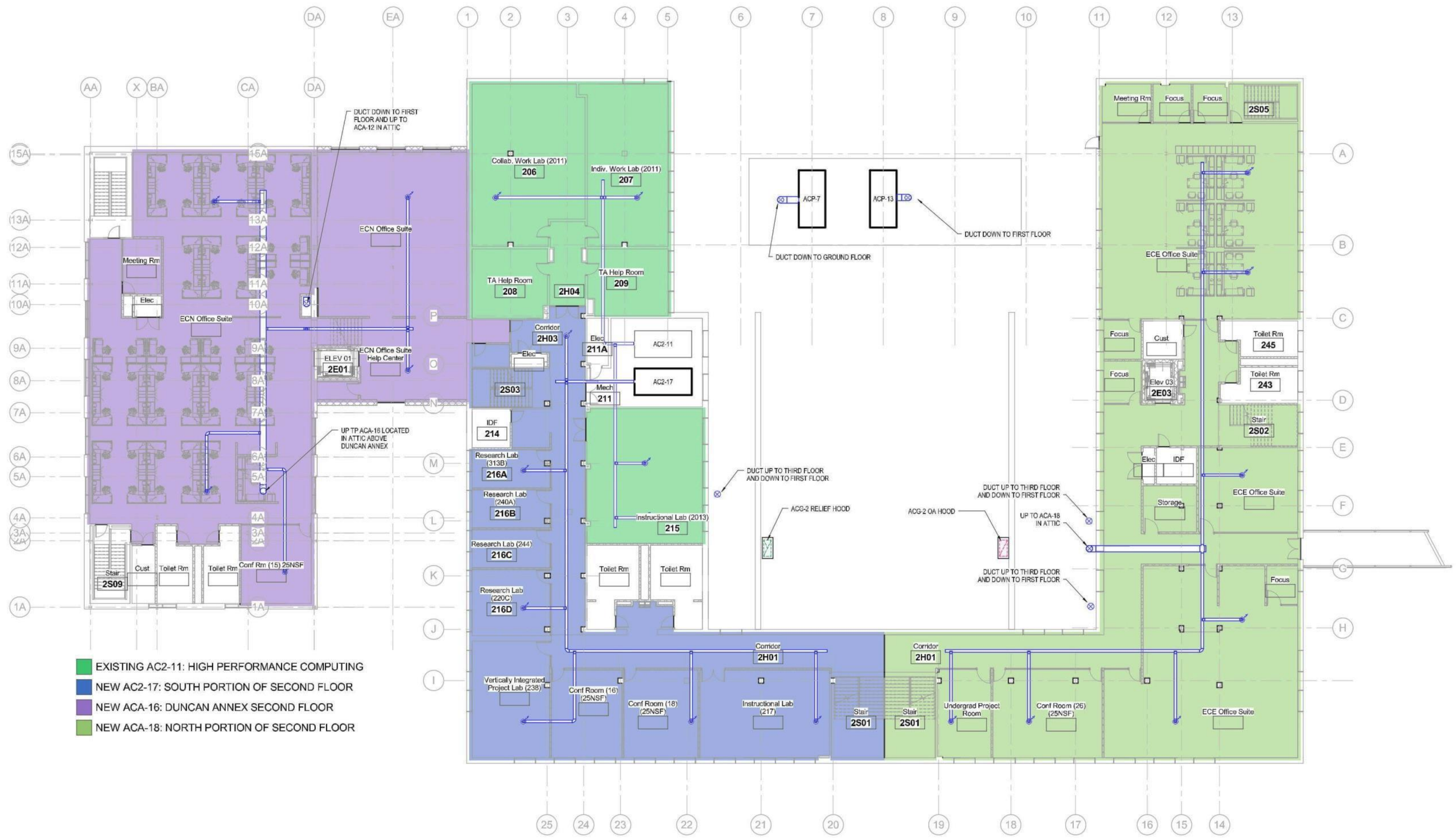

EXISTING ACB-32: NUCLEAR LAB B070A
EXISTING ACG-5: LAB B084
EXISTING ACG-6: NUCLEAR FACILITIES
EXISTING ACG-8: UG THERMAL HYD TL
NEW ACB-1: ECE SHOP AREA
NEW SHELL AND TUBE HEAT EXCHANGER AND HEATING HOT WATER PUMPS
UP TO ACG-5, ACG-6, AND ACG-8
New Basement HVAC Zoning Plan
TRUE NORTH
PROJECT NORTH



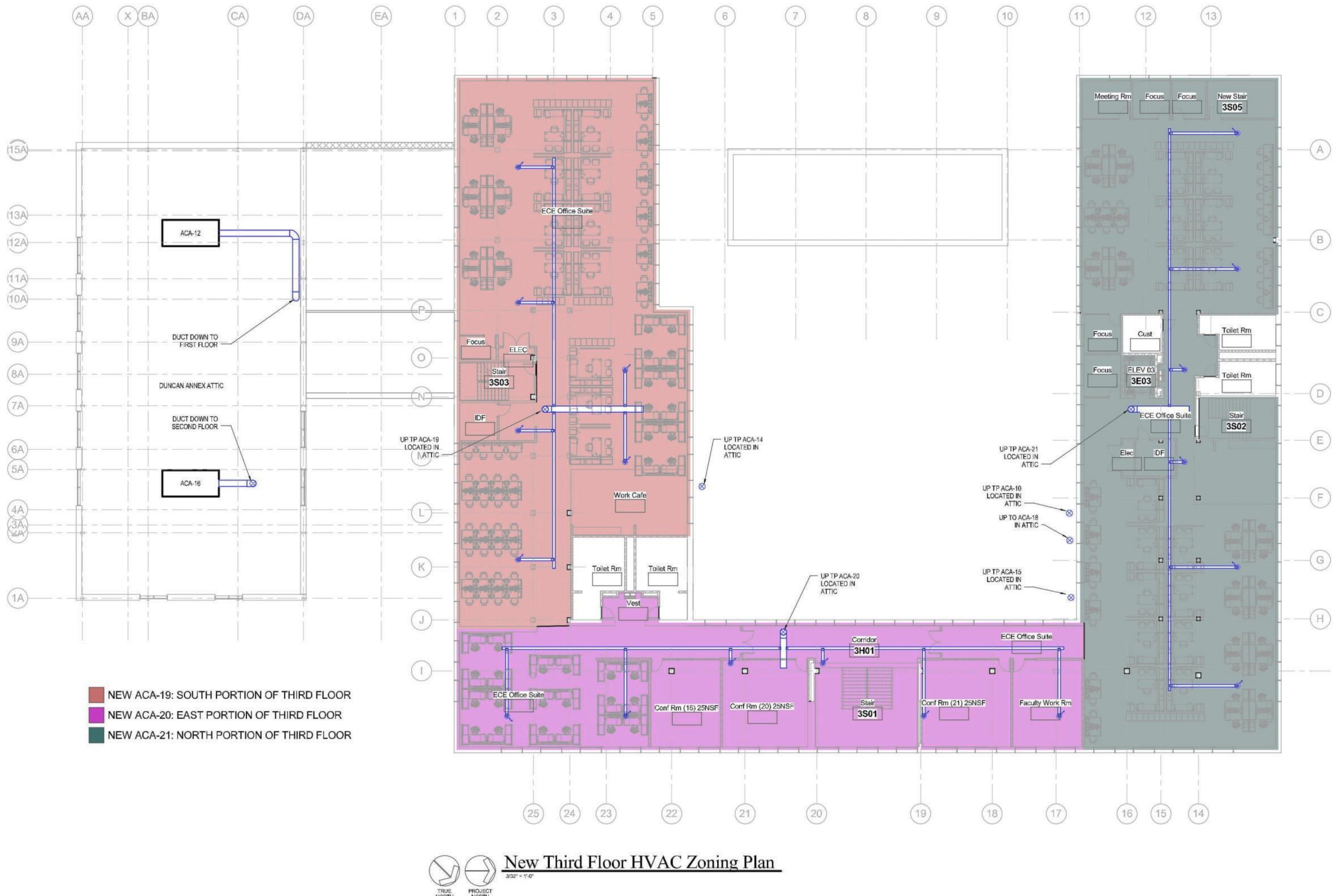
New Ground Floor HVAC Zoning Plan



New First Floor HVAC Zoning Plan



New Second Floor HVAC Zoning Plan



New Third Floor HVAC Zoning Plan

HVAC Zone Schedule						
Name	Perimeter	Gross Area (SF)	SF/Ton	Estimated Cooling Load (Tons)	CFM/ Ton	Nominal CFM
EXISTING ACG-6: NUCLEAR FACILITIES	464' - 0"	1,960	267	7.3	400	2,930
EXISTING ACG-5: LAB B084	105' - 0"	530	267	2.0	400	800
EXISTING ACG-8: UG THERMAL HYD TL	97' - 6"	520	267	1.9	400	780
EXISTING ACB-32: NUCLEAR LAB B070A	144' - 0"	1,060	267	4.0	400	1,590
NEW ACB-1: ECE SHOP AREA	291' - 0"	2,340	267	8.8	400	3,500
NEW ACG-3: GROUND FLOOR DUNCAN ANNEX AND CONNECTOR	348' - 6"	2,040	267	7.6	400	3,050
EXISTING ACG-2: LECTURE HALL 129	296' - 6"	7,840	267	29.4	400	11,740
NEW ACG-4: ECN SERVER ROOM	146' - 6"	1,070	107	10.0	400	4,000
NEW ACP-7: DL2	690' - 6"	11,280	267	42.2	400	16,900
NEW ACG-9: SOUTHEAST AREA OF GROUND FLOOR	527' - 0"	7,950	267	29.8	400	11,900
NEW ACA-10: NORTHEAST PORTION OF GROUND FLOOR	463' - 0"	8,520	267	31.9	400	12,760
NEW ACA-12: ATTIC OF DUNCAN ANNEX	544' - 6"	8,110	267	30.4	400	12,150
NEW ACP-13: FIRST FLOOR WEST	764' - 0"	12,160	267	45.6	400	18,220
NEW ACA-14: SOUTHEAST PORTION OF FIRST FLOOR	500' - 6"	8,140	267	30.5	400	12,190
NEW ACA-15: NORTHEAST PORTION OF FIRST FLOOR	466' - 6"	8,540	267	32.0	400	12,800
NEW ACA-16: DUNCAN ANNEX SECOND FLOOR	592' - 0"	8,220	267	30.8	400	12,320
NEW AC2-17: SOUTH PORTION OF SECOND FLOOR	515' - 6"	5,630	267	21.1	400	8,430
NEW ACA-18: NORTH PORTION OF SECOND FLOOR	640' - 0"	9,830	267	36.8	400	14,730
EXISTING AC2-11: HIGH PERFORMANCE COMPUTING	424' - 6"	4,080	267	15.3	400	6,110
NEW ACA-19: SOUTH PORTION OF THIRD FLOOR	419' - 6"	7,380	267	27.6	400	11,050
NEW ACA-21: NORTH PORTION OF THIRD FLOOR	548' - 0"	8,320	267	31.2	400	12,470
NEW ACA-20: EAST PORTION OF THIRD FLOOR	467' - 0"	5,220	267	19.6	400	7,820
Grand total: 22		130,730		495.6		198,250

Electrical Narrative

Existing Power – Duncan Annex Building

<u>Service</u>

The Duncan Annex has its own electrical service. The existing electrical service is fed off the campus medium voltage (12.47 kV) system. There is a 500 kVA transformer providing power to a 240 volt, 3 phase Delta system. There is also a 333 kVA transformer providing power to a 120/240 volt, 1 phase system. The vault is located outside room B70. The gear for the 3 phase and 1 phase systems are located in room G71. The existing equipment is old Bull Dog Electric gear with fusible switches. The gear is located in the southwest corner of the building on the main floor. The gear appears to be custom sized to fit in the space. The meters are non-functional.

<u>Emergency</u>

An emergency system consisting of an inverter, set of batteries, and a panel is located in the main electrical room. It could not be determined if the system was functional.

<u>Distribution</u>

The distribution panels feeding the Duncan Annex has not been updated since original construction. Each floor has common panels in the corridors. Large labs have panels located in the corridor walls that are accessible from both the corridor side and the room side.

<u>Receptacles</u>

Most areas of the building have flush mounted receptacles. Due to the age of the building, only a few per room were originally installed. Some rooms have single- or multi-channel raceway. This appears to have been added on an as-needed basis. Placement is inconsistent throughout the building. The robotics labs have more recently been upgraded with new panels, surface raceway along the perimeter, and overhead receptacles.

Existing Lighting – Duncan Annex Building

<u>Normal</u>

The entire building has been retrofitted with T-8 lamps. In most cases, the original T12 fluorescent fixtures are still installed; only the lamps were replaced with T8. Corridor lighting is a combination of recessed 2' x 2' and 2'x4' fixtures with sporadic placement. Labs and classrooms are a combination of surface and pendant mounted linear fixtures of varying styles. Offices typically have 2'x4' flat plastic fixtures. Light levels were inconsistent throughout. Light quality was poor.

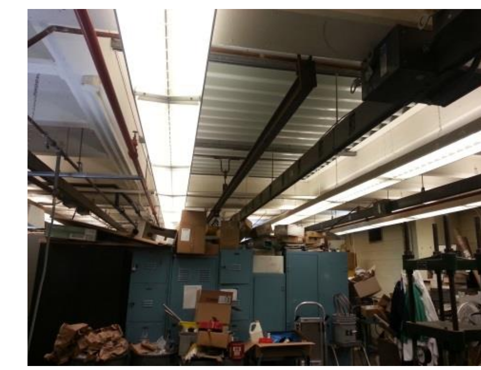
<u>Emergency</u>

Limited emergency lighting is provided by wall mounted battery powered units. Locations are inconsistent and do not provide complete coverage of this area. The majority of the fixtures are located in the stairwells.

<u>Fire Alarm</u>

Fire alarm devices were not observed in any of the individual classrooms or labs. One or two older style horn/strobes are found on each floor in the corridors. The spacing and location do not meet current code requirements. See attached plan for current device locations. There is currently one pull station on each floor, located at the main stair tower. No smoke detectors were observed. Tamper and flow switches are monitored.

Existing Power – EE Building



<u>Service</u>

The main building service is located on the south side of the building. The incoming service for the main EE building was recently upgraded. New 277/480V (MDP-P) and 120/208V (MDP-L) switchgear was installed at this time. This new gear is located in a separate room on the southwest side of the building. Both sets of gear are the maximum length that will fit in the room. They also both have power meters installed. The 480V gear has a total of (17) spare switches, but does not have space available for any additional switches. The 208V gear has (7) spare switches and also has space for one additional 400A switch. This equipment does not need replacement or upgrading.

<u>Emergency</u>

Emergency power is not currently distributed through the building.

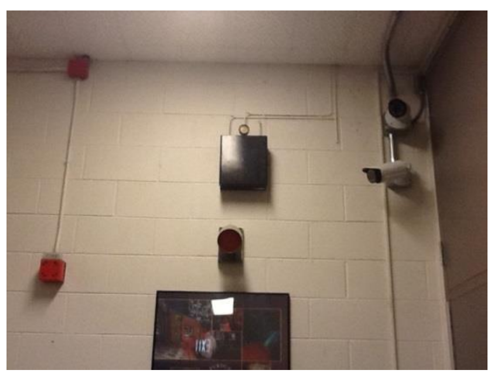
<u>Distribution</u>

The original distribution panels are located in the corridors. Some labs also have dedicated panels for specific functions. A few recently renovated computer labs have newer dedicated panels in each lab. An electrical distribution center was installed on the second floor during the most recent electrical upgrade. Due to minor updates over time, most existing panels have no spare breakers for additional loads. Overhead bus duct is unused but still installed in multiple areas of the building, including some areas converted to offices.

Receptacles

Most areas of the building have flush mounted receptacles. Due to the age of the building, only a few per room were originally installed. Most workrooms, offices, and classrooms have multi-channel surface raceway which contains power and communications circuits. The surface raceway is in good condition and can be reused or relocated, pending space requirements for electrical. Surface raceway and poke-throughs are used in the renovated labs. A few of the classrooms have been updated to include smart boards or short throw projectors.

Existing Lighting – EE Building



Normal

The entire building has been retrofitted with T-8 lamps. In most cases, the original T12 fluorescent fixtures are still installed; only the lamps were replaced with T8. Corridor lighting is a combination of surface mount and recessed 2'x4' fixtures with sporadic placement. Labs and classrooms are a combination of surface and pendant mounted linear fixtures of varying styles. Offices typically have 1'x4' or 2'x4' flat plastic fixtures. A few labs on the second floor have new high efficiency fixtures with T8 lamps. Lighting in non-renovated areas is inconsistent and poor quality. More recently renovated areas have higher quality even illumination.

Emergency

Limited emergency lighting is provided by wall mounted battery powered units. Locations are inconsistent and do not provide complete coverage of this area. The majority of the fixtures are located in the corridors. The upper floors did not have observable emergency lighting.

Fire Alarm

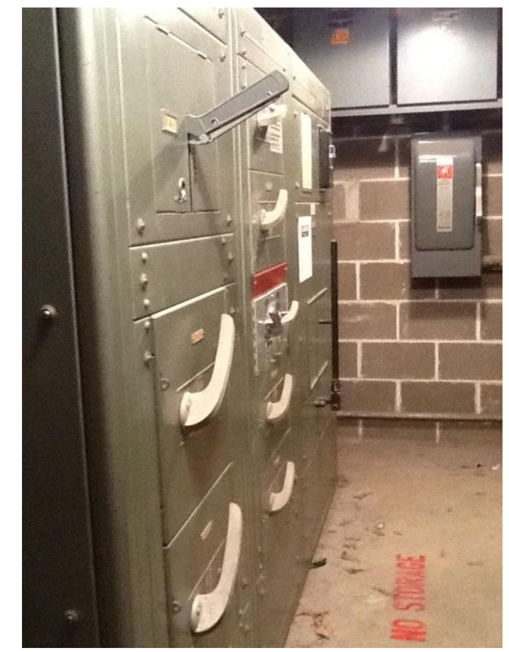
The main fire alarm panel is located on the ground floor near the main entrance. It does not have a smoke detector above. Duct mounted smoke detectors were observed on newer mechanical units. Fire alarm horn/strobe devices are located in corridors only. Spacing and mounting height does not meet current code requirements. Pull stations are located near stairs and exits. Tamper and flow switches are monitored. Smoke detectors are located near the elevator on each floor.

Proposed New Systems

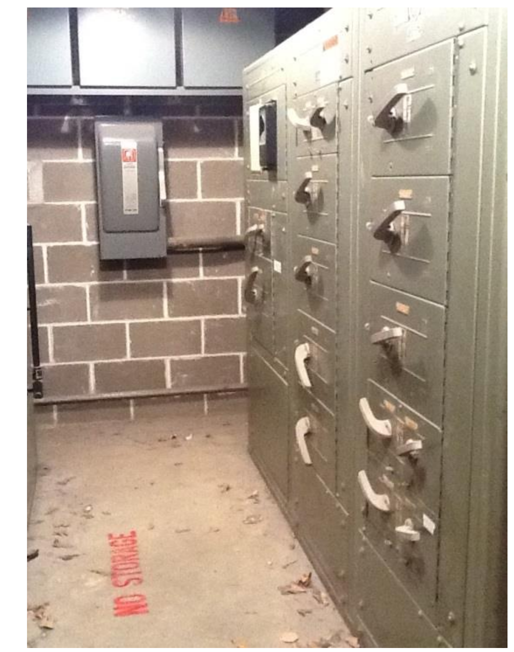
DUNCAN ANNEX

Demolition

The Duncan Annex has its own electrical service. The existing electrical service is fed off the campus medium voltage (12.47 kV) system. There is a 500 kVA transformer providing power to a 240 volt, 3 phase Delta system. There is also a 333 kVA transformer providing power to a 120/240 volt, 1 phase system. The vault is located outside room B70 underground on the East side of Duncan Annex. The Main switchgear for the 3 phase and 1 phase systems are located in room G71. The existing equipment is old Bull Dog Electric gear with fusible switches. The switchgear is 1957 vintage and will be removed.



Existing 240 volt 3∅ Delta Gear



Existing 120/240 volt 1∅ gear

Power Systems

(Note all references to North, South, East and West are based on Plan North not true North)

The transformer vault is located outside room B70. The new electrical service will be a 480/277 volt, 3 phase system with a step-down transformer to provide 208/120 volt power. The 480 volt will be used for HVAC and large motor loads. 277 volt will be used for lighting circuits and the 208/120 volt power for smaller loads and general purpose receptacle circuits.

In general, electrical panels will be installed in closets and will be located to provide power for the specific floor that they are located on. The electrical closets will be stacked from floor to floor.

Classrooms:
New receptacles and circuits will be installed in classrooms. Backboxes and pathways will be installed to support the technology cabling.

Labs:
New receptacles and circuits will be installed in classrooms. Backboxes and pathways will be installed to support the technology cabling.

Offices:
New receptacles and circuits will be installed in classrooms. Backboxes and pathways will be installed to support the technology cabling.

In general, the power feeds to the workstations that are located next to a wall will be fed through conduit and receptacles in the wall. Workstations located not adjacent to a wall or column will be fed with bus and power poles down to the workstations as required. The raceway system will have two conduits or channels to provide distribution of the power conductors and also allow distribution of data cabling to the workstations.

Emergency Power:
The existing generator located at the EE building will be utilized to provide emergency power. The optional equipment branch will provide power for the IDF’s and elevator power.

At the present time there are no requirements to provide emergency or stand-by power in any of the lab, classroom or office areas.

Reactor Area:
The reactor and auxiliary support equipment are fed from the Duncan Annex Electrical system. When the Electrical Service at Duncan Annex is upgraded, provisions will need to be made to set up a temporary feed from the EE building electrical distribution.

Reactor Room

Electrical Duct to Transformer Vault

Lighting:

Labs:
New LED light fixtures will people be provided in the lab areas. In general, the lighting will be designed to provide light levels that will be 80 – 100 foot-candles.

Lighting controls will allow “ab” switching of all light fixtures to provide dual lighting levels in the lab. Occupancy sensors will be installed in the lab areas and will be configured as vacancy sensors, i.e. the lighting will have to be manually turned on when entering the room and once the room is vacant the light fixtures will shut off after a programmed, pre-set time.

Office areas will be provided with LED light fixtures and full range dimming controls. Occupancy sensors will be installed in the office areas and will be configured as vacancy sensors.

Corridors will be provided with LED light fixtures and will be controlled by occupancy sensors. Occupancy sensors will be installed at ingress/egress points and will be configured as to automatically turn the light fixtures on.

The existing generator located at the EE building will be utilized to provide emergency power. The existing life safety branch of the emergency generator system will be used to provide emergency lighting in the lab areas.

The Life safety branch will be used to provide power to exit and egress lighting in the corridors and stairs.

Emergency egress lighting will be provided in all Labs and egress paths in the corridors. In addition, emergency egress light fixtures will be installed on the exterior of the building at the exit doors.

Electrical rooms, mechanical rooms and IDF’s will have emergency battery packs installed in the rooms to provide lighting during normal power failure. These fixtures will provide emergency illumination in these spaces without the normal delay of the emergency generator system.

Fire Alarm System:
The existing Fire Alarm system in Duncan Annex will be removed. New fire alarm devices will be installed in rooms and spaces to meet present Fire Alarm code requirements and ADA requirements. At this time, the intent for the new Fire Alarm system in the Duncan Annex is to be an addressable system with standard audible/visual notification devices. The new Fire Alarm system will not have voice evacuation or mass notification capabilities. A Class A, digital, addressable system will be provided. Smoke detectors provided in Server Rooms, electrical and mechanical rooms, elevator lobbies, MDF, IDF's, storage rooms. Duct mounted smoke detectors will be provided in all return air and exhaust air plenums of each RTU system. They will also be installed in all vertical duct that serves two or more floors on each floor. Pull stations will be provided as required by code. Strobes will be provided as required by code and to meet ADA requirements. Notification will be installed throughout the facility, including in elevators and all stairways. All tamper and flow switches will be monitored by the system.

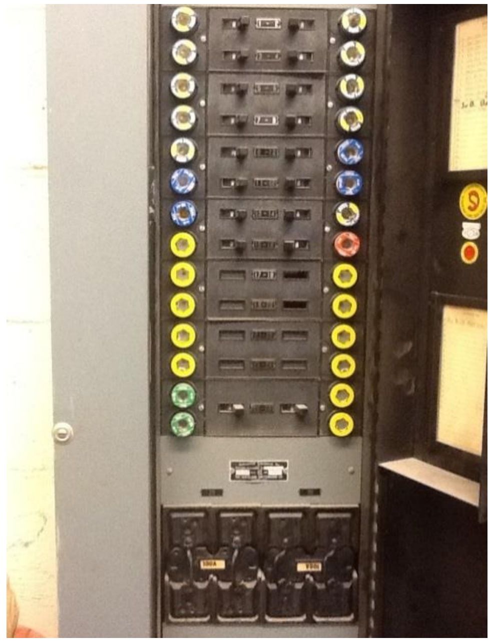
Telecommunications Infrastructure
The existing Duncan Annex area is served by a skeletal conduit system that is attached to the ceiling within the corridors and above the rooms being served as well. Access panels in ceilings have been located to allow access to junction boxes for cabling to be pulled and installed back to the nearest telecom room. Skeletal conduit sizes range from 2" up to 4" and vary in quantity depending on the cable quantity in the area.

The new raceway system for the Duncan Annex area will use a skeletal conduit system installed above drop ceiling and in exposed/no ceiling areas. The skeletal system will be used in the rooms to allow installation of the cabling out into the corridor to the IDF room. A single cable tray will be installed in the corridor to serve the new horizontal cable outlets in the area.

Proposed New Systems

EE BUILDING

Demolition
The Electrical Engineering building has several electrical panels, electrical connector panels and electrical bus duct that are no longer in use. In addition there are several electrical panels that are old, obsolete and are located in unacceptable locations such as corridors, classrooms and offices. Extensive demolition will be required to remove the existing electrical panels, electrical connectors and electrical feeders in the EE building area. The existing light fixtures and lighting controls in the EE building area will be removed.



Electrical Panel

Electrical Panel with tapped disconnects

Power Systems
(Note all references to North, South, East and West are based on Plan North not true North)

The incoming electrical service enters a medium voltage transformer vault North and adjacent to the DL2 area. The main electrical panels, MDP–P" (277/480 volt, 3ϕ, 4w) and MDP–L (120/208 volt, 3ϕ, 4w) are located on the level above the transformer vault, approximately 10'-10". The DL2 area elevation is located approximately halfway between the transformer vault level and the main electrical panel room. To allow access to the main electrical room a chase will be built along the North wall of Lab 63 to allow conduit and feeders to distribute to the DL2 area and the rest of the EE building. See conceptual architectural plans for more detail.

To allow the addition of a mechanical room, the East wall of electrical room 62 will be moved to the West. It will be required to relocate Automatic Transfer Switch "ATS-E1" and emergency electrical panel "E1" to the new West wall of room 62.

Electrical Room 62 South Wall

Electrical Room 62 Looking East

The Arc Flash mitigation breakers will be installed in electrical room 62. A small room or closet will be built on the North side of this room to accommodate the electrical enclosure cabinets of the breakers. Due to the high incident energy on the electrical system, these breakers will need to be operated remotely within this room and with the doors closed.

The existing main electrical panels “MDP–P” (277/480 volt, 3 ⍰, 4w) and MDP–L (120/208 volt, 3 ⍰, 4w) were upgraded in 2007 and have sufficient capacity and spare switches to provide distribution power to the EE building. New distribution panels will be installed in electrical closets to provide power for the specific floor that the panels are located on.

MDP-P

MDP-L

In general, the power feeds to the workstations that are located next to a wall will be fed through conduit and receptacles in the wall. Workstations located not adjacent to a wall or column will be fed with bus and power poles down to the workstations as required. The raceway system will have two conduits or channels to provide distribution of the power conductors and also allow distribution of data cabling to the workstations.

<u>Classrooms</u>:
New receptacles and circuits will be installed in classrooms. Backboxes and pathways will be installed to support the technology cabling.

<u>Labs</u>:
New receptacles and circuits will be installed in classrooms. Backboxes and pathways will be installed to support the technology cabling.

<u>Offices</u>:
New receptacles and circuits will be installed in classrooms. Backboxes and pathways will be installed to support the technology cabling.

<u>Emergency Power:</u>
The existing generator located at the EE building will be utilized to provide emergency power. The optional equipment branch will provide power for the IDF’s and elevator power.

At the present time there are no requirements to provide emergency or stand-by power in any of the lab, classroom or office areas.

<u>Lighting:</u>

<u>Labs</u>:
New LED light fixtures will people be provided in the lab areas. In general, the lighting will be designed to provide light levels that will be 80 – 100 foot-candles.

Lighting controls will allow “ab” switching of all light fixtures to provide dual lighting levels in the lab. Occupancy sensors will be installed in the lab areas and will be configured as vacancy sensors, i.e. the lighting will have to be manually turned on when entering the room and once the room is vacant the light fixtures will shut off after a programmed, pre-set time.

Office areas will be provided with LED light fixtures and full range dimming controls. Occupancy sensors will be installed in the office areas and will be configured as vacancy sensors.

The existing life safety branch of the emergency generator system will be used to provide emergency lighting in the lab areas.

The Life safety branch will also be used to provide power to exit and egress lighting in the corridors and stairs.

Emergency egress lighting will be provided in all Labs and egress paths in the corridors. In addition, emergency egress light fixtures will be installed on the exterior of the building at the exit doors.

Electrical rooms, mechanical rooms and IDF’s will have emergency battery packs installed in the rooms to provide lighting during normal power failure. These fixtures will provide emergency illumination in these spaces without the normal delay of the emergency generator system.

<u>Fire Alarm System:</u>
The existing Fire Alarm system in EE building will be removed. New fire alarm devices will be installed in rooms and spaces to meet present Fire Alarm code requirements and ADA requirements. At this time, the intent for the new Fire Alarm system in the EE building is to be an addressable system with standard audible/visual notification devices. The new Fire Alarm system will not have voice evacuation or mass notification capabilities. A Class A, digital, addressable system will be provided. Smoke detectors provided in Server Rooms, electrical and mechanical rooms, elevator lobbies, MDF, IDF's, storage rooms. Duct mounted smoke detectors will be provided in all return air and exhaust air plenums of each RTU system. They will also be installed in all vertical duct that serves two or more floors on each floor. Pull stations will be provided as required by code. Strobes will be provided as required by code and to meet ADA requirements. Notification will be installed throughout the facility, including in elevators and all stairways. All tamper and flow switches will be monitored by the system.

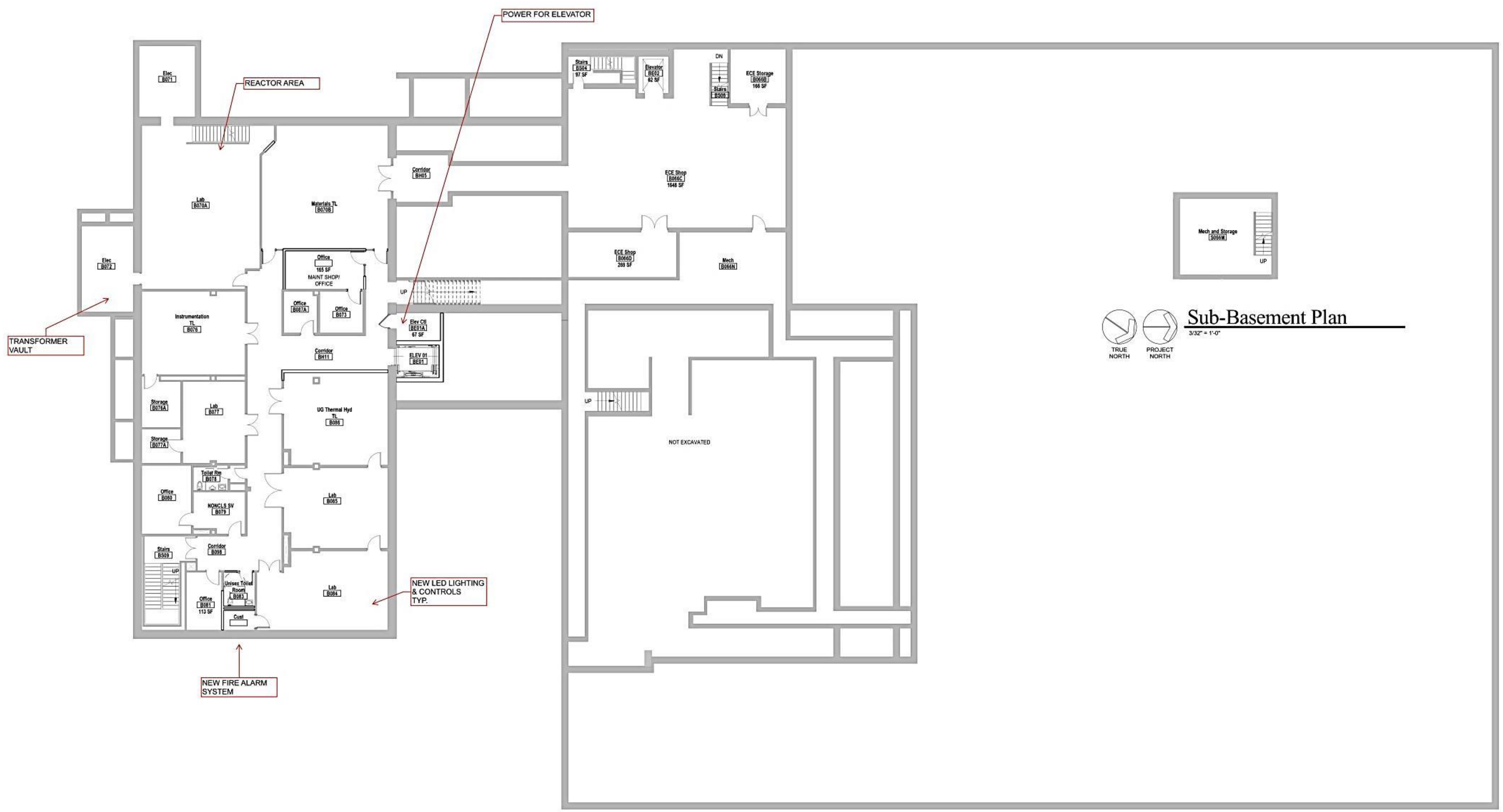
Telecommunications Infrastructure

The existing EE building is served by a skeletal conduit system that is attached to the ceiling within the corridors and above the rooms being served as well. Access panels in ceilings have been located to allow access to junction boxes for cabling to be pulled and installed back to the nearest telecom room. Skeletal conduit sizes range from 2" up to 4" and vary in quantity depending on the cable quantity in the area.

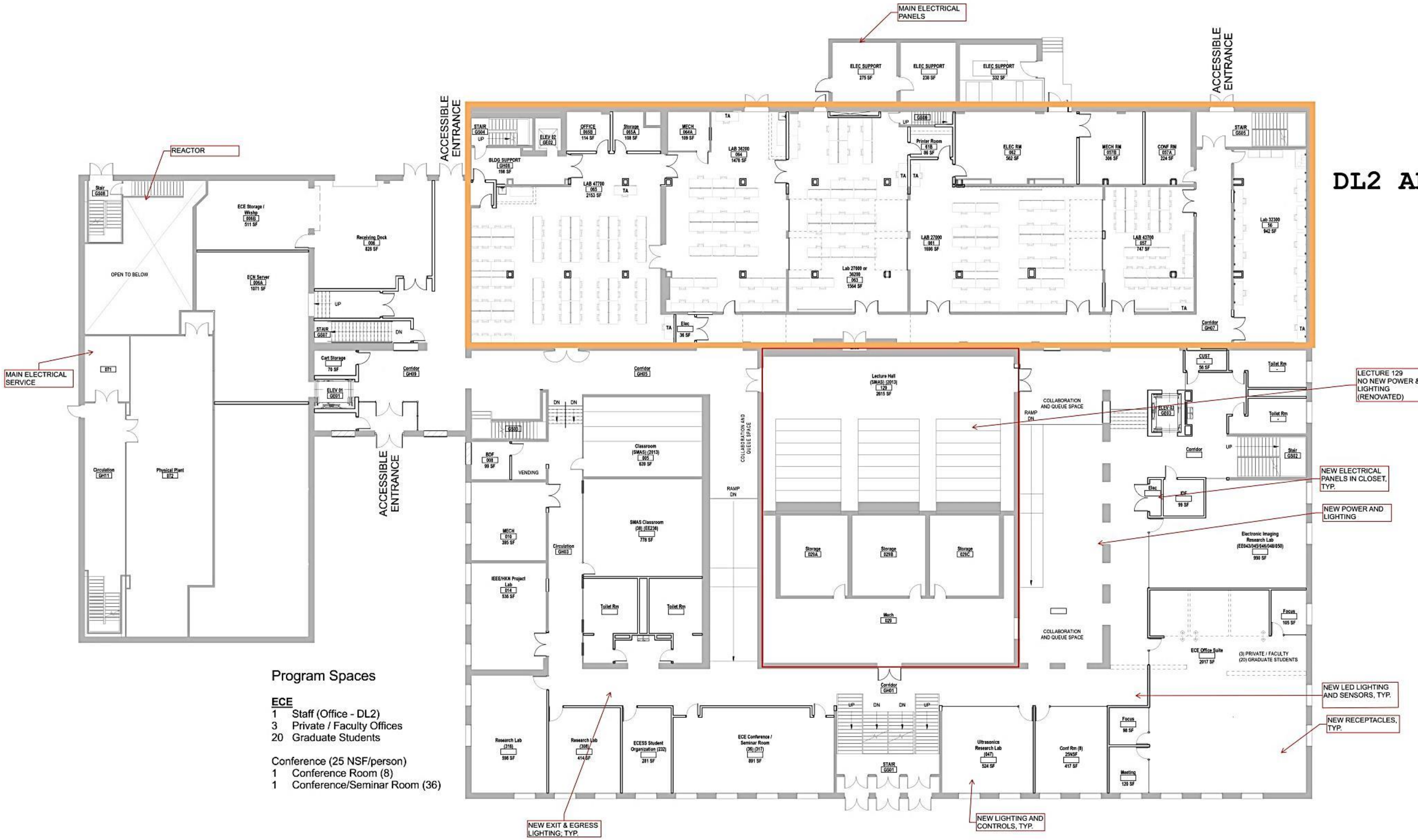
The new raceway system for the EE building area will use a skeletal conduit system installed above drop ceiling and in exposed/no ceiling areas. The skeletal system will be used in the rooms to allow installation of the cabling out into the corridor to the IDF room. A single cable tray will be installed in the corridor to serve the new horizontal cable outlets in the area.

Refer to the **Technology** section of this Narrative for additional details.

Proposed Electrical Plans
Basement



Proposed Electrical Plans
Ground Floor

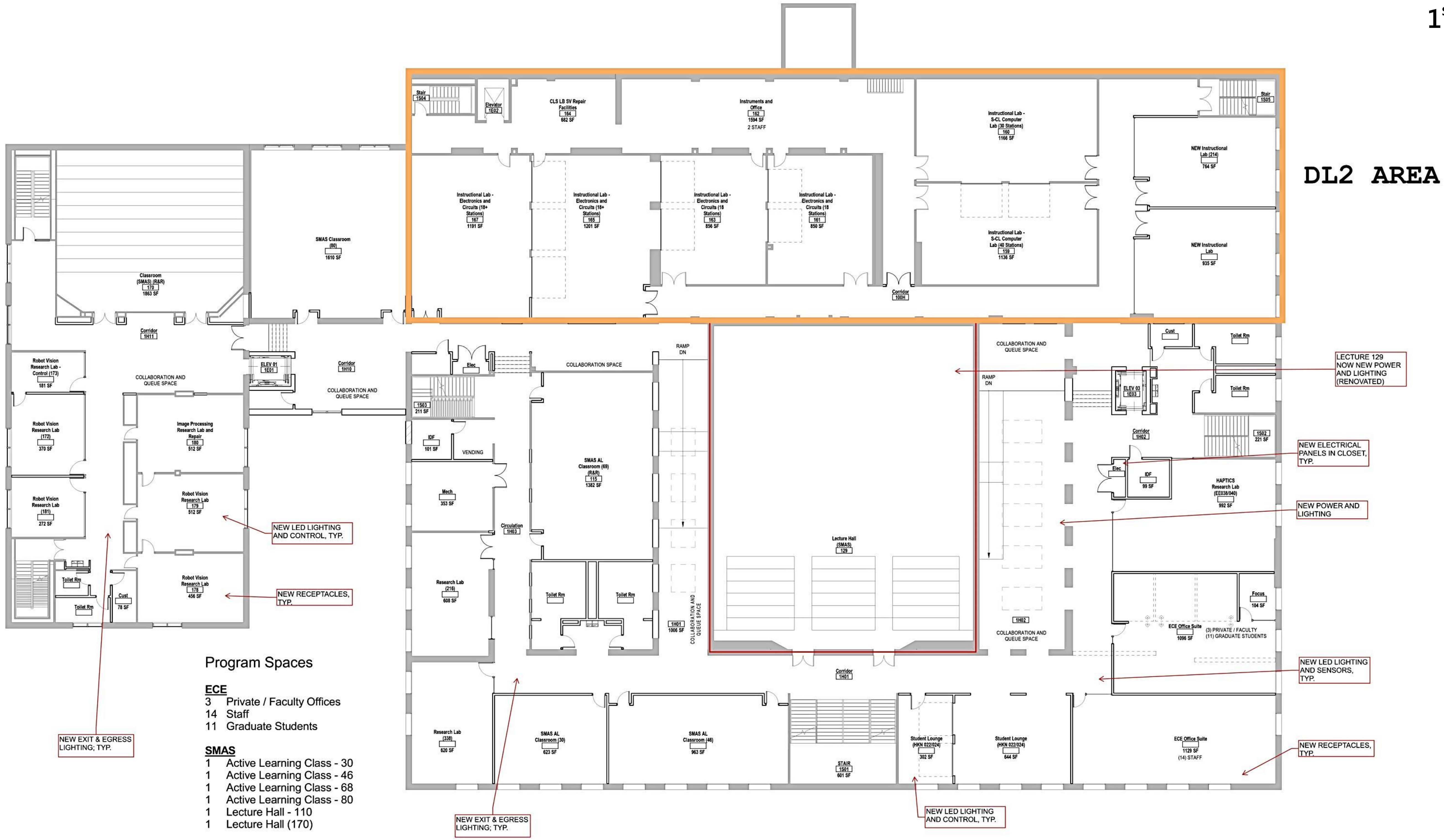


Program Spaces

ECE
1 Staff (Office - DL2)
3 Private / Faculty Offices
20 Graduate Students

Conference (25 NSF/person)
1 Conference Room (8)
1 Conference/Seminar Room (36)

Proposed Electrical Plans
1st Floor



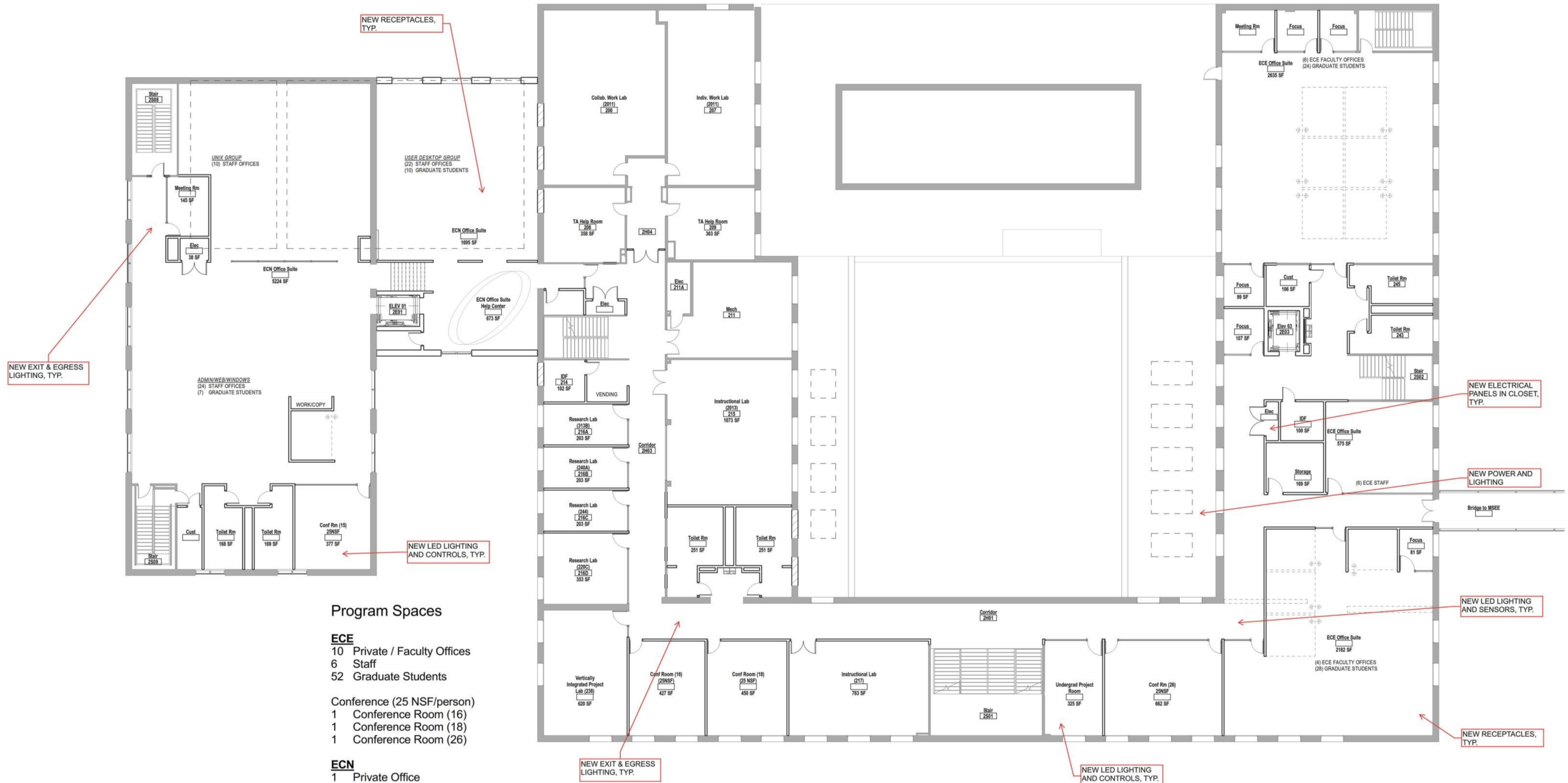
Program Spaces

ECE
3 Private / Faculty Offices
14 Staff
11 Graduate Students

SMAS
1 Active Learning Class - 30
1 Active Learning Class - 46
1 Active Learning Class - 68
1 Active Learning Class - 80
1 Lecture Hall - 110
1 Lecture Hall (170)

PURDUE UNIVERSITY

Proposed Electrical Plans
2nd Floor



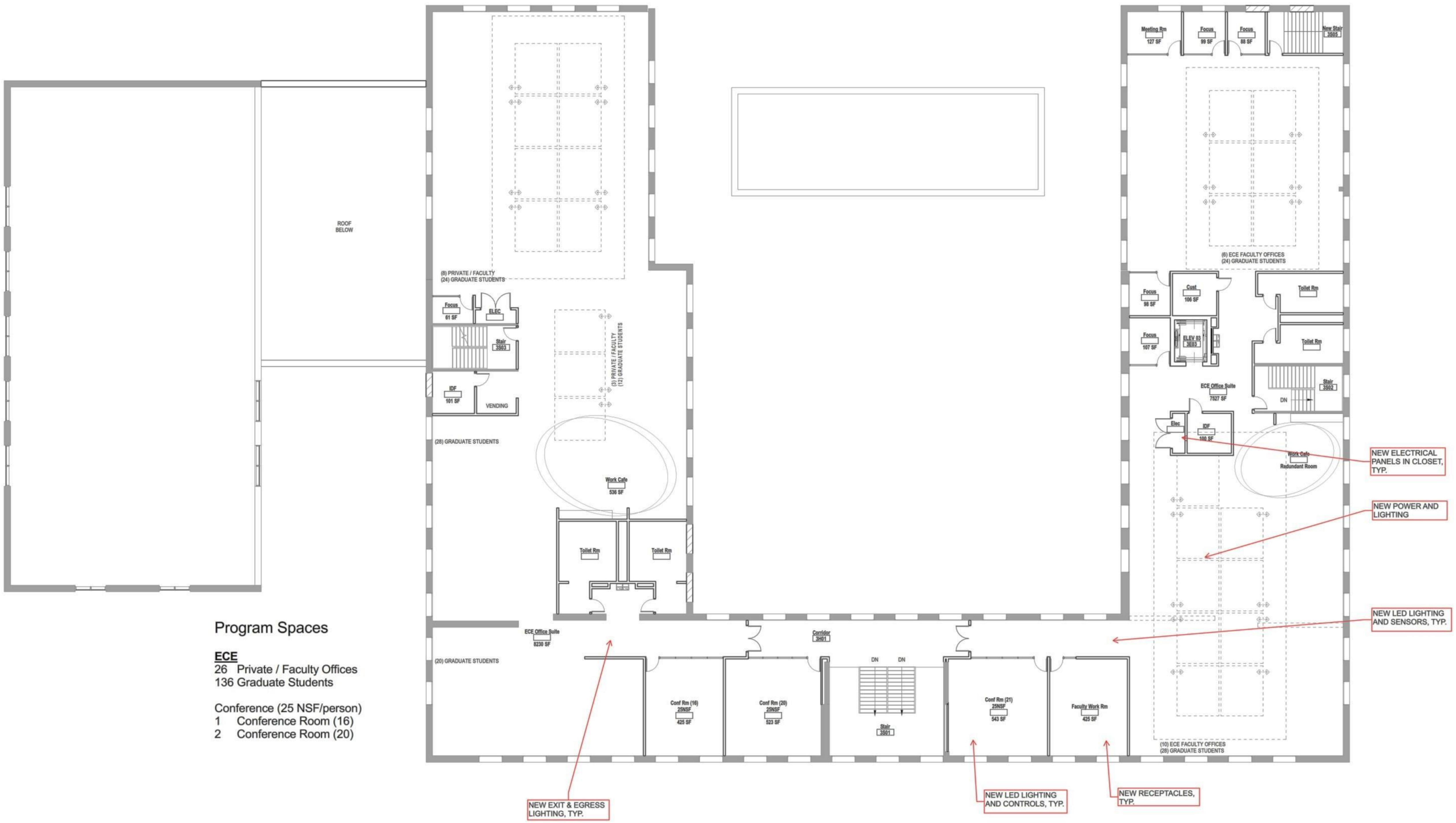
Program Spaces

ECE
10 Private / Faculty Offices
6 Staff
52 Graduate Students

Conference (25 NSF/person)
1 Conference Room (16)
1 Conference Room (18)
1 Conference Room (26)

ECN
1 Private Office
56 Staff
17 Graduate Students
1 Conference Room (15)

Proposed Electrical Plans
3rd Floor



PURDUE UNIVERSITY

Technology Narrative

I. **TECHNOLOGY**

A. Telecommunications Cabling Infrastructure:

1. Overview:

a. This infrastructure will provide support for Voice, Data and Cable TV distribution systems and services. In addition it will support interconnection of control panels for other ancillary building systems such as Fire Alarm, Electronic Security and Building Automation.

b. The Cabling Systems will be designed utilizing the Purdue ITaP guidelines and specifications as outlined in the Consultants Handbook.

c. It will be assumed that all offices, conference rooms, and other appropriate spaces shall be equipped with telephone circuits and one or more computer workstations. These will be connected via separate intra-building networks as well as separate inter-building networks. Currently, the telephone circuits, including dedicated 2-wire and 4-wire, security, fire, etc. operate on a copper backbone. The data network operates on copper from the workstation to the telecommunication room and then is connected via fiber optic cable to the Purdue fiber optic backbone.

d. CATV and Purdue Cable operate over a mixture of coaxial cable and fiber optic cables.

2. Demolition and Phasing:

a. The existing telecommunications rooms including the BDF and IDFs shall be demolished as part of any renovation to the building. The existing spaces do not meet the current campus standards and must be replaced with new room's part of any renovation to the building.

b. As part of the initial phase of demolition the building will require temporary telecommunications spaces to be created to serve the horizontal and riser cabling within Phase 1 of the project. Temporary IDF spaces will be established on the first and second floors of the Duncan Annex. All permanent horizontal cabling within this phase will be given appropriate slack during construction to allow the cable to be pulled from each temporary TR to the final IDF upon completion of Phase 2 of the project. Temporary riser cabling will be used to connect all temporary TR's created to serve Phase 1. Temporary riser cabling will be demolished as part of the completion of Phase 2 of the building renovation.

c. Phase 1 will require the creation of the new permanent BDF and entrance conduits on the south side of the Ground Floor of building to serve the renovated building. The existing riser and backbone cabling serving the building will be extended/moved as needed to the new BDF to serve any IDFs serving portions of the building remaining occupied. All temporary riser cabling shall also be cabled back to the new BDF.

d. Phase 2 will require the demolition of the existing BDF and all remaining IDFs serving the building. The existing entrance conduit pathway serving the BDF will be demolished back to the existing utility tunnel.

e. The existing riser cabling serving all telecommunications rooms shall be demolished as part of any renovation to the building. The existing riser cabling does not meet the current campus standards for grade and type of fiber optic cabling. As well all riser cabling must be replaced as part of the creation of the new telecommunications rooms.

f. The existing data horizontal cabling serving the EE Building shall be demolished as a part of any renovation to the building. The existing Category 5e cabling infrastructure for data cabling does not match the current campus standards.

g. The existing telephone horizontal cabling serving the EE Building shall be demolished as part of any renovation to the building. The existing Category 5e cabling does not meet the current campus standards for new construction.

3. Topology:

a. This infrastructure shall include workstation outlets (WO) at specific locations throughout the facility. The cabling system shall utilize a "Star" homerun topology. Each individual WO shall be run to a dedicated Telecommunication Room (TR) where it will be terminated to a patch panel within the 90 meter distance limitations dictated by industry standards.

b. All Telecommunication Rooms shall then connect to a central point known as the Main Cross Connect, aka Building Distribution Frame (BDF) located in the Main Equipment Room (ER). This connection shall include a combination of fiber optic cable as well as a multi-pair copper cable.

c. That BDF shall connect via backbone copper and fiber cabling to Campus Telecommunications Systems.

4. Communications Pathways

a. The building's new communications pathways will be designed as an easily accessible system that provides for flexibility and relative ease of modification throughout the lifecycle of the building.

b. Pathways will be sized for voice, data, video, and any other Owner approved low voltage cabling. Systems, may include fire alarm, security, building automation, etc. each will be provided with separate pathway for wire management. This may be a separate tier on the corridor cable tray system.

c. The cable tray system will be sized to handle required cable loading for building plus 50% expansion for future applications, above the ceilings in the corridors and elsewhere as required.

d. The distribution cable tray system within the corridors will allow a minimum 3" of clearance between the tray and the ceiling, a minimum 6" of clearance in front of the tray, and a minimum 12" of clearance above the tray.

e. Basket type cable tray will be provided and will be wall hung and mounted on the wall above the accessible ceiling in the corridors as required. The cable tray will be a minimum of 12" W by 4"H

5. Telecommunications Rooms:

a. The project scope includes the establishment of all new telecommunication rooms and the intention to complete the work in two phases. The initial phase will incorporate the space of Duncan Annex and the creation of a new BDF location to service the entire facility. The new BDF will be established with all service prior to a cutover from the existing BDF.

b. A new permanent BDF will be established in the space just south of the existing south stair tower the main building to allow the completion of the construction on the Ground Level of Duncan Annex without disruption of service to the upper portions of the building that will remain occupied.

c. This main building will require a single new IDF on the ground level of the building and a minimum of two telecommunications rooms per floor (initial, locations shown on the proposed floor plans). These telecommunications rooms shall be located so that every new or future PIC is by wire length within 90 meters of its distribution point in the telecommunications room. This includes areas where PICs are not currently designed to be installed but may be installed in the future (i.e. Far ends of the building, attic spaces, mechanical rooms, etc.).

d. The new telecommunications spaces have been designed to operate 24/7 at the required temperature and humidity range required for these types of spaces. As well no HVAC ducts, plumbing, gas lines, air lines, clean outs, etc. will be located in or routed through the shown telecommunications spaces.

e. The new BDF room has been located within the building near the point where the existing utility tunnel meets the building. Also all the new telecommunications rooms will accessible directly from a hallway.

f. The location of the BDF telecommunications room has been chosen to allow new 4" entrance conduits to be added to replace the existing conduits serving the existing BDF location.

g. The BDF and IDF telecommunication rooms have been sized by area served (ASF).

1) Telecommunication Room Service Entrance will be located in the BDF. It will include two new 4" rigid conduits routed to the existing utility tunnel location . Additional entrance conduits may be required based upon area (ASF) of building and number of Telecommunications circuits required. The entrance conduits will be installed below the ground floor slab and routed between the tunnel and the BDF room.

2) The BDF will be located on the ground level of the building and shall be sized as a 100 SF room to serve as the telecommunications service entrance for all outside plant communications cabling for the building. This room is needed to serve the work area outlets in the southern portion of the ground level as well as the termination area for all backbone and riser communications cabling to the new ground level IDF and all new IDF locations on the floors above.

3) The ground floor will have a single telecommunications room to serve the portion of the floor that cannot be served by the new BDF. This ground floor IDF shall be approximately 99 SF and be located directly below the upper floor IDF locations.

4) The first floor will have 2 telecommunications rooms. The first IDF will be a 101 SF area and be located directly above the ground floor IDF and be used to serve the southern portion of the floor. The second IDF will be a 99 SF area and be located directly above the BDF and be used to serve the northern portion of the floor.

5) The second floor will have 2 telecommunications rooms that will be located directly above the first floor IDF locations. This should allow for ease of routing communications cable from floor to floor. The first IDF will be a 102 SF area and be located adjacent to the southern stair tower and will serve the southern portion of the floor. The second IDF will be a 100 SF area and be located near the center of the northern portion of the building and be used to serve the northern portion of the floor.

6) The third floor will have 2 telecommunications rooms that will be located directly above the second floor IDF locations. This should allow for ease of routing communications cable from floor to floor. The first IDF will be a 101 SF area and be located near the center of the southern of the floor. The second IDF will be a 100 SF area and be located near the center of the northern portion of the floor and be used to serve the northern portion of the floor.

h. All new telecommunication room walls will have an added layer of 3/4" plywood, B-B ext. grade 5. Plywood will be fire-retardant. Plywood will be installed horizontally on walls from 2'-0" to 6'-0"AFF from corner to corner.

i. All BDF and IDF telecommunication rooms shall have ladder type cable tray installed around the perimeter of the room at approximately 7'-2" AFF.

j. One dedicated, 110V, 20A double –duplex electrical outlets will be provided on each wall. One of those outlets in particular will be provided on the wall near the equipment frames.

k. Two dedicated, 208V, 30A, twist lock (NEMA L6-30R), single phase electrical outlet will be located 25" behind the front rail of the equipment frame on the wall in the telecommunications room BDF for the owner provided UPS.

l. Two dedicated, 208V, 20A, twist lock (NEMA L6-20R), single phase electrical outlet will be located 25" behind the front rail of the equipment frame on the wall in telecommunications room IDF for the owner provided UPS.

6. Workstation Outlets Requirements:

a. Workstation outlets will be placed in general office space, conference rooms, commons areas, laboratories, classrooms and other facility spaces as required. Special Circuit Requirements:

1) Wireless Access Point location will require one data cable each.
2) Every FACP (Fire Alarm Control Panel) requires two voice cables, terminated per telecom specifications, to be installed to the nearest telecommunications room.
3) Every environmental control cabinet requires two data cables, terminated per telecom specifications, to be installed to the nearest telecommunications room.
4) Every building electrical switch gear meter requires two data cables, terminated in an enclosure outside of the metering cabinet per telecom specifications, and to be installed to the nearest telecommunications room.
5) Every elevator requires two voice cables, terminated per telecom specifications, to be installed to the nearest telecommunications room.

b. Each standard PIC Station will be one 4-11/16" square by 2-1/8" deep flush mounted box with double gang, square drawn extension or tile ring. Provide 1" EMT conduit from the box to cable tray in corridor.

7. Video Wiring System:
   a. This system shall provide the signal to the television / display from the Cable Television (CATV) Distribution System.

B. Wireless Network Systems for Data:
1. Overview:
   a. Wireless network systems shall be engineered by Purdue's Information Technology Networks and Security (ITNS) department during the design phase of the project. ITNS will provide the A&E team with wireless access point locations based on a computer generated site survey for new buildings so they may be incorporated into the construction documents. The contractor will be responsible for installing a turn-key wireless system as part of the project. The wireless system shall be included in the building project budget.

C. Telephone System and Service:
1. Overview:
   a. The telephone system equipment and handsets will be provided by the University.
   b. Service to the system will be provided by connecting this facility to the existing Campus Telecommunications Systems.

D. Emergency Communications:
1. Overview:
   a. Emergency Communications in the facility will be provided by "Voice Evacuation" capabilities of the Fire Alarm System.
   b. It is yet to be determined whether any other emergency phones are required.

E. Paging System
1. No paging system will be provided.

F. Clock System:
1. No clock system will be provided.
2. Battery powered clocks may be installed by Owner in selected locations.

G. Local Area Network (LAN) Electronics:
1. Overview:
   a. This includes Hubs, Routers, and Switches required to activate data ports. The University will provide all Network Electronic for this Project. Space will be allocated in the BDF and IDF rack to accommodate these requirements.

H. Security Systems:
1. Overview:
   a. This includes Hubs, Routers, and Switches required to activate data ports. The University will provide all Network Electronic for this Project. Space will be allocated in the BDF and IDF rack to accommodate these requirements.
2. Access Control:
   a. A new electronic access control system will be provided. All readers, controllers, and wiring shall be providing, installed, and programmed by the University. The design of the building shall include all required rough-ins, conduit, junction boxes, and power to allow for the installation at each opening to be completed.
   b. A single gang box with a single gang plaster ring and a 1" EMT conduit to above ceiling cable tray will be provided for each card reader location.
   c. All keypads, card readers, cables, security cabinet, etc. shall be provided by the University.
   d. During the design phase of the project key openings on the exterior and interior of the facility will need to be identified that require access control and card readers.
3. CCTV:
   a. A CCTV system will be provided to serve the building.
   b. Interior camera locations will be recorded by a new local DVR located within the each that require monitoring. It will be mounted in a locked room or enclosure to protect it from tampering. It is not recommended to place all cameras on the campus network system as it is not accessible by staff and faculty, only campus police.
   c. Currently cameras are required to view and monitor all lab spaces to ensure the security of ongoing experiments taking place in the spaces.
   d. During the design phase other key areas of the facility will need to be identified that require camera coverage.
   e. All exterior camera locations will be provided with a two gang box with a single gang ring and a 1" EMT conduit to nearest above ceiling cable tray. All interior camera location will be provided with a two gang box with single gang plaster ring and 1" EMT conduit to the nearest above ceiling cable tray.

I. Audio Visual Systems:

1. Overview:

a. The Audio Visual (AV) system requirements for this facility have not yet been determined and are not currently included in the design responsibility of the Architect or its consultants. It will be critical that these requirements be determined in the DD phase as they will impact the design of electrical pathways and power systems as well CATV and Network Connections.

b. We expect the AV requirements at a minimum to include technologies such as "way finding" and general information displays in common areas, projectors, and screens in conference rooms and dedicated audio systems in workout areas. In addition many pieces of exercise equipment have built in video displays that can connect to CATV signals and some equipment can connect to data networks.

II. SPECIFICATIONS

A. Main Bid Package:

1. Division 27:

27 00 00	Communications (Common Work Results)
27 05 26	Grounding and Bonding for Communication Systems
27 05 28	Pathways for Communications Systems
27 05 53	Identification for Communication Systems
27 11 01	Telecommunications Room Finishes
27 11 16	Cabinets and Frames
27 11 19	Termination Blocks and Patch Panels
27 14 13	Copper Riser Cabling
27 14 23	Fiber Riser Cabling
27 14 33	Coaxial Riser Cabling
27 15 13	Copper Horizontal Cabling
27 15 33	Coaxial Horizontal Cabling
27 15 43	Faceplates and Connectors
27 21 33	Wireless Access Points

ARC FLASH REPORT

The executive summary and calculated arc flash data follow. This is just a summary; calculated data and the full report are provided under separate cover.

PURDUE
UNIVERSITY

Arc Flash Hazard Analysis
With Fault-Current Analysis and
Protective Device Coordination Analysis
October 29, 2014

Electrical Engineering Building

Applied
Engineering Services

Project No. 14-063

1 Executive Summary

Warning

The PPE requirements, when working on the line side of main disconnects, buswork and cabling between main transformers, main disconnects, and the connections within main transformers are not affected by the recommendations made in this report. That part of the system is protected by devices on the input side of the transformers that are normally owned and set by the utility.

- All of the panelboards and switchboards fall within NFPA 70E limits for PPE (personal protective equipment) categorized as Category 0, 1, or 2 unless noted below. Refer to **Section 2** of this report for a table describing the categories and results of the arc flash hazard calculations.
- The rated fault current for all busses is sufficient to clear a bolted fault unless noted below. Refer to **Section 4** of this report for a table describing the results.
- The rated fault current for all protective devices is sufficient to clear a bolted fault unless noted below. Refer to **Section 4** of this report for a table describing the results.

Findings

At the following bus, the calculated incident energy is above 8.0 cal/cm2 and PPE Category is 3 or above.

Purdue University
EE Building
Applied Project No. 14-063

October 29, 2014
1

Arc Flash Evaluation NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	PPE Level
1	MAF-L LINESIDE	PD-Pri-Fuse T-L	0.208	42.04	11.92	42.04	11.92	2	234	18	80	Dangerous! (*N9) (*S3)
2	MAF-P LINESIDE	PD-Pri-Fuse T-P	0.48	19.24	11.47	18.93	11.28	2	226	18	76	Dangerous! (*N9) (*S3)
3	SDP-LBA LINESIDE	PD-T-LA	0.24	9.65	4.45	9.65	4.45	2	122	18	28	Category 4 (*N9) (*S3)
4	G&W SWITCH	PD-Pri-Fuse T-P	12.47	12.35	11.94	0.01	0.01	0.083	1026	36	31	Category 4 (*N2) (*N9) (*S3)
5	MDP-L LINESIDE	PD-MAIN MAF-L	0.208	41.10	11.74	41.10	11.74	0.39	85	18	15	Category 3 (*S3)
6	MDP-P LINESIDE	PD-MAIN MAF-P	0.48	19.03	11.36	18.72	11.18	0.39	83	18	15	Category 3 (*S3)
7	MDP-L	PD-MAIN MAF-L	0.208	41.09	11.73	41.09	11.73	0.39	85	18	15	Category 3 (*N5) (*S3)
8	MDP-P	PD-MAIN MAF-P	0.48	19.03	11.36	18.72	11.18	0.39	83	18	15	Category 3 (*N5) (*S3)
9	SDL-LAA	PD-SDL-LAA	0.208	27.93	7.61	27.93	7.61	0.88	105	18	22	Category 3 (*N3) (*S2)
10	SDL-LAB	PD-SDL-LAB	0.208	27.93	7.61	27.93	7.61	0.88	105	18	22	Category 3 (*N3) (*S2)
11	SDP-PA	PD-SDP-PA	0.48	16.74	8.65	16.74	8.65	0.48	79	18	13	Category 3 (*N3) (*S2)
12	SDP-LBA	PD-T-LA	0.24	9.65	3.78	9.65	3.78	2	109	18	23	Category 3 (*N3) (*N5) (*N9) (*S3)
13	SDP-LBB	PD-T-LA	0.24	9.63	3.78	9.63	3.78	2	109	18	23	Category 3 (*N3) (*N5) (*N9) (*S3)
14	GEN BUS	MaxTripTime @2.0s	0.208	2.05	1.43	2.05	1.43	2	58	18	8.1	Category 3 (*N2) (*N9) (*S3)

2

Equations used with permission from IEEE 1584 *Copyright 2012*, by IEEE. The IEEE disclaims any responsibility or liability resulting from the placement and use in the described manner.

Recommendations

- Provide arc flash mitigation circuit breaker, MAF-L and MAF-P, with Electronic Trip Unit (LSIG), similar to Siemens WLL Series, ETU 586 Trip Unit, between Transformer Secondary and MDP-P/MDP-L Main Bus. These breakers will be remotely operated.
- Adding these breakers will reduce incident energy from 79 cal/cm^2 to 15 cal/cm^2.
- MDP-P and MDP-L, Main Device is Fuse and these fuses don't clear the fault in allocated time to reduce incident energy. Removing Main Fuse with Bus Link and/or Fast Tripping Fuse may allow to reduce incident energy at these boards.

Findings

TCC SDP-LBA & TCC SDP-LBB: The main breaker does not coordinate with the branch breakers.

Recommendations

- Replace existing breaker with electronic trip breaker.

2 Calculated Arc Flash Data

The table included in this section is the screen displayed at the conclusion of the SKM arc-flash analysis. It was printed as a pdf file and merged into the report.

The arc-flash hazard analysis is done to conform to OSHA recommendations described in 29CFR 1910.333. Procedures for arc-flash hazard analysis are described in both NFPA Standard 70E-2009 and IEEE Standard 1584-2002. IEEE Standard 1584-2002 describes a method for calculating the potential arc-flash energy based on the anticipated “bolted” fault current. The results reported within have been calculated using the more conservative, interpretation of IEEE Standard 1584-2002.

IEEE Standard 1584-2002 states that equipment rated below 208V does not need be considered unless it involves a low-impedance transformer larger than 125 kVA for its immediate supply. The reason for this exclusion is the inability of such small capacity systems to initiate and support arcing conditions. NFPA Standard 70E-2009 applies the same reasoning to equipment rated 208V and less. NFPA Standard 70E is recognized as the guiding document. We have expanded the study to 208V systems per Purdue's request.

The table beginning on the next page shows arc-flash data calculated. Included in the tables are the critical distances, the incident energies, the fault currents, and the PPE category level required for the indicated working distance. Arc-flash hazard warning labels for the equipment are created from this table.

If future changes are made in the electrical system or to the protective device settings, new calculations should be completed on the specific circuits and new warning labels printed to reflect any changes in the hazard.

- Arc Flash Study Table AFlash BKR (S3)

Arc Flash Evaluation NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report   Project: Purdue EE building, Worst Case Scenarios: Scenario - S2, S3

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	PPE Level
1	MAF-L LINESIDE	PD-Pri-Fuse T-L	0.208	42.04	11.92	42.04	11.92	2	234	18	80	Dangerous! (*N9) (*S3)
2	MAF-P LINESIDE	PD-Pri-Fuse T-P	0.48	19.24	11.47	18.93	11.28	2	226	18	76	Dangerous! (*N9) (*S3)
3	SDP-LBA LINESIDE	PD-T-LA	0.24	9.65	4.45	9.65	4.45	2	122	18	28	Category 4 (*N9) (*S3)
4	SDP-LBA	PD-T-LA	0.24	9.65	4.45	9.65	4.45	2	122	18	28	Category 4 (*N5) (*N9) (*S3)
5	SDP-LBB	PD-T-LA	0.24	9.63	4.44	9.63	4.44	2	122	18	28	Category 4 (*N5) (*N9) (*S3)
6	G&W SWITCH	PD-Pri-Fuse T-P	12.47	12.35	11.94	0.01	0.01	0.083	1026	36	31	Category 4 (*N2) (*N9) (*S3)
7	MDP-L LINESIDE	PD-MAIN MAF-L	0.208	41.10	11.74	41.10	11.74	0.39	85	18	15	Category 3 (*S3)
8	MDP-P LINESIDE	PD-MAIN MAF-P	0.48	19.03	11.36	18.72	11.18	0.39	83	18	15	Category 3 (*S3)
9	MDP-L	PD-MAIN MAF-L	0.208	41.09	11.73	41.09	11.73	0.39	85	18	15	Category 3 (*N5) (*S3)
10	MDP-P	PD-MAIN MAF-P	0.48	19.03	11.36	18.72	11.18	0.39	83	18	15	Category 3 (*N5) (*S3)
11	SDL-LAA	PD-SDL-LAA	0.208	27.93	7.61	27.93	7.61	0.88	105	18	22	Category 3 (*N3) (*S2)
12	SDL-LAB	PD-SDL-LAB	0.208	27.93	7.61	27.93	7.61	0.88	105	18	22	Category 3 (*N3) (*S2)
13	SDP-PA	PD-SDP-PA	0.48	16.74	8.65	16.74	8.65	0.48	79	18	13	Category 3 (*N3) (*S2)
14	GEN BUS	MaxTripTime @2.0s	0.208	2.05	1.43	2.05	1.43	2	58	18	8.1	Category 3 (*N2) (*N9) (*S3)
15	ATS-E1E	PD-ATS-E1E	0.208	1.95	1.38	1.95	1.38	2	57	18	7.8	Category 2 (*N9) (*S3)
16	ATS-E2E	PD-ATS-E2E	0.208	1.95	1.38	1.95	1.38	2	56	18	7.8	Category 2 (*N9) (*S3)
17	E1	PD-MAIN E1	0.208	1.94	1.37	1.94	1.37	2	56	18	7.8	Category 2 (*N9) (*S3)
18	E1 LINESIDE	PD-ATS-E1E	0.208	1.94	1.37	1.94	1.37	2	56	18	7.8	Category 2 (*N9) (*S3)
19	E2	PD-MAIN E2	0.208	1.87	1.34	1.87	1.34	2	55	18	7.6	Category 2 (*N9) (*S3)
20	E2 LINESIDE	PD-ATS-E2E	0.208	1.87	1.34	1.87	1.34	2	55	18	7.6	Category 2 (*N9) (*S3)
21	EE-141 Contactor	PD-EE-141	0.48	37.86	20.45	37.86	20.45	0.017	18	18	1.2	Category 1 (*S3)
22	BUSDUCT BD-P1	PD-BUSDUCT BD-P1	0.24	9.58	3.76	9.58	3.76	0.332	37	18	3.8	Category 1 (*N3) (*S2)
23	PP-ATTIC-1	PD-PP-ATTIC-1	0.48	18.59	9.47	18.59	9.47	0.048	21	18	1.5	Category 1 (*N3) (*S2)
24	SDP-L	PD-SDP-L	0.208	39.96	9.78	39.96	9.78	0.075	28	18	2.4	Category 1 (*N3) (*S2)
25	SDP-P	PD-SDP-P	0.48	18.59	9.47	18.59	9.47	0.048	21	18	1.5	Category 1 (*N3) (*S2)
26	A COMP(RMB66)	PD-A COMP(RMB66)	0.24	9.60	4.43	9.60	4.43	0.012	5	18	0.16	Category 0 (*S3)
27	ATS-E1N	PD-ATS-E1N	0.208	15.66	5.96	15.66	5.96	0.012	6	18	0.22	Category 0 (*S3)
28	ATS-E2N	PD-ATS-E2N	0.208	16.18	6.10	16.18	6.10	0.012	6	18	0.22	Category 0 (*S3)
29	ATTIC PNL	PD-ATTIC PNL	0.24	9.56	4.42	9.56	4.42	0.014	6	18	0.19	Category 0 (*S3)
30	BUSDUCT BD-L1(RM61)	PD-BUSDUCT BD-L1	0.208	28.16	9.00	28.16	9.00	0.025	13	18	0.73	Category 0 (*S3)
31	BUSDUCT(RM241B)	PD-BUSDUCT(RM241B)	0.208	28.02	8.97	28.02	8.97	0.017	11	18	0.50	Category 0 (*S3)
32	COND PUMPS	PD-COND PUMPS	0.24	9.60	4.43	9.60	4.43	0.012	5	18	0.16	Category 0 (*S3)

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PURDUE UNIVERSITY

Arc Flash Evaluation NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report   Project: Purdue EE building, Worst Case Scenarios: Scenario - S2, S3

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	PPE Level
33	EE-57b Laser	PD-EE-57B Laser	0.48	37.78	20.41	37.78	20.41	0.017	18	18	1.2	Category 0 (*S3)
34	EX PNL	PD-EX PNL	0.24	9.59	4.43	9.59	4.43	0.012	5	18	0.16	Category 0 (*S3)
35	EX PNL(RM011)	PD-EXPNL(RM011)	0.208	27.93	8.95	27.93	8.95	0.012	8	18	0.34	Category 0 (*S3)
36	EX PNL-1	PD-EX PNL-1	0.24	9.56	4.42	9.56	4.42	0.014	6	18	0.19	Category 0 (*S3)
37	EX PNL-208(RM38)	PD-EX PNL-208	0.208	27.53	8.86	27.53	8.86	0.017	11	18	0.49	Category 0 (*S3)
38	EX12 (RM57)	PD-XD12 (RM57)	0.24	9.60	4.43	9.60	4.43	0.012	5	18	0.16	Category 0 (*S3)
39	FDR 27/8	PD-FDR P27/8	0.24	9.59	4.43	9.59	4.43	0.012	5	18	0.16	Category 0 (*S3)
40	H3(RM309)	PD-H3(RM309)	0.24	9.62	4.44	9.62	4.44	0.04	11	18	0.56	Category 0 (*S3)
41	L3A(RM306)	PD-L3A,L3A2(RM306)	0.208	28.03	8.97	28.03	8.97	0.025	13	18	0.73	Category 0 (*S3)
42	L3A2(RM306)	PD-L3A,L3A2(RM306)	0.208	24.30	8.11	24.30	8.11	0.026	13	18	0.69	Category 0 (*S3)
43	LASER	PD-LASER	0.208	27.93	8.95	27.93	8.95	0.012	8	18	0.34	Category 0 (*S3)
44	LASER (RM57B)	PD-LASER(RM57B)	0.208	27.53	8.86	27.53	8.86	0.017	11	18	0.49	Category 0 (*S3)
45	LG1	PD-LG1,LG2	0.208	27.87	8.94	27.87	8.94	0.012	8	18	0.34	Category 0 (*S3)
46	LG2	PD-LG1,LG2	0.208	24.17	8.08	24.17	8.08	0.012	8	18	0.30	Category 0 (*S3)
47	LG-2	PD-PNL LG-1,LG-2, LG-PH	0.208	24.17	8.08	24.17	8.08	0.012	8	18	0.30	Category 0 (*S3)
48	LG-PH	PD-PNL LG-1,LG-2, LG-PH	0.208	21.32	7.40	21.32	7.40	0.012	7	18	0.28	Category 0 (*S3)
49	LIBERT A/C	PD-LIBERT A/C	0.24	9.59	4.43	9.59	4.43	0.014	6	18	0.19	Category 0 (*S3)
50	MCC-1 (P.H)	PD-MCC-1 (P.H)	0.24	9.60	4.43	9.60	4.43	0.012	5	18	0.16	Category 0 (*S3)
51	MDP-2(RM209)	PD-MDP-2(RM209)	0.24	9.62	4.44	9.62	4.44	0.04	11	18	0.56	Category 0 (*S3)
52	PNL ATTIC	PD-PNL ATTIC	0.208	27.87	8.94	27.87	8.94	0.012	8	18	0.34	Category 0 (*S3)
53	PNL LG-1	PD-PNL LG-1,LG-2, LG-PH	0.208	27.87	8.94	27.87	8.94	0.012	8	18	0.34	Category 0 (*S3)
54	PNL P(ATTIC)	PD-PNL P(ATTIC)	0.208	27.87	8.94	27.87	8.94	0.012	8	18	0.34	Category 0 (*S3)
55	PNL(RM206)	PD-PNL(RM206)	0.24	9.60	4.43	9.60	4.43	0.012	5	18	0.16	Category 0 (*S3)
56	PNL(RM47-51)	PD-PNL(RM47-51)	0.24	9.60	4.43	9.60	4.43	0.012	5	18	0.16	Category 0 (*S3)
57	PNL-P(ATTIC)	PD-PNL-P(ATTIC)	0.24	9.60	4.43	9.60	4.43	0.012	5	18	0.16	Category 0 (*S3)
58	SDP(RM139)	PD-SDP(RM139)	0.24	9.63	4.44	9.63	4.44	0.04	11	18	0.56	Category 0 (*S3)
59	SDP(RMB66N)	PD-SDP(RMB66N)	0.24	9.56	4.42	9.56	4.42	0.014	6	18	0.19	Category 0 (*S3)
60	SDP-1(LEC-HALL)	PD-SDP-1(LEC-HALL)	0.24	9.56	4.42	9.56	4.42	0.014	6	18	0.19	Category 0 (*S3)
61	SDP-7(RM7)	PD-SDP-7(RM7)	0.24	9.60	4.43	9.60	4.43	0.012	5	18	0.16	Category 0 (*S3)
62	SW EX ELEV-1	PD-EX ELEV-1	0.48	18.55	9.45	18.24	9.29	0.008	7	18	0.26	Category 0 (*N3) (*S2)

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Arc Flash Evaluation NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report   Project: Purdue EE building, Worst Case Scenarios: Scenario - S2, S3

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	PPE Level
63	Category 0: Nonmelting or Untreated Fiber with Weight >= 4.5 oz/sq yd	0.0 - 1.2 cal/cm^2									#Category 0 = 37	(*N2) < 80% Cleared Fault Threshold
64	Category 1: Arc-rated shirt & pants or arc-rated coverall	1.2 - 4.0 cal/cm^2									#Category 1 = 5	(*N3) - Arcing Current Low Tolerances Used
65	Category 2: Arc-rated shirt & pants or arc-rated coverall	4.0 - 8.0 cal/cm^2									#Category 2 = 6	(*N5) - Miscoordinated, Upstream Device Tripped
66	Category 3: Arc-rated shirt & pants + arc-rated coverall + arc-rated arc flash suit	8.0 - 25.0 cal/cm^2									#Category 3 = 8	(*N9) - Max Arcing Duration Reached
67	Category 4: Arc-rated shirt & pants + arc-rated coverall + arc-rated arc flash suit	25.0 - 40.0 cal/cm^2									#Category 4 = 4	
68	Category Dangerous!: DO NOT WORK ON LIVE!	40.0 - 999.0 cal/cm^2									#Danger = 2	NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report (- 80% Cleared Fault Threshold, mis-coordination checked
69											Worst Case Scenarios:	(*S2) - Purdue EE U-Low EXTBKR (S2)
70	For additional information refer to NFPA 70 E, Standard for Electrical Safety in the Workplace.											(*S3) - Purdue EE U-High EXTBKR (S3)
71												
72												

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PURDUE UNIVERSITY

Arc Flash Hazard Analysis
With Fault-Current Analysis and
Protective Device Coordination Analysis
October 29, 2014

Electrical Engineering (NUC) Building

Applied Engineering Services

Project No. 14-063

1 Executive Summary

Warning

The PPE requirements, when working on the line side of main disconnects, buswork and cabling between main transformers, main disconnects, and the connections within main transformers are not affected by the recommendations made in this report. That part of the system is protected by devices on the input side of the transformers that are normally owned and set by the utility.

- All of the panelboards and switchboards fall within NFPA 70E limits for PPE (personal protective equipment) categorized as Category 0, 1, or 2 unless noted below. Refer to **Section 2** of this report for a table describing the categories and results of the arc flash hazard calculations.
- The rated fault current for all busses is sufficient to clear a bolted fault unless noted below. Refer to **Section 4** of this report for a table describing the results.
- The rated fault current for all protective devices is sufficient to clear a bolted fault unless noted below. Refer to **Section 4** of this report for a table describing the results.

Findings

At the following bus, the calculated incident energy is above 8.0 cal/cm2 and PPE Category is 3 or above.

Purdue University
EE Building
Applied Project No. 14-063

October 29, 2014
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Arc Flash Evaluation NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	PPE Level
1	AF-P-1 LINESIDE	MaxTripTime @2.0s	0.24	21.84	8.01	21.84	8.01	2	180	18	52	Dangerous! (*N2) (*N9) (*S3)
23	Category 0: Nonmelting or Untreated Fiber with Weight >= 4.5 oz/sq yd	0.0 - 1.2 cal/cm^2									#Category 0 = 17	(*N2) < 80% Cleared Fault Threshold
24	Category 1: Arc-rated shirt & pants or arc-rated coverall	1.2 - 4.0 cal/cm^2									#Category 1 = 4	(*N3) - Arcing Current Low Tolerances Used
25	Category 2: Arc-rated shirt & pants or arc-rated coverall	4.0 - 8.0 cal/cm^2									#Category 2 = 0	(*N5) - Miscoordinated, Upstream Device Tripped
26	Category 3: Arc-rated shirt & pants + arc-rated coverall + arc-rated arc flash suit	8.0 - 25.0 cal/cm^2									#Category 3 = 0	(*N8) - Fault Current Unlink w/ Study
27	Category 4: Arc-rated shirt & pants + arc-rated coverall + arc-rated arc flash suit	25.0 - 40.0 cal/cm^2									#Category 4 = 0	(*N9) - Max Arcing Duration Reached
28	Category Dangerous!: DO NOT WORK ON LIVE!	40.0 - 999.0 cal/cm^2									#Danger = 1	NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report (- 80% Cleared Fault Threshold, mis-coordination checked
29											Worst Case Scenarios:	(*S2) - Purdue EE NUC U-Low AFBKR(S2)
30	For additional information refer to NFPA 70 E, Standard for Electrical Safety in the Workplace.											(*S3) - Purdue EE NUC U-High AFBKR (S3
31												
32												

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Page 1

Recommendations

- Provide arc flash mitigation circuit breaker, AF-P-1 and AF-L-1, with Electronic Trip Unit (LSIG), similar to Siemens WLL Series, ETU 586 Trip Unit, between Transformer Secondary and MDP-P/MDP-L Main Bus. These breakers will be remotely operated.
- AF-P-1 LINESIDE PPE category is dangerous. This bus is connected to secondary of transformer with no protection in between. Use proper PPE and work offline.

2 Calculated Arc Flash Data

The table included in this section is the screen displayed at the conclusion of the SKM arc-flash analysis. It was printed as a pdf file and merged into the report.

The arc-flash hazard analysis is done to conform to OSHA recommendations described in 29CFR 1910.333. Procedures for arc-flash hazard analysis are described in both NFPA Standard 70E-2009 and IEEE Standard 1584-2002. IEEE Standard 1584-2002 describes a method for calculating the potential arc-flash energy based on the anticipated “bolted” fault current. The results reported within have been calculated using the more conservative, interpretation of IEEE Standard 1584-2002.

IEEE Standard 1584-2002 states that equipment rated below 208V does not need be considered unless it involves a low-impedance transformer larger than 125 kVA for its immediate supply. The reason for this exclusion is the inability of such small capacity systems to initiate and support arcing conditions. NFPA Standard 70E-2009 applies the same reasoning to equipment rated 208V and less. NFPA Standard 70E is recognized as the guiding document. We have expanded the study to 208V systems per Purdue’s request.

The table beginning on the next page shows arc-flash data calculated. Included in the tables are the critical distances, the incident energies, the fault currents, and the PPE category level required for the indicated working distance. Arc-flash hazard warning labels for the equipment are created from this table.

If future changes are made in the electrical system or to the protective device settings, new calculations should be completed on the specific circuits and new warning labels printed to reflect any changes in the hazard.

- Arc Flash Study Table AFlash BKR (S3)

Arc Flash Evaluation NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report   Project: Purdue EE NUC building, Worst Case Scenarios: Scenario - S2, S3

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	PPE Level
1	AF-P-1 LINESIDE	MaxTripTime @2.0s	0.24	21.84	8.01	21.84	8.01	2	180	18	52	Dangerous! (*N2) (*N9) (*S3)
2	M-P-1 LINESIDE	PD-AF-P-1	0.24	21.79	6.80	21.79	6.80	0.16	35	18	3.5	Category 1 (*N3) (*S3)
3	P-B-1	PD-P-B-1	0.24	21.34	6.70	21.34	6.70	0.073	21	18	1.6	Category 1 (*N3) (*S2)
4	M-P-1	PD-AF-P-1	0.24	21.79	6.80	21.79	6.80	0.16	35	18	3.5	Category 1 (*N3) (*N5) (*S3)
5	P-B-2	PD-AF-P-1	0.24	21.72	6.78	21.72	6.78	0.16	35	18	3.5	Category 1 (*N3) (*N5) (*S3)
6	AC UNIT-179	PD-AC UNIT-179	0.24	21.37	7.89	21.37	7.89	0.004	4	18	0.11	Category 0 (*S3)
7	P-1-1	PD-P-1-1	0.24	21.55	7.94	21.55	7.94	0.008	6	18	0.22	Category 0 (*S3)
8	E-1	PD-E-1	0.24	40.00	12.39	40.00	12.39	0.004	6	18	0.17	Category 0 (*N8) (*S3)
9	L-1-1	PD-L-1-1	0.24	40.30	12.45	40.30	12.45	0.004	6	18	0.18	Category 0 (*N8) (*S3)
10	L-1-2	PD-L-1-2	0.24	40.30	12.45	40.30	12.45	0.004	6	18	0.18	Category 0 (*N8) (*S3)
11	L-1-3	PD-L-1-3	0.24	40.00	12.39	40.00	12.39	0.004	6	18	0.17	Category 0 (*N8) (*S3)
12	L-2-1	PD-L-2-1	0.24	40.30	12.45	40.30	12.45	0.004	6	18	0.18	Category 0 (*N8) (*S3)
13	L-2-2	PD-L-2-2	0.24	40.30	12.45	40.30	12.45	0.004	6	18	0.18	Category 0 (*N8) (*S3)
14	L-2-3	PD-L-2-3	0.24	40.00	12.39	40.00	12.39	0.004	6	18	0.17	Category 0 (*N8) (*S3)
15	L-B-1	PD-L-B-1	0.24	40.80	12.57	40.80	12.57	0.008	9	18	0.35	Category 0 (*N8) (*S3)
16	LB3 (RM70B)	PD-LB3(RM70B)	0.24	40.00	12.39	40.00	12.39	0.004	6	18	0.17	Category 0 (*N8) (*S3)
17	L-G-1	PD-L-G-1	0.24	40.00	12.39	40.00	12.39	0.004	6	18	0.17	Category 0 (*N8) (*S3)
18	M-L-1	PD-MAIN M-L-1	0.24	42.02	12.84	42.02	12.84	0.008	6	18	0.18	Category 0 (*N8) (*S3)
19	M-L-1 LINESIDE	PD-MAIN M-L-1	0.24	42.06	12.84	42.02	12.83	0.008	9	18	0.36	Category 0 (*N8) (*S3)
20	AF-L-1 LINESIDE	PD-AF-P-1	0.24	36.96	11.70	36.96	11.70	0.03	18	18	1.2	Category 0 (*N8) (*S2)
21	M-C-P	PD-M-C-P	0.24	21.32	6.69	21.32	6.69	0.023	11	18	0.50	Category 0 (*N3) (*S2)
22	P-1-2	PD-P-1-2	0.24	21.29	6.69	21.29	6.69	0.014	8	18	0.30	Category 0 (*N3) (*S2)
23	Category 0: Nonmelting or Untreated Fiber with Weight >= 4.5 oz/sq yd	0.0 - 1.2 cal/cm^2									#Category 0 = 17	(*N2) < 80% Cleared Fault Threshold
24	Category 1: Arc-rated shirt & pants or arc-rated coverall	1.2 - 4.0 cal/cm^2									#Category 1 = 4	(*N3) - Arcing Current Low Tolerances Used
25	Category 2: Arc-rated shirt & pants or arc-rated coverall	4.0 - 8.0 cal/cm^2									#Category 2 = 0	(*N5) - Miscoordinated, Upstream Device Tripped
26	Category 3: Arc-rated shirt & pants + arc-rated coverall + arc-rated arc flash suit	8.0 - 25.0 cal/cm^2									#Category 3 = 0	(*N8) - Fault Current Unlink w/ Study

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Arc Flash Evaluation NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report   Project: Purdue EE NUC building, Worst Case Scenarios: Scenario - S2, S3

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	PPE Level
27	Category 4: Arc-rated shirt & pants + arc-rated coverall + arc-rated arc flash suit	25.0 - 40.0 cal/cm^2									#Category 4 = 0	(*N9) - Max Arcing Duration Reached
28	Category Dangerous!: DO NOT WORK ON LIVE!	40.0 - 999.0 cal/cm^2									#Danger = 1	NFPA 70E 2012 Annex D.7 - IEEE 1584 Bus Report (- 80% Cleared Fault Threshold, mis-coordination checked
29											Worst Case Scenarios:	(*S2) - Purdue EE NUC U-Low AFBKR(S2)
30	For additional information refer to NFPA 70 E, Standard for Electrical Safety in the Workplace.											(*S3) - Purdue EE NUC U-High AFBKR (S3
31												
32												

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PRELIMINARY CODE STUDY

Preliminary Code Study
Indiana Building Code 2008 (IBC 2006 Amended)
Prepared by RAD

History:
Multiple- phase building.

- 192x Original Central Lecture Hall: load bearing masonry.
- 192x South Wing: load bearing masonry, pan-joist, steel roof framing.
- 192x North Wing: load bearing masonry, pan-joist, steel roof framing.
- 1930 East Wing: load bearing masonry, pan-joist, steel roof framing.
- 1940 West Wing/ Connecting Link: load bearing masonry, pan-joist, steel roof framing.
- 1940 Duncan Annex: masonry with steel frame, steel roof framing
- 1957 Duncan Annex Renovation

4- story building with partial basement
Top of existing roof peak: 55'-0" +/- AFG
Higher Ed classrooms, labs and offices (B) with one lecture hall over 50 occupants (A-3).

Floor Elevations:

- Basement: (10'-8") BFG
- Ground Floor 0'-0" AFG
- Ground Floor 1940: 4'-1" AFG
- First Floor: 11'-8" AFG
- First Floor 1940 13'-2" AFG
- Second Floor: 22'-8" AFG
- Second Floor 1940: 28'-2" AFG
- Third Floor: 35'-8" AFG
- Attic Floor 47'-8" AFG

Proposal:

Duncan Annex- Total Assignable Area:	**22,684 SF**	
• Basement:	7,462 SF	+157 SF (not included)
• Ground Floor:	4,925 SF	+0 SF
• First Floor:	8,108 SF	+728 SF
• Second Floor:	6,369 SF	+2,554 SF

EE Main Building- Total Assignable Area:	**126,794 SF**	
• Basement:	11,112 SF	+0 SF (not included)
• Ground Floor:	34,790 SF	+2,684 SF
• First Floor:	31,041 SF	+2,864 SF
• Second Floor:	22,884 SF	+0 SF
• Third Floor:	21,419 SF	+0 SF

Higher Ed classrooms, labs and offices (B) with one lecture hall over 50 occupants (A-3).
Reuse existing four- story concrete structure and add non-combustible building additions.

IBC Classification:

Chapter 3- Occupancy Classification

Item:	**Section:**
Building is mixed use.	
Assembly Group A Assembly for classrooms over 50 occupants or 750 SF are Occupancy A-3.	303.1
Education classrooms and offices above the 12th grade; Occupancy B.	304.1

PURDUE UNIVERSITY

Chapter 5- Building Heights and Areas

Item:	**Section:**
Allowable building height and area will not exceed the limits of Table 503, except as modified in this Chapter.	503.1

~~**Occupancy A-3; Lecture Halls**~~
~~Target: Main 126,794 SF, 4- stories~~
~~Duncan: 22,684; 3- stories~~

- ~~Type 2B: 9,500 SF per floor. 2 stories or 55'-0".~~
- ~~Type 2A: 15,500 SF per floor. 3 stories or 65'-0".~~
- ~~Type 1B: Unlimited SF per floor. 11 stories or 160'-0".~~ Table 503

Occupancy B; Classroom and Office Construction
Target: Main 126,794 SF, 4- stories
Duncan: 22,684; 3- stories

- Type 2B: 23,000 SF per floor. 4 stories or 55'-0".
- Type 2A: 37,500 SF per floor. 5 stories or 65'-0".
- Type 1B: Unlimited SF per floor. 11 stories or 160'-0". Table 503

Building height increase. Where a building is equipped with an approved automatic FP system, the height value in Table 503 may be increased by 20'-0" and one story. 504.2

Building area increase. The areas limited by Table 503 may be increased due to frontage and automatic FP systems. 506.1

Automatic sprinkler area increase. Where a multi- story building is equipped with an automatic FP system the area limitation of Table 503 may be increased by 300%. 506.3

~~**Occupancy A-3; Lecture Halls**~~
~~Target: Main 126,794 SF, 4- stories~~
~~Duncan: 22,684; 3- stories~~

- ~~Type 2B: 28,500 SF per floor. 3 stories or 75'-0".~~
- ~~Type 2A: 14,500 SF per floor. 4 stories or 85'-0".~~
- ~~Type 1B: Unlimited SF per floor. 11 stories or 160'-0".~~

Occupancy B; Classroom and Office Construction
Target: Main 126,794 SF, 4- stories
Duncan: 22,684; 3- stories

- Type 2B: 69,000 SF per floor. 5 stories or 75'-0" (sprinkler increase only).
- Type 2A: 127,500 SF per floor. 6 stories or 85'-0" (yard and sprinkler increase).
- ~~Type 1B: Unlimited SF per floor. 11 stories or 160'-0".~~

Main Building Area Increase Calculation

A = {37,500+[37,500 x 0.4] + [37,500 x 2]} = 127,500 SF

Incidental use areas. Will be separated from other building occupancies as noted in Table 508.2. 508.2

- Storage Rooms = 1- hour

Where occupancies are subsidiary to the main occupancy and not occupy more than 10 percent of the area of the story or Table 503, they will be considered Accessory Occupancies. Accessory Occupancies are not be classified separately from the main occupancy. 508.3.1

- Lecture Halls are still A-3 occupancy

Fire separations are not required for accessory occupancies. 508.3.1.3

Chapter 6- Types of construction

Item:	**Section:**
Fire resistance rating requirements for building elements.	Table 601

Type 2A: Main Building
- Structural frame: 1 hour
- Bearing walls (interior and exterior):
  - Exterior 1 hour
  - Interior 1 hour
- Non-bearing interior walls: 0 hour
- Floor construction (including structure): 1 hour
- Roof construction (including structure): 1 hour

Type 2B: Duncan Annex
- Structural frame: 0 hour
- Bearing walls (interior and exterior):
  - Exterior 0 hour
  - Interior 0 hour
- Non-bearing interior walls: 0 hour
- Floor construction (including structure): 0 hour
- Roof construction (including structure): 0 hour

Fire Resistance Rating of Exterior Walls Based Upon Separation • Type 1 buildings, Occupancy B: < 30 feet = 1- hour • Type 1 buildings, Occupancy B: > 30 feet = zero hour • Type 1B buildings with exterior load bearing walls = 2- hour regardless of distance.	Table 602
Type 1 buildings consist of non-combustible materials, except as permitted by this code.	602.3

Chapter 7- Fire Resistive Construction

Item:	**Section:**
Buildings on the same lot. The required wall and opening Protection requirement will be based upon an imaginary Property line running between the buildings.	704.3
Fire resistance ratings for exterior walls will be based upon Table 601 and 602. The fire resistance rating of exterior walls Greater than five feet will be rated for fire exposure from the Inside. Less than five feet the exposure to fire is from both sides.	704.5
Maximum Area of Exterior Wall Openings Protected >25 to 30 = No Limit Protected >20 to 25 feet = No Limit Protected >15 to 20 feet = 75%	Table 704.8
Buildings with sprinklers are limited to the area of unprotected openings is the same tabulated area for protected openings.	704.8.1
Fire walls. Each portion of a building separated by fire walls will be considered a separate building.	705.1
Structural stability. Fire walls will have sufficient structural stability to allow the collapse of the structure on either side of the wall during a fire.	705.1.1
Fire walls shall have a fire rating of not less than stated in Table 705.4	705.4
Fire walls shall not be less than 2- hour fire resistive for Type 2, B Occupancy buildings.	Table 705.4
Where fire walls intersect exterior walls, the fire resistance rating of the exterior wall will have a rating on one- hour on both sides. Openings will have ¾ hour ratings. The fire resistance rating will extend a minimum of four feet on each side of the intersection.	705.5.1
Fire walls will be horizontally continuous from exterior wall to exterior wall and extend 18 inches beyond Exception 3: Fire walls may terminate at the interior non-combustible exterior walls when both building are protected with an automatic sprinkler system.	707.5
Fire walls will extend from the foundation to a point of at least 30 inches above both adjacent roofs. Exception 2. Two- hour fire walls may terminate at the underside of the roof deck provided the lower roof and structure is rated for one- hour not less than 4 feet from the fire wall; there are no roof openings within 4 feet of the fire wall; and each building has a minimum Class C roof covering.	705.6
Fire walls for stepped buildings may stop 30 inches above the lower roof and the wall above is fire-resistive with protested openings for a distance of 15 feet above the lower roof. Exception 1: The fire wall may terminate at the lower roof deck provided the lower roof and structure is rated for one- hour not less than 10 feet from the fire wall and there are no roof openings within 10 feet of the fire wall.	705.6.1
Shaft enclosures will be constructed as fire barriers.	707.1
Shaft enclosures will have a fire-resistance rating of two hours when connecting four stories or more.	707.4
Enclosed elevator lobbies are required where the shaft connects three stories or more. Exception 4: Enclosed lobbies are not required where the	

Item:	Section:
Highest occupied level is less than 75 feet above the street And the building is equipped with an automatic sprinkler system.	707.14.1
Penetrations of pipe, conduit and ductwork can pass through rated floor assemblies without rated enclosures when the area of the penetration is less than 144 square inches in 100 SF and the penetrations are fire stopped.	712.4.1.1

Chapter 9- Fire Protection Systems

Item:	Section:
FD connections for sprinklers, standpipes, yard hydrants and other fire hose connections must be approved by the local FD.	901.4
Automatic sprinkler systems will be monitored by an approved supervising station.	901.6.1
Fire alarm systems will be monitored by an approved supervising station.	901.6.2
Automatic sprinkler systems are not required for B Occupancy or A-3 Occupancy less than 12,000 SF; <300 occupants and the rooms are at the exit discharge level.	Figure 903.2
In every required stairway a Class 1 standpipes will be installed with a hose connection at each intermediate landing.	905.4
Manual fire alarms are not required in Group A-3 or B occupancies where the building is equipped with an automatic sprinkler system with automatic water flow monitoring and alarm activation.	907.2.1 & 2

Chapter 10- Means of Egress

Item:	Section:
Exiting from multiple levels will be computed using the occupant loads of the individual floors (worst case). Occupant loads are not combined with other floors.	1004.4
Egress convergence in a stair where upper and lower floor occupant loads combine with be calculated to be not less than the sum of the two floors.	1004.5
Egress width (based upon number of occupants with sprinklers) Stairs: 0.2 X number of occupants Other egress components: 0.15 X number of occupants	Table 1005.1

Total Occupants:	**2,775**	Min. Door Width	Min. Stair Width
• Third Floor:	270	41 inches (2- 36" doors)	54 inches
• Second Floor:	369	56 inches (2- 36" doors)	74 inches
• First Floor:	1,211	181 inches (6- 36" doors)	243 inches
• Ground Floor	778	117 inches (4- 36"doors)	n/a
• Basement:	147	23 inches (1- 36" door)	30 inches

Item:	Section:
Accessible means of egress are required. For new construction no Less than two accessible routes should be provided for each space.	1007.1
Accessible means of egress shall be continuous to a public way.	1007.2
Exit stairways on an accessible route need to provide a minimum of 48 inches between the handrails.	1007.3
Areas of refuge are not required at exit stairs when the building is Equipped with an automatic sprinkler system	1007.3, ex.4
Doors required for egress will provide a minimum clear width of not less than 32 inches for required door leafs. Egress doors will not exceed 48" be leaf.	1008.1.1
Door handles, pulls, latches, locks and other hardware will be accessible per Chapter 11.	1008.1.8.1
Interior stairway doors should be openable from either side. See the exceptions including automatic unlocking.	1008.1.8.7
The minimum width of egress stairways will be not less than 44 inches. Exception 1: Stairs serving 50 or less shall not be less than 36" in width.	1009.1
Stair tread depth will be a minimum of 11 inches. Risers are a maximum of 7" in height.	1009.3

Stairway landings will be located at the top and bottom of a stairway. Width will equal the stair width. Run will be 48 inches minimum. Doors opening onto the landing cannot reduce the landing width by more than 50%. 1009.4

The usable areas under stairs shall be protected by one- hour fire resistive construction or match the rating of the exit enclosure (whichever is greater). 1009.5.3

Handrails must be mounted between 34 and 38 inches with a circular cross section not greater than 2 inches or if not circular have a perimeter of not less than 4 inches, but not greater than 6.25 inches with a maximum cross-section dimension of 2.25 inches, 1012.3

Handrails will be continuous without interruption. 1012.4

Handrails will return to the wall and have extensions at the top and bottom of the stair flight. Extension to be a minimum of 12 inches. 1012.5

Intermediate handrails are required where all portions of the required width of an egress stair is within 36" of a handrail. 1012.8

Guardrails are required adjacent to walking surfaces and stairs where they are located more than 30" in height from the adjacent surface below. 1013.1

Guardrails will be 42 inches high. 1013.2

Guardrails will have opening limitations where a 4" sphere cannot pass through the balusters. 1013.3

Egress through intervening spaces.

1. Egress through a room is allowed where the adjoining room is accessory to or of lesser hazards which has a discernable exit.
2. Egress through kitchens, storage rooms, closets and other similar spaces are prohibited. 1014.2

Common path of egress. In Group B the common path of egress is 100 feet when the building is equipped with an automatic fire suppression system. 1014.3

Spaces with greater than 49 occupants require two means of egress for Groups A and B. Table 1015.1

Where a building is equipped with an automatic sprinkler system the distance between required exits will not be less than one-third the diagonal distance of the room. 1015.2.1

Boiler, furnace and incinerator rooms. Two exit doors are required where the area is over 500 square feet and any fuel- fired equipment exceeds 400,000 Btus input capacity. 1015.3

Maximum travel distance for
Occupancy A egress: 250 feet with sprinklers.
Occupancy B egress: 300 feet with sprinklers. Table 1016.1

Corridors in Groups A & B with sprinklers have zero hour fire rating. Table 1017.1

Corridors will not be less than 44 inches in width. 1017.2

In Group A dead end corridors cannot exceed 20 feet in length.
In Group B dead end corridors cannot exceed 50 feet in length. 1017.3

Corridors will not serve as supply, return, exhaust, relief or ventilation air ducts. 1017.4

Corridor continuity regarding fire resistance ratings will be continuous from the point of entry to exit (excluding lobbies, foyers and vestibules). 1017.5

Number of exits per floor based upon occupant load:

- **1-500:** **2 exits per story.**
- **500-1,000:** **3 exits per story.**
- 1,000 or more: 4 exists per story. Table 1019.1

Vertical exit enclosures connecting four stories or greater will have a fire resistance rating of no less than two hours.
Exceptions

1. Stairs serving <10 are not required to be enclosed when serving one level above or below the level of discharge to the exterior.
4. Stairs are not required to be enclosed when not part of the of the means of egress.
8. A maximum of 50% of egress stairs serving one adjacent floor are not required to be enclosed provided two means of egress are provided from both floors. Any two such interconnected floor shall not be connected to other floors.
9. Interior egress stairs serving only the first and second floors of a building equipped with a sprinkler system are not required to be enclosed provided at least two means of egress are provided from both floors. Any two such interconnected floor shall not be connected to other floors. 1020.1

Exit passageways may be used to connect interior exit enclosures to the exterior of the building. 1021.1

Exit passageways shall not be less than 44 inches in width. 1021.2

Exit passageways shall not be less than one- hour fire rated construction or should match the rating of the connected exit enclosure. 1021.3

Horizontal exits shall not serve as the only means of exiting a portion of the building where two or more exits are required. 1022.1

A horizontal exit will be separated by fire walls or fire barriers of not less than two-hours including the floor and ceiling assemblies Doors will be rated for 1 ½ hours. . 1022.2

Exits will discharge directly to the exterior of the building at grade.
The exit discharge shall not re-enter the building.
Exceptions:

1. A maximum of 50%of the exit enclosure capacity may discharge onto the building's level of discharge provided all of the following are met.
    a. Egress is readily visible to the exterior.
    b. The entire area of discharge is separated from areas below with fire rated construction equal to the exit enclosure rating.
    c. The egress path is protected by an automatic sprinkler system.

2. A maximum of 50%of the exit enclosure capacity may discharge into a vestibule at the building's level of discharge provided all of the following are met.
    a. The entire vestibule area is separated from areas below with fire rated construction equal to the exit enclosure rating.
    b. The depth from the exterior is no greater than 10 feet. Width less than 30'feet.
    c. A minimum of wire glass and steel frames will separate the vestibule from the rest of the floor level.
    d. The vestibule is only used for exiting. 1024.1

Discharge identification. A stairway in an exit enclosure shall not continue below the level of exit discharge unless an approved barrier is provided (gate or door), to prevent persons from continuing past the exit level. 102-.1.5

Chapter 11- Accessibility

Item:	Section:
Sites, buildings, structures, facilities, elements and spaces will be accessible to persons with disabilities.	1103.1
Elevators are required for building with three stories or more.	1104.4
At least 60% of all public entrance will be accessible.	1105.1
Assembly areas with fixed seating need to be provided with Wheelchair spaces complying with A117.1 and Table 1108.2.2.1	1108.2.2
Accessible Wheelchair Spaces 4 to 25 capacity: 1 wheelchair space 26 to 50 capacity: 2 wheelchair spaces 51 to 100 capacity: 4 wheelchair spaces	Table 1108.2.2.1
In assembly occupancies, unisex toilets will be provided where an aggregate of six or more male and female water closets are required. In buildings of mixed occupancy only those water closets for the assembly occupancy will be used to determine the unisex toilet requirement.	1109.2.1
Unisex toilet rooms will include one water closet and one lavatory minimum. A urinal may also be installed.	1109.2.1.2
Elevators on an accessible route will be accessible and comply with Section 3001.3	1109.6

Chapter 29- Plumbing Fixtures

Item:	Section:
Fixture counts.	
Plumbing fixtures will be provided in the minimum number listed in Table 29. The number of occupants for a building can be calculated using the actual (anticipated) number of occupants or by using the net area divided by the occupant load in Table 10-A.	2901.1

Group A-3 (lecture hall = 468):

- Water closets (male): 1 per 125 =2
- Water closets (female): 1 per 65 =4
- Urinals: <50% of WCs
- Lavatories: 1 per 200 =4
- Drinking Fountains: 1 per 500 =1
- Service Sink: 1 required =1 — Table 29

Group B (all other areas = 2,307):

- Water closets (male): 1 per 25 =46
- Water closets (female): 1 per 25 =46
- Urinals: <50% of WCs
- Lavatories: 1 per 40 =58
- Drinking Fountains: 1 per 100 =23
- Service Sink: 1 required =1 — Table 29

Toilet rooms will be located no more than one story above or below the space being supported. The path will not exceed 500 feet.	2902.4.1

Chapter 30- Elevators

Item:	Section:
Hoistway and hoistway openings will be one-hour fire rated.	3002.1
In buildings of four or more stories, at least one elevator car will be provided with FD emergency access and sized to accommodate stretcher 24" x 84"	3002.4
Where standby power is provided for the elevators, the elevator machine room ventilation or A/C will be connected to the standby power source.	3003.1.4
Firefighters' emergency operation will be provided for all elevators.	3003.2
Hoistways greater than three stories in height will be provided with smoke and hot gas venting to the outside air.	3004.1

Code Resolution Summary

Currently, the existing building as a whole exceeds the allowable area requirements for Type 2B construction. The building additions will require the building to be separated into two buildings where the Main Building will need to be upgraded to Type 2A construction and the Duncan Annex/ Connector Link will remain Type 2B construction. After splitting the building and calculating the sprinkler and side yard increases, the Main Building with additions will nearly maximize the allowable area for Type 2A construction.

A two- hour fire wall is required between the Main and Duncan buildings. Exterior walls that are perpendicular to the fire wall will need to be rated four feet from the intersection (one-hour both sides) with openings rated at 3/4- hour. The west egress doors near the dock will need to be upgraded. It appears that the new and existing widows on the connector link meet the four foot requirement.

To maintain the Third Floor windows that face south towards the Duncan Annex, the new roof will need to be rated one- hour, 10'-0" minimum from the fire wall. By definition this would include the supporting exterior walls that are initially rated four feet from the fire wall. ***Does the rating of the exterior walls change to 10'-0" all the way down to the foundations?***

The A-3 lecture halls can be considered part of the B occupancy which is the rest of the building.

The Main Building has three open stairways that are currently not allowed by Code. Buildings can only have 50% of the egress stairs open where only two floors can communicate to each other. Separating the buildings helps to allow the project to "grandfather" this condition and leave the stairs open. If closing the stairs is preferred recommend introducing a barrier between the First and Second Floors due to the main lecture hall.

Other than open stairs that do not meet the rise & run, or the guardrail requirements there appears to be plenty of egress capacity for the building. There will be some door changes required to install 36" doors.

Corridor continuity indicates that additional corridors or horizontal exits should be considered for exiting from ECE Shop B066C in the Basement and Stair GS04 at grade.

The new elevator shaft will be required to be two- hour fire rated. No elevator lobbies are required. The elevator shaft must be vented to the exterior for hot gases. The elevator cab must be accessible to building users and accommodate a gurney.

Exit stairways should exit directly to the exterior or have rated horizontal egress extending to the exterior. Recommend modifying the Stair GS09 of the Duncan Annex to exit directly to the exterior. Also, at the same door delete the double 60" and replace with 36" doors at the upper floors.

Egress path distances are less than 300'-0". There are some potential dead end corridors, but B Occupancy buildings allow dead ends to be extended to 50'-0" when sprinklers are installed. Some of the proposed doors may not be required.

At new Lobby GH09 consider moving the new entrance vestibule to the north to free-up space for elevator queuing. At each level this same Lobby area could be considered an area of refuge, even though it is not required by the building code. This change would allow exiting into the office suites n the Second and Third Floors which may not be desirable.

At the Third Floor a double egress door will be required at the the entrance of the ECE Office Suite. A second means of egress is required for the conference room along the east wall.

Preliminary Code Study
Basement

Preliminary Code Study
Ground Floor

Renovation

- Lab Renovation (DL2)
- Research Lab
- Office Renovation
- SMAS Renovation
- General Circulation
- Toilet Room Renovation
- Support Space
- Student Organization

Program Spaces

ECE
1 Staff (Office - DL2)
3 Private / Faculty Offices
20 Graduate Students

Conference (25 NSF/person)
1 Conference Room (8)
1 Conference/Seminar Room (36)

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Preliminary Code Study
First Floor

Renovation

- Lab Renovation (DL2)
- Instructional Lab
- Research Lab
- Office Renovation
- SMAS Renovation
- General Circulation
- Toilet Room Renovation
- Support Space
- Student Organization

Program Spaces

ECE

3 Private / Faculty Offices
14 Staff
11 Graduate Students

SMAS

1 Active Learning Class - 30
1 Active Learning Class - 46
1 Active Learning Class - 68
1 Active Learning Class - 80
1 Lecture Hall - 110
1 Lecture Hall (170)

Preliminary Code Study
Second Floor Plan

Renovation

- Instructional Lab
- Research Lab
- Office Renovation
- General Circulation
- Toilet Room Renovation
- Support Space

Program Spaces

ECE
10 Private / Faculty Offices
6 Staff
52 Graduate Students

Conference (25 NSF/person)
1 Conference Room (16)
1 Conference Room (18)
1 Conference Room (26)

ECN
1 Private Office
56 Staff
17 Graduate Students
1 Conference Room (15)

Preliminary Code Study
Third Floor Plan

Renovation

- Office Renovation
- General Circulation
- Toilet Room Renovation
- Support Space

Program Spaces

ECE
26 Private / Faculty Offices
136 Graduate Students

Conference (25 NSF/person)
1 Conference Room (16)
2 Conference Room (20)

CONCEPTS

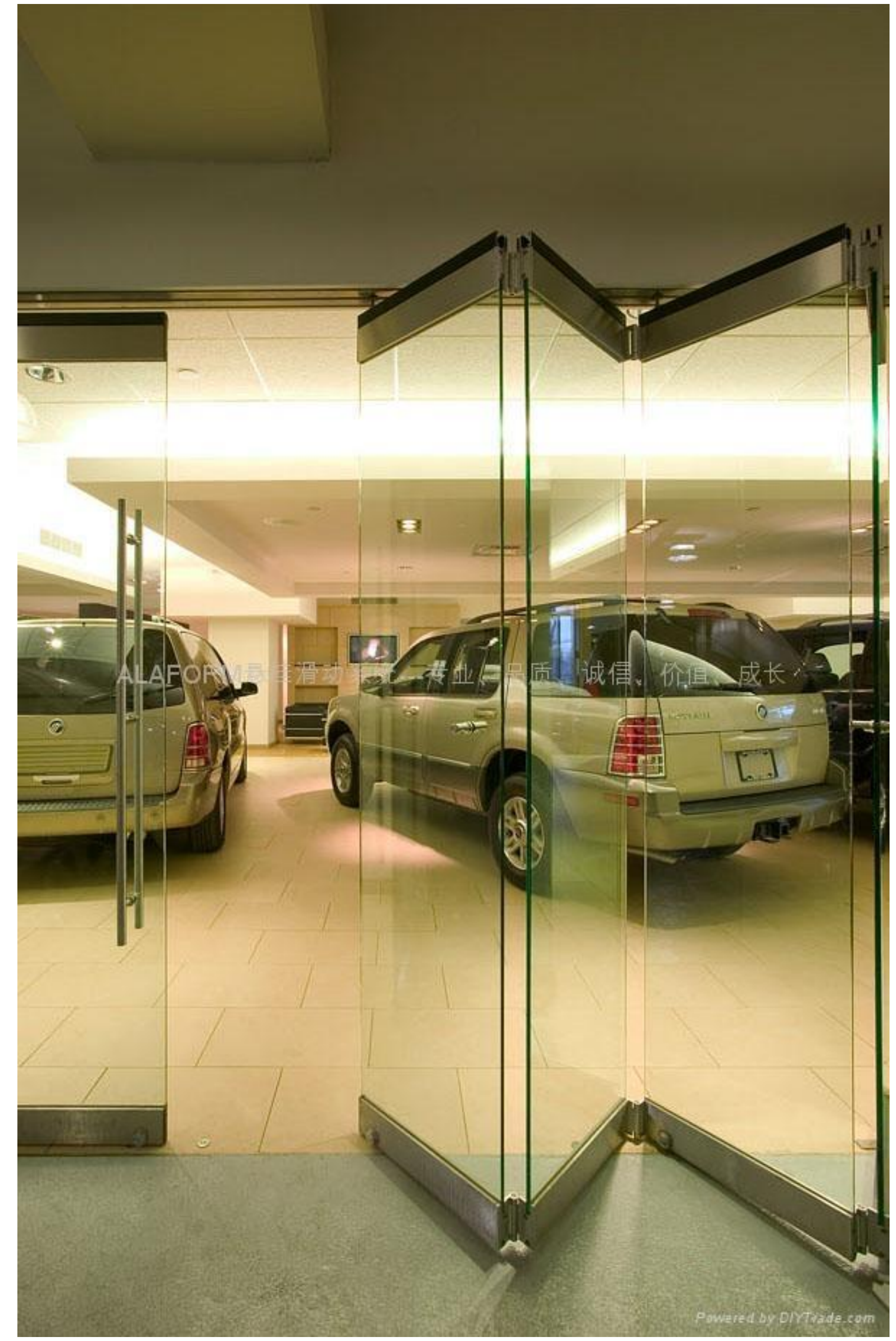
Flexible Lab Doors

There was a strong desire to provide maximum flexibility between the Lab rooms so that the sections of each lab could grow or shrink depending on the demand every semester. We have seen the use of large operable bi-folding or bi-parting glass doors, sectional overhead doors and other variations used in installation for offices in recent times. Below are some examples of possible options.

Glass Bifold Sectional Overhead Doors

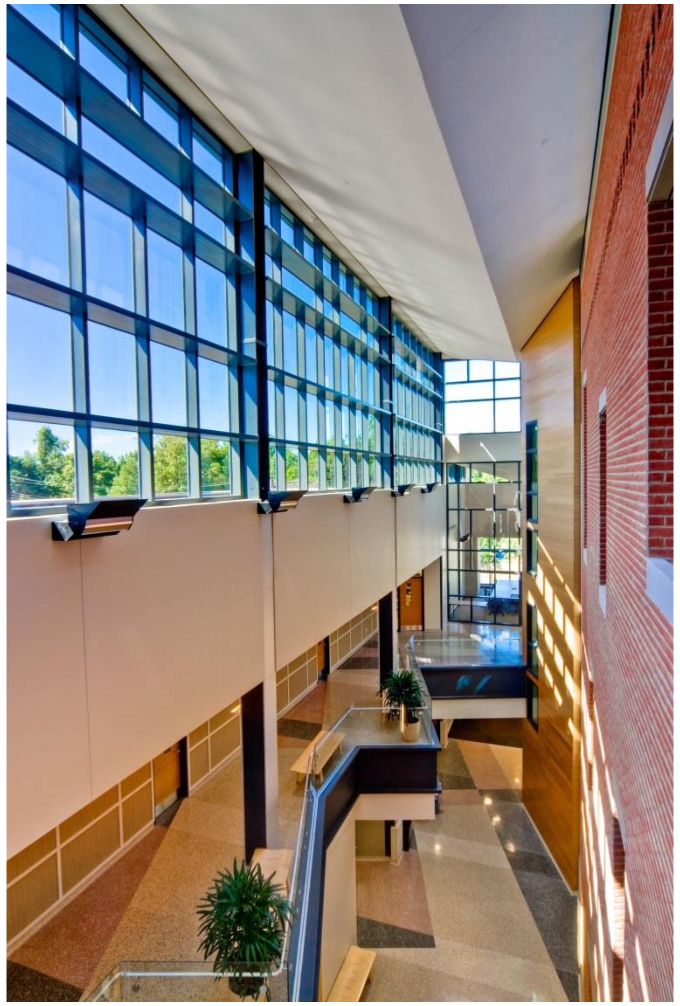
This image represents the use of large doors that can be opened up for maximum space flow.

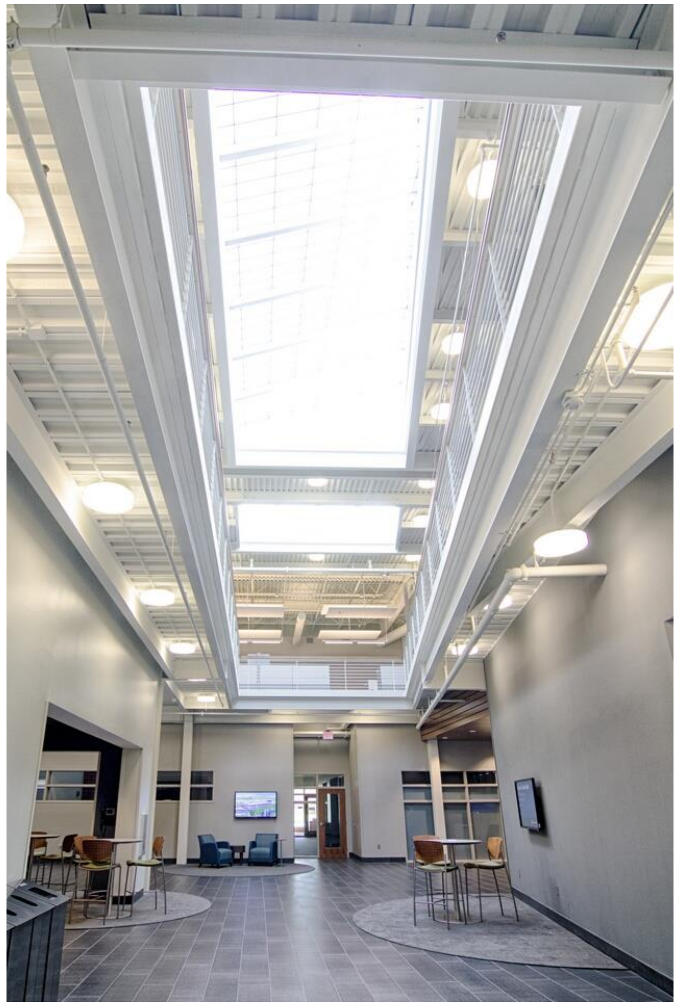
Glass Bi-Folding or Bi-Parting Doors



This image represents bi-folding glass doors that also can open up between rooms.

Skylights and Open Atriums





Natural Daylighting in Offices

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PROPOSED PLANS

Final Plan Option Description:

The following images represent our options for the design and layout of the Electrical Engineering Building space. From early discussions, it seemed obvious that the instructional labs would remain inside the building stacked on the ground and first floors. Various planning steps also seemed to focus on providing more general public spaces on the lower floors of the building and the more private offices and student graduate spaces along with research on the upper floors of the building.

The following plans represent the last and final step in the process of this design step.

Basement

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PROPOSED PLANS
Ground Floor

Renovation

- Lab Renovation (DL2)
- Research Lab
- Office Renovation
- SMAS Renovation
- General Circulation
- Toilet Room Renovation
- Support Space
- Student Organization

Program Spaces

ECE
1 Staff (Office - DL2)
3 Private / Faculty Offices
20 Graduate Students

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PROPOSED PLANS
First Floor Plan

Renovation

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14 Staff
11 Graduate Students

SMAS

1 Active Learning Class - 30
1 Active Learning Class - 46
1 Active Learning Class - 68
1 Active Learning Class - 80
1 Lecture Hall - 110
1 Lecture Hall (170)

PROPOSED PLANS
Second Floor Plan

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PROPOSED PLANS
Third Floor Plan

Renovation

- Office Renovation
- General Circulation
- Toilet Room Renovation
- Support Space

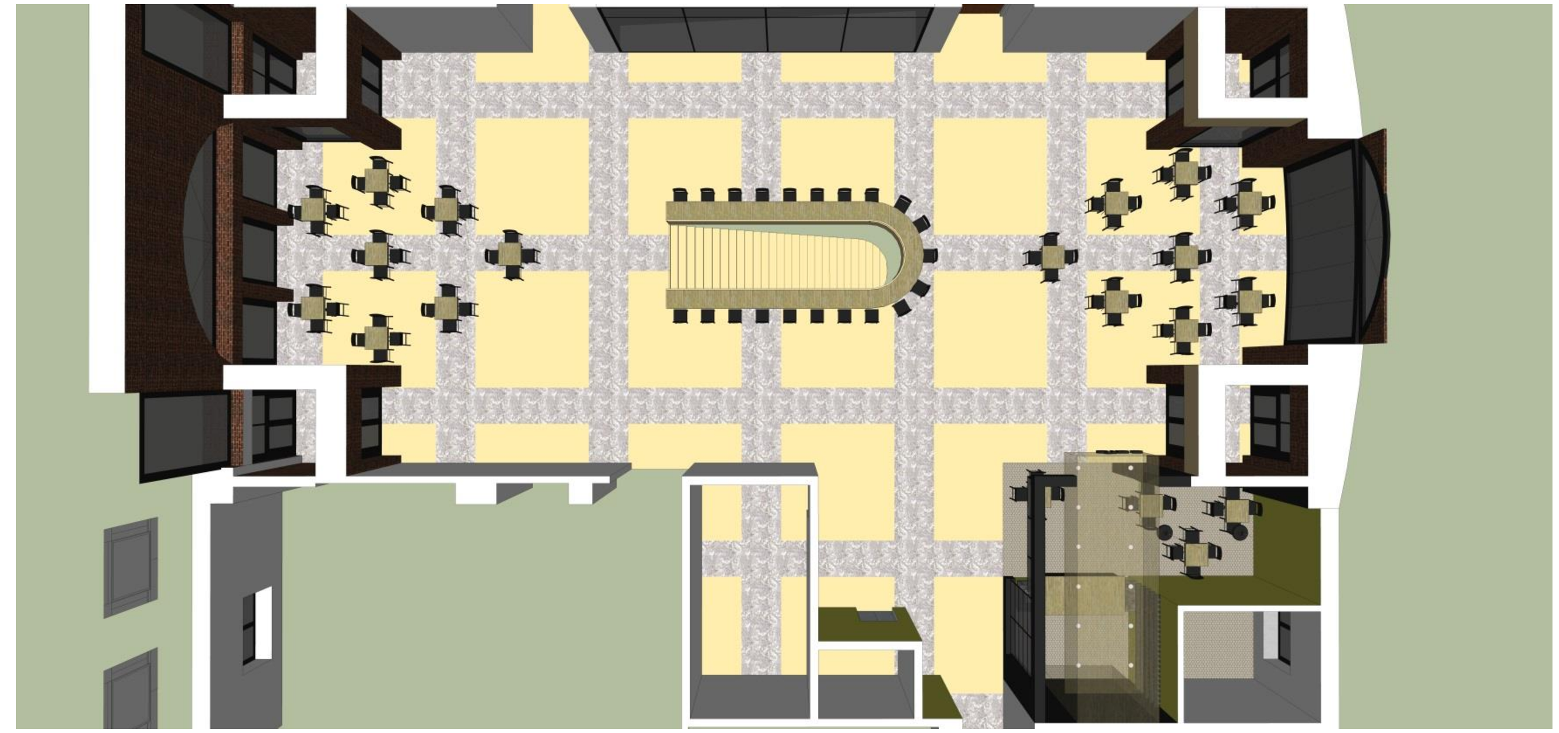
Program Spaces

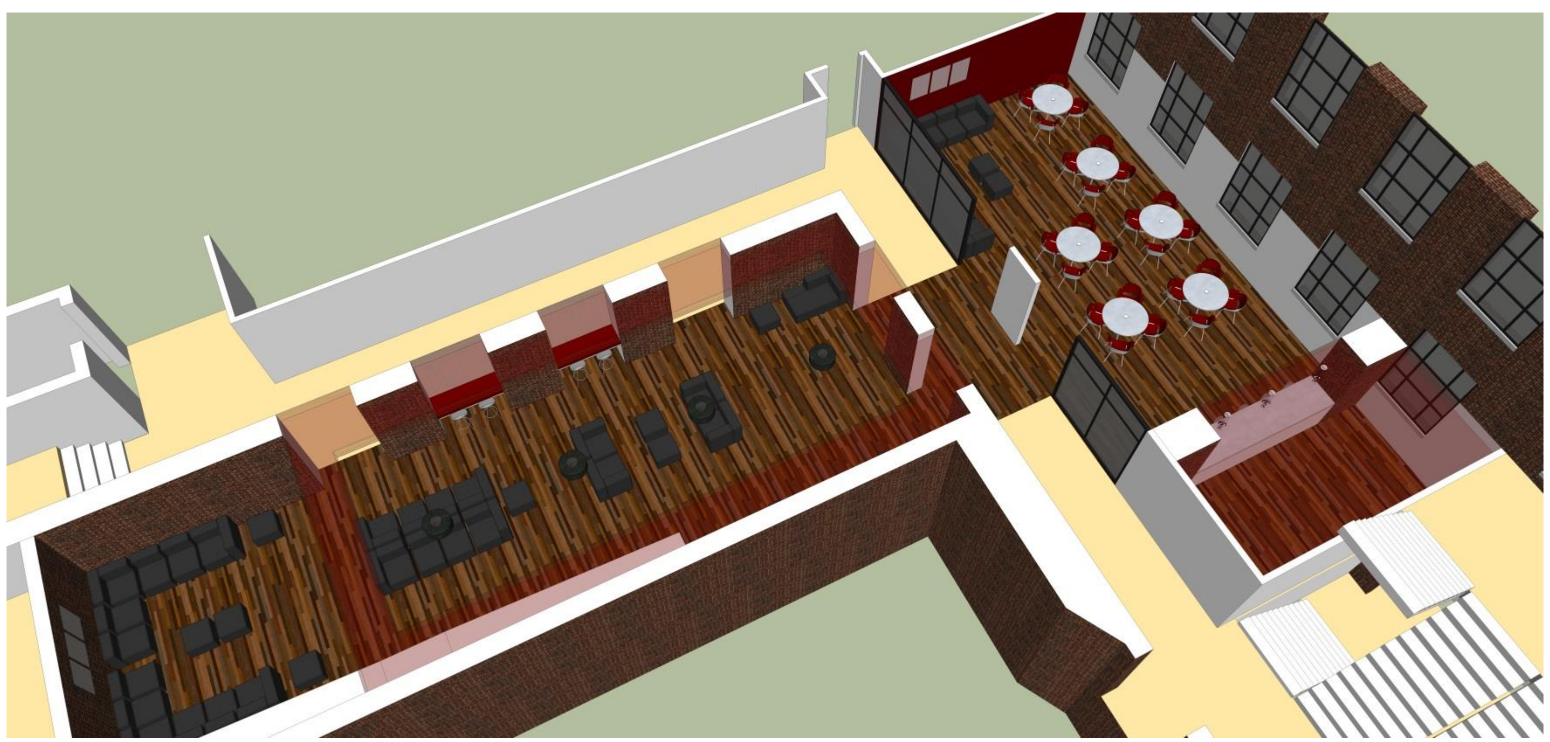
ECE
26 Private / Faculty Offices
136 Graduate Students

Conference (25 NSF/person)
1 Conference Room (16)
2 Conference Room (20)

PROPOSED PLANS

Interior Courtyard Lounge and Student Spaces





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PROPOSED PLANS

Duncan Annex

The Duncan Annex was part of an addition and renovation of the EE building in 1940. When it was originally constructed, much of the interior space was open, and a later renovation added intermediate floor levels. Although the floors do not align with related floors in EE, the Duncan Annex includes a basement, first, and second floors. There is not an existing ground floor in Duncan, but some of the basement spaces take advantage of the available high bays for mezzanine levels. In addition, the existing basement and second floors are not accessible by ramp or elevator.

The existing interior of Duncan is not well lit, and the building does not have any existing windows. The existing floors include various small research labs, offices, and classrooms, as well as mechanical and electrical support spaces and toilet rooms; however, the square footage available within Duncan for the proposed renovation provides adequate space for larger renovated research labs, classrooms, and an open office suite on the second floor. With the proposed renovation, accessibility to the floors with elevator access, as well as renovated toilet rooms on the floors, provides much needed improvements to the facility.

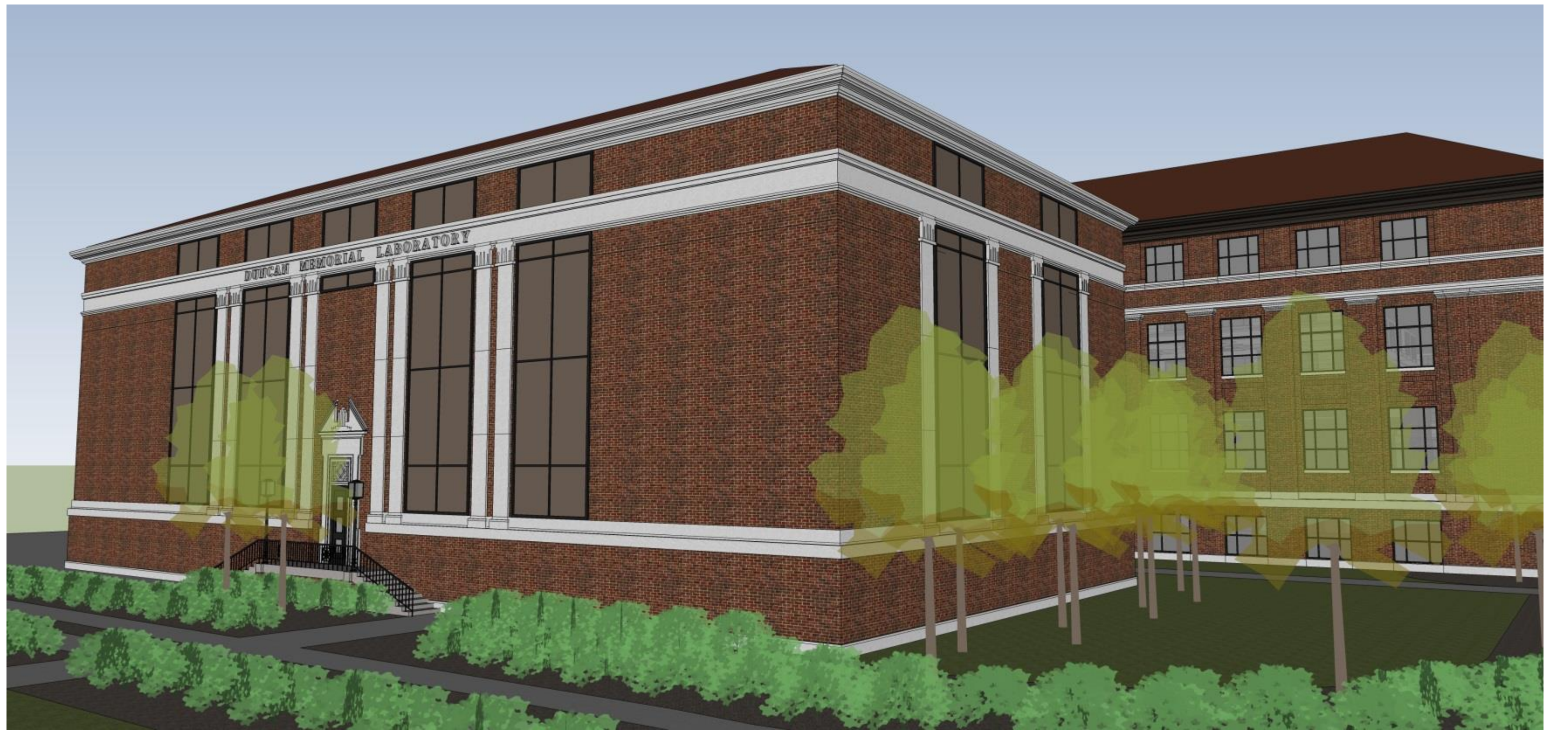
A primary consideration in the current project is to improve the interior space by incorporating glass to provide views and natural daylight to the renovated spaces within the Duncan Annex. The exterior of the existing building includes classical features, such as limestone veneer columns and capitals, as well as horizontal limestone banding. One option to bring natural daylight into interior spaces on the south, west, and north elevations is to introduce aluminum curtainwall framing and glass between the existing limestone columns and bands. The curtainwall system complements and works with the existing limestone columns through simple, uniform glazing systems, and it eliminates the need for multiple punched window openings that would distract from the building's original features and ultimately not align with the punched window openings of EE.

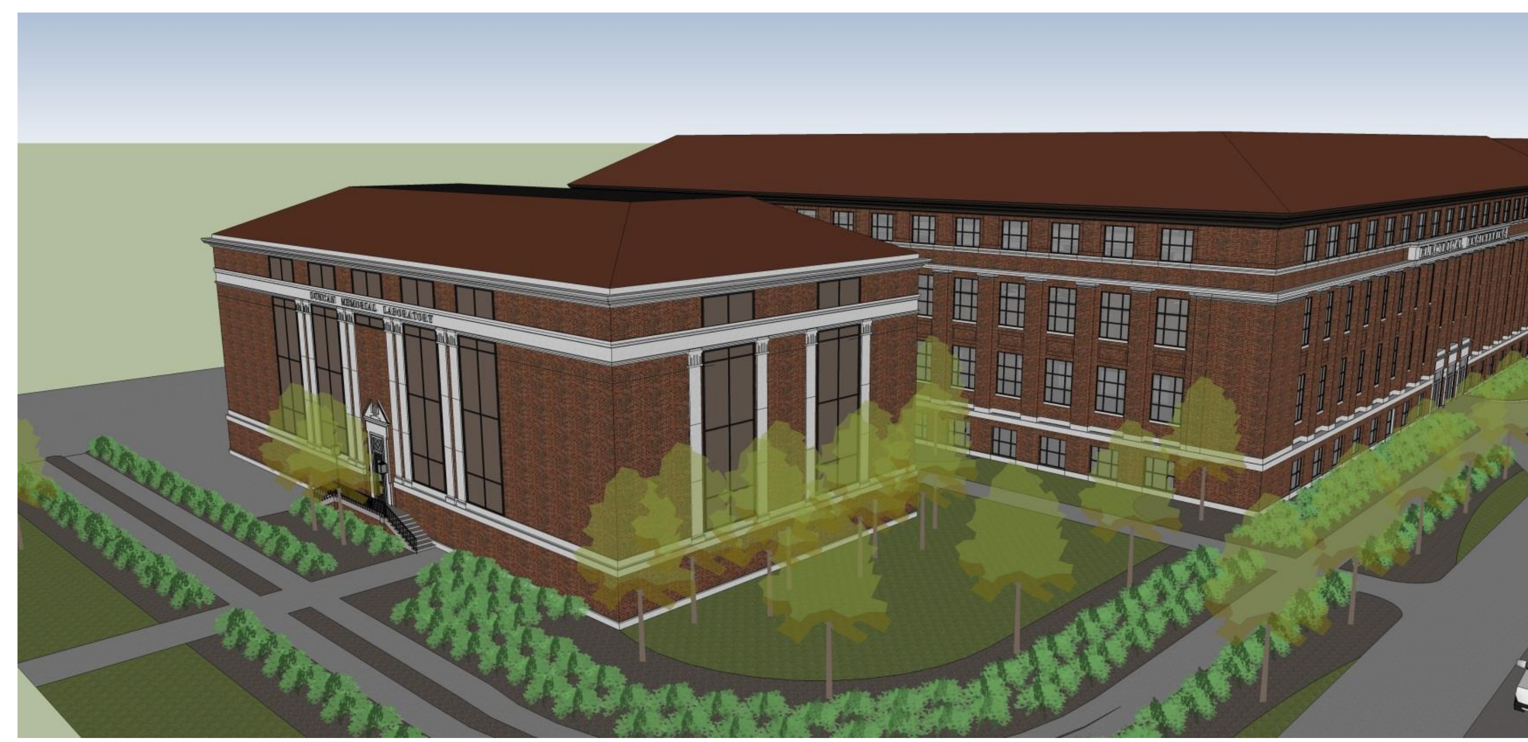
Between EE and the Duncan Annex on the east side, another feature of the proposed renovation is the new, renovated, accessible public entry at the connector between the two buildings. Where there is currently only limited internal physical connectivity between the two buildings on the first floor, the renovation plans propose extending the connector up to include interior spaces and a link between the two buildings on the second floor. This link takes advantage of the opportunity to provide a new elevator to help bridge and mitigate the floor level differences between the buildings, as well as provide a main point of accessible entry on the east side of the building.

The proposed east façade of the connector pulls cues from the existing EE building and Duncan Annex to visually tie the two buildings together. A single, central, covered entry with curtainwall spanning all floors highlights the entry, and accessibility into the building is reinforced by the location of the new elevator just inside the door. The curtainwall ties to the proposed solution for new glazing in the Duncan Annex, and the curtainwall is bordered by brick columns with limestone caps to visually connect to the existing EE facades.

PROPOSED PLANS

Duncan Annex





PURDUE UNIVERSITY

PROJECT PHASING PLAN

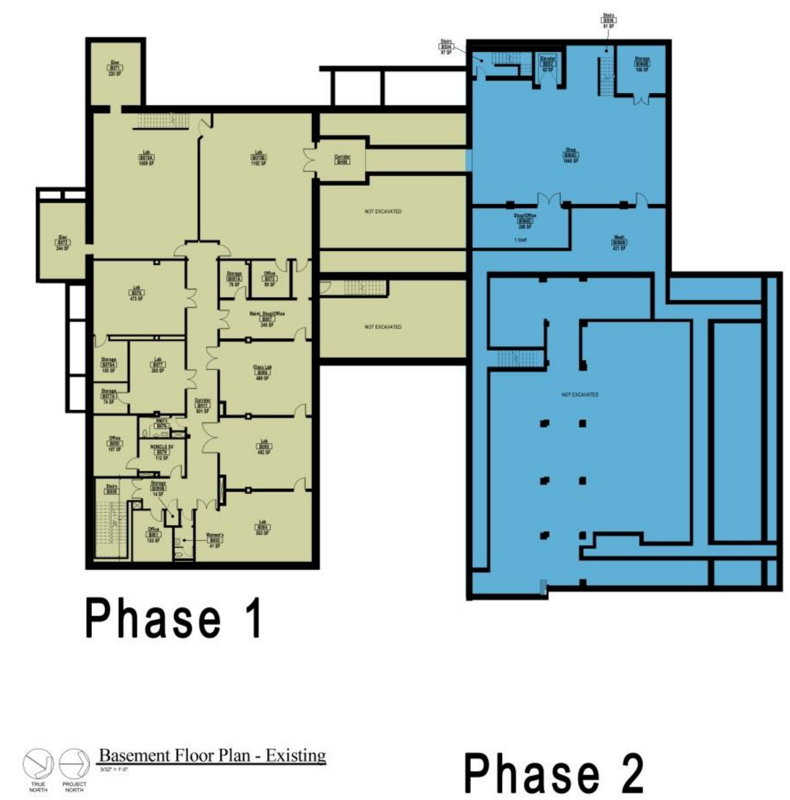
This project is a very complicated interior renovation of an older building that has been modified numerous times over the years. In addition to this being very challenging, the phasing will require that a portion of the building remain occupied during construction. This area is a very large 460+ person lecture hall style classroom. Life safety issues must be accounted for and addressed in the phasing construction plan.

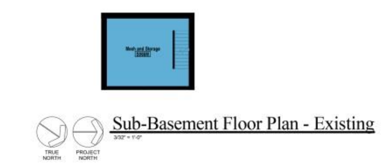
In the review of phasing for EE and the Duncan Annex, considerations and related discussions spanned from a single-phase to a multi-phase renovation project. The original schedule proposed as part of the College of Engineering Facility Master Plan was based on a limited renovation scope that focused primarily on efficiency renovations. In addition, initial efforts focused on a pull-ahead DL2 project associated with existing instructional labs and support spaces on the ground floor. As part of this feasibility study, the scope was expanded to include review of overall building space relationships to maximize function and reinforce appropriate space relationships and efficiencies within the building.

In discussions and review of the academic calendar and impact on the proposed renovation project, the preferred option was a one-time, building-wide renovation project. However, due to the scale of the existing Lecture Hall 129 and impact on classroom scheduling, maintaining operation of this classroom was identified as a necessary component for phasing. The final proposed solution is to treat the overall building renovation as a two-phase project, based on Purdue University's availability and schedule for swing space and to minimize departmental, research and instructional space moves.

The first phase of the project includes renovation of the Duncan Annex and associated connector space between EE and Duncan for all floors, including extending the connector up to the second floor. This initial phase provides options for renovating this portion of the building while maintaining occupancy within EE, and it includes a new elevator designed to integrate and bridge the differences in elevation between EE and Duncan. This renovation also provides options for relocating an ECN data center and ECN offices from MSEE, providing more flexibility in the scheduled move of the ECE admin offices from the first floor of EE and into the first floor of MSEE.

The second phase of the project includes renovation of all levels of EE. The intent is to maintain occupancy of Lecture Hall 129, as well as the newly renovated areas of the Duncan Annex and associated connector levels completed as part of the first phase. Please refer to the systems narratives associated with the mechanical, electrical and telecommunications systems for additional systems information on phasing.



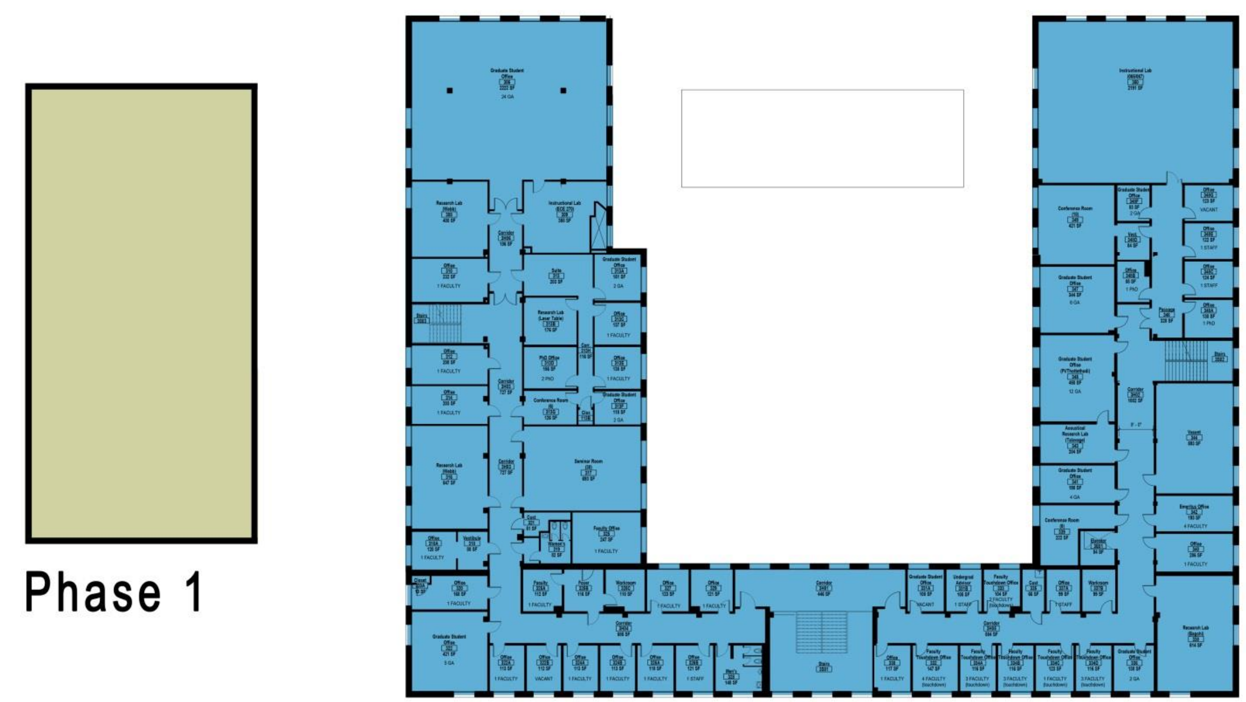


NEW SPACE OVERVIEW

Ground Floor Plan - Existing

First Floor Plan - Existing

Second Floor Plan - Existing



Third Floor Plan - Existing

PURDUE UNIVERSITY

CONCEPTUAL COST OF CONSTRUCTION

The conceptual cost estimate attached indicates a nearly $30+ million dollar renovation of the Electrical Engineering Building as shown in our final schematic design plan. We have reviewed all divisions of construction based upon the CSI format and have provided an estimate based upon a construction start time of Late Fall early Winter quarter 2015 time frame. We do not hold any escalation factors in this estimate. We do show general requirements and standard overhead and profit based upon a conventional unified design bid build construction method of delivery. We do want to point out that the project does contain some additional costs for multi-phasing.

Design and Construction Contingency

Careful review of the conceptual estimate reveals that we are showing a 10% design contingency. It is normal for us as designers to hold a relatively high level of design contingency in this phase of design due to the potential changes that can occur over the next few major milestones of design. As we move toward a more solid solution, this contingency will be reduced. We do want to point out that we are showing no construction contingency. The construction contingency and escalation are normally carried in the overall project cost model and not in this detailed cost estimate. Generally we recommend a construction contingency in the 5% range due to this being a renovation project. Normal escalation is running 2% on an annual basis.

Phasing

The general conditions portion of this estimate is based upon a multi-phased renovation of the building along with a portion of the building remaining operational during construction. These factors add cost and complexity to the project.

Alternates and Other Significant Issues

Due to the significant scale of the project, Purdue has asked that specific portions of the work be pulled out separately for pricing. These costs are provided in order to allow funding sources available to the University to potentially fund specific areas or items in the overall project. The other costs being represented here might involve areas of the building that were not intended to be moved or changed in any way and it was felt that improvements and upgrades would be necessary such that the few areas remaining in the building untouched were brought up to current levels equal all other areas. These significant areas are as follows:

Elevator Upgrades..$21,051.00

This cost represents the expense to provide modernization and improvements to the elevator located in the EE building which serves the instructional lab spaces on ground and first floors. The elevator is primarily used to carry large pieces of equipment and materials from the lower shop area to the lab spaces.

First Floor Lab Upgrades (DL2 Areas)...$1,967,871.00

The cost for renovating all of the DL2 space as previously described in the project documentation from MSKTD on May 30, 2014 is represented here in this cost. Please refer to that report for more information.

Robotics Lab Area Upgrades $299,254.00

Renovations and improvements to the Robotics lab located on the First Floor of the Duncan Annex is reflected in this cost. Generally, we intend to upgrade and improve the entire existing space.

HKN Lab Area Upgrades...$101,360.00

Renovations and improvements to the HKN Lab area located on the Ground Floor of the EE building is reflected in this costs. Generally, we intend to upgrade and improve the entire existing space.

SMAS Classroom Modifications $1,382,976.00

This price represents all modifications to all general SMAS classrooms inside the EE building. We have only included rooms that are highlighted in the plans. Significant changes and improvements to all of the classrooms are expected in this project.

Furniture Furnishings and Equipment

The estimate does not include standard furniture, furnishings and equipment. Benches, computers, monitors, projectors, artwork, display cases for awards, testing and lab equipment, etc. are all excluded from this estimate. We do include the cost of built in equipment that is normal and standard to construction projects such as white marker boards, projection screens, built in casework, etc. The extensive list of owner supplied FF&E would need to be provided by Purdue University.

Conceptual Estimate - Phase 1		
Division 1	General Requirements	$421,063.23
Division 2	Demolition	$0.00
Division 3	Concrete	$498,168.00
Division 4	Masonry	$61,575.00
Division 5	Metals	$33,250.00
Division 6	Wood, Plastics, & Composites	$0.00
Division 7	Thermal & Moisture Protection	$0.00
Division 8	Doors & Windows	$350,712.50
Division 9	Interior Finishes	$1,148,884.24
Division 10	Specialties	$38,836.00
Division 11	Equipment	$0.00
Division 12	Casework & Furnishings	$0.00
Division 13	Special Construction	$0.00
Division 14	Conveying Equipment	$134,500.00
Division 21	Fire Suppression	$127,784.75
Division 22	Plumbing	$240,235.33
Division 23	Heating, Ventilating, & Air Cond.	$1,465,766.25
Division 26	Electrical Systems	$562,098.00
Division 27	Communications	$211,247.00
Division 28	Electronic Safety & Security	$66,951.00
Division 31	Earthwork	$13,677.00
Division 32	Exterior Improvements	$0.00
Division 33	Utilities	$0.00
	Sub - Total	**$5,374,748.30**
	Design Contingency 10%	$537,474.83
	Performance & Payment Bonds	$118,244.46
	General Contractor Overhead &Profit 7%	$376,232.38
	Total Construction Costs	**$6,406,699.97**
Phases	Duncan Annex & Connector	$6,406,699.97
	Balance of EE Building	$23,078,582.81
		$29,485,282.78
Alternates	Elevator Upgrade to #5,000 lbs	$21,051.00
	First Floor Lab Upgrades	$1,967,871.00
	Robotics Lab Area Upgrades	$299,254.00
	HKN Lab Area Upgrades	$101,360.00
	SMAS Classroom Modifcation	$1,382,976.00

Conceptual Estimate - Phase 2		
Division 1	General Requirements	$1,516,778.17
Division 2	Demolition	$0.00
Division 3	Concrete	$589,998.00
Division 4	Masonry	$61,575.00
Division 5	Metals	$245,125.00
Division 6	Wood, Plastics, & Composites	$0.00
Division 7	Thermal & Moisture Protection	$0.00
Division 8	Doors & Windows	$61,875.00
Division 9	Interior Finishes	$5,878,204.34
Division 10	Specialties	$0.00
Division 11	Equipment	$0.00
Division 12	Casework & Furnishings	$0.00
Division 13	Special Construction	$0.00
Division 14	Conveying Equipment	$134,500.00
Division 21	Fire Suppression	$509,711.00
Division 22	Plumbing	$958,256.68
Division 23	Heating, Ventilating, & Air Cond.	$5,846,685.00
Division 26	Electrical Systems	$2,336,695.00
Division 27	Communications	$927,209.00
Division 28	Electronic Safety & Security	$286,429.00
Division 31	Earthwork	$8,186.00
Division 32	Exterior Improvements	$0.00
Division 33	Utilities	$0.00
	Sub - Total	**$19,361,227.19**
	Design Contingency 10%	$1,936,122.72
	Performance & Payment Bonds	$425,947.00
	General Contractor Overhead &Profit 7%	$1,355,285.90
	Total Construction Costs	**$23,078,582.81**

RECOMMENDATIONS:

After numerous meetings with the College of Engineering Building Committee, the School of Electrical and Computer Engineering, Nuclear Engineering and Purdue Physical Facilities Energy and Construction we are making the following recommendations for the development of the Electrical Engineering Building:

- We recommend proceeding with the development of the final proposed floor plan as represented in our previous section labeled New Space Overview and described as Proposed Plans. It represents a refinement of all of our discussions to date. Although much discussion surrounded the location of classrooms and instructional labs in these plans, we recommend leaving the instructional labs in their current locations for support from the basement and the overall cohesiveness of the plan. We also feel strongly about developing ECE inside the Duncan Annex along with the Data Center, as well as creating more student access around the main ground and first floors by introducing student friendly breakout areas, lounges and open areas within the atriums. The office layouts similar to Wang Hall and Grissom will go a long way in creating open flexible space which provides more natural daylighting into the building, more community interaction and more student and faculty collaboration.

- We also recommend the introduction of new accessible entrances. This will be an improvement to overall building access. We also plan to introduce a new elevator into the link between EE and the Duncan Annex. This strategic location along with various new ramps inside the building will permit us to service all areas of the building with minimal travel distances.

- Upgraded restroom size and locations will also facilitate this building renovation by bringing consistency to each floor and placing services where they are most needed.

- Other recommended improvements to the plan include office suites located on various upper floors, student common space for collaboration and improved interaction among students, classroom upgrades and technology improvements.

- More development of this plan and further development of the overall EE master building plan will provide better locations for some of the rooms in the program.

- A functional improvement to the Duncan Annex is the installation of windows in many sides of this building. Natural daylighting will improve the spaces inside and make the building more acceptable to the current and proposed user groups.

- We also recommend the installation of new mechanical rooms and new equipment for all floors on the roof and attic areas to limit using valuable space on the habitable floors of the building and to eliminate unwanted noise.

- We believe that new flooring, paint and ceiling finishes in all areas will breathe new life into this building and into these Engineering departments. Our vision is showcased in the images reflecting a new teaching and learning lab environment for the College of Engineering as well as the student collaboration spaces created inside the new atrium and spilling into the student run café's.