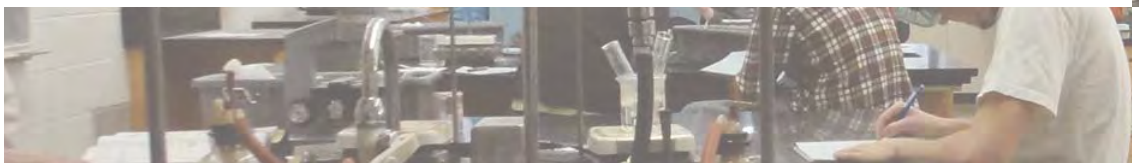
UNIVERSITY OF WISCONSIN - MADISON

CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION



WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

ARO EBERLE Ballinger

SPACE ASSESSMENT AND FEASIBILITY STUDY

VOLUME I

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UNIVERSITY OF WISCONSIN - MADISON
CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

ANALYSIS OF NEED

The UW-Madison chemistry complex is comprised of the Mathews and Daniels buildings completed in the late 1960's and the Shain Research Tower completed in 2000. The complex (224,180 ASF / 409,079 GSF) houses all administrative, instructional, and research functions of the Department of Chemistry, as well as the Chemistry Library and Chemistry Learning Center. While the department has addressed its immediate research needs in recent years with the completion of the Shain Research Tower, it has grappled with the limitations of the older buildings for its instructional programs for at least five biennial capital budget cycles. The department has investigated a series of unattractive options to address facility needs off-site and has implemented various undesirable changes to pedagogy.

The outdated and deteriorated state of UW-Madison's chemistry's instructional facilities, including both lecture rooms and laboratories, has become a serious limitation to effective instruction in nearly all undergraduate chemistry courses, especially the largest courses in general and organic chemistry. The need for new labs is driven both by safety considerations that cannot be met by remodeling of the current labs, and by substantially increased enrollments that have forced subpar modifications of the content of the core curriculum solely to accommodate the increased enrollment. Demand for chemistry classes has continuously increased over the last 20 years. The existing facilities do not support contemporary instructional methods and are unable to accommodate the growing number of students required to use them. The laboratories fail to conform to modern safety and hygiene standards.

The Madison Initiative for Undergraduates (MIU) targets improvements in undergraduate education, with particular emphasis on eliminating "bottleneck" courses. Chem 343 (organic chemistry lecture) and 344 (organic chemistry lab) are documented as courses whose limited throughput is an impediment to timely graduation of undergraduates across campus. While increased MIU funding for additional chemistry faculty and staff will alleviate pressure in lecture courses, it is the physical infrastructure of the building that currently limits throughput in the laboratory courses.

The impact of the project will be broadly felt, affecting more than half of all undergraduate students on the Madison campus. Fifty-five percent of entering freshmen take a chemistry course during their undergraduate career. Forty percent of entering freshmen take a chemistry course during their first semester on campus. Because virtually all students majoring in science, engineering, and allied health fields require chemistry courses as prerequisites to courses in their major, the ability to accommodate large general chemistry (freshman) and organic chemistry (sophomore) enrollments is a crucial factor in influencing the time-to-degree for a substantial fraction of all undergraduate majors on campus. Upon graduation, these students gain employment in a myriad of professions, including medicine, pharmacy, health sciences, education, biotechnology, and engineering – contributing substantially to the economic enterprise of the State.

INSTRUCTIONAL LABORATORY PROGRAM

Instructional laboratory facilities in all areas of chemistry require renovation in order to:

- Accommodate enrollments that have increased by 50-100%
- Conform to modern safety and ventilation standards
- Better integrate instrumentation and computers into the curriculum, provide safe, hygienic space for group discussion, data analysis, and preparation of reports
- Upgrade chemical storage and dispensing facilities
- Provide lab directors with support space for development of new laboratory experiments
- Provide students with adequate storage for coats and backpacks while working in the laboratory

Lack of sufficient laboratory space for general chemistry students necessitated a curriculum change (in 1996) limiting students in Chemistry 103 to one hands-on laboratory session every other week rather than the norm of weekly laboratory sessions. Computer experiments are being used to fill in the other weeks. The inability to hold weekly labs for general chemistry represents a serious degradation of instructional pedagogy. While computer labs can be advantageous in some aspects of learning, they cannot replace the hands-on lab skills that are important to teaching chemistry and currently severely limit the ability of faculty and staff to innovate.

The lack of laboratory space for organic chemistry students has resulted in an even more serious enrollment problem, resulting in a backlog that has grown steadily over the past decade. This increasing backlog has reached near-crisis proportions as seniors and juniors have become the primary clientele of what is nominally a sophomore lab course. Most students are forced to delay taking the lab course by one or more semesters after completing the lecture sequence, which significantly undermines the effectiveness of the curriculum. The unrelenting enrollment pressure necessitated a curriculum change (in 2009), in which the laboratory period for students in Chemistry 344 (organic chemistry laboratory) was decreased from 8 hours/week to 6 hours/week.

SUPPORT FACILITIES

Beyond the issue of inadequate laboratory space, per se, chemistry instructional facilities lack adequate support facilities. The existing facilities lack appropriate areas for reading/writing, instrumentation, and discussion in immediate proximity to the laboratories. Students are forced to use the hallways outside the labs to do their calculations, record information and discuss experimental data and results with other students. In effect, the public corridors have become classrooms. The lack of separate instrument rooms means that instruments and computers must be located directly in the laboratory. This situation results in premature instrument failure and poorer data from instruments that have been exposed to corrosive fumes.

SAFETY

Safety deficiencies are particularly problematic in the instructional laboratories. Chemical safety and hygiene standards have changed dramatically in the 40 years since the current undergraduate chemistry laboratories were built. No major renovations have taken place since that time and the existing facilities are woefully inadequate by today's standards. The inadequacies relate primarily to insufficient ventilation and insufficient total space. Essentially all modern university chemistry laboratories, whether designed for research or instructional purposes, provide each student with access to an efficient fume hood to perform all procedures that may emit potentially hazardous fumes. Even some of the most common and least toxic laboratory reagents represent an exposure hazard over time when handled in a work area that is not properly ventilated.

Additionally, modern chemistry laboratories provide nearby writing, instrumentation, computing and discussion areas that are physically separated for safety and hygiene reasons from the area where the chemicals are handled. Current laboratories do not meet the ventilation or hygiene standards considered essential for contemporary instructional laboratories.

LECTURE ROOMS

Despite substantial growth in the enrollments in chemistry courses, the primary lecture rooms used for undergraduate chemistry courses (Room 1351, capacity 350; Room 1361, capacity 250) have not been refurbished since construction (1967). These lecture rooms suffer from poor sight lines, painfully inadequate spacing between rows, and inadequate space for multiple projection screens and chalkboards. The largest and most heavily used of these lecture halls, Room 1351, has more seats per assignable square

EXECUTIVE SUMMARY

ANALYSIS OF NEED - CONTINUED

foot area than any other lecture hall on the UW-Madison campus. Design guidelines in effect for many years have not allowed such a crowded configuration for newer lecture halls. Increasing student demand results in over-crowded lecture halls. Chemistry 103 and Chemistry 104 are the highest-enrollment courses on campus during the fall and spring semesters, respectively. In order to accommodate the largest number of students, the courses are allowed to enroll more students than the lecture halls can accommodate. This form of demand management relies on the facts that some students will ultimately drop their enrollment in the course, while other students will simply not attend lectures. Innovative pedagogy has been successful in increasing student attendance at lectures and decreasing the number of students who drop courses prior to completion. Both factors further increase facility utilization.

FUTURE TRENDS AND PEDAGOGICAL ISSUES

The 20 years of continually increasing enrollments in chemistry courses are fueled, in part, by chemistry's central role in the life sciences and biotechnology. Looking ahead another 20 years, further enrollment pressures may be anticipated, by virtue of growth in UW-Madison's undergraduate population and by virtue of chemistry's central role in emerging areas such as climate change/global warming, energy, environmental sciences, and nanotechnology. Chemistry faculty and staff actively conduct research in these areas and are eager to develop innovative new courses and teaching methods, but the lack of laboratory space (combined with staffing issues) have thus far hindered the ability to do so. In order to be successful, efforts to improve undergraduate education (such as the Madison Initiative for Undergraduates) require additional space to accommodate more students, and also require a different mix of space to facilitate modern teaching methods such as small-group discussions. Restoring weekly laboratory sessions to general chemistry (103) is an important pedagogical goal of the department. For many non-science majors, this course may be the only laboratory course these students will ever take, and it is incumbent upon this institution to provide a high-quality laboratory experience. Organic chemistry is a crucial component of the education of most life science majors, pre-medical students, pre-pharmacy students, and many others. Re-establishing an integrated curriculum, in which the organic chemistry laboratory course is taken in conjunction with the lecture course (not 2-4 semesters later) is another important objective.

MECHANICAL SYSTEMS

Although renovations accomplished through the WISTAR program (2000-2003) and an energy conservation project (2009-2010) have afforded acceptable programmatic space in the Mathews and Daniels buildings, the ongoing viability of the space is put in jeopardy by the dilapidated condition of the mechanical systems. The HVAC equipment has reached the end of its useful life, is failure-prone, has very poor energy efficiency, and cannot be properly serviced. Failure of one or more major components would have a catastrophic impact on both teaching AND research in the chemistry department.

The heat recovery system serving nearly all of Mathews and Daniels buildings is non-functional and non-serviceable. The plugged and leaking coils have been shut off and large sections removed just to get airflow back to the exhaust stream. Ventilation demands are large for any research lab, especially chemistry labs, and rejecting all the conditioned air through the exhaust system without recovering any energy is extremely wasteful. Despite the recognition of this critical situation by the Division of State Facilities and UW-Physical Plant, it has been impossible to devise a plan to implement a massive renovation without shutting down the buildings for a period of at least one year. Coupling the construction of a

new building addition with the rehabilitation of the mechanical systems of the Mathews and Daniels buildings is the ONLY viable strategy that can be envisioned. This renovation project will also eliminate the exhaust fans on the second floor roof of the Daniels building, which is an important objective in light of the construction of a 14-story residential tower directly across Mills Street. The new mechanical systems will greatly enhance energy efficiency, relative to their aging predecessors.

ALTERNATIVES

Inclusion of organic chemistry instructional laboratories in various major construction projects (BioStar IV, WID, Biochemistry Phase III, Integrative Biology Building) has been considered during the past several years. None of these options was pursued, because each option splits organic chemistry labs from other chemistry support facilities and the rest of the instructional chemistry enterprise, and fails to address the critical problems associated with general chemistry laboratories and chemistry lecture rooms.

- An option to relocate chemistry instructional labs to Chamberlin Hall was rendered infeasible with the decision to relocate the Physics Department to that building.
- An option to relocate chemistry instructional labs to the site of the Brogden Psychology building – either in an extensively renovated building or a new building – was rendered infeasible with the decision for the Psychology Department to remain in Brogden Hall.
- An option to construct a chemistry instructional facility at the southwest corner of Mills and Johnson Streets is incompatible with the Campus Master Plan for the use of that site.
- The redevelopment of the Medical Sciences Center was investigated as part of the current pre-design study and determined to be infeasible.

The lack of any other suitable site in proximity to the chemistry complex suggests that the existing chemistry site represents the only viable option.

Renovation of the main chemistry lecture rooms was considered in 2005. It was determined that the stepped concrete floor imposes serious constraints on the designs of these rooms. Replacement of seating would do nothing to address the other limitations related to poor sight-lines, poor layout of chalkboards and projection screens, the need for upgraded lighting, etc. It was determined that high quality lecture rooms, of comparable seating capacity, simply cannot be accommodated within the existing physical space.

A project to rebuild the HVAC system of the Mathews and Daniels buildings was considered by the Division of State Facilities and UW-Physical Plant in 2006. The plan would have required the complete shut-down of both buildings for a period of at least one year. The project could not be implemented because of the untenable logistical implications.

SUMMARY

The need to modernize and expand the instructional facilities for the Department of Chemistry at UW-Madison has been acknowledged by stakeholders for a number of years. The outdated and deteriorated state of these facilities has become a serious limitation to effective instruction in nearly all undergraduate chemistry courses, especially the largest courses in general and organic chemistry. The need for new labs is driven both by safety considerations that cannot be met by remodeling of the current labs, and by substantially increased enrollments that have forced subpar modifications of the content of the core curriculum solely to accommodate the increased enrollment. The existing facilities neither support contemporary instructional methods nor accommodate the growing number of students required to use them.

Recognizing that the absence of a suitable building site stood in the way of any serious attempt to address these problems, the University acquired a parcel of land adjoining the existing chemistry building complex in late 2009. A master planning project was subsequently initiated in late 2010. Planners were charged with determining the best use of the site, and defining the scope and budget for a major project to address both the programmatic and infrastructure needs of the chemistry complex. The current report describes the analysis and conclusions of the year-long master planning project.

DESIGN REPORT SUMMARY

INTRODUCTION

The University of Wisconsin-Madison Chemistry Department has built one of the nation's premier chemistry programs over the past century. Housed in Science Hall, Chamberlin Hall, and then building incrementally on the current site since 1962, this department continues as a top 10 chemistry program despite teaching facilities that are approaching 50 years old. Ten years ago, these sub standard facilities were noted as part of a planning process that resulted in the construction of the Shain Tower for research. Its completion in 2000 allowed UW Chemistry to prosper and maintain its leading edge in research and recruitment of new faculty. Now in 2011, the time has come to address the other half of a successful science enterprise: the instructional programs.

PROJECT GOALS

- Size undergraduate teaching space to support continuing growth of UW Chemistry enrollment
- Develop modern instructional space to effectively utilize chemistry faculty and staff
- Integrate new emerging technologies into existing mechanical systems to promote energy efficiency and sustainability for teaching and research spaces
- Develop a master plan strategy for optimization of the existing site and facilities for future development.

Chamberlin Hall (1905)

Mathews (1962) & Daniels (1967) Buildings

PROGRAM AND FACILITY BENCHMARKING

We looked at the landscape of chemistry teaching with particular focus on other premier teaching and research programs nationally. Six were identified as peers: University of California Berkeley, Northwestern, Michigan, Cornell, University of North Carolina and Illinois. The thrust of the comparison involved interviewing the chemistry leaders at each school and analyzing their facilities for important lessons and comparisons. In every case, these institutions built significant research and teaching buildings in the past 20 years. Below is a summary of recent chemistry projects for comparison.

SPACE AND COST BENCHMARKING: PEER INSTITUTIONS

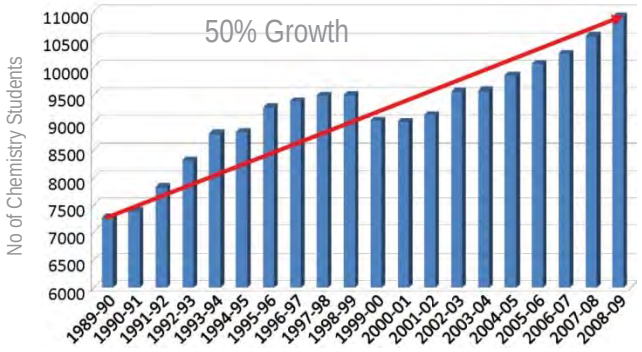
UNIVERSITY	GROSS ASSIGNABLE	EFFICIENCY	COST COST/SF (2011)	FUNCTIONAL MIX (Teaching/Research)	COMPLETION DATE
University of Illinois* Chemistry, New	227,600 118,000	52%	$82M $360/SF	Teaching / Research	1997
UC Berkely* Chemistry, New	110,000 69,000	57%	$40.6M $369/SF	Teaching / Research / Commons	1997
University of Michigan* Chemistry & Research, New	260,000 146,000	56%	$92M $354/SF	Teaching / Research / Commons	1990
Johns Hopkins University Science Teaching	105,000 70,000	66%	$45.4M $438/SF	Teaching / Commons	2013
Cornell University* Physical Sciences	204,000 112,200	53%	$103M $504/SF	Teaching / Research / Commons	2010
Princeton University Chemistry	268,200 145,500	54.2%	$133.2M $497/SF	Teaching / Research / Commons	2010
Indiana University Chemistry	261,100 150,000	57.5%	$93.9M $360/SF	Teaching / Research / Commons	1993
Harvard University* Chemistry	60,400 34,700	58%	$21.1M $349/SF	Research / Commons	2001
Vanderbilt University Chemistry	104,000 52,300	50%	$38.9M $374/SF	Teaching / Research	1996
Iowa State University Chemistry	131,700 81,600	62%	$53.5M $409/SF	Teaching / Research	2010
AVERAGES	172,000 98,300	57%	$375 / S.F.	Teaching / Research	8 Years Old

*2011 Pricing, adjusted for Madison, Wisconsin

PROGRAM DRIVERS

The program for chemistry teaching has continued to grow despite limited growth on the UW Madison campus overall.

- Over 10,000 students currently take chemistry every year.
- The facilities for teaching chemistry are obsolete in every way: safety, systems, space per student and simply age (45-50 years old).
- Given the high volume of students, particularly in core courses for general and organic chemistry, we studied a number of different utilization models aiming at high utilization (60% is the gold standard), effective space per student, and highly efficient mechanical, plumbing and electrical systems.
- The resulting program of 125,300 ASF (assignable square feet) would expand the current space (70,000 ASF) by 79%.
- A number of features of the program are aimed at best practices growing out of the comparative benchmarking of peers.
- Lecture halls using continuous table tops with moveable chairs for visibility and collaboration
- Classrooms based on flexible tabletop layouts for write-up and portable computers
- Teaching labs vary by function and density of fume hoods. Organic labs utilize one hood for two students, e.g.; general chemistry labs utilize downdraft station, one station for two students, etc.
- Write-up rooms and shared instrument rooms allow the most effective use of the teaching lab itself
- Safety and best chemistry practices govern the layouts. For example, two teaching assistants share the lab to allow visibility of experiments and backup, if necessary.



Undergraduate Chemistry Enrollment: 1989-2008

SITE STRATEGIES ON AND OFF THE CURRENT SITE

With the program demand at 125,300 ASF, we examined multiple on site and off site options to find the best location. Out of four choices considered, we determined that demolishing the obsolete lecture halls at the north end of the current complex (Daniels North End) was the most effective way to provide the needed space while maintaining the bulk of the complex intact. The details of these strategies are described in the Design Section of this report. The three basic possibilities were:

- Do Nothing: Given obsolescence and performance shortcomings, an untenable prospect. Programs would require relocation to repair and replace systems.
- Expand into Existing Medical Sciences Center Complex: Another infeasible prospect; cost would be 80-90% of proposed with configurations that don't fit 40' wide wings and 12' floor to floor heights.
- Expand on The Existing Chemistry Block: The east-west scheme offers the most efficient footprint, a means of continued growth into the future, and maximizes site capacity.

Chemistry Block - Optional Massing Strategies

DESIGN REPORT SUMMARY

DESIGN STRATEGY

Working with the 125,300 ASF Program and the adjacencies that grew out of faculty collaborations, we maximized the buildable area while creating a pedestrian scale that respects the context of University Avenue. A major public zone for the building provides three floors of lecture, library and commons space. Above that are five floors of instructional laboratories with a two story penthouse on top. This penthouse allows the cross connection of air handling and exhaust systems to the existing Daniels building.

A key design strategy is to recreate the major entry point off University Avenue leading into a “main street” type space. The lower three floors of Daniels and Mathews will be interconnected with double height spaces and openings in the floors. The intended effect of this design is to feel open and welcoming while providing space for students to study between classes. The functionality and atmosphere of the Laboratory floors are enhanced by maximizing the daylight entering each space. By integrating new and existing, we imagine a transformation of function and character for the chemistry block.

Aerial view from Northwest

COST AND PHASING

In a tight capital environment for construction dollars, we broke the project apart in order to enhance affordability.

BASE PROJECT

- An addition on the north end of Daniels Building: 170,000 GSF (Includes 2 shell floors)
- General Chemistry Labs and Core Renovations: 49,800 SF
- The provision of new air handling for Daniels and exhaust systems for both Daniels and Mathews Buildings

FUTURE PROJECTS

- The fit-out of two shell floors to complete the chemistry program space needs.
- Renovation and backfill of remaining portions of Daniels and Mathews lower three floors.
- Renovation of M/E/P systems in Daniels and Mathews.
- Renovation of fire suppression systems in Daniels and Mathews.

These components were carefully tested using peer benchmark data and recent UW science buildings. The total time to implement the base project is 60 months including design and construction. Timing of future work is funding dependent, but is depicted sequentially below

OTHER INFRASTRUCTURE AND MISCELLANEOUS PROJECTS

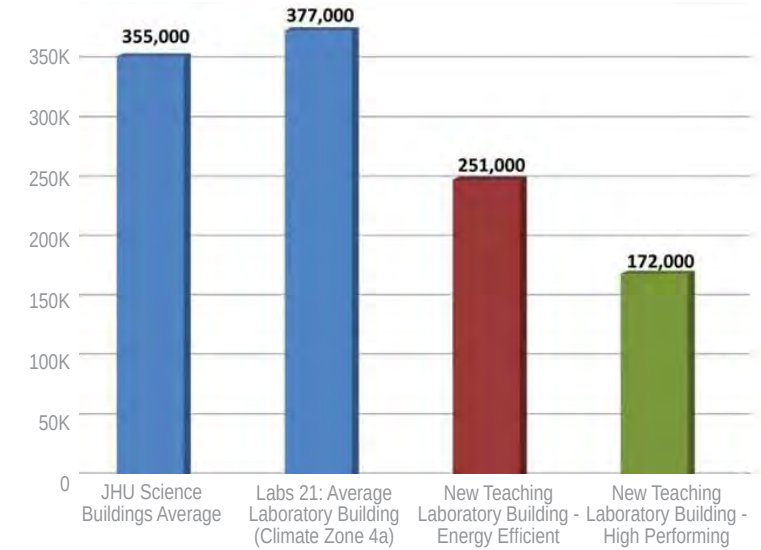
See systems repair matrix, appendix D in Volume II of the Space Assessment and Feasibility Study.

SUSTAINABILITY

Sustainability and the evolution of the LEED Criteria have captivated thinking about the long term use of buildings and their performance. Nowhere is this more important than in chemistry buildings: the highest BTU/SF/Year consumers of energy on campus. Coupled with high volumes of chemical and water use, chemistry is the perfect opportunity to make significant progress toward conservation. Using a sustainability charette, we assembled the best minds on campus and within DSF, with the consultant team to look for ideas that would transform this usage profile. A key early finding was to reuse much of the existing Daniels / Mathews complex by transferring the more intensive labs (organic, analytical and physical chemistry) out of the existing into the new addition. A second discovery was that by building adjacent to the Daniels Building, we could replace the obsolete air handling, exhaust and heat recovery in Daniels with new systems in the penthouse of the new addition. Thus, for starters, we achieve a long term reuse of Daniels and Mathews buildings – a core sustainability principle, and harvest a large amount of energy currently being wasted in the warm exhaust of Mathews and Daniels.

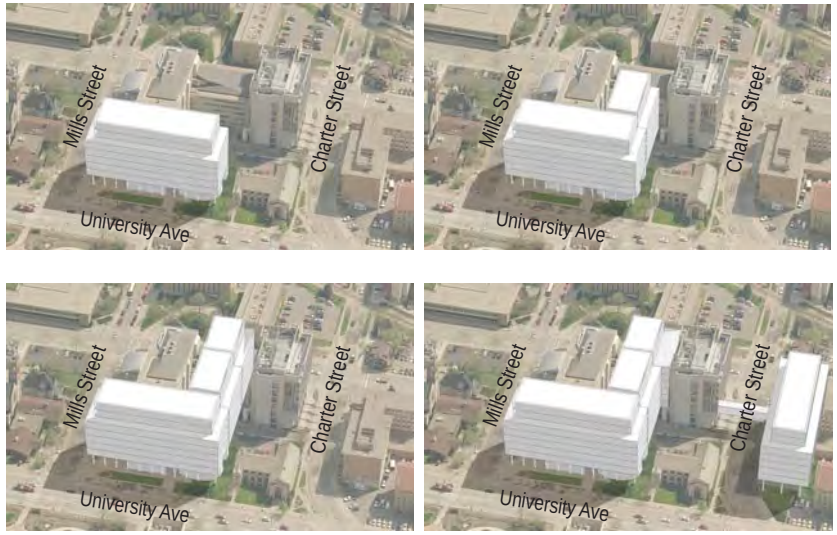
A second big move grew out of the charette itself. We targeted a range of possibilities all aimed at energy and other utility reductions of 40%. Illustrated below is a comparison of modern lab energy consumption versus and older building of the same type.

Annual Energy Consumption: BTU / SF



LONG TERM VISION OF THE SITE

This summary points to the future and what is possible for the effective reuse of most of the existing complex of 410,000 SF. In addition, we looked well beyond the scope of this study to explore how Chemistry would thrive for the foreseeable future on this block (see master plan below). The basic premise was to look to integrating the best of the existing (Shain Tower) with the new instructional tower over time. Floor to floor heights are matched at 16'. Through careful sequencing, it is feasible to master plan a series of building initiatives that will continue to transform the Chemistry Program. Illustrated below is a four-step evolution of this premier teaching and research enterprise 25-50 years ahead.



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DEPARTMENT OF STATE FACILITIES

Russ Van Gilder	Project Manager
Doug Schorr, PE	A/E Supervisor
Jim Schey, PE	A/E Manager
Rick Cibulka, PE	A/E Supervisor

UNIVERSITY OF WISCONSIN | System Administration

Kate Sullivan	Capital Planning and Budget - Director of Facilities Planning
Jeff Kosloske	Capital Planning and Budget - Senior Facilities Architect

UNIVERSITY OF WISCONSIN - MADISON | Facilities Planning & Management

Alan Fish	Associate Vice Chancellor
Pete Heaslett	Capital Planning and Development - Project Manager
Dan Okoli	Capital Planning and Development - Director/University Architect
Pat Richards	Capital Planning and Development - Program Office Assistant
Teresa Adams	Capital Planning and Development - Capital Budget
Kim Todd	Space Management Office - Sr Administrative Program Specialist
Doug Rose	Space Management Office - Director
Angela Pakes Ahlman	Capital Planning and Development - Architect/Engineer Manager
Dan Motl, PE	UW Physical Plant - Architect Engineer Manager
Gary Brown	Campus Planning and Landscape Architecture - Director

UNIVERSITY OF WISCONSIN - MADISON | Department of Chemistry

Robert McMahon	Professor - Project Leader
F. Fleming Crim Jr.	Professor - Project Leader
Matthew Sanders	Executive Director
James Weisshaar	Professor - Department Chair
Kyle Roux	Building Manager
Cheri Barta	Undergraduate Chemistry Coordinator
Jeanine Batterton	Undergraduate Chemistry Coordinator
Matt Bowman	Assistant Lab Director - Organic
Steve Burke	Professor - Organic Chemistry
Judith Burstyn	Professor - Inorganic Chemistry
Allen Clauss	Lecturer / Faculty Associate
Pam Doolittle	Lab Director - Analytical
Mark Ediger	Professor - Physical Chemistry
Daniel Fredrickson	Professor - Inorganic Chemistry
Sam Gellman	Professor - Organic Chemistry
Jeanne Hamers	Faculty Associate
Nicholas Hill	Lab Director - Organic Chemistry
Song Jin	Professor - Analytical Chemistry
Tony Jacob	Director - Chemistry Learning Center
Clark Landis	Professor - Organic / Inorganic Chemistry
Rob McClain	Lab Director - Analytical
Cathy Middlecamp	Director - Chemistry Learning Center
John Moore	Professor
Sharon Mulvey	Librarian - Chemistry Library
Gil Nathanson	Professor Physical Chemistry
Hans Reich	Professor - Organic Chemistry
Ieva Reich	Senior Lecturer
Jennifer Schomaker	Professor - Organic Chemistry
Ned Sibert	Professor - Physical Chemistry
Mark Wendt	Lab Director - Physical Chemistry
Chad Wilkinson	Lab Director - General Chemistry
Emily Wixson	Librarian - Chemistry Library
John Wright	Professor - Analytical Chemistry

BALLINGER | Architecture

Bill Gustafson, FAIA	Principal - Team Leader
Craig Spangler, AIA	Principal - Design Leader
Jeffrey S. French, FAIA	Principal - Program Development
Marc Ferrer, RA	Architect - Lab Planner

ARO EBERLE | Architecture

Michael Eberle, AIA	Principal - Project Manager
Matthew Aro, AIA	Principal - Design
Doug Pahl	Architect - Design

AEI | MEP Engineering

Michael Broge, PE	Principal - MEP Team Leader
Tim Lavin	Chief Estimator
Jeff Kaehny, PE, LEED AP	Mechanical Engineer
Bob Braucher, PE	Electrical Engineer
Paul Raymond, PE	Plumbing Engineer
JC Carver	Fire Protection Engineer

MORTENSON | Cost Estimating

Angela Brzowksi	Pre-Construction Manager

HENNEMAN | Structural Engineering

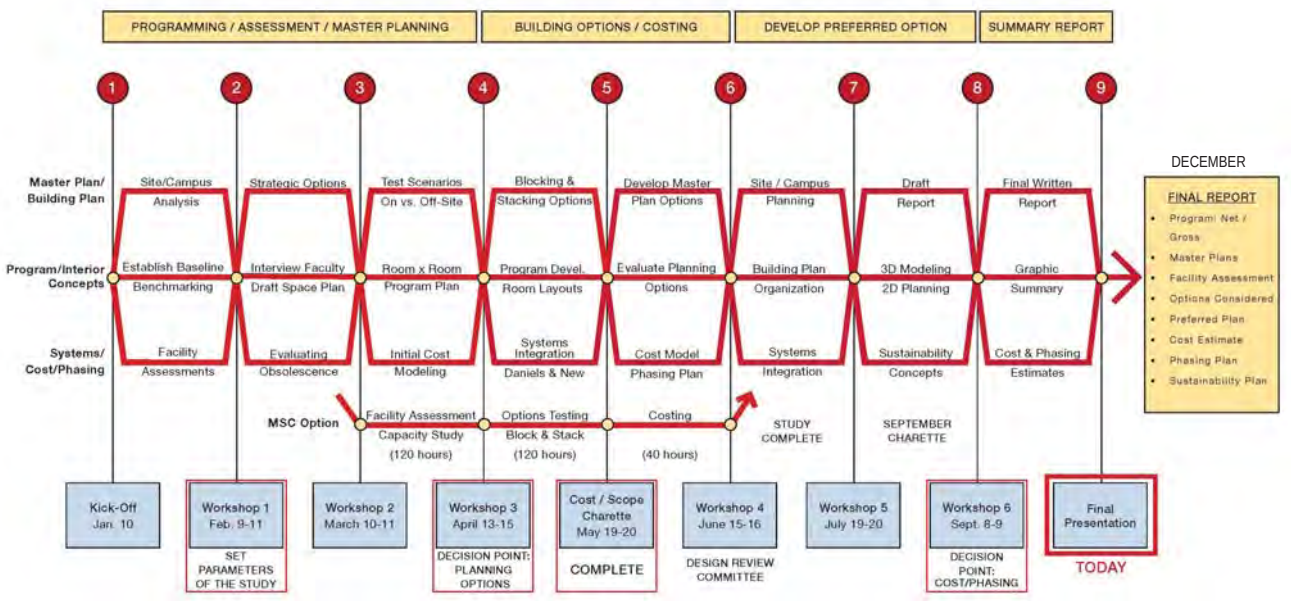
Mike Schmidt, PE	Structural Engineer

BENCHMARKING

Professor John Arnold	University of California - Berkeley
Professor James Burlitch	Cornell University
Professor John Ekerdt	University of Texas
Professor Anna Mapp	University of Michigan
Professor Jeffrey Moore	University of Illinois - urbana Champaign
Professor Royce Murray	University of North Carolina - Chapel Hill
Dr. Owen Priest	Northwestern University
Professor John Toscano	Johns Hopkins University
Mark Wilson, AIA	Princeton University

PROCESS SUMMARY

WORKPLAN | FEBRUARY - NOVEMBER 2011



This design process was intensively collaborative with DSF, UW System, and UW-Madison campus representatives. Given the importance and scale of the outcome, it became clear that a combination of addition and renovation would be the long term answer for chemistry. Four basic steps guided the process; each involved workshops with all of the stakeholders at regular intervals.

STEP 1: PROGRAM AND BUILDING ASSESSMENT

The initial effort was to establish the long term Vision and Program for chemistry while assessing the existing 410,000 SF complex for obsolescence and conformity.

STEP 2: BUILDING OPTIONS TESTING

Multiple on site and off site options were considered leading to the recommended solution. A key element of this was the realization that Mathews and Daniels could be re-used with MEP renovation for another generation.

STEP 3: DEVELOP PREFERRED OPTION

The north side of Daniels emerged as the best site for long term development. Consideration was given to phasing this strategy over multiple biennia and further, how we could phase additional work beyond today's immediate needs.

STEP 4: SUMMARY REPORT

The final steps involved carefully estimating the cost and phasing of the total plan and recording the study in graphical and written form.

UNIVERSITY OF WISCONSIN - MADISON
CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION

EXISTING CONDITIONS

SITE AND CAMPUS CONTEXT

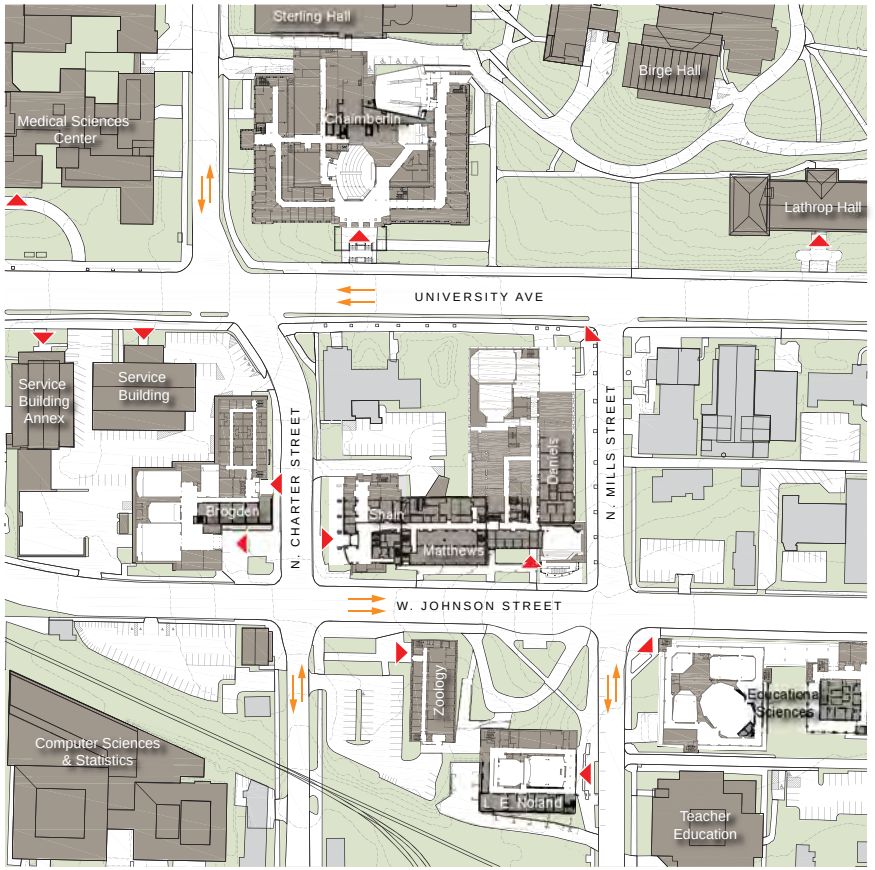
OVERVIEW

The current site for the Chemistry complex is intensely urban in character. Three major buildings are interconnected to form the complex. The defining characteristic of the complex is a major hallway system that progresses from the main entrance off University and North Mills Street southward and then westward exiting out at Charter Street and West Johnson Street. Service occurs off Charter Street at mid block. The University United Methodist Church occupies the northwest corner of the block and is viewed as permanent. Sandwiched between University Avenue and Johnson Street, this complex is 50 years old starting with Mathews in 1962, Daniels in 1967 and Shain in 2000. Site topography is significant. A full 12' floor difference occurs along N. Mills Street so the entrance at the south end is one level below the main entrance at University Avenue.

Architecturally speaking, the complex is bland in character with precast, ribboned windows typical for 1960's vintage buildings. The Shain Tower, predominantly research, fronts Charter Street with a more contemporary quality of curtain wall with a granite base.

In the pages that follow, we've described our analysis of the different site development strategies.

Site Photo from Northwest



Site Map

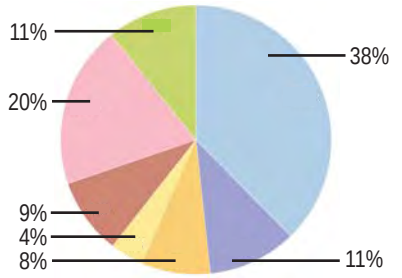
EXISTING SPACE PROGRAM: UNDERGRADUATE INSTRUCTION

The outdated and deteriorated state of UW-Madison's chemistry instructional facilities, including both lecture rooms and laboratories, has become a serious limitation to effective instruction in nearly all undergraduate chemistry courses, especially the largest courses in general and organic chemistry. The need for new labs is driven both by safety considerations that cannot be met by remodeling of the current labs, and by substantially increased enrollments that have forced subpar modifications of the content of the core curriculum solely to accommodate the increased enrollment. Demand for chemistry classes has continuously increased over the last 20 years. The existing facilities do not support contemporary instructional methods and are unable to accommodate the growing number of students required to use them. The laboratories fail to conform to modern safety and hygiene standards.

Fifty-five percent of entering freshmen take a chemistry course during their undergraduate career. Forty percent of entering freshmen take a chemistry course during their first semester on campus. Because virtually all students majoring in science, engineering, and allied health fields require chemistry courses as prerequisites to courses in the major, the Department's ability to accommodate large general chemistry (freshman) and organic chemistry (sophomore) enrollments is a crucial factor in influencing the time-to-degree for a substantial fraction of all undergraduate majors on campus.

Funds from the Madison Initiative for Undergraduate are targeted to address improvements in undergraduate education, particularly "bottleneck" courses. Chemistry 343 (lecture) and 344 (lab) are routinely hailed as examples of large courses whose limited throughput is an impediment to timely graduation of undergraduates across campus. While increased funding for additional faculty and staff will alleviate some of the pressure, it is the physical infrastructure of the building that currently limits throughput in the laboratory courses.

The campus has grappled with this problem for a number of years, has investigated a series of unattractive options to address facility needs off-site and has implemented various undesirable changes to pedagogy. The recent acquisition of a parcel of land immediately to the west of the existing Daniels Building has finally provided a site for the addition required to improve the quality and quantity of chemistry instructional space.

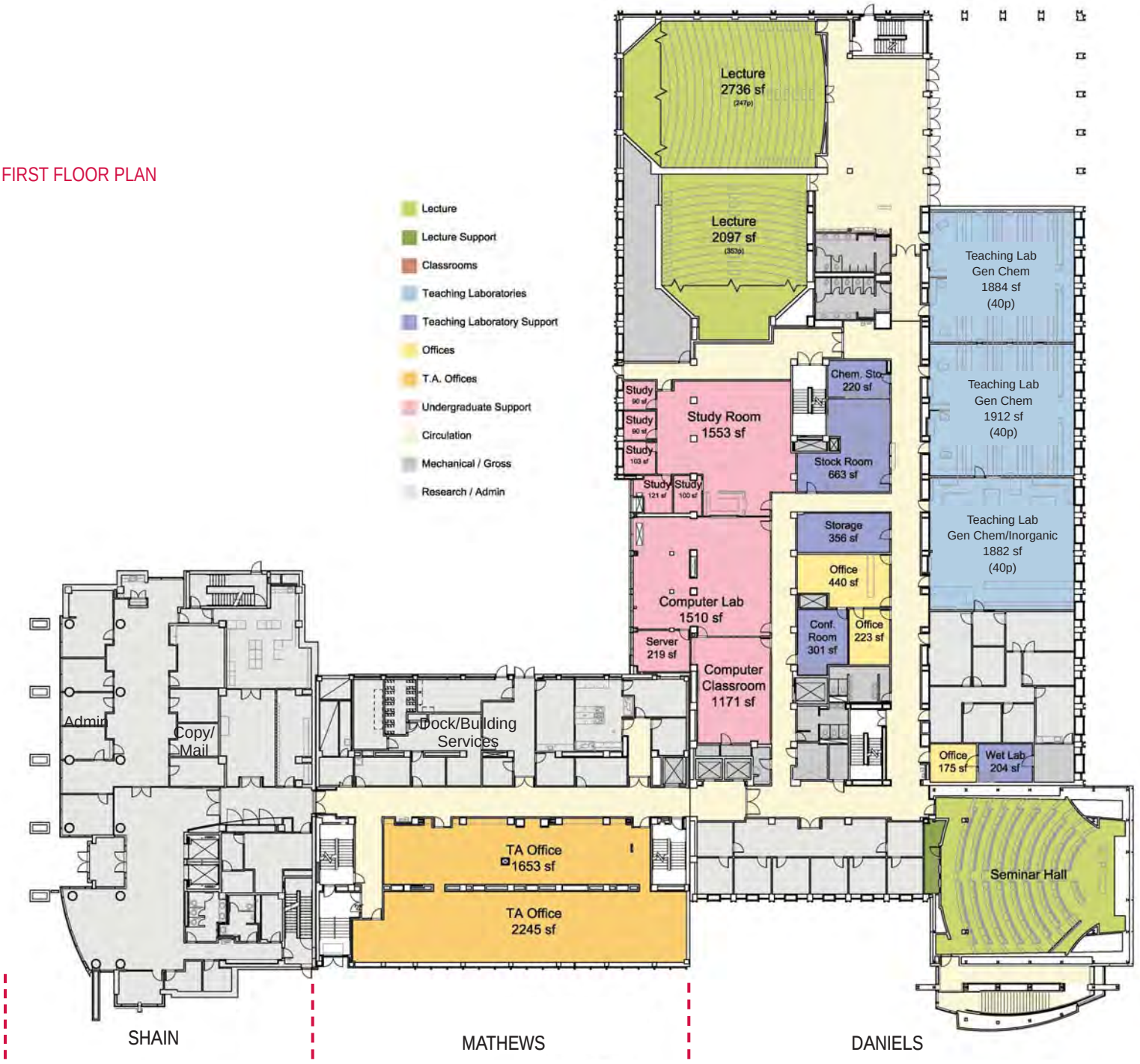


EXISTING PROGRAM SUMMARY 70,061 ASF

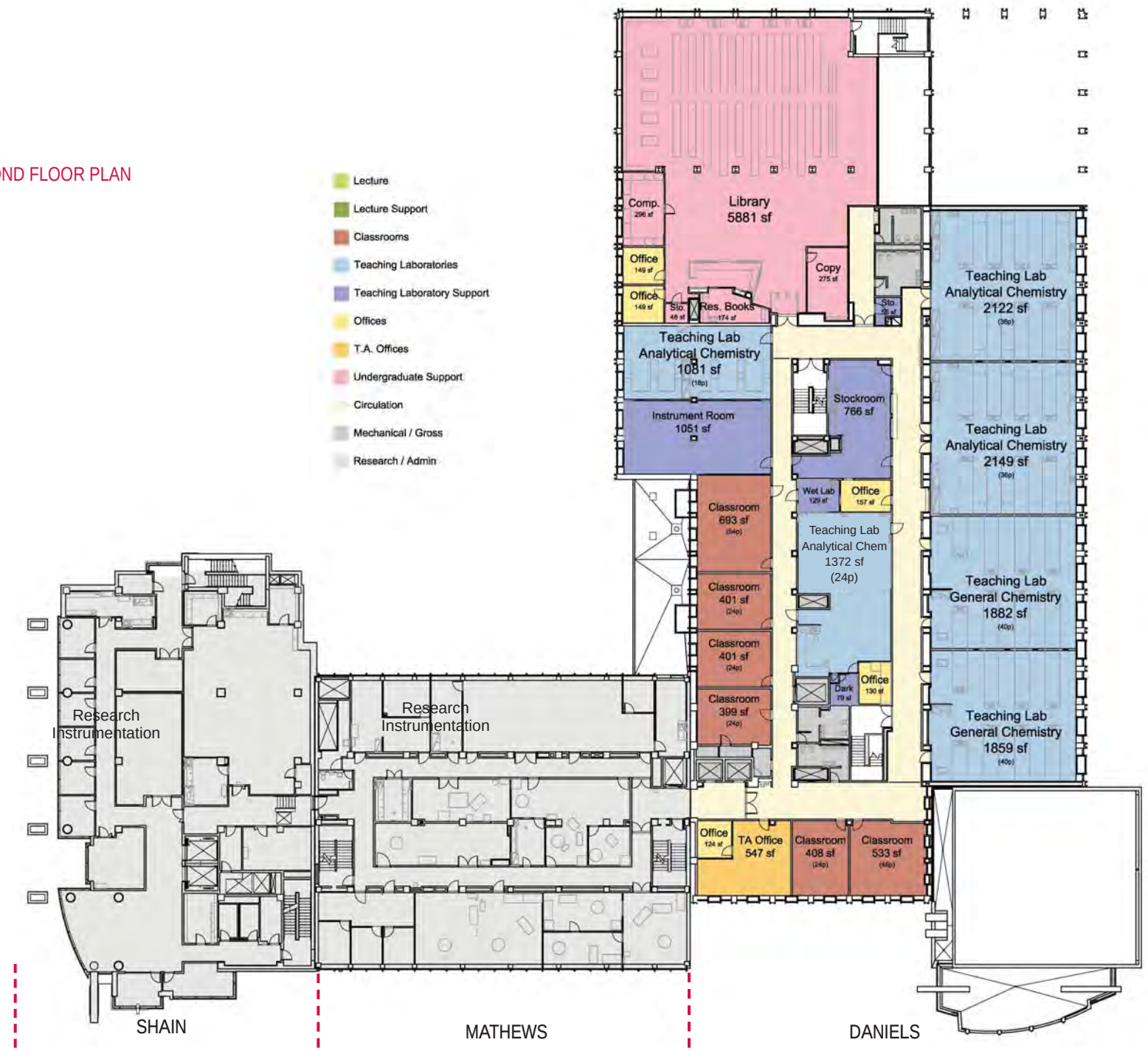
TEACHING LABS	**26,751**	ASF
General Chemistry Teaching Labs	9,419	
Organic/ Inorganic Chemistry Teaching Labs	6,229	
Analytical Chemistry Teaching Labs	5,352	
Physical Chemistry Teaching Labs	5,751	
TEACHING LAB SUPPORT	**7,547**	ASF
Instrument Rooms/ Work Rooms	3,769	
Stock Rooms	3,778	
TA OFFICE	**5,866**	ASF
TA Offices/ Meeting Rooms	5,866	
OFFICE	**2,820**	ASF
Department Offices	1,631	
Lecture Offices	372	
Chemistry Learning Center Offices	817	
CLASSROOMS	**6,521**	ASF
Teaching Classrooms	5,794	
Chemistry Learning Center Classrooms	727	
UNDERGRADUATE SUPPORT	**13,819**	ASF
Library	6,931	
Computer Rooms/ Lab	2,504	
Study/ Student Activity	4,133	
Chemistry Learning Center Group Rooms	251	
LECTURE	**7,672**	ASF
Lecture Halls	7,672	
TOTAL ASSIGNABLE SQUARE FEET (ASF)	**70,996**	**ASF**

EXISTING BASEMENT FLOOR PLAN

EXISTING FIRST FLOOR PLAN



EXISTING SECOND FLOOR PLAN



FACILITY ASSESSMENT EXECUTIVE SUMMARY

OVERVIEW

A limited facility assessment was performed to gauge the usefulness and longevity of two of the component buildings that comprise the Department of Chemistry Complex. A draft of the preferred format for the study was provided to the design team by Jeff Kosloske of the UW System. The format for the data collection was based on the "Uni-format" system of categorizing building components. Our Assessment utilized an expanded version of the draft format to provide a complete system for facility analysis.

The Facilities Assessment as a whole was subdivided into individual categories that could be studied independently and allow efficient data collection. The categories are: Structure; Shell; Interiors; Services. The results are merged in this summary to create a picture of the current condition of the building.

The purpose of the Assessment was to evaluate the usefulness and condition of targeted spaces within the building, as well as highlight issues related to mechanical, electrical, and plumbing equipment, structures, exterior skin, accessibility, energy efficiency, and safety. A list of prioritized maintenance and replacement ideas accompanies this report, as well as a commentary on the overall condition of various areas.

The information amassed during the performance of this assessment allowed the design team to make informed decisions about the reuse of the existing space, the extent of remodeling required to bring the building up to modern standards, and the types of program functions that the existing space can accommodate. The Assessment, along with input from University staff, also allow us to analyze possible solutions to existing problems that are only made possible by the execution of a large scale project such as the one proposed in other sections of the Planning Study.

The Facility Assessment is designed to build consensus about the appropriateness of proposed replacement and/or renovation of spaces within the existing complex . It looks at the instructional space at a room by room level for the interior portion of the assessment, and a building-wide level for the other major components. We utilized the UW System grading metric for analysis of the building. In many cases, photographs of graded items were taken and catalogued in the appendix portion of this report.

ANALYSIS METHOD

STRUCTURE – FOUNDATIONS AND SLABS ON GRADE (UNI-FORMAT SECTION A)

- Since the foundations are not visible, a visual inspection of the interior side of the basement walls and the top surface of the slabs on grade was made.

SHELL – SUPERSTRUCTURE AND EXTERIOR SKIN (UNI-FORMAT SECTION B)

- Superstructure: Visual inspection of portions of the structure that was visible. Looked for signs of distress from structure movement.
- Exterior Skin: Analysis of original as-built documents of building details as well as ground level inspection of the façade was performed. Interviews and walk-throughs with the Building Manager, Kyle Roux, were conducted to gather further information based on his experience. The condition as it pertains to basic function was analyzed as well as estimating the thermal performance of the skin based on the original composition of the walls. R-values for the walls were established using the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) R-values of building materials from their 1997 Handbook of Fundamentals.

INTERIORS – (UNI-FORMAT SECTION C)

- The team spent a week going through the undergraduate instructional space room by room evaluating the various items that define the quality of the space. Photographs were taken in each room of the general area and also any particular items where description of its condition was easiest with a photograph. The evaluation went beyond mere condition reporting into an evaluation of various architectural issues:
    - Presence or likely presence of asbestos containing materials such as floor tiles, counter tops, and other existing finishes
    - Anomalous hazards in areas where years of the presence of chemicals has degraded the condition of their surroundings to a point of concern.
    - Non-compliance with current ADA standards (American National Standards Institute A117.1) and other accessibility or life safety issues.

FACILITY ASSESSMENT EXECUTIVE SUMMARY

SERVICES – ELEVATORS, MEP, FIRE PROTECTION, LOW VOLTAGE SYSTEMS (UNI-FORMAT SECTION D)

- Elevators were assessed based on age and the modernization schedule held by UW FP&M
- MEP: A walkthrough inspection and interviews with the building manager were conducted by Mike Broge Jeff Kaehny, Paul Raymond and Bob Braucher.
- Fire Protection: No fire sprinkler systems are in place in either the Mathews or Daniels buildings. Assessment of the fire alarm system was not done.
- Low Voltage Systems: Not assessed

EQUIPMENT AND FURNISHINGS (UNI-FORMAT SECTION E)

- Included as part of the interior assessment and documented in the associated appendix.

SPECIAL CONSTRUCTION (UNI-FORMAT SECTION F) WAS NOT ASSESSED

SITEWORK (UNI-FORMAT SECTION G) WAS NOT ASSESSED

FINDINGS

STRUCTURE – FOUNDATIONS AND SLABS ON GRADE

- The slabs on grade were found to be in good condition. No evidence of foundation distress found.

SHELL – SUPERSTRUCTURE AND EXTERIOR SKIN

- Superstructure: The superstructure appears to be performing satisfactory. In Daniels Room 9367 (ceiling in Room 8369), the floor does not pitch to the drain. The ionized water has corroded the floor structure in the room and leaked in Room 8369.
- Exterior Skin: The exterior skin of the buildings comprises mostly durable materials that are in satisfactory condition. Generally, the precast concrete is soiled and could benefit from cleaning. The caulking is most likely original and is due for inspection or replacement. The windows in Daniels are water tight but do not have insulated glazing or thermally broken framing. This would most likely cause an issue if the window heating units are replaced with a different system. Mathews building already has condensation issues and damage to the steel headers and window film is already present.

INTERIORS

- A room by room description of the interior spaces surveyed is included as part of the appendix. Generally speaking, anything that was not included in the circa 2000 renovation is in need of repair and replacement.
  - Furnishings: Laboratory furnishings are in unsatisfactory condition. Supply Storage areas are showing the worst wear on their furnishings. Most finish surfaces throughout the surveyed area are abraised or marred and cannot be repaired.
  - Equipment: is in varying conditions. Many areas have new fume hoods. See appendix for piece by piece descriptions of condition.
  - Doors and hardware: are in generally poor condition. Doors have chipped and cracked veneers and are heavily soiled. Hardware does not meet ADA requirements.
  - Floor finishes: throughout the surveyed area are inconsistent, and some areas still have 9x9 tile which may contain asbestos
  - Ceiling Finishes: where present, the ACT systems are in poor condition. The tracks have yellowed significantly, and the tiles are sagging and stained in many areas.
  - Wall finishes: are mostly painted CMU and vary from good condition to unsatisfactory condition.

SERVICES – ELEVATORS, MEP, FIRE PROTECTION, LOW VOLTAGE SYSTEMS

- Elevators

- Daniel's freight elevator is in poor condition
- Daniel's passenger elevators are in poor condition
- Mathews freight elevator is in poor condition

MECHANICAL

- Daniels Building:
    1. There is no bypass of the Chilled Water pump
    2. Air Conditioning units 1,2 and 4 are at the end of their useful life
    3. Noise from mezzanine due to improperly isolated equipment causing issues in spaces below
    4. Air Handling Units F1 and F2: Outside Air dampers malfunctioning, original to building and past their useful lives.
    5. Air Handling Units F3: Issues with air intake clogging with leaves. Steam coil, Cooling coil, and outside air dampers all at the end of useful life.
    6. Exhaust discharge at second floor roof of Daniels is a noise problem and a safety concern as it is adjacent to the 3rd floor of the Daniel's Building.
    7. Heat Reclaim system not functioning.
    8. Plastic Ductwork present in portions of the building is cracked and leaking, and does not meet current flame and smoke spread requirements.
- Mathews Building
    1. Hot Deck Steam heating coils at each floor malfunctioning
    2. Air Handling Units S1 and S2 serve hot and cold decks – they are in poor condition and are difficult to maintain.
    3. Issues with debris and particles coming out of ductwork have been identified
    4. Dual duct terminals are a maintenance problem as they are constantly breaking down.

ELECTRICAL

- The existing electrical main distribution consisting of primary service equipment and step down unit substations are in satisfactory condition.
- Use of existing 1964 and 1967 feeder breakers in the unit substations and remote distribution panels for renovations is satisfactory to poor.
- Secondary distribution installed in 1964 and in 1967 is in poor condition and in many instances replacement parts are not available.
- Lighting and general purpose power receptacles installed in 2004 are in good condition.
- Lighting fixtures and general purpose receptacles installed in 1964 and 1967 are in poor condition.
- The existing emergency generator in the Daniels building installed in 1967 is in poor condition and has very limited capacity to serve new loads.

PLUMBING

- Building has many dead-end domestic water legs
- Eyewash stations not connected to a tempered water system
- The Daniels drain tile system is connected to the roof drain system. Rain events surcharge the system which pushes water out the drain tile and up through cracks in the sub-basement floor.
- Liquid nitrogen dispensing system has hose bib type valve which is inappropriate. Venting of gases is also inadequate
- Mathews and Daniels RO/DI systems are not cross connectable
- Daniels RO/DI plant has leaks

FACILITY ASSESSMENT EXECUTIVE SUMMARY

RECOMMENDATIONS

In the course of this study, we have identified a need to continue use of the existing Mathews and Daniel's buildings for the Chemistry Department's various functions (both undergraduate instruction and research functions as well as administrative functions). The intensity of their use has not been downgraded in any way.

In order to support continued use, a range of projects have been proposed to address the issues currently plaguing the buildings and enhance their functionality, safety, and environment.

A comprehensive maintenance list containing projects that lie outside of planned routine maintenance scheduled for the complex can be found in Appendix D. The cost estimate for this body of maintenance work will be included in the estimate of probably cost section (Appendix H) of this report.

CODE AND ZONING SUMMARY

ZONING

The Chemistry Department properties are currently zoned Planned Unit Development (PUD) per the City of Madison zoning code and was approved in 1998. The parcel to be acquired from the church is currently zoned R6. The proposed project would re-zone the acquired property to PUD and join the existing parcel into a Specific Implementation Plan (SIP) under the current zoning code. This process would require approval by the City's Urban Design Commission, Plan Commission, and Common Council. The church and the attached house on the northwest corner of the block is not considered a landmark, and therefore review by the Landmarks commission is not anticipated at this time. The project would require demolition of the house that is attached to the church and a new Certified Survey Map submitted and approved by the city for the new lot line that would run through the current location of the house. The line is to be 10' from the façade of the church, and this line will demarcate the point from which the side yard setback is determined.

The building height is not capped by any specific criteria, however, the Core Team agreed it reasonable to assume the height of the Shain Tower is the datum to work within when studying the capacity of the site and to promote inter-connectivity to the Shain tower in the future. Other buildings in the University and Johnson Street corridor have a similar height to the Shain tower. According to City documents, the Grand Central Apartments at 1022 West Johnson street has a USGS datum height of 1022 feet, whereas the Shain tower has a datum height of 1025 feet. The nearest buildings that surpass the Shain Tower height datum are the Atmospheric building on Orchard and Dayton Streets, as well as Van Hise and Van Vleck halls near Bascom Hill.

The lower three floors would be interconnected via an atrium containing a wide, open stair that would help facilitate the movement of large numbers of students to and from the lecture halls on each floor. Appropriate separations and a smoke control system are anticipated, however, if a rated glass enclosure can separate the library space from the open atrium, a smoke control system may not be required for this area.

Future phasing concepts were studied that the owner may wish to consider pursuing as part of a General Development Plan (GDP) for the block that would provide a long term plan for

BUILDING CODE

the infill and renewal of the Chemistry facilities for the future.

The new tower could be classified minimally as a Type 1B structure under the International Building Code (IBC 2009), which would allow unlimited area and up to 12 stories of noncombustible construction. A tower would require a 3 hour fire wall at the interface with the remaining portions of the Daniels building following demolition of the north portion. The building will be fully sprinklered, and quantities of hazardous and flammable materials typically used in Chemistry experiments are limited based on the floor, with higher floors having less allowable flammable and hazardous materials. The new tower will house space for Mechanical equipment that will serve the existing Daniels tower, and crossovers of supply, return and exhaust will have to navigate around the 3 hour fire wall which extends a short length beyond the roof and facades of the Daniels tower, and provide appropriately rated dampers where applicable. The new tower is considered a high-rise building and should interconnect to the fire department command center that is currently located in the Mathews building. The Fire Command Center was established in Mathews as part of an agreement reached with the Madison Fire Department as part of the 1998 project. At that time, the Fire Department indicated they would enter through the loading dock area to access the fire command center.

The existing Mathews and Daniels (MD) buildings are interconnected and constitute a single building for this study. The Shain tower is completely separated by a fire wall from Mathews and is not considered in this analysis. The existing construction type of MD is best classified at 1B with protected moment frame steel columns and beams with concrete floors. The building is not sprinklered currently, but standpipes and hose cabinets exist at each exit stair. It is understood that hoses were removed from the hose cabinets at some point, but the hose connections remain. The entire remodeling remains under 50% of the aggregate floor area of MD. The remodeling scope exceeds 50% on floors B, 1, and 2 and thus a sprinkler system is required to be installed on those floors entirely. The penthouse in Daniels is undergoing substantial demolition and remodeling, and depending on the A/E design sprinklering on the 9th floor/penthouse in Daniels may be required. Work on intermediate floors in Daniels is anticipated to be less than 10% of the areas of those floors at the north end interface with the new tower.

New openings in the floors between B, 1, and 2 in Daniels constitute small atria, and opening protectives and separations are required as appropriate to the condition. The use of rated glass is suggested for the openings to maintain the visual connections and to attenuate sound transfer.

Exit stairs for Mathews and Daniels will require the creation of rated exit enclosures to discharge at grade or exit horizontally through the new tower. The north Daniels exit stair will exit horizontally via rated enclosure into the lower level of the new tower. The south Daniels exit stair will connect to discharge at grade via a rated remodeled vestibule on the basement level. The existing Mathews stairs will continue to function without alteration.

Restroom facilities in MD are not currently accessible. Restrooms would be completely remodeled on floors B, 1, and 2 to meet accessibility standards. Door hardware in MD does not meet accessibility standards and is recommended for replacement throughout the building. Existing elevator controls, signage and signal require evaluation for replacement to meet accessibility standards.

For more information, see Appendix E.

UNIVERSITY OF WISCONSIN - MADISON
CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION

PROGRAM

PROGRAMMING SUMMARY

JUSTIFICATION

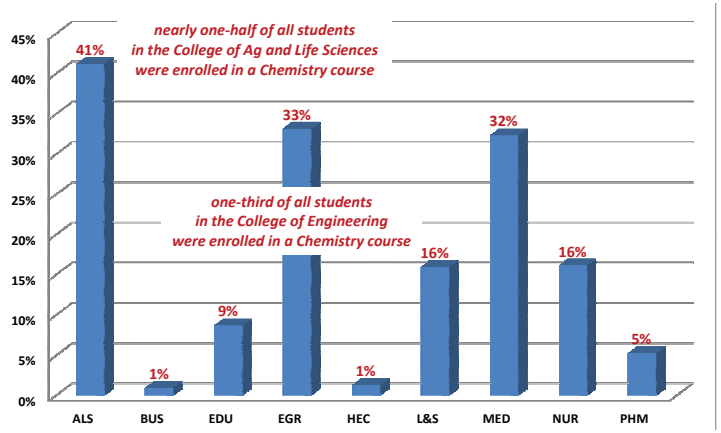
The Chemistry program acts as a gateway to many fields of study at UW Madison (chart at lower right). As such, its undergraduate numbers have continued to grow steadily over 20 years (see chart), despite a cap on enrollment at UW Madison. This has resulted in overstressing the teaching labs with quantities of students and the systems that support them, i.e. the program capacity has long been exceeded. In examining the question for the future, we sought to maintain a high utilization of space while rectifying the lack of space per student in both lecture and lab. The chart on page 29 summarizes the basic differences. For example, in organic chemistry, we projected a need for five labs compared with three today. These labs are based on standards at 80 sf / student vs. today's 57 sf / student. This same pattern is true for all of the teaching labs. A more detailed decision of the utilization methodology occurs on the next page.

Similarly, we knew that in replacing the obsolete lecture halls in Daniels, we wanted to adopt a contemporary pedagogical model. Fortunately, we found examples already existing on campus in the Microbial Sciences Building and in the Health Science Learning Center. Both of these examples use the low rake, continuous table top design that encourages better interactions. Chairs are moveable, tilt swivel type on castors. We also looked closely at the distance from front to back. Fourteen rows emerged as the limit: 18-20 sf / student is the standard.

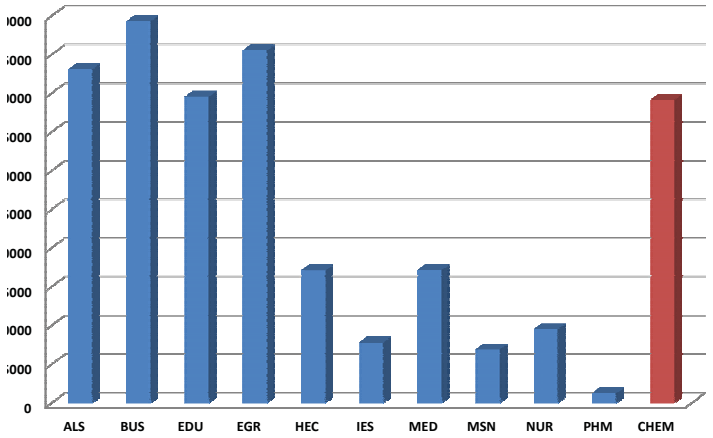
Classroom spaces utilize the table top model as well. Sizes vary from 24-50 students. This model has been used extensively and typically at 25 sf / student size.

CAMPUS-WIDE IMPACT

Undergraduate Students in Each Unit Taking a Chemistry Course As a Percentage of Total Undergrad Enrollment in the Unit - Fall 2009 Semester



Undergraduate Credit Hours Taught by Unit - 2008-09 Academic Year



Chemistry Instruction is a Major Service to the Entire Campus

PROGRAM DEVELOPMENT

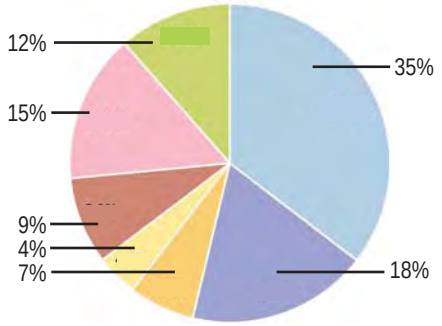
The core of this effort revolved around five working groups who helped shape the detailed program. This involved many hours of workshop time by devoted faculty and staff. Led by Bob McMahon and Fleming Crim, the group saw the potential to improve the department for the long term.

The Five Working Groups:

1. Organic/Inorganic Chemistry
2. General Chemistry
3. Analytical Chemistry
4. Physical Chemistry
5. Common / Shared Space (Library, Lecture, CLC)

In total, the plan is to grow from 70,000 ASF today to 125,300 ASF (78% increase). It should be noted that the added space isn't sized based on future enrollment projections, but is actually right-sizing the program to fit today's enrollment within space that meets moderns standards. This program is broken down into seven categories of space. The technical data to support these activities are described in room by room detail in Appendix F. A brief discussion of the space categories follows.

- Lab / Lab Support: The core of the program (54%) is devoted to lab and lab support. The rationale behind these rooms and their quantities are described on pages 30 and 31. The salient point is that their quantities, standards and supporting space will create a premier teaching / learning environment.
- Lecture Halls and Classrooms: 20% of the program is devoted to replacing the three obsolete lecture halls in Daniels with contemporary models. So too with the 16 classrooms.
- Undergraduate Support: 15% of total. The current library for science is being replaced with a new one. In so doing, we envisioned eliminating the bulk of the stacks and creating an information commons. As part of this effort, we identified a need for student space in the building. Today's study hall is literally the hall itself (photo page 30). These new study spaces are intended to allow students to have a place to work when not in lecture or lab mode.
- Offices for Teaching Faculty: TA's and Professors: 11% of program. No substantial growth in staff is forecast. These spaces are based on 120-150 sf / person.

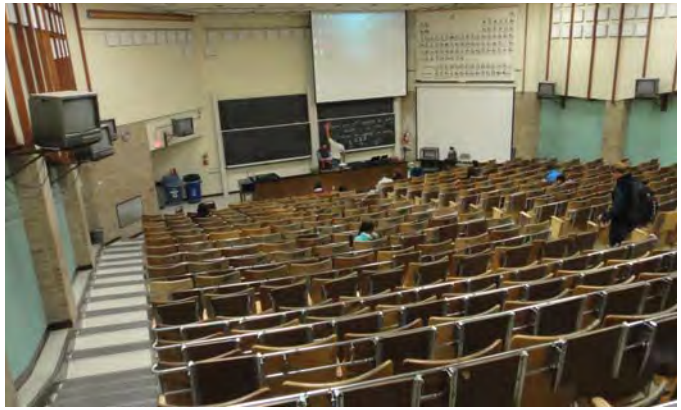


PROGRAM SUMMARY 125,000 ASF

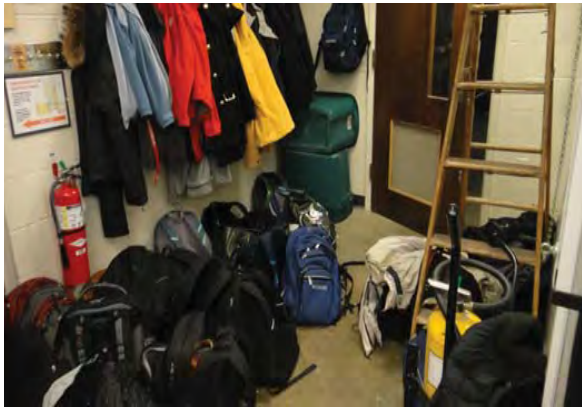
TEACHING LABS	**44,400**	ASF
General Chemistry Teaching Labs	16,800	
Organic/ Inorganic Chemistry Teaching Labs	14,400	
Analytical Chemistry Teaching Labs	6,000	
Physical Chemistry Teaching Labs	4,800	
Student Project Labs	2,400	
TEACHING LAB SUPPORT	**22,930**	ASF
Instrument Rooms/ Work Rooms	5,855	
Stock Rooms	4,275	
Write Up Rooms	12,800	
TA OFFICE	**8,350**	ASF
TA Offices/ Meeting Rooms	8,350	
OFFICE	**5,300**	ASF
Department Offices	1,550	
Lecture Offices	1,650	
Chemistry Learning Center Offices	2,100	
CLASSROOMS	**11,100**	ASF
Teaching Classrooms	10,300	
Chemistry Learning Center Classrooms	800	
UNDERGRADUATE SUPPORT	**18,870**	ASF
Library	5,040	
Computer Rooms/ Lab	2,505	
Study/ Student Activity	9,975	
Chemistry Learning Center Group Rooms	1,350	
LECTURE	**14,350**	ASF
Lecture Halls/Work Room	14,350	
TOTAL ASSIGNABLE	125,300	ASF

INSTRUCTIONAL SPACE COMPARISON | CURRENT VS PLANNED

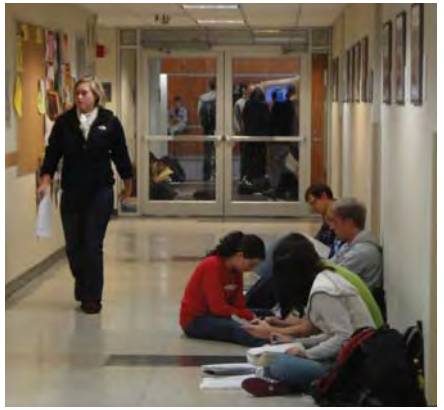
LAB TYPE	CURRENT QNTY	SIZE (ASF/Person)	PLANNED QNTY	SIZE (ASF/Person)	DELTA
GENERAL CHEMISTRY	5	1,884 (47 SF/P)	7	2,400 (60 SF/P)	7,385 SF
ANALYTICAL CHEMISTRY	2.5	2,136 (59 SF/P)	2.5	2,400 (60 SF/P)	648 SF
ORGANIC / INORGANIC	3	2,076 (57 SF/P)	5	2,880 (80 SF/P)	8,171 SF
PHYSICAL CHEMISTRY	2	2,186 (61 SF/P)	2	2,400 (60 SF/P)	(-951) SF
OPEN CHEMISTRY	0	0	1	2,440 (60 SF/P)	2,400 SF
TEACHING LAB SUPPORT	NA	7,547 ASF	NA	22,930 ASF	15,383 ASF
LECTURE HALLS	3	7,672 (8 SF/P)	3	14,350 (12-20 SF/P)	6,678 SF
CLASSROOMS	12	6,521	16	11,100	4,579 SF
TOTAL	12.5 (Labs)	49,491 SF	22.5 (Labs)	92,780 ASF	43,289 ASF



Existing Lecture Hall - 50 Years Old



Student Book and Coat Storage



Existing Student Study Space

KEY PROGRAMMING PRINCIPLES

Provide Facilities Commensurate with Scale of Existing Instructional Program

- Current program is dramatically compressed
- Existing 70,000 ASF increases to 125,000 ASF

Renovate Obsolete Instructional Lab Space

- Restore weekly lab sections for Chem 103
- Adjacent lab and Write-up space
- Improve stockroom / instrumentation spaces

Replace Cramped, Obsolete Lecture Halls

- Table / chair model - greater interaction
- Increase in size from 12 to 25 SF / student

Enhance Programmatic Space

- Learning Center - “at risk” students
- Majors and student organizations
- Lobby space - poster sessions & receptions

Rehabilitate Infrastructure for Daniels / Mathews Reuse

- Only viable strategy to maintain the existing research facilities

Create a “Home” for Chemistry

- Enhance Chemistry Block as home for department
- Provide social center to foster community
- Transform Internal spatial character with openness
- Engage interior with campus context
- Enhance external image of facilities

New Lab Space Standards with Adjacent Discussion Space

New Tabletop / Moveable Chair Model Lecture Halls

Social & Study Space / Science in Sight

Engage Building with Campus Experience

UTILIZATION SUMMARY

OVERVIEW

We studied the current utilization of the Chemistry Department's lecture, classrooms and teaching laboratories based on the current enrollment, class sizes, and the current room count for the three types of teaching spaces. Lecture and classroom spaces are based on 9 daytime classroom sessions per day for five days per week, a total of 45 lecture and classroom sessions per week. Laboratory spaces are based on three 3-hour sessions per day for five days a week, a total of 15 laboratory sessions per week. Two laboratory sections are scheduled to share one teaching laboratory per session.

We found that teaching laboratory space is **over-scheduled for the current enrollment for organic and general chemistry classes**. This over-scheduling issue impacts the current pedagogy for both disciplines, and each has had to modify the scheduling of lab sessions differently.

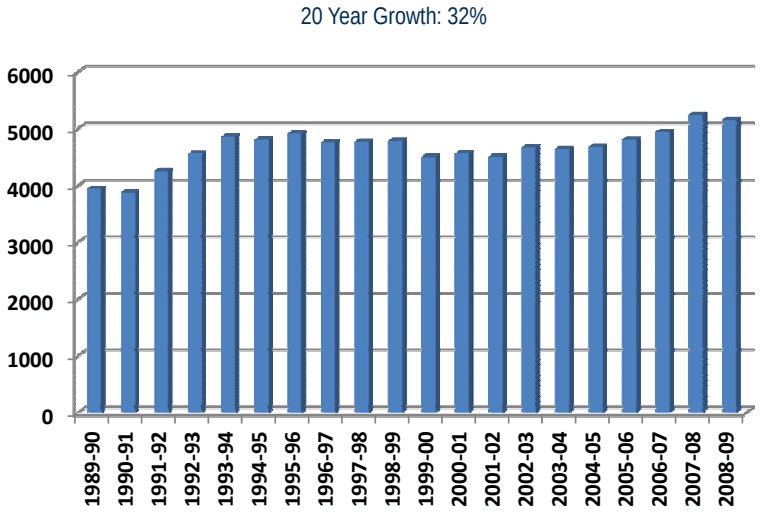
General Chemistry 103, an elementary level chemistry course, has had to schedule its laboratory sessions on a bi-weekly basis, based on course enrollment. Organic Chemistry 344, an intermediate level chemistry course, has had to schedule evening laboratory sessions in a futile effort to meet its course enrollment. Physical and Analytical Chemistry laboratory sessions are operating at near capacity and will gain additional capacity as the needs for laboratory space for general and organic chemistry are addressed.

The table shown on the next page shows the classroom/teaching laboratory requirements for general chemistry and organic chemistry for the current year and for 2015-16 year based on: freshman student enrollment, number of students per section, number of sections required per teaching space and the number of sessions required per week based on teaching space.

The goal for utilization of lecture halls and classroom is 67 percent*. The goal for teaching laboratories is 80 percent*.

**This is extraordinarily high compared to the gold standard of 60% gathered from the peer benchmarking study*

GENERAL CHEMISTRY ENROLLMENT: 1989-2009



CLASSROOM / TEACHING LAB REQUIREMENTS

	DESCRIPTION	GENERAL CHEMISTRY		ORGANIC CHEMISTRY	
		2010 – 11	2015 – 16	2010 – 11	2015 - 16
ENROLLMENT	Campus Freshmen	5,960	6,200	NA	NA
	Chemistry Students	3,576 *(60% of Campus Freshmen)*	3,720 *(60% of Campus Freshmen)*	1,192 *(33% of Chemistry Students)*	1,228 *(33% of Chemistry Students)*
SECTION	Students per Section	22	22	18	18
	Number of Sections *(Chemistry Students / Students per Section)*	162	170	66	68
SECTIONS / SEMESTER	Lecture Sections	10 *(Chemistry Students / 352 Seats)*	11 *(Chemistry Students / 352 Seats)*	8 *(Organic Students / 247 Seats)*	8 *(Organic Students / 247 Seats)*
	Discussion Sections	162	170	66	68
	Lab Sections *(2 Sections / Lab)*	81	85	33	34
SESSIONS / WEEK	Lectures Sessions *(Lecture Sections X 3 / Week)*	30	33	24	24
	Discussion Sessions	324 *(2 Sections / Week)*	340 *(2 Sections / Week)*	132 *(1 Section / Week)*	136 *(1 Section / Week)*
	Lab Sessions	81 *(1 Section / Week)*	85 *(1 Section /Week)*	66 *(2 Sections /Week)*	68 *(2 Sections / Week)*
# OF ROOMS REQUIRED	# of Lecture Halls *(Lect. Sess./ 27 Hrs (9hrs / Day x 3 Days/ Wk.))*	1.1 *(352 Seat Lecture Hall)*	1.2 *(352 Seat Lecture Hall)*	0.9 *(247 Seat Lecture Hall)*	0.9 *(247 Seat Lecture Hall)*
	# of Classrooms *(Discussion Sessions / 36 Hrs. / Wk.)*	9	9.4	2.5	2.5
	# of Teaching Labs *(Lab Sess. / 13 Periods)* *(5 Sessions /Day = 15 – 2(M/F) = 13 Periods)*	6.2	6.5	5.1	5.2

BENCHMARKING SUMMARY

OVERVIEW

In addition to analyzing the data and the current space for chemistry teaching, we sought to extract a national perspective on chemistry teaching by benchmarking peer schools. Six schools were identified and conversations were held with their leaders to glean the major pedagogical principles that were driving their programs and in many cases, their recent facility initiatives. To further hone in on comparative data, we looked at the cost of these initiatives and studied their general chemistry and organic chemistry teaching labs for comparison. A number of interesting parallels and differences came out of these conversations. In addition to this measure of the design, we visited these campuses to get a first hand look at what they have done recently. Below are the highlights of the study:

THE LECTURE / LAB MODEL PREDOMINATES:

All of the schools utilize lectures to share basic principles and data with the students. The University of Illinois has captured these lectures on video so students can go on line to review the material. The size of the lecture sections vary by school: 200 - 500 seats.

LAB SECTIONS ARE TYPICALLY 20-25 STUDENTS

The typical organic chemistry section is 20-25 students but with variations. The ratio of fume hoods per student varied widely but the norm of 3'-4' per student was typical. Looking at trending, the consensus pointed to increasing the hood space per student and moving to 1 hood per student rather than sharing. Given safety and environmental concerns, the consensus is that all organic work is done in the hood wearing goggles. General chemistry is often the orphan component of the program, operating in the older hand-me-down space. Bench top hoods are the norm here as opposed to full height.

SUPPORT SPACES TO TEACHING:

Chemistry is a materials intensive regime. Lots of supplies of chemical and glassware are used at every lab. Supporting these are expensive pieces of equipment. Everyone has their particular materials, supply management, and dispensing system, but the key emerging principle is to have the shared equipment and prep areas between labs to allow joint access and use.

UNIQUE TEACHING STYLE AT UW: TWO TA's FOR TWO SECTIONS

General and organic chemistry labs are taught by teaching assistants. UW has evolved a methodology of having two sections combined in one room. This allows the two TA's to back each other up. If one has to leave the room, the other is there to watch the group of 40-50 students. For safety reasons, this is a preferred mode of operation.

WHAT'S MISSING FROM YOUR PLAN?

Since the majority of schools had built recently, we asked what, if anything, would they do differently. A consistent answer was the lack of discussion and write up space adjacent to the lab so students can meet beforehand, discuss the experiments of the day's lab and then reconvene afterward to write up and synthesize their findings. This feature is part of our model and will put UW in the best practice model for the future.

SUMMARY OF BENCHMARKING RESULTS:

1. Confirmed the basic space standards of the teaching labs: 55-60 SF / student in general chemistry and 75-80 SF / student in organic
2. Confirmed the basic pedagogy of lecture and lab
3. UW will be premier in the efficient use of TA's in a shared lab configuration and in the use of work rooms adjacent to the lab itself.
4. Last we looked for comparable building costs and found our proposal to be in line with the $375-425 / SF norm. A few schools went well above this.

BENCHMARKING SUMMARY: COMPARABLE CHEMISTRY TEACHING AND RESEARCH CONSTRUCTION PROJECTS

UNIVERSITY	GROSS ASSIGNABLE	EFFICIENCY	COST COST/SF (2011)	FUNCTIONAL MIX (Teaching/Research)	COMPLETION DATE
University of Illinois* Chemistry, New	227,600 118,000	52%	$82M $360/SF	Teaching / Research	1997
UC Berkely* Chemistry, New	110,000 69,000	57%	$40.6M $369/SF	Teaching / Research / Commons	1997
University of Michigan* Chemistry & Research, New	260,000 146,000	56%	$92M $354/SF	Teaching / Research / Commons	1990
Johns Hopkins University Science Teaching	105,000 70,000	66%	$45.4M $438/SF	Teaching / Commons	2013
Cornell University* Physical Sciences	204,000 112,200	53%	$103M $504/SF	Teaching / Research / Commons	2010
Princeton University Chemistry	268,200 145,500	54.2%	$133.2M $497/SF	Teaching / Research / Commons	2010
Indiana University Chemistry	261,100 150,000	57.5%	$93.9M $360/SF	Teaching / Research / Commons	1993
Harvard University* Chemistry	60,400 34,700	58%	$21.1M $349/SF	Research / Commons	2001
Vanderbilt University Chemistry	104,000 52,300	50%	$38.9M $374/SF	Teaching / Research	1996
Iowa State University Chemistry	131,700 81,600	62%	$53.5M $409/SF	Teaching / Research	2010
AVERAGES	172,000 98,300	57%	$375 / S.F.	Teaching / Research	8 Years Old

*2011 Pricing, adjusted for Madison, Wisconsin

UNIVERSITY OF WISCONSIN - MADISON
CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION

SITE & BUILDING STUDIES

SITE SELECTION OPTIONS

The accompanying tables reflect multiple different ideas that were tested early in the design process. Initially we considered three basic approaches to the challenge:

OPTION 1: RENOVATE EXISTING (NO NEW CONSTRUCTION)

Given the obsolescence of existing space and systems, the program load, and the desire to shift pedagogy, this proved to be an untenable idea.

OPTION 2: RETAIN EXISTING AND SHIFT TEACHING ACROSS UNIVERSITY AVENUE TO THE MEDICAL SCIENCE CENTER (MSC)

A second strategy tested involved renovation on-site to keep Mathews / Daniels alive by transferring the teaching labs across University Avenue to the Medical Science Center on the upper floors. The test of this idea proved equally untenable given structural and floor plate dimensions and low floor to floor heights. With all of the dimensional limits, we priced this option and found it would cost 80-90% of replacement cost with an inferior end result.

OPTION 3: EXPAND THE ISLAND WITH AN ADDITION / RENOVATION STRATEGY

At first look, the best on-island strategy appeared to be at the north end of Daniels along University. Before jumping to that conclusion, we tested multiple approaches to on-site expansion (see pages 39-41).

Renovate Existing Mathews / Daniels

Relocate Teaching to MSC

Expand / Renovate Mathews Daniels

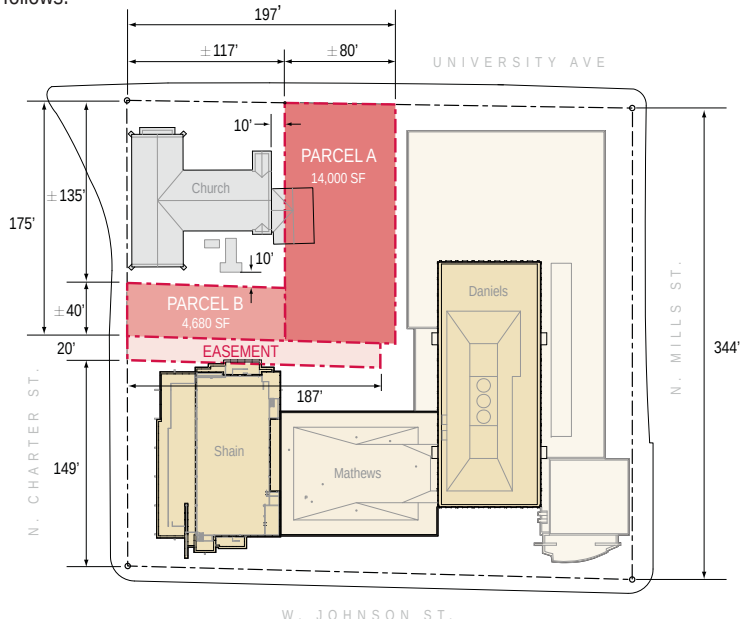
CHEMISTRY BLOCK ANALYSIS

PROPOSED PROPERTY ACQUISITION

Prior to the beginning of this study, the University acquired two important parcels that expanded the block significantly. Parcel A added 14,000 sf behind the church, eliminating an existing extension to the church itself. Parcel B added 4,600 sf running westward toward Charter Street. Taken together, these two parcels allowed consideration of on-site expansion as both an immediate and long term approach.

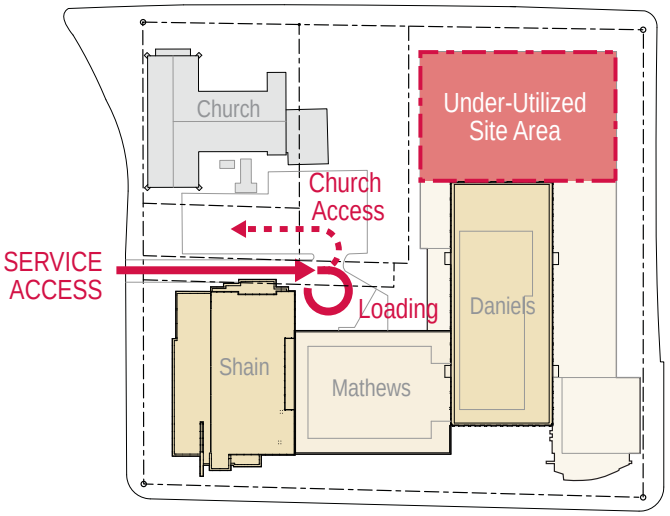
Parcel "A" is not fully purchased. Until such time as construction commences, the house built next to the church remains in use by, and in possession of the church. The City does not want a property line to run through the existing structure. When the project is ready, Parcel "A" will expand slightly West to the line shown below and we will be required to demo the house and replace the East facade of the church.

The accompanying aerial and site plan show key elements that influenced the strategy. Service currently occurs off Charter Street in mid block and given all that goes with that (tanks, docks, etc.), we decided to retain this feature. Second, it was recognized that the northern parcel along University Avenue was underdeveloped and contained obsolete lecture halls that remain central to the Chemistry Program. These factors influenced both the immediate and longer term thinking that follows.



BLOCK ANALYSIS

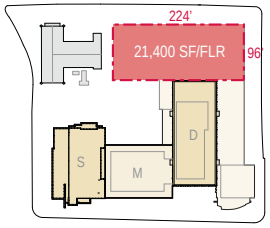
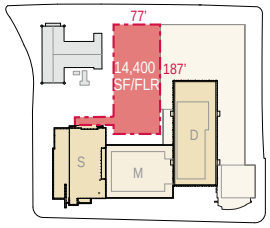
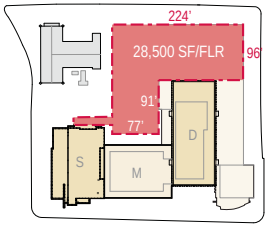
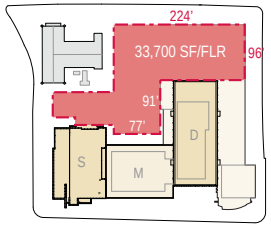
Site Photo from Northwest

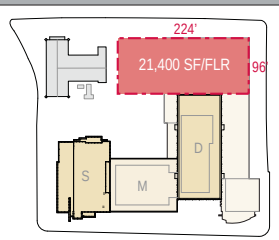
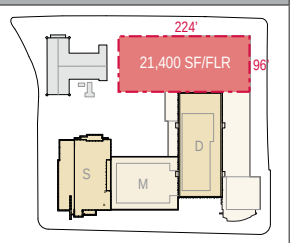


Block Service Access and Site Utilization

BLOCK UTILIZATION STRATEGIES: ON SITE

Four distinctly different approaches were tested for expansion on site. As the accompanying table summarizes, the simplest approach (expanding along University Avenue) proved to be the best. It allowed for a large block of space (21,400 sf/floor), a simple construction logic and promised potential for integrating mechanical systems with the aging Daniels Building that would extend its life another generation.

CRITERIA	STRATEGY 1 East West	STRATEGY 2 North South	STRATEGY 3 "L" Shape	STRATEGY 4 "Z" Shape
				
Demo Daniels North Wing	●		●	●
Floor to Floor Height	16' (To Match Shain)	16' (To Match Shain)	16' (To Match Shain)	16' (To Match Shain)
Number of Floors	7 Floors Above Grade + PH 2 Floors Below Grade	7 Floors Above Grade + PH 2 Floors Below Grade	7 Floors Above Grade + PH 2 Floors Below Grade	7 Floors Above Grade + PH 2 Floors Below Grade
Floor Plate Dimensions	224' x 96'	77' x 187'	224' x 96' / 77' x 91'	224' x 96' / 77' x 91' / 108' x 50'
Floor Plate Description	Flexible Width	Narrow Width	Flexible Width / Narrow Width	Flexible Width/ Narrow Width
Area per Floor	21,400 GSF	14,400 GSF	28,500 GSF	33,700 GSF
Total Building Area	214,000 GSF	140,000 GSF	280,000 GSF	321,000 GSF
Connects all Buildings		●	●	●
Daniels Infrastructure "Chassis"	●	●	●	●
New Image to University	●		●	●
Clear Service Access	●	Require 2-Story open space at grade near dock		
Maximize Long-Term Site Capacity	●	●	●	●

STRATEGY 5 East West	STRATEGY 6 East West
	
●	●
16' (To Match Shain)	16' (To Match Shain)
6 Floors Above Grade + PH 2 Floors Below Grade	5 Floors Above Grade + PH 2 Floors Below Grade
224' x 96'	224' x 96'
Flexible Width	Flexible Width
21,400 GSF	21,400 GSF
171,200 GSF	149,800 GSF
◐	◐
●	●
●	●

UNIVERSITY OF WISCONSIN - MADISON
CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION

DESIGN

PRINCIPLES OF THE DESIGN CONCEPT

Many design ideas were considered. Those that emerged are central to the concept presented here.

- Connectivity:
  Building off the Shain Addition and Renovation of 2000, we discovered the potential of linking the new addition with the existing through a multi-level zone of space on all three floors. Added to the existing east west circulation, this will bring coherence to the current chaos. (see diagram)

  Three elevators will transport large numbers of students to the teaching labs and create inter-floor connections between the addition and the Daniels Building.

  New and Improved entry off of Mills Street and Improved entry at the South end of Daniels off of Johnson Street.

- Stacking Logic / Integration of Daniels and New Addition:
  A second strong integrator is the mechanical system. By connecting the new addition to Daniels, it became possible to switch the air handling, exhaust and heat recovery from Daniels to the new addition thereby extending the life of the Daniels research tower and teaching base, as well as increasing energy efficiency. (see diagram on page 46)

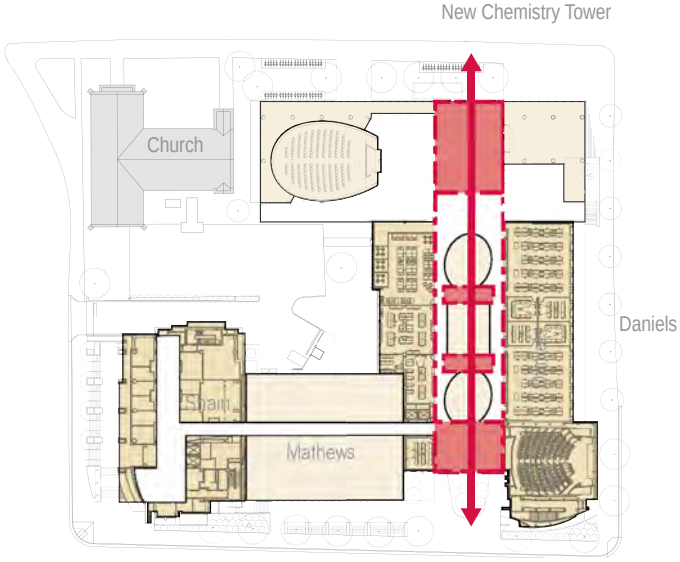
- Floor to Floor Height for Modern Chemistry:
  The section reflects a third design principle: providing adequate floor to floor height (16') for all of the teaching floors while connecting the base floors to allow easy circulation. (see diagram on page 46)

- Site Massing Along University Avenue:
  The character of University Avenue has become more urban as blocks have shifted from low rise to mid rise scale. The proposed addition follows this pattern with an important exception: the development of a two story public zone that opens chemistry to the rest of the University. This lightens the mass of the addition but also provides daylight into the public spaces of the first three floors. This addition is also set back from the street to allow development of a green landscape buffer and bicycle parking zone. This, too, is consistent with other recent projects like WID/MIR, a block away. (see page 48)

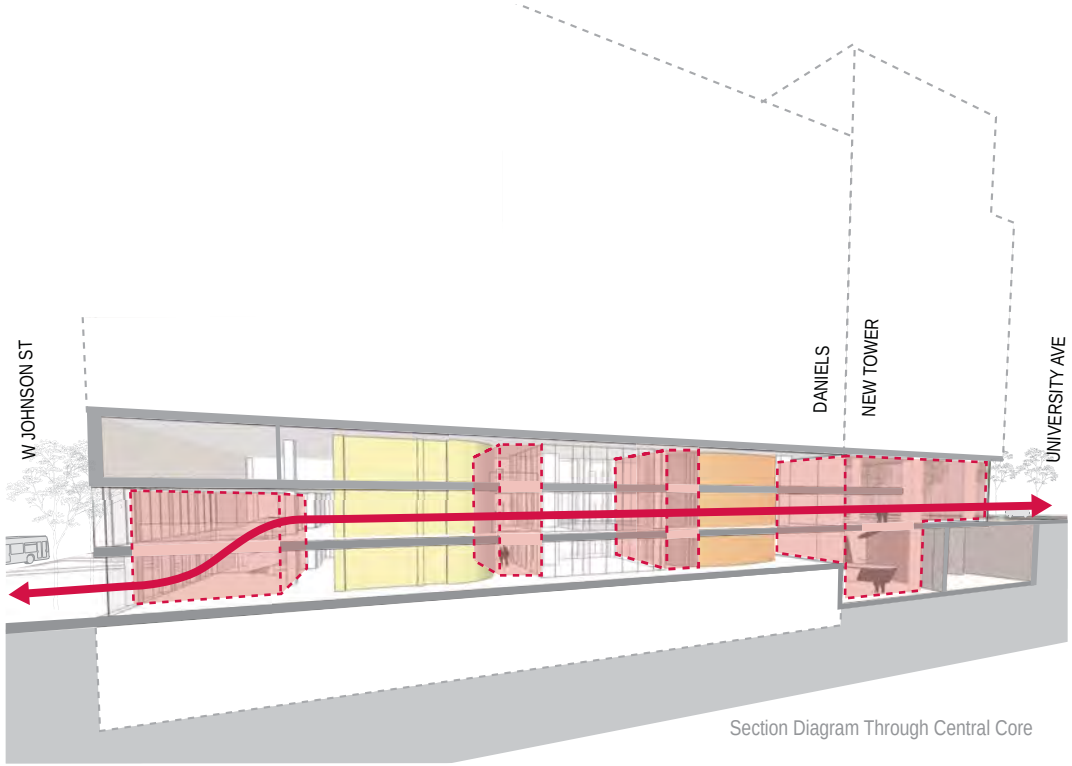
- Long Term Evolution of the Block:
  This design stacking has the immediate effect of replacing seriously obsolete teaching labs and lecture space in Daniels and Mathews. At the same time, we looked at the potential longer term (50 years) cycle of renewal. These five stages suggest a pattern of development that aligns with Shain Tower and makes the ultimate replacement possible with like (16' floor to floor) spaces for teaching and research. (see pages 50-51)

- A Public Zone for Chemistry:
  The most important transformation sought is to change the character inside the chemistry block to one of welcoming students and the entire community. This will be done with openness and spatial character that takes the public character of University Avenue and literally brings it into the building. In the future, we anticipate a social quality to this front door that allows students and faculty a sense of "home" and a place to study and interact. (see page 45)

CONNECTIVITY AS A DESIGN THEME



Central Core Connection



Section Diagram Through Central Core

Ground Floor Level at Johnson Street Lobby

General Chemistry Central Core

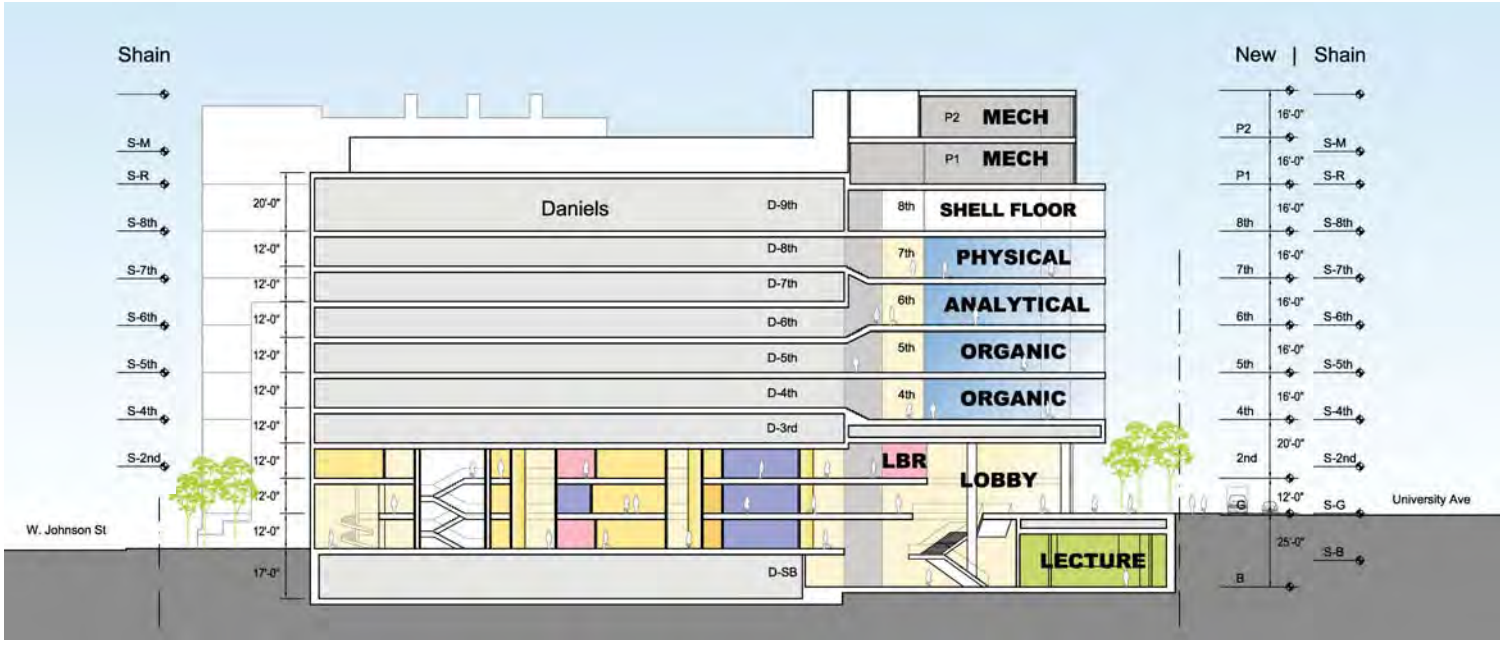
BUILDING SECTION

OVERVIEW

The blocking and stacking of the proposed program responds to the constraints of the site in terms of maximizing the site capacity vertically with a small building footprint by addressing the following:

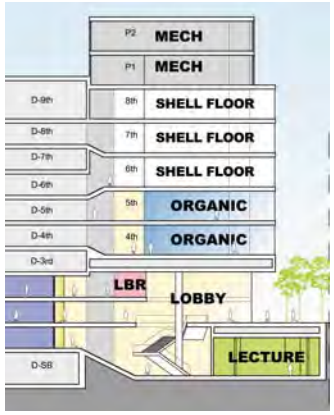
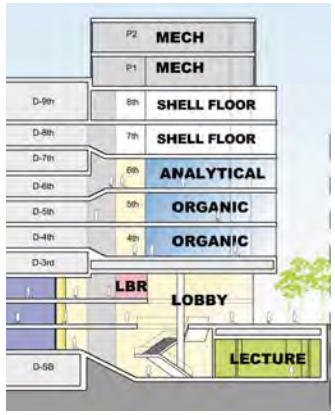
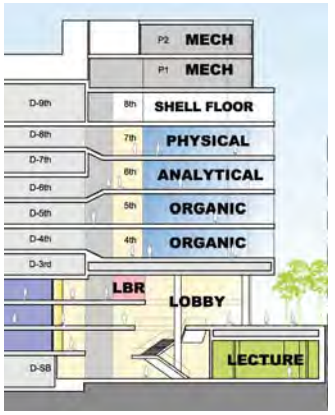
- Upper level Chemistry teaching labs in the new addition to provide for fume hood and instrument intensive laboratories with new air handling and exhaust fan systems.
- Locate larger General Chemistry labs on lower floors of Daniels Building providing for better flow of students.
- Locate Organic/Inorganic Labs on floors 4 & 5 of the new addition to comply with maximum flammable liquid quantity requirements
- Locate lecture halls and chemistry library along University Avenue to create Front Door and identity for the Chemistry Department.
- Locate new addition adjacent to Daniels Building for supplying and exhausting existing research laboratories from the tower penthouse
- Create multi-story spaces in the base of Daniels Building to provide interaction and link through to a Johnson Street entrance to the tower lobby.

SECTION A (NORTH-SOUTH)



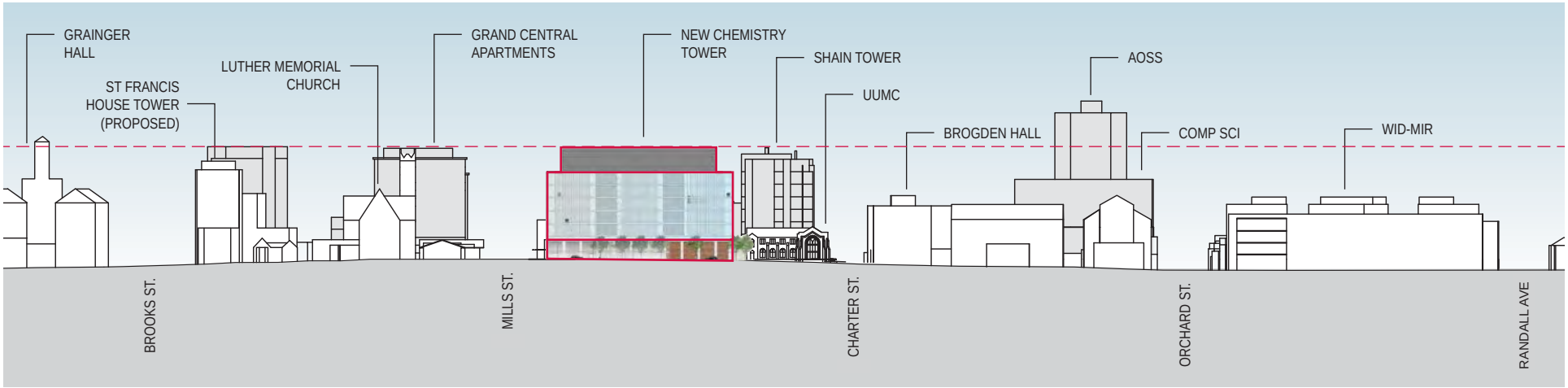
PROGRAM STACKING SCHEMES: THREE ALTERNATES

Using those ideas as a springboard, we then examined different stacking options with the program to arrive at a minimum, medium and maximum strategy. The logic of stacking is illustrated by sectioning below. Place the teaching labs on the top four floors for the most intensive disciplines: organic, physical, and analytical chemistry leaving the general chemistry in renovated space in Daniels. Group the lecture, library and collaborative spaces to form a three story public zone along University with circulation linkages back through these same floors of Daniels. This creates a shared public domain of space with ease of access for the high volume lecture halls. In order to hold down the cost, three different concepts were priced: The minimum, the medium and the maximum. Given the constrained capital environment ahead, but also the fact that the minimum scheme overconstrained the program, we concluded that the mid-range cost scheme was preferred. (see cost / phasing section of the report).

CRITERIA	SCHEME 1 Minimum	SCHEME 2 Medium	SCHEME 3 Maximum
			

BUILDING MASSING

SITE ELEVATION (UNIVERSITY AVE)

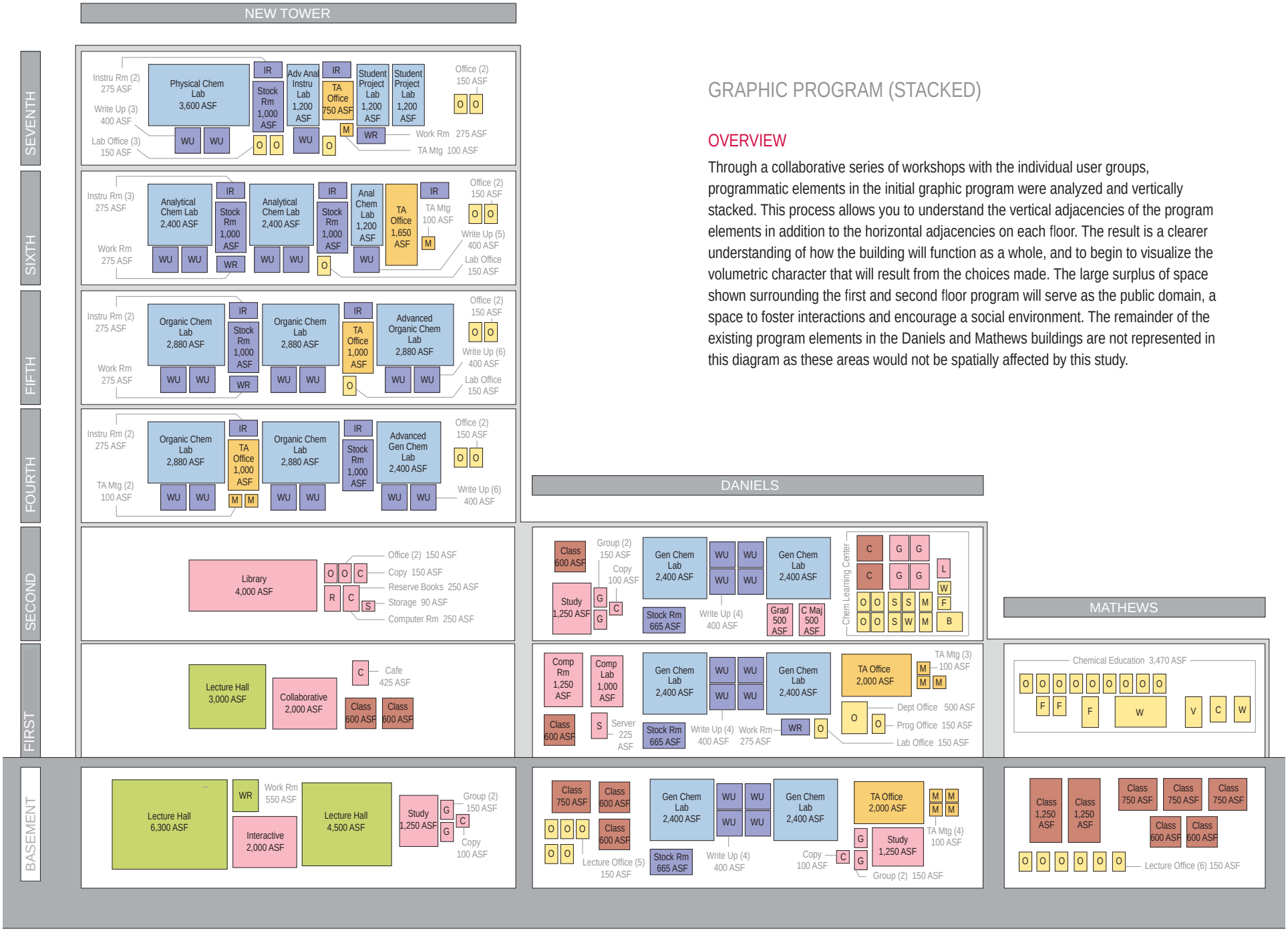


OVERVIEW

We have located the new tower back 10 feet from the front setback (25 feet from the property line) to lessen the presence of the seven story tower on University Avenue. This moves the building back 10' farther than the current Daniels Building. The first two levels of the addition are pulled back an additional 10 feet, exposing structural columns to allow the connection of the interior and exterior for the public spaces. New entrances are located at the intersection of University Avenue and Mills Street providing a gateway from the main campus to the new building.

The floor-to-floor heights of the new tower match the Shain Tower providing potential for connection between the buildings with a future building.

View from Northeast



GRAPHIC PROGRAM (STACKED)

OVERVIEW

Through a collaborative series of workshops with the individual user groups, programmatic elements in the initial graphic program were analyzed and vertically stacked. This process allows you to understand the vertical adjacencies of the program elements in addition to the horizontal adjacencies on each floor. The result is a clearer understanding of how the building will function as a whole, and to begin to visualize the volumetric character that will result from the choices made. The large surplus of space shown surrounding the first and second floor program will serve as the public domain, a space to foster interactions and encourage a social environment. The remainder of the existing program elements in the Daniels and Mathews buildings are not represented in this diagram as these areas would not be spatially affected by this study.

LONG TERM PLAN FOR THE CHEMISTRY SITE

A

Figure A shows the site consisting of three existing chemistry laboratory buildings and the UUMC building. The chemistry laboratory buildings include the Shain Tower (2000), Mathews (1962), and the Daniels Building (1967). The UW Department of Chemistry occupies all of these three buildings, providing research laboratories and undergraduate instructional space. The lowest three floors of Daniels/Mathews include the undergraduate instructional laboratories, classrooms, lecture halls, and chemistry library for the department. Total Building Area: 410,000 GSF; 224,400 ASF.

B

Figure B shows the first phase of expansion proposing the demolition of northern two-story portion and basement area of the Daniels Building, and the house adjoining the church. The new seven-story addition is erected parallel to University Avenue, providing four floors of instructional laboratories, one floor for chemistry library, and two floors of lecture halls and the new main entrance. The upper floors are 16' high to match the floor levels of the Shain Tower.

C

Figure C shows the next phase of expansion, infilling the last open space on the chemistry block, parallel to the Daniels Tower. This building would expand chemistry research capacity and provide additional, instructional space. New building shipping/receiving area would need to be provided. This addition would allow for connection of the instructional tower to the Shain Building.

D

Figure D shows additional expansion of the research building to the south toward Johnson Street. This expansion would allow for the replacement of the aging Mathews building providing for additional research, instructional, administration or office space. This configuration of the expansion could be a separate phase or a large expansion of the earlier phase.

E

Figure E shows future expansion crossing Charter Street to the west toward the Wisconsin Institute for Discovery. This phase of expansion could provide inter-disciplinary research and instructional space in the future.

F

Figure F shows the demolition of the Daniels tower and new expansion of space along the south side of the chemistry block parallel to Johnson Street. The configuration shows with the elimination the Daniels Building and the possibility to provide green space along Mills Street.

UNIVERSITY OF WISCONSIN - MADISON
CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION

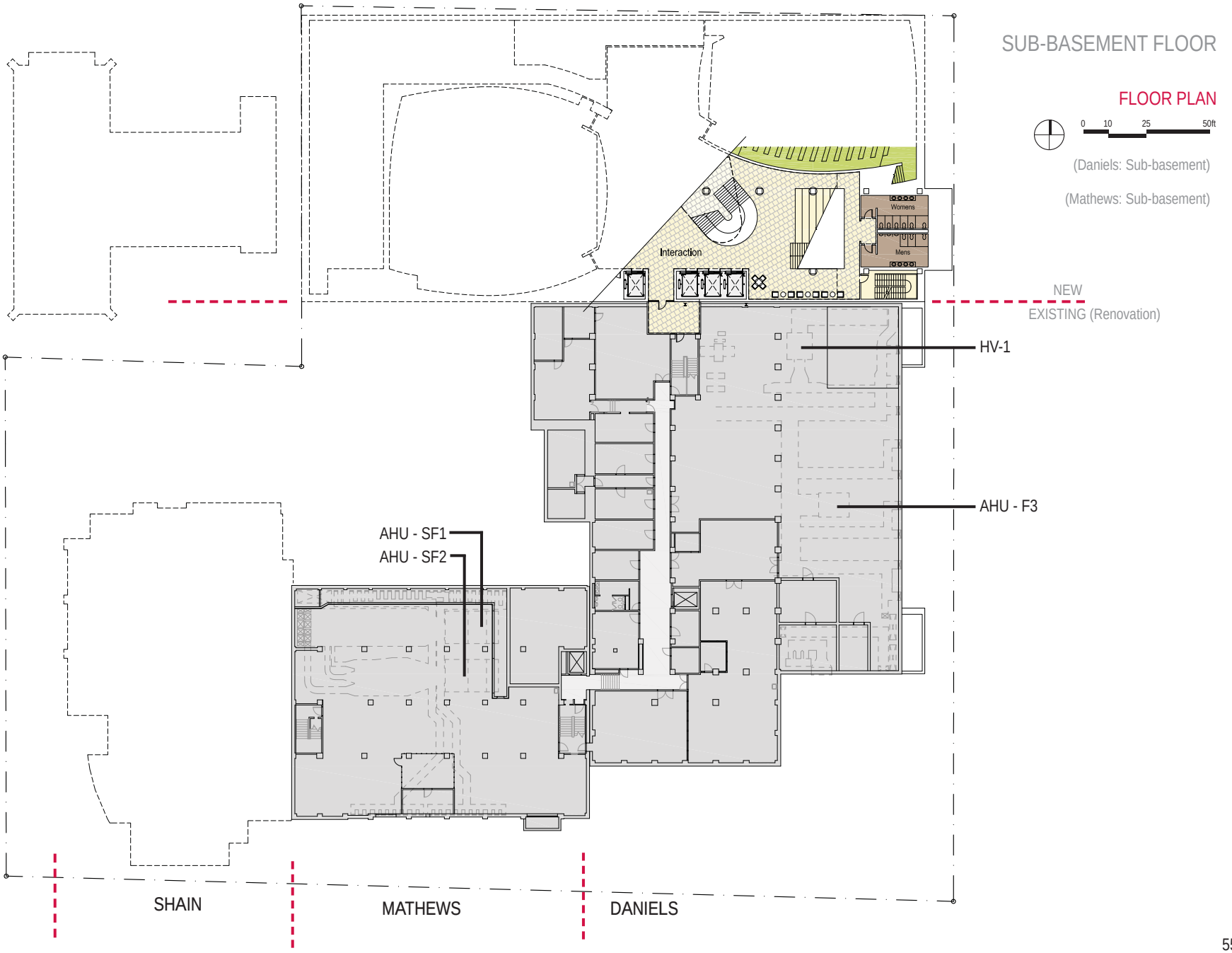
FLOOR PLANS

SUB-BASEMENT FLOOR

OVERVIEW

The Sub-basement of the Daniels building is actually below the lowest level of the New Addition. None of the instructional program is planned for this space. There will however, be work done within the space to accommodate circulation between the buildings, and MEP services needed for the addition.

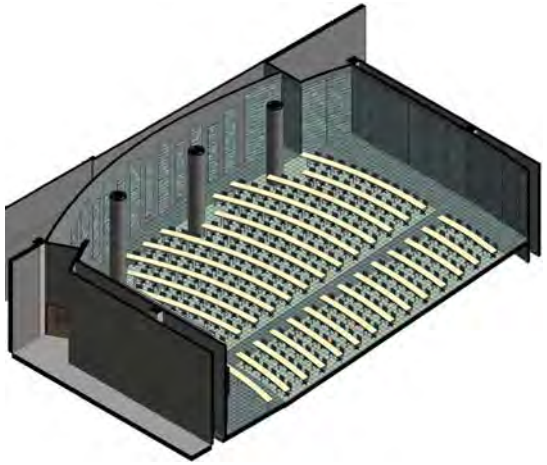
Removal and replacement of the existing air handler located in the sub-basement that is currently serving the lower three floors of Daniels will be done as part of the base project.


SUB-BASEMENT FLOOR
FLOOR PLAN
0 10 25 50ft
(Daniels: Sub-basement)
(Mathews: Sub-basement)
Womens
Mens
Interaction
NEW
EXISTING (Renovation)
HV-1
AHU - F3
AHU - SF1
AHU - SF2
SHAIN
MATHEWS
DANIELS

BASEMENT FLOOR

LECTURE HALL IMAGES

LECTURE HALL AXONOMETRIC

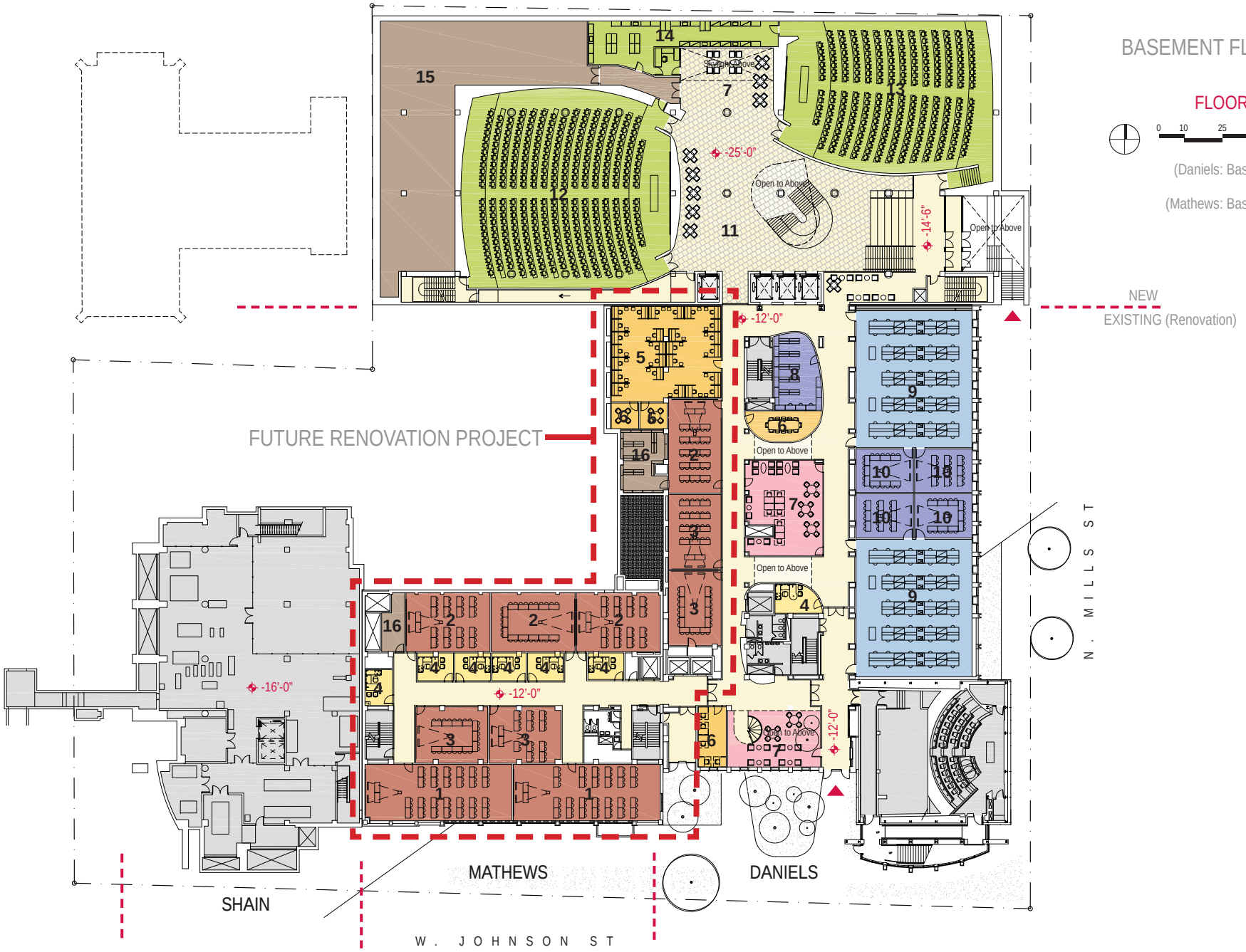


OVERVIEW

The basement level of the new Chemistry Tower/Mathews/Daniels houses the two larger lecture halls and the majority of the teaching classrooms. A new entrance to the basement level from Mills Street helps the flow of students from the lecture halls. The space is opened to the ground by means of a communicating stair and by a skylight along University Avenue. The open space outside of the lecture hall is intended to act breakout space for the lecture rooms and to be utilized as interaction/poster/reception space for the chemistry department.

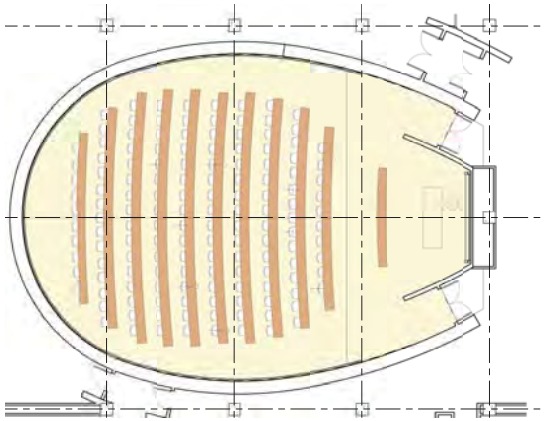
BASEMENT LEVEL
PROGRAM SUMMARY AND KEY

	DESCRIPTION	#	AREA	TOTAL ASF
1	Classroom (50p)	2	1,250	2,500
2	Classroom (30p)	4	750	3,000
3	Classroom (24p)	4	600	2,400
4	Lecture Office	7	150	1,050
5	TA Office	1	2,000	2,000
6	TA Meeting	4	100	400
7	Study	2	1,650	3,300
8	Stock Room	1	665	665
9	Gen Chem Teaching Lab	2	2,400	4,800
10	Write-Up	4	400	1,600
11	Interaction	1	2,000	2,000
12	Lecture (350 seats)	1	6,300	6,300
13	Lecture (250 seats)	1	4,500	4,500
14	Demo Work Room	1	550	550
15	Mechanical/Electrical			
16	Storage			
	TOTAL ASSIGNABLE SQUARE FOOTAGE			35,065

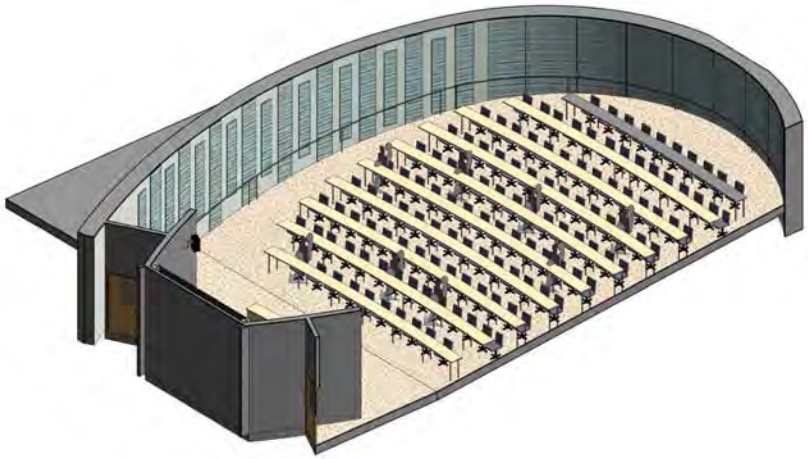

BASEMENT FLOOR
FLOOR PLAN
0 10 25 50ft
(Daniels: Basement)
(Mathews: Basement)
NEW
EXISTING (Renovation)
FUTURE RENOVATION PROJECT
Open to Above
-25'-0"
-14'-6"
-12'-0"
-16'-0"
N. MILLS ST
W. JOHNSON ST
MATHEWS
DANIELS
SHAIN

FIRST FLOOR

LECTURE HALL FLOOR PLAN



LECTURE HALL AXONOMETRIC

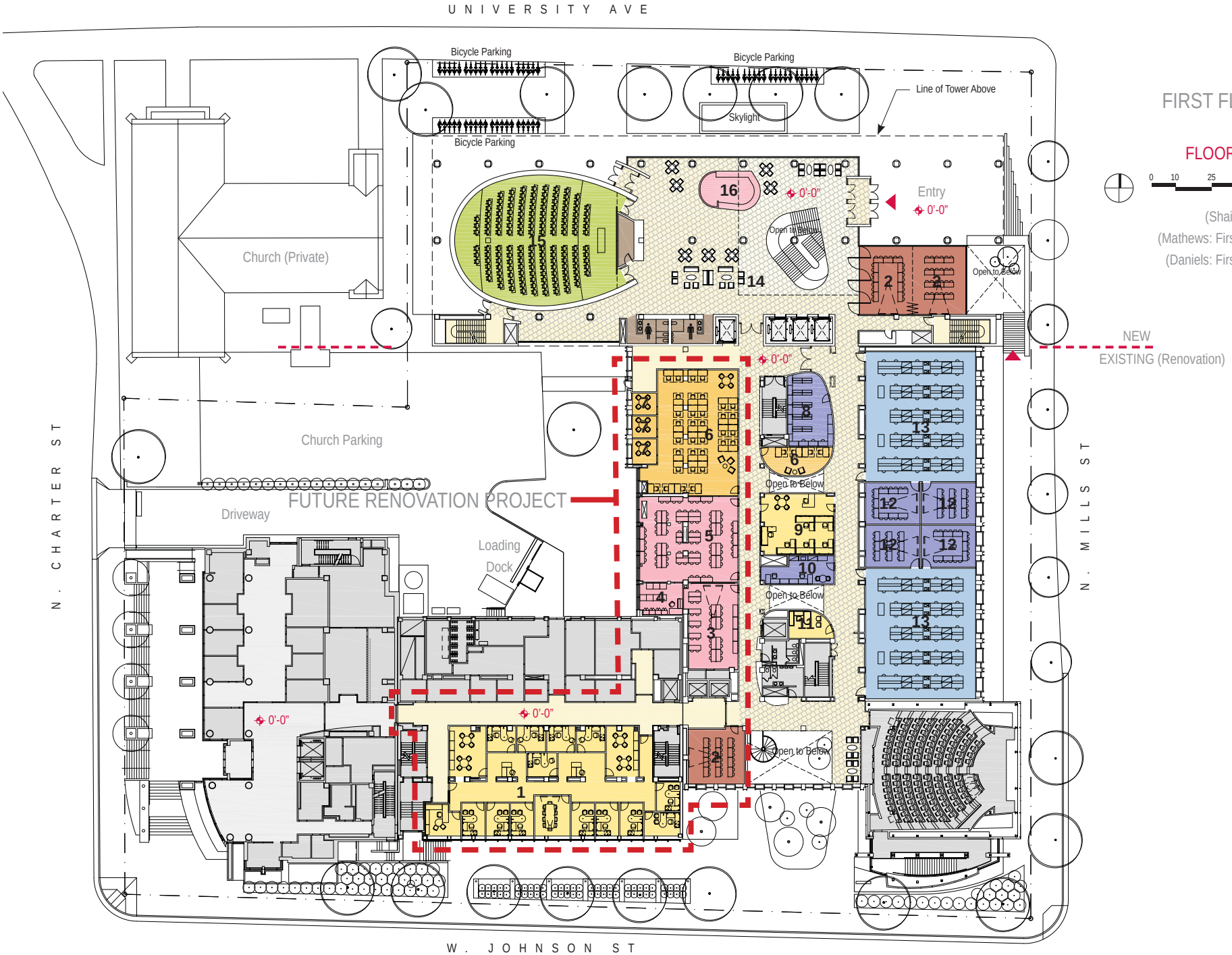


OVERVIEW

Serving as the main entrance into the chemistry complex, the two-story lobby space helps to provide connection between the new tower and the existing Mathews/Daniels building. Students coming from the main campus have access and orientation to all chemistry instructional space as they enter the main lobby from University Avenue. The space is designed to allow for large volume of students coming and going from lecture halls, classrooms and general chemistry teaching laboratories located on the lower three floors of the existing and new buildings of the chemistry program.

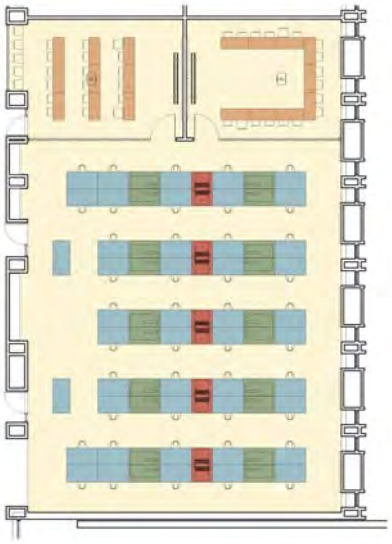
FIRST FLOOR
PROGRAM SUMMARY AND KEY

	DESCRIPTION	#	AREA	TOTAL ASF
1	Chemical Education	1	3,470	3,470
2	Classroom (24p)	3	600	1,800
3	Computer Lab	1	1,000	1,000
4	Server Room	1	225	225
5	Computer Room	1	1,250	1,250
6	TA Office	4	100	400
7	TA Meeting	1	1,250	1,250
8	Stock Room	1	665	665
9	Gen Chem Department Office	1	500	500
10	Gen Chem Work Room	1	275	275
11	Gen Chem Lab Director	1	150	150
12	Write-Up	4	400	1,600
13	Gen Chem Teaching Lab	2	2,400	4,800
14	Lobby/Collaboration	1	2,000	2,000
15	Lecture (150p)	1	3,000	3,000
16	Café	1	450	450
	TOTAL ASSIGNABLE SQUARE FOOTAGE			22,835


UNIVERSITY AVE
Bicycle Parking
Bicycle Parking
Bicycle Parking
Line of Tower Above
Skylight
Church (Private)
Church Parking
Driveway
Loading Dock
FUTURE RENOVATION PROJECT
Entry
0'-0"
Open to Below
N. CHARTER ST
N. MILLS ST
W. JOHNSON ST
NEW
EXISTING (Renovation)
FIRST FLOOR
FLOOR PLAN
0 10 25 50ft
(Shain: First)
(Mathews: First Floor)
(Daniels: First Floor)

SECOND FLOOR

LAB DETAIL FLOOR PLAN



GENERAL CHEM LAB IMAGES

OVERVIEW

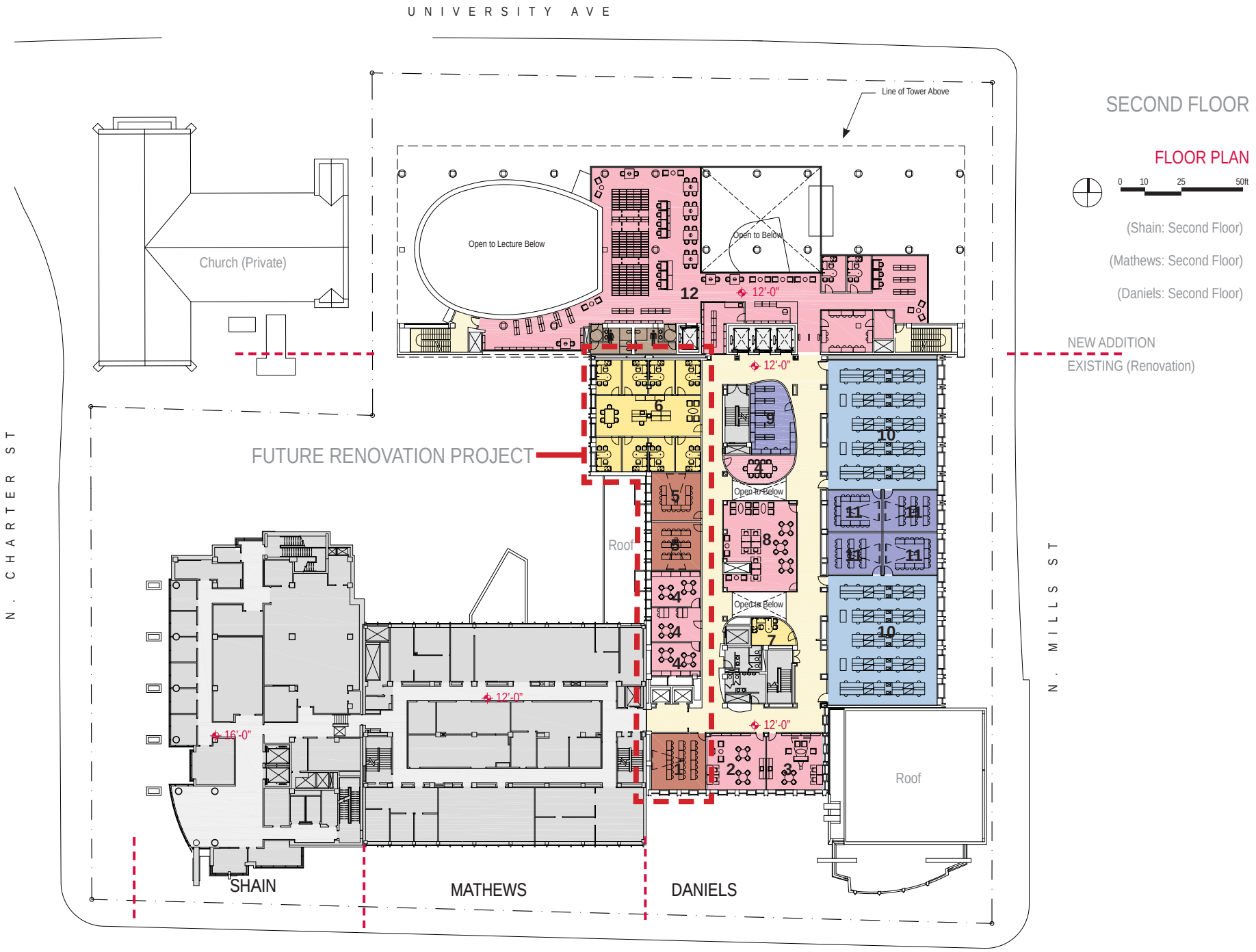
A new Chemistry Library, Chemistry Learning Center (CLC), student study area, and two General Chemistry laboratories are located on the second floor of the new chemistry tower and the Mathews/Daniels Buildings. The Chemistry Library is located along University Avenue and overlooks the entrance/lobby/study areas located on the ground floor. The CLC classrooms, study rooms and offices are collocated on the second floor to create a home for this student outreach program and to foster interaction between students and staff. Shown on this page are floor plan, axonometric and example images of the General Chemistry teaching laboratories communicating the transparency and modular approach envisioned.

SECOND FLOOR
PROGRAM SUMMARY AND KEY

	DESCRIPTION	#	AREA	TOTAL ASF
1	Classroom (24p)	1	600	600
2	Chem Major Lounge	1	500	500
3	Chem Graduate Lounge	1	500	500
4	Chem Learning Center Group Room	4	300	1,200
5	Chem Learning Center Classroom	2	400	800
6	Chem Learning Center Office	1	2,000	2,000
7	Gen Chem Program Director	1	150	150
8	Study Room	1	1,650	1,650
9	Stock Room	1	665	665
10	Gen Chem Teaching Lab	2	2,400	4,800
11	Write-Up	4	400	1,600
12	Library	1	5,030	5,030
	TOTAL ASSIGNABLE SQUARE FOOTAGE			19,495

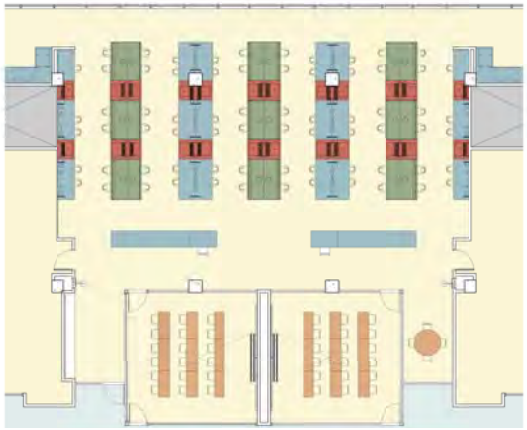
SECOND FLOOR

FLOOR PLAN



FOURTH FLOOR (NO THIRD FLOOR)

ORGANIC LAB DETAIL FLOOR PLAN



ORGANIC LAB IMAGES

OVERVIEW

The Fourth Floor is the first level of teaching labs in the new chemistry tower. Organic Chemistry labs are located on both the fourth and fifth floors to maximize the allowable use of flammable liquids in these fume hood intensive labs. Orientation of benches and transparent student fume hoods are two aspects of design to promote safety in these upper level undergraduate courses. The third lab on the fourth floor is for advanced General Chemistry courses. The lab support core areas provide stock room and TA office space to support the organic/ inorganic curriculum.

FOURTH FLOOR
PROGRAM SUMMARY AND KEY

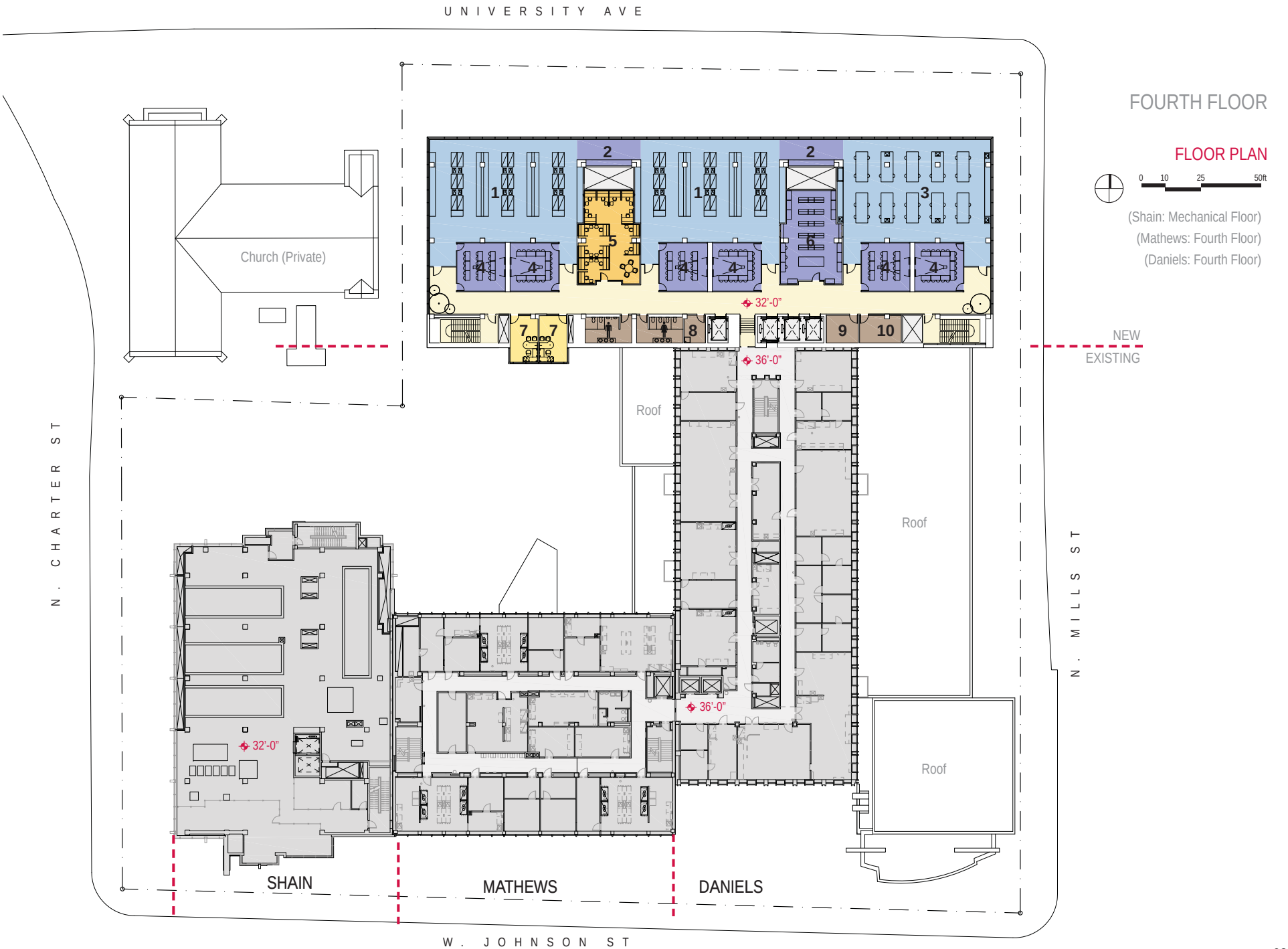
	DESCRIPTION	#	AREA	TOTAL ASF
1	Organic Chem Teaching Lab	2	2,880	5,760
2	Instrument Room	2	275	550
3	Adv Gen Chem Teaching Lab	1	2,400	2,400
4	Write-Up	6	400	2,400
5	Organic Chem TA Office	1	1,000	1,000
6	Organic Chem Stock Room	1	1,000	1,000
7	Faculty Office	2	150	300
8	Janitor			
9	Tele/Data			
10	Electrical			
	TOTAL ASSIGNABLE SQUARE FOOTAGE			13,410

FOURTH FLOOR

FLOOR PLAN

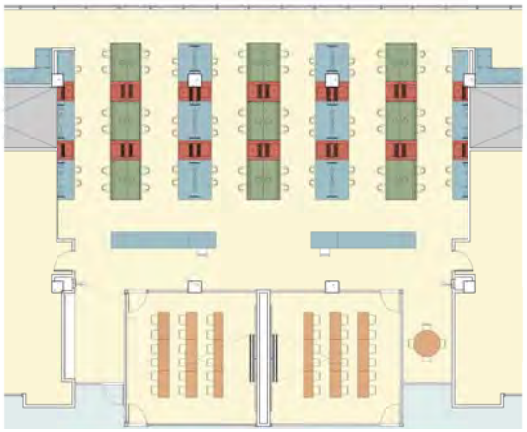
0 10 25 50ft

(Shain: Mechanical Floor)
(Mathews: Fourth Floor)
(Daniels: Fourth Floor)



FIFTH FLOOR

ORGANIC LAB DETAIL FLOOR PLAN



ORGANIC LAB IMAGES

OVERVIEW

Three fume hood-intensive teaching laboratories for majors and non-majors located on the fifth floor of the new chemistry addition. One teaching laboratory is dedicated for upper-level organic chemistry classes. The labs are sized at 2,880 asf to accommodate 2 sections of 18 students and 2 TAs. The program concept allows for the pedagogical integration of discussion and lab.

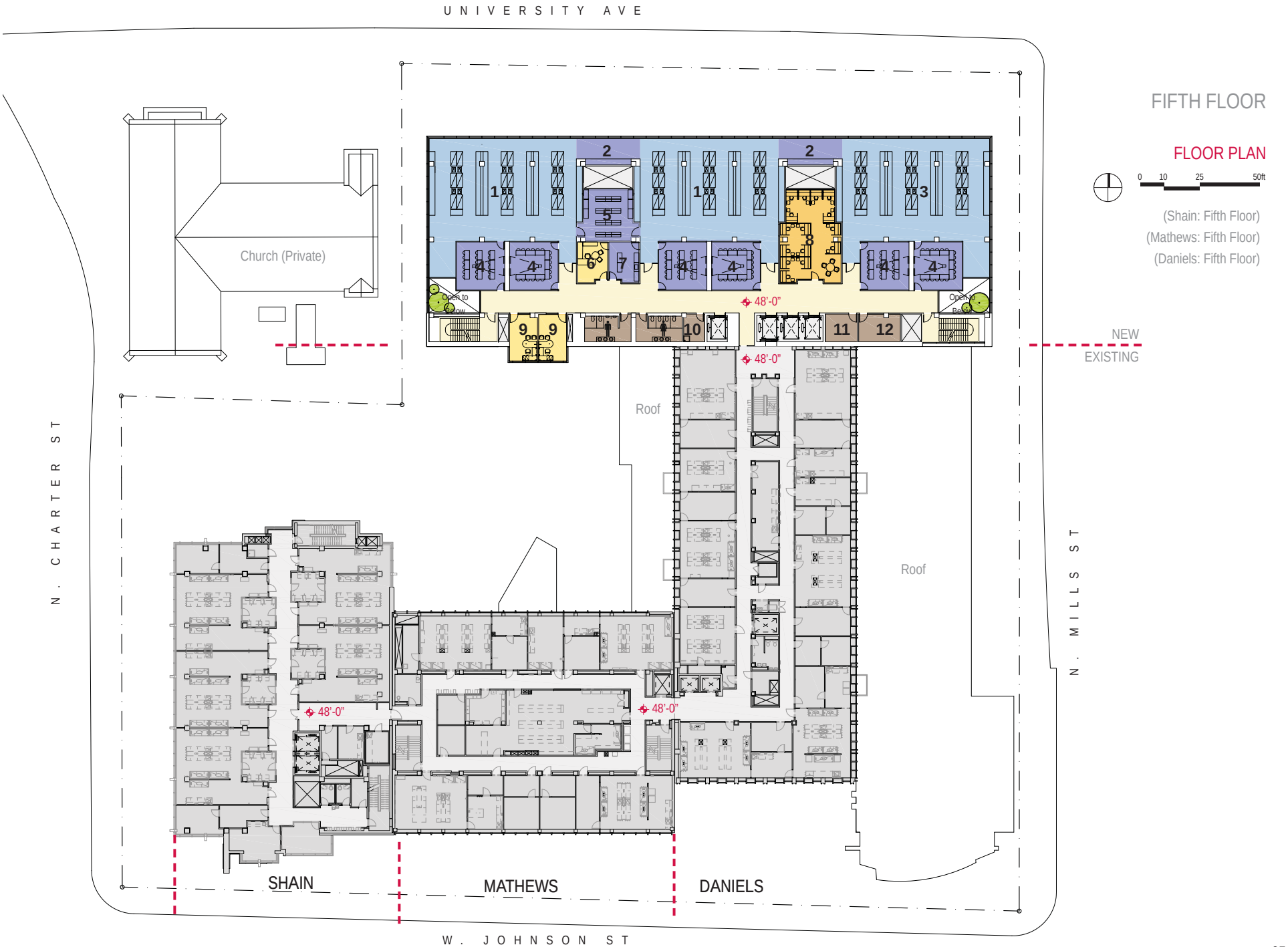
Each laboratory has two write-up rooms located adjacent to the teaching lab and corridor with direct access from each. Eighteen chemical fume hoods, each shared by two students, increases the hood density over current laboratories. Shared instrument space adjoins the three laboratories per floor and provides access to stock rooms and director prep labs.

FIFTH FLOOR
PROGRAM SUMMARY AND KEY

	DESCRIPTION	#	AREA	TOTAL ASF
1	Organic Chem Teaching Lab	2	2,880	5,760
2	Instrument Room	2	275	550
3	Adv Organic Chem Teaching Lab	1	2,880	2,880
4	Write-Up	6	400	2,400
5	Organic Chem Stock Room	1	1,000	1,000
6	Organic Chem Lab Director	1	150	150
7	Organic Chem Work Room	1	275	275
8	Organic Chem TA Office	1	1,000	1,000
9	Faculty Office	2	150	300
10	Janitor			
11	Tele/Data			
12	Electrical			
	TOTAL ASSIGNABLE SQUARE FOOTAGE			14,315

FIFTH FLOOR

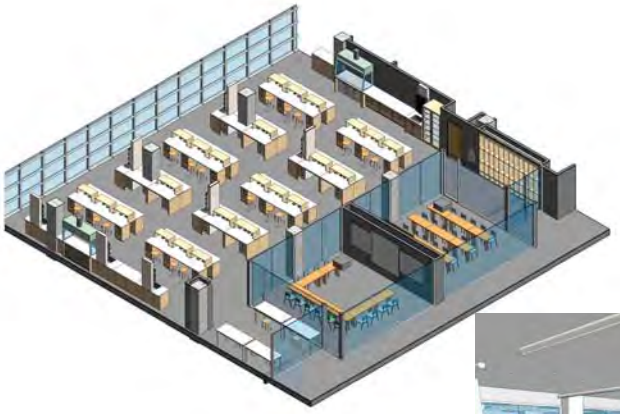
FLOOR PLAN



SIXTH FLOOR

ANALYTICAL LAB DETAIL FLOOR PLAN

ANALYTICAL LAB IMAGES



OVERVIEW

Two 36 student and one 18 student Analytical Chemistry teaching laboratories are collocated on the sixth floor in the new chemistry tower. The labs are sized at 2,400 and 1,200 asf to accommodate single or double sections of 18 students and 2 TAs. The program concept allows for the pedagogical integration of discussion and lab.

Each laboratory has two write-up rooms located adjacent to the teaching lab and corridor with direct access from each. These laboratories are bench intensive with individual student stations and shared prep and instrument bench areas. Hood density is one 6 foot chemical fume hood per section. Shared instrument space adjoins three laboratories per floor and provides access to stock rooms and director prep labs.

SIXTH FLOOR
PROGRAM SUMMARY AND KEY

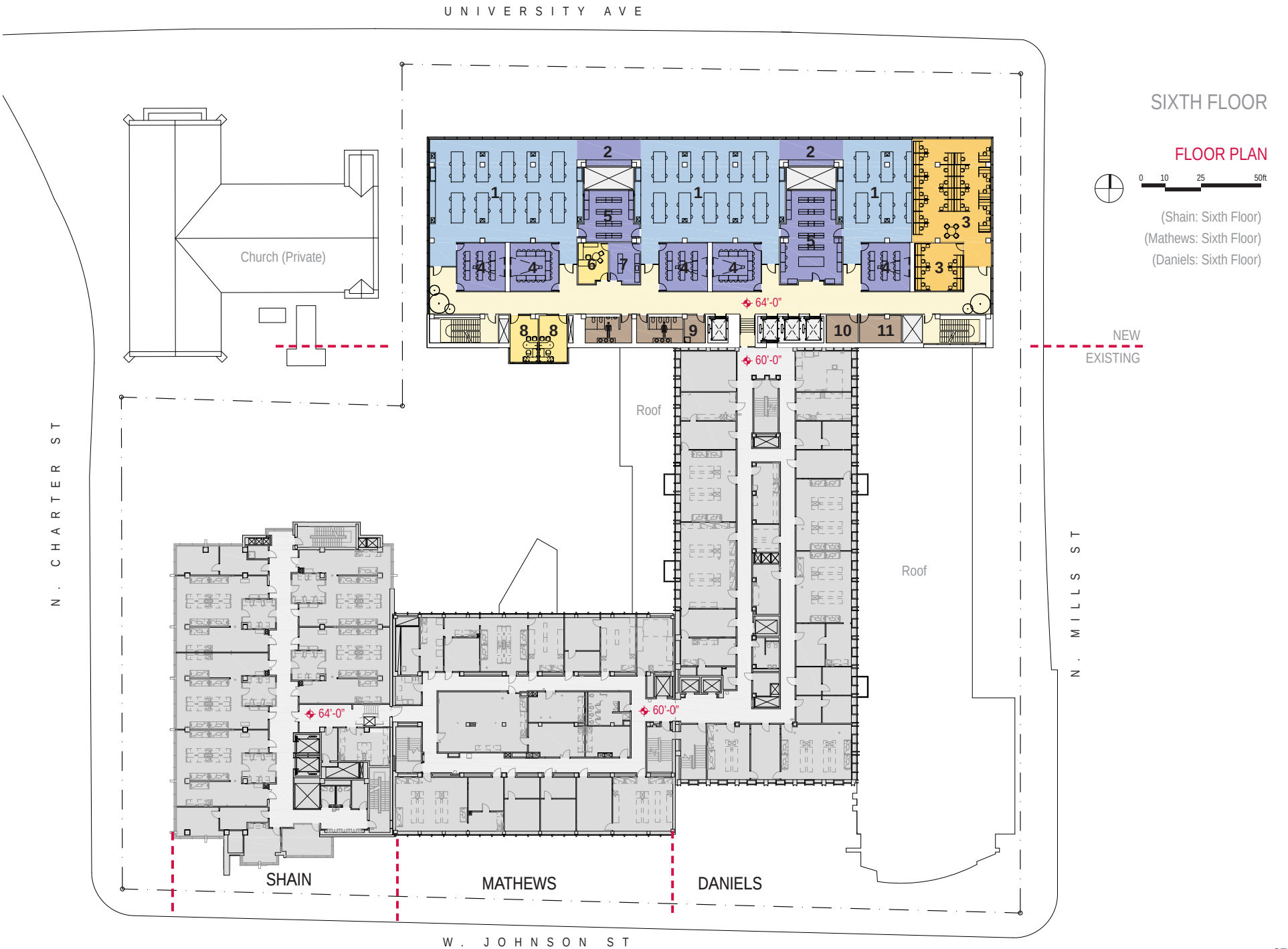
	DESCRIPTION	#	AREA	TOTAL ASF
1	Analytical Chem Teaching Lab	2	2,400	4,800
1	Analytical Chem Teaching Lab	1	1,200	1,200
2	Instrument Room	2	275	550
3	Analytical Chem TA Office	1	750	750
3	Physical Chem TA Office	1	500	500
4	Write-Up	5	400	2,000
5	Analytical Chem Stock Room	1	1,000	1,000
5	Analytical Chem Store Room	1	1,000	1,000
6	Analytical Chem Lab Director	1	150	150
7	Analytical Chem Work Room	1	275	275
8	Faculty Office	2	150	300
9	Janitor			
10	Tele/Data			
11	Electrical			
	TOTAL ASSIGNABLE SQUARE FOOTAGE			12,525

SIXTH FLOOR

FLOOR PLAN

0 10 25 50ft

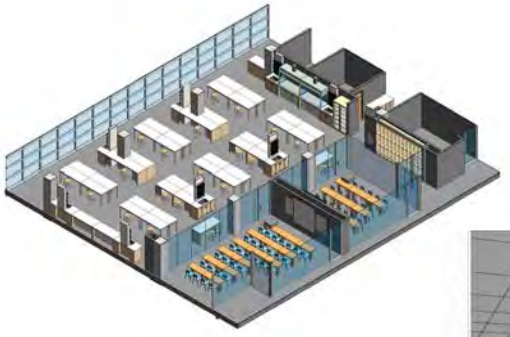
(Shain: Sixth Floor)
(Mathews: Sixth Floor)
(Daniels: Sixth Floor)



SEVENTH FLOOR

LAB DETAIL FLOOR PLAN

LAB IMAGES



OVERVIEW

The Physical Chemistry, Analytical Chemistry Instrument Lab and Student Project Labs are located on the seventh floor. Relocated from the basement and second floors of Daniels during the Fourth Phase of construction, these three laboratories are set up for flexibility to support instrument-based experiments. Physical Chemistry and Analytical Instrument Lab are collocated to share instruments and to have access to smaller support rooms for light sensitive instrumentation. The Student Project Lab is an open access lab space to support independent lab projects and “Capstone” classes for undergraduate students.

SEVENTH FLOOR
PROGRAM SUMMARY AND KEY

	DESCRIPTION	#	AREA	TOTAL ASF
1	Physical Chem Teaching Lab	1	3,600	3,600
2	Instrument Room	3	275	825
3	Instrument Room	2	100	200
3	Analytical Instrument Lab	1	1,200	1,200
4	Student Project Lab	2	1,200	2,400
5	Analytical Chem Stock Room	1	1,000	1,000
6	Write-Up	4	400	1,600
7	Physical Chem Lab Director	1	150	150
7	Analytical Chem Lab Director	1	150	150
8	Student Project Lab Director	1	150	150
9	Student Project Work Room	1	275	275
10	Study Room	2	400	800
11	Faculty Office	2	150	300
12	Janitor			
13	Tele/Data			
14	Electrical			
	TOTAL ASSIGNABLE SQUARE FOOTAGE			12,650


UNIVERSITY AVE
N. CHARTER ST
N. MILLS ST
W. JOHNSON ST
Church (Private)
FUTURE BUILD-OUT
Roof
Roof
Roof
80'-0"
84'-0"
84'-0"
80'-0"
SHAIN
MATHEWS
DANIELS
SEVENTH FLOOR
FLOOR PLAN
0 10 25 50ft
(Shain: Seventh Floor)
(Mathews: Roof)
(Daniels: Eighth Floor)
NEW
EXISTING (no work)

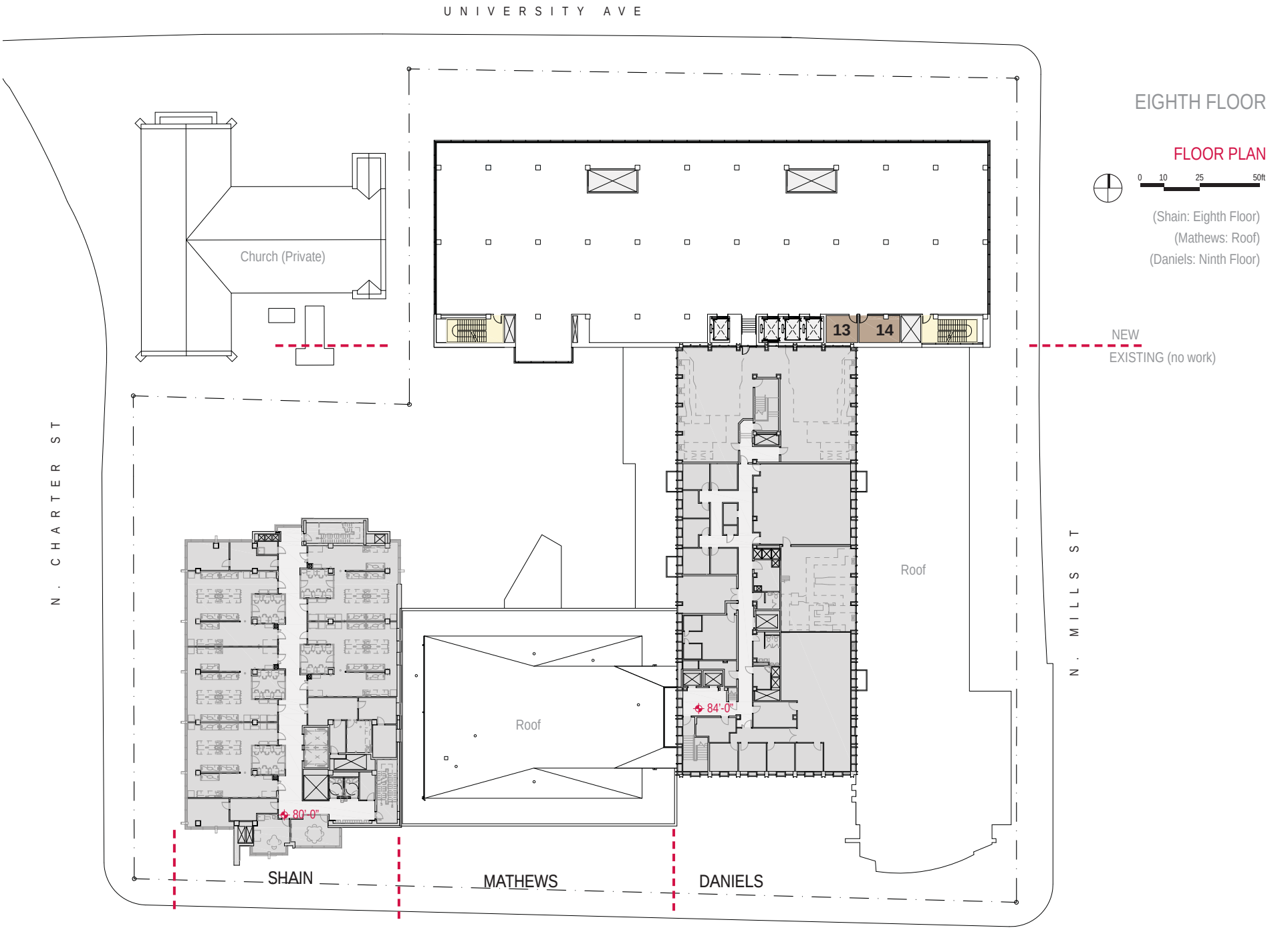
EIGHTH FLOOR

OVERVIEW

The Eighth floor is currently planned as an empty shell space to accommodate future growth within the department of Chemistry. The goal of maximizing site capacity is central to this project and therefore, building the structure to its maximum height potential was desired.

EIGHTH FLOOR
PROGRAM SUMMARY AND KEY

	DESCRIPTION	#	AREA	TOTAL ASF
13	Tele/Data			
14	Electrical			



EIGHTH FLOOR

FLOOR PLAN

0 10 25 50ft

(Shain: Eighth Floor)
(Mathews: Roof)
(Daniels: Ninth Floor)

NEW
EXISTING (no work)

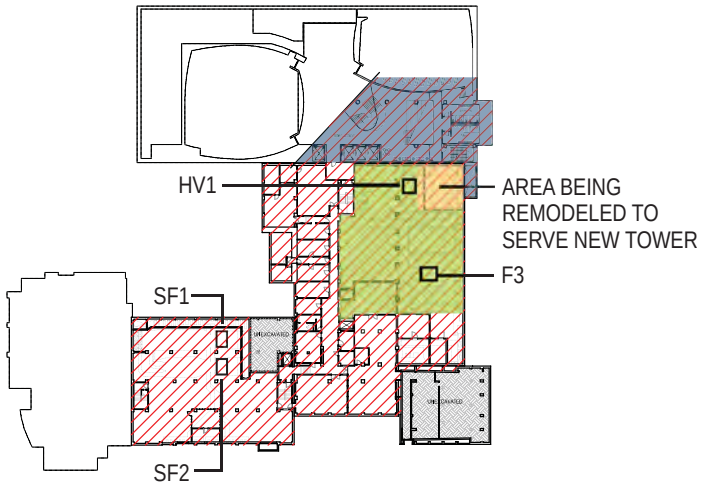
UNIVERSITY OF WISCONSIN - MADISON
CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION

COST & PHASING

CONSTRUCTION PHASING

BASE AND FUTURE PROJECTS

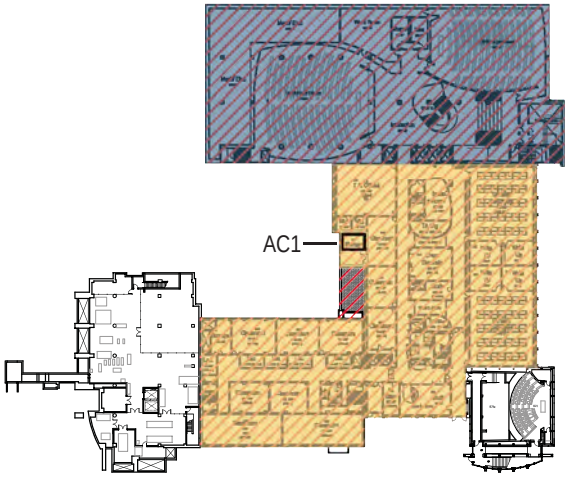
As part of this study we developed a construction schedule for the construction of the new chemistry tower and renovation of the lower three floors of the Mathews/Daniels Buildings. The proposed project is broken into different construction phases to allow for maximizing the use of existing instructional lab and classroom space during the construction. The first phases which comprise the base project, address the immediate need for expanding teaching space for General Chemistry and Organic Chemistry classes. The remaining phases - "Future Proejects" - include fit-out of the seventh floor for Analytical and Physical Chemistry teaching labs and lab support, renovating the remainder of the lower Mathews/Daniels floors for classrooms, study rooms, Chemistry Learning Center and TA/departmental office space, and a fit-out of eighth floor shell space.



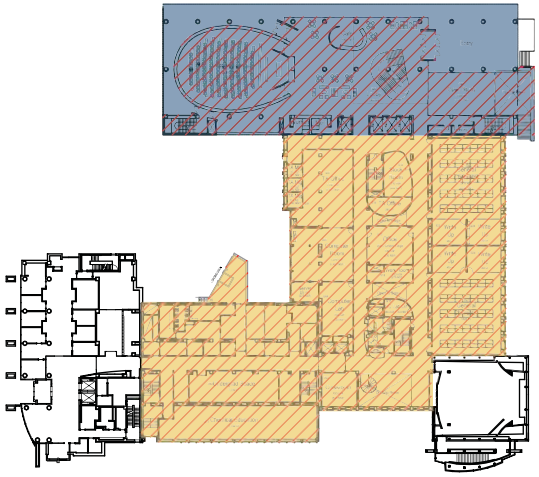
Sub-Basement Floor

DIAGRAM KEY:

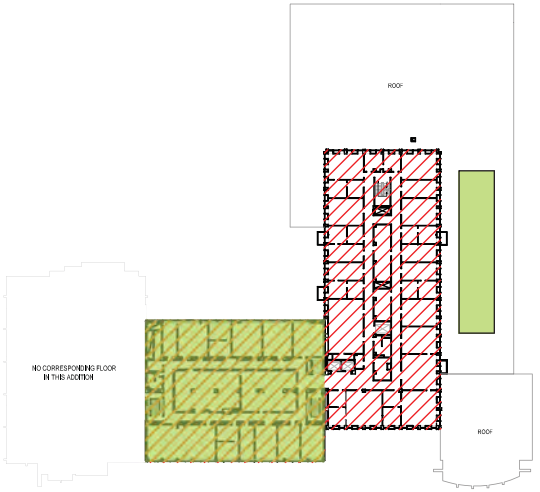
- New Construction
- Fire Sprinkler Installation Only
- Infrastructure Improvements
- Complete Renovation



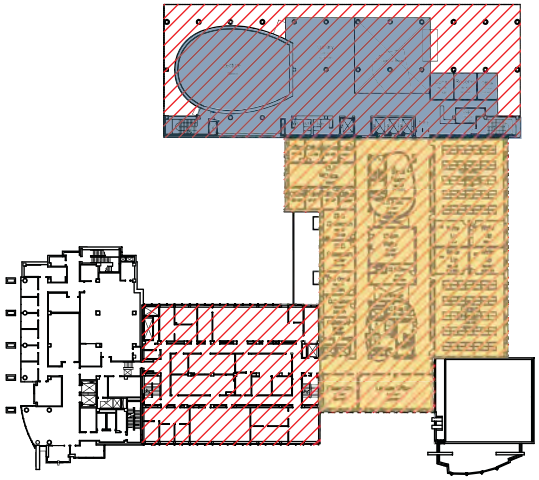
Basement Floor



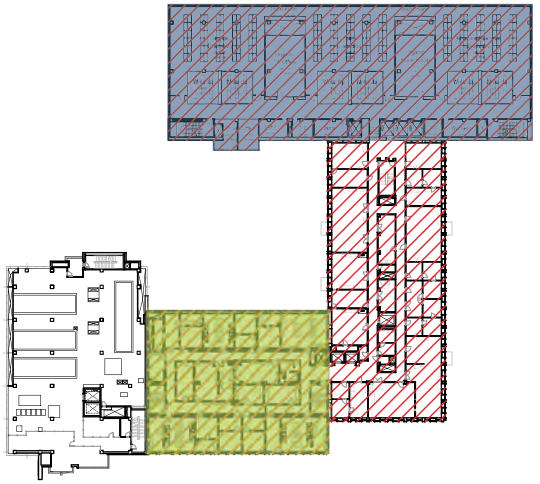
First Floor



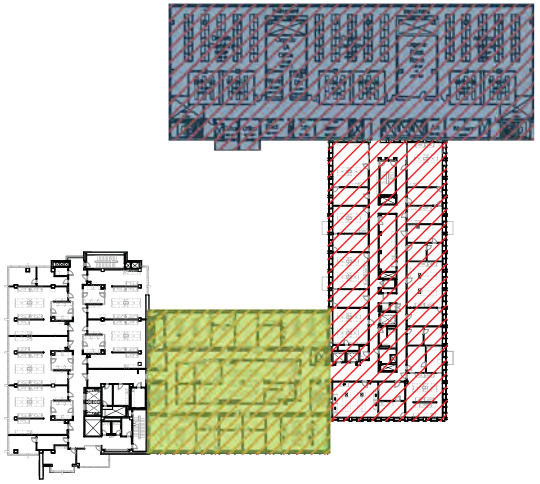
Third Floor



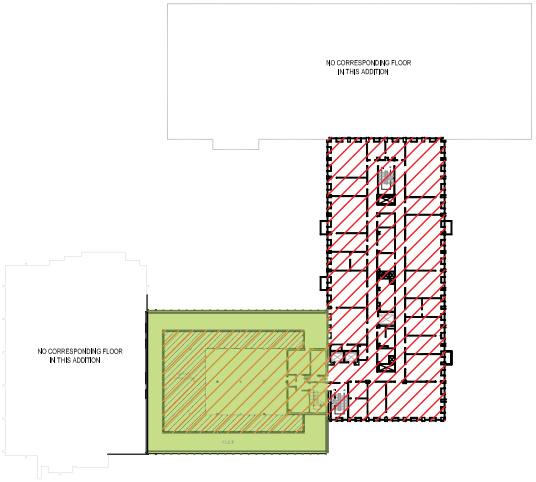
Second Floor



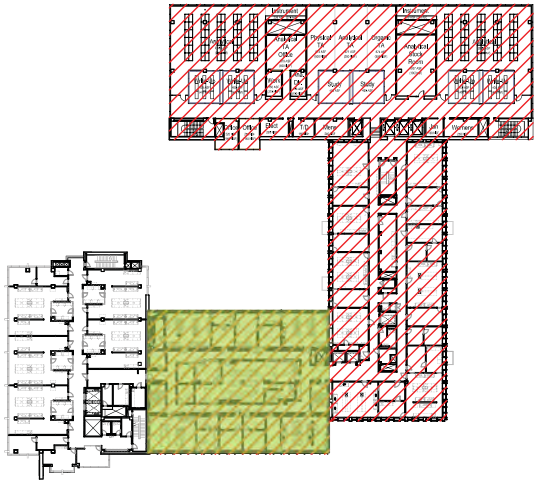
Fourth Floor



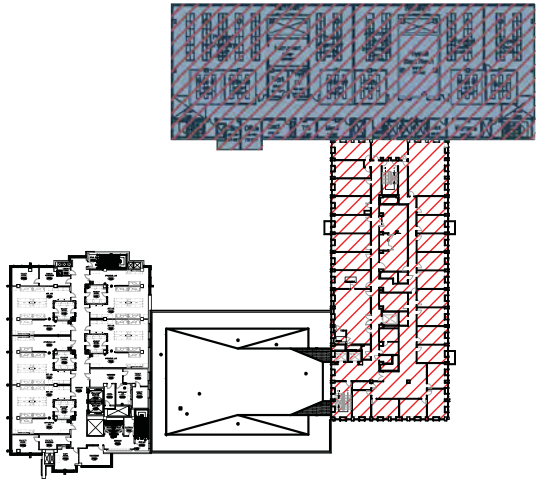
Fifth Floor



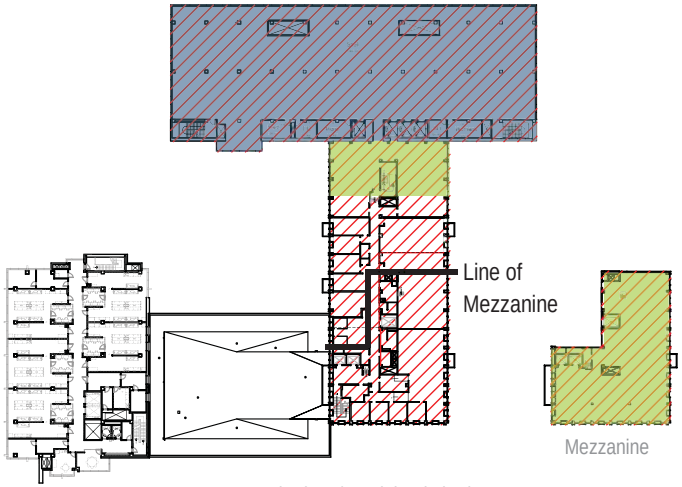
Daniels Seventh Floor / Mathews Penthouse



Sixth Floor

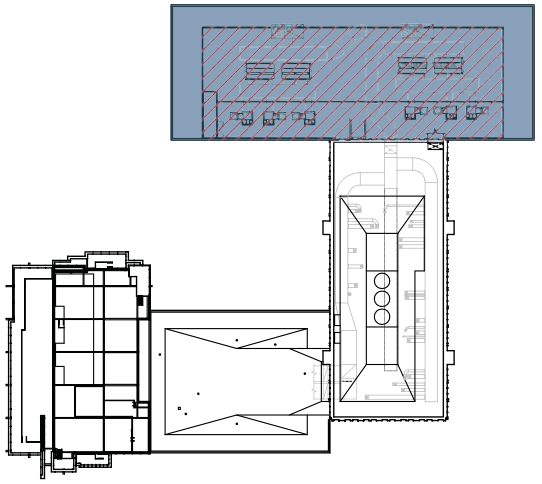


New Tower Seventh Floor / Daneils Eight Floor

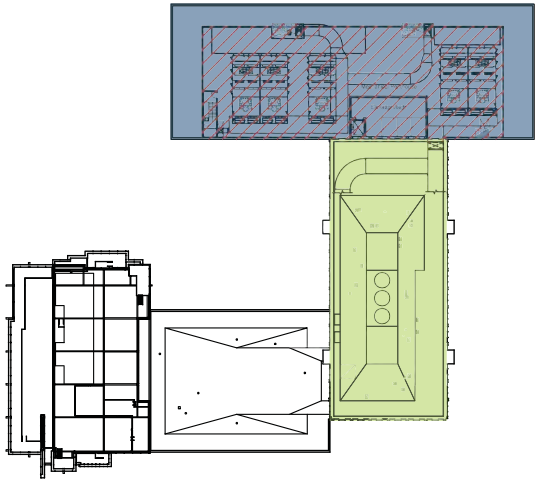


Mezzanine

New Tower 8th Floor / Daniels Ninth Floor

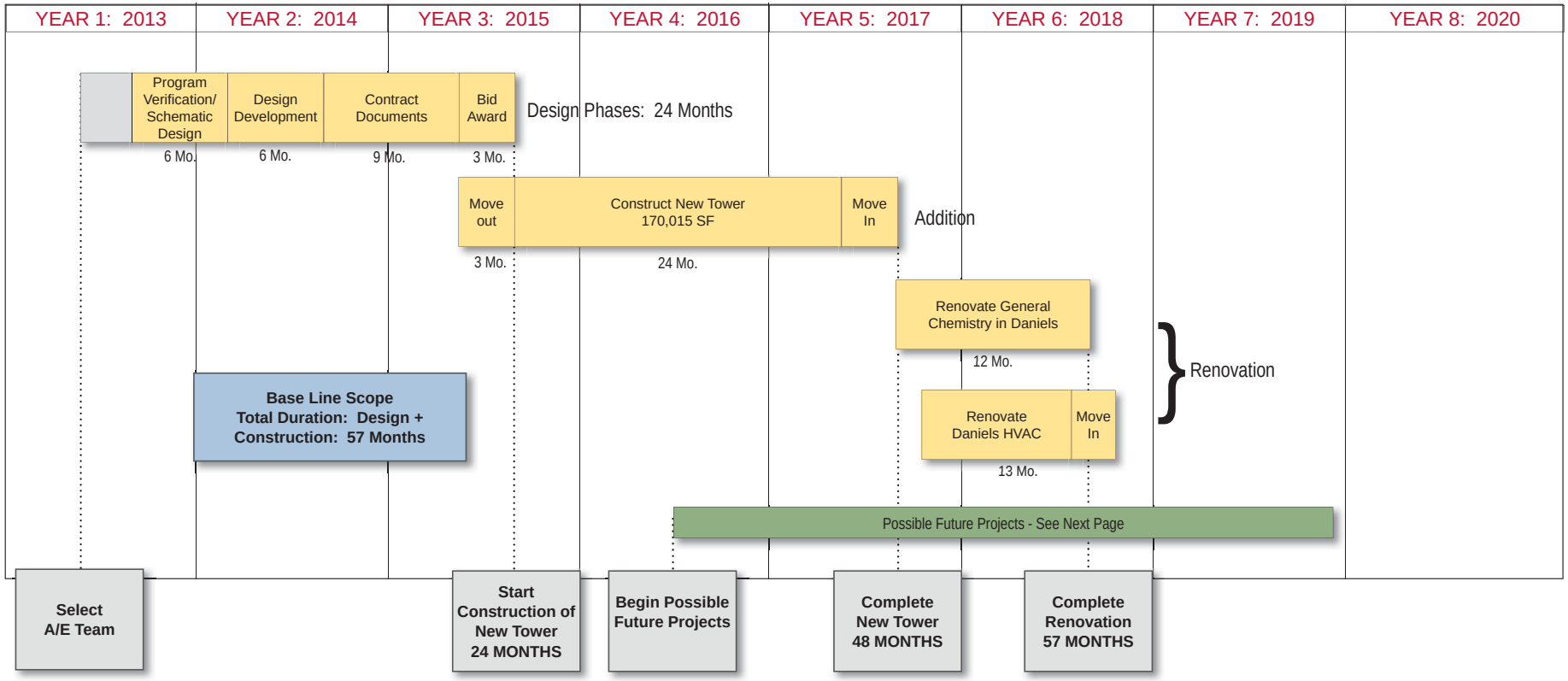


Penthouse Second Floor



Penthouse First Floor

MULTI-PHASE IMPLEMENTATION PLAN: BASE PROJECT



Assumes traditional delivery method

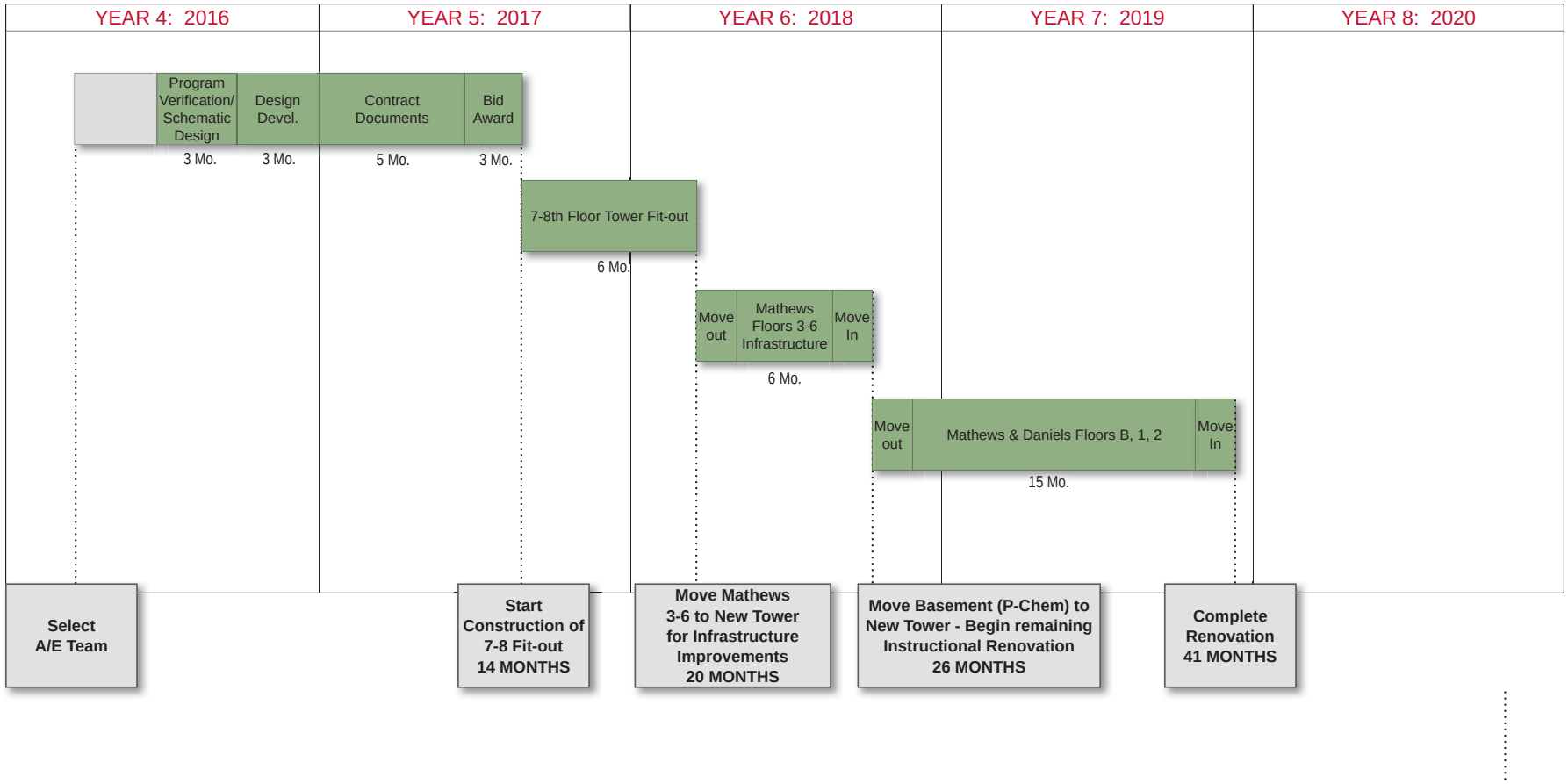
See detailed project phaisng schedule (pages 81-85) for more information

BASE PROJECT

FUTURE PROJECTS

MULTI-PHASE IMPLEMENTATION PLAN: FUTURE PROJECTS

Assumes traditional delivery method



BASE PROJECT

FUTURE PROJECTS

PROJECT PHASING FLOW-CHART

BASE PROJECT

RELOCATE (OFF-SITE): 2015

- LECTURE HALLS
- LECTURE PREP
- GENERAL CHEMISTRY
- DANIELS NORTH END FUNCTIONS AS REQUIRED
- LIBRARY
  - Computer Servers
  - Collections to storage

DEMOLITION:

- *LECTURE HALLS*
- *LABS AT NORTH END*
- *LIBRARY*
- *RESTROOMS*
- *DEMO HV-1 - PROVIDE TEMPORARY INTAKE ELSEWHERE*
- *F-1/F-2 - 9TH FLOOR - TEMP INTAKE AS TOWER RISES*

CONSTRUCTION:

- SITE/UTILITIES
- CORE/SHELL
- INTERIORS
- INTERCONNECTIONS
- TOWER COMMISSIONING / *DANIELS COMMISSIONING*
- *STAGING OF AHU-F3 THROUGH NORTH AREA WELL*
- IN NEW TOWER: *DANIELS NEW HIGH ROOF INFRASTRUCTURE: AHU'S, EXHAUST FANS AND FUTURE E.A. SHAFT*

MOVE:

- ORGANIC/INORGANIC MOVE TO 4TH/5TH FLOOR OF NEW TOWER
- LIBRARY, LECTURE HALLS AND LECTURE PREP MOVE TO NEW TOWER

DEMOLITION:

- *DANIELS PENTHOUSE DEMO*

CONSTRUCTION:

- *STAGING OF REPLACEMENT AHU F3 THROUGH AREA WELL*
- *TEMP DANIELS ROOF DISTRIBUTION*
- NEW MATHEWS E.A. AND CONNECTION ON ROOF OF DANIELS
- *NEW DANIELS MECHANICAL SCREENING*
- *COMMISSIONING*

CONSTRUCTION:

- *DANIELS NEW SUPPLY AIR, SMALL EXHAUST RISERS, BALANCE (56 PHASES)*
- *AREA BY AREA/RISER BY RISER (3-9)*
- *DANIELS HIGH ROOF COMPLETE*
- *DISRUPTION (1-2 WEEK SHUT-DOWN, CHEMICAL MOVE)*
- *BALANCING*

FLOWCHART KEY:

TEXT — RELOCATION / SWING PHASE

TEXT — DEMOLITION PHASE - *DANIELS* - MATHEWS

TEXT — CONSTRUCTION PHASE - NEW - *DANIELS* - MATHEWS

DEMOLITION:

- *DANIELS B,1,2 INSTRUCTIONAL LABS*
- *EAST CORRIDOR AND CENTRAL SUPPORT ROOMS*
- *KEEP DANIELS WEST CORRIDOR OPERATIONAL*
- *DANIELS AHU F-3, AC-1, HV-1 AND LOW ROOF EXHAUST*
- *FLOOR OPENINGS*

CONSTRUCTION:

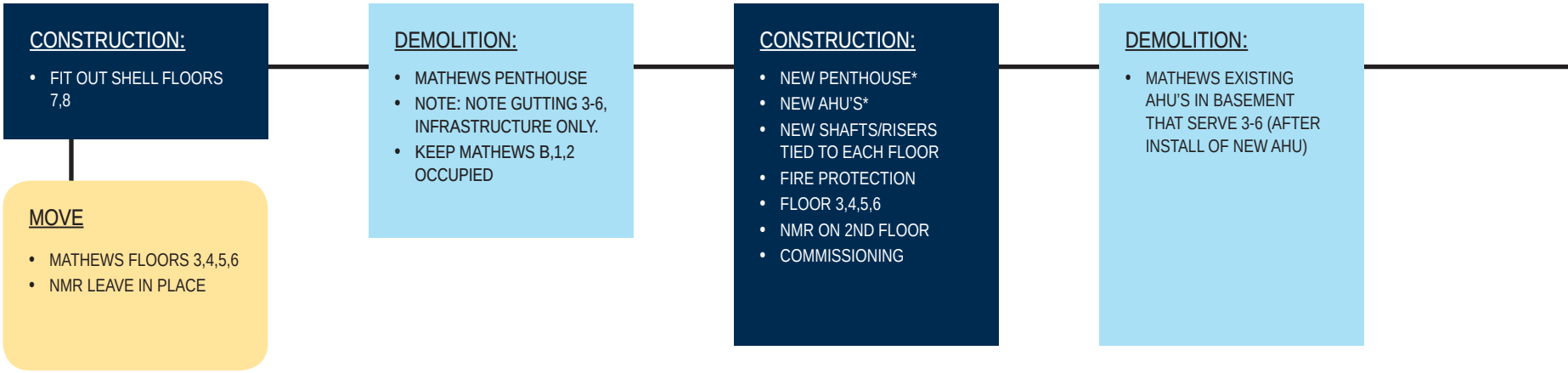
- *DANIELS B,1,2 INSTRUCTIONAL LABS*
- *EAST CORRIDOR AND CENTRAL SUPPORT ROOMS*
- *STOCK ROOMS*
- *FIRE PROTECTION: SB, B, 1, 2*
- *CONNECT B,1,2 TO NEW EXHAUST*
- *INSTALL NEW AHU F3*
- *RECONNECT WEST SIDE DANIELS TO AHU*
- *COMMISSIONING*

MOVE:

- GENERAL CHEMISTRY RETURNS TO B,1,2 DANIELS
- STOCK ROOMS

PROJECT PHASING FLOW-CHART

FUTURE PROJECTS



FLOWCHART KEY:

TEXT RELOCATION / SWING PHASE

TEXT DEMOLITION PHASE - *DANIELS* - MATHEWS

TEXT CONSTRUCTION PHASE - NEW - *DANIELS* - MATHEWS

MOVE:

- RETURN MATHEWS FLOORS 3,4,5,6 TO FORMER USE, MOVE FROM SWING SPACE ON FLOORS 7-8 IN NEW TOWER
- MOVE MATHEWS FLOOR B,1,2 PHYSICAL CHEMISTRY TO 7TH FLOOR OF NEW TOWER
- CHEMISTRY LEARNING CENTER
- TA OFFICES
- CLASSROOM / TESTING ROOM / COMPUTER LAB

DEMOLITION:

- GUT MATHEWS FLOOR B,1,2 (EXCEPT NMR)
- *GUT DANIELS REMAINDER OF FLOORS B,1,2 (NOTE: SYSTEMS COMPLETE, NEW DISTRIBUTION NEEDED)*
- NMR COOLING FROM NEW ROOF UNIT

CONSTRUCTION:

- *DANIELS REMAINDER OF B,1,2 INTERIOR INCLUDING WEST CORRIDOR, INCLUDING FIRE PROTECTION*
- MATHEWS B,1,2 INTERIORS, INCLUDING FIRE PROTECTION
- LOADING DOCK

MOVE:

- INTO MATHEWS AND DANIELS B,1,2
- CLASSROOMS, CLC, TA OFFICES, IN WEST DANIELS, ETC.

CONSTRUCTION:

- *DANIELS FIRE PROTECTION (IF NOT DONE EARLIER) SB, 3-9*
- *PLASTIC DUCT WORK*
- *PLUMBING MAINS*
- *BUS DUCT, OTHER*

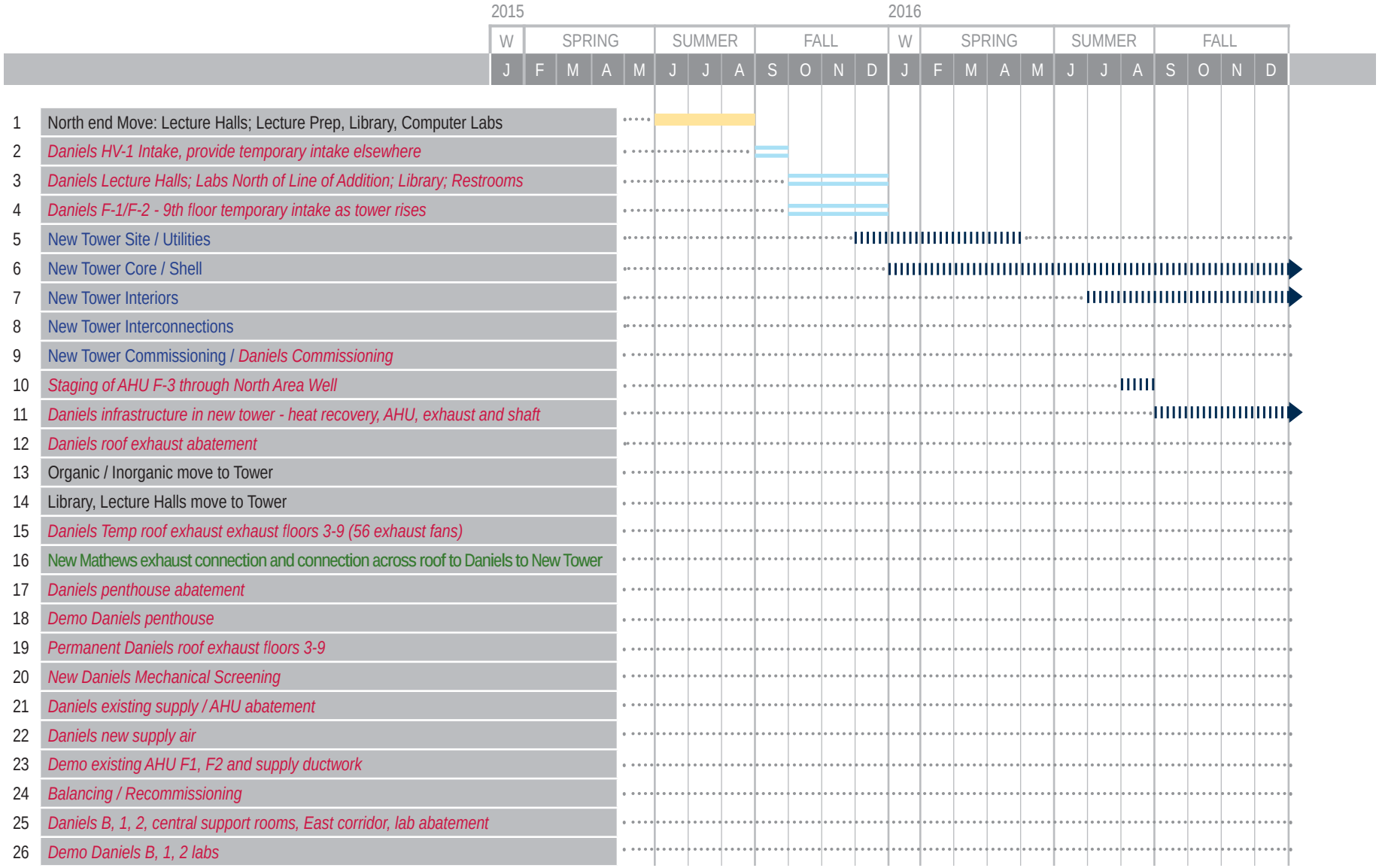
CONSTRUCTION:

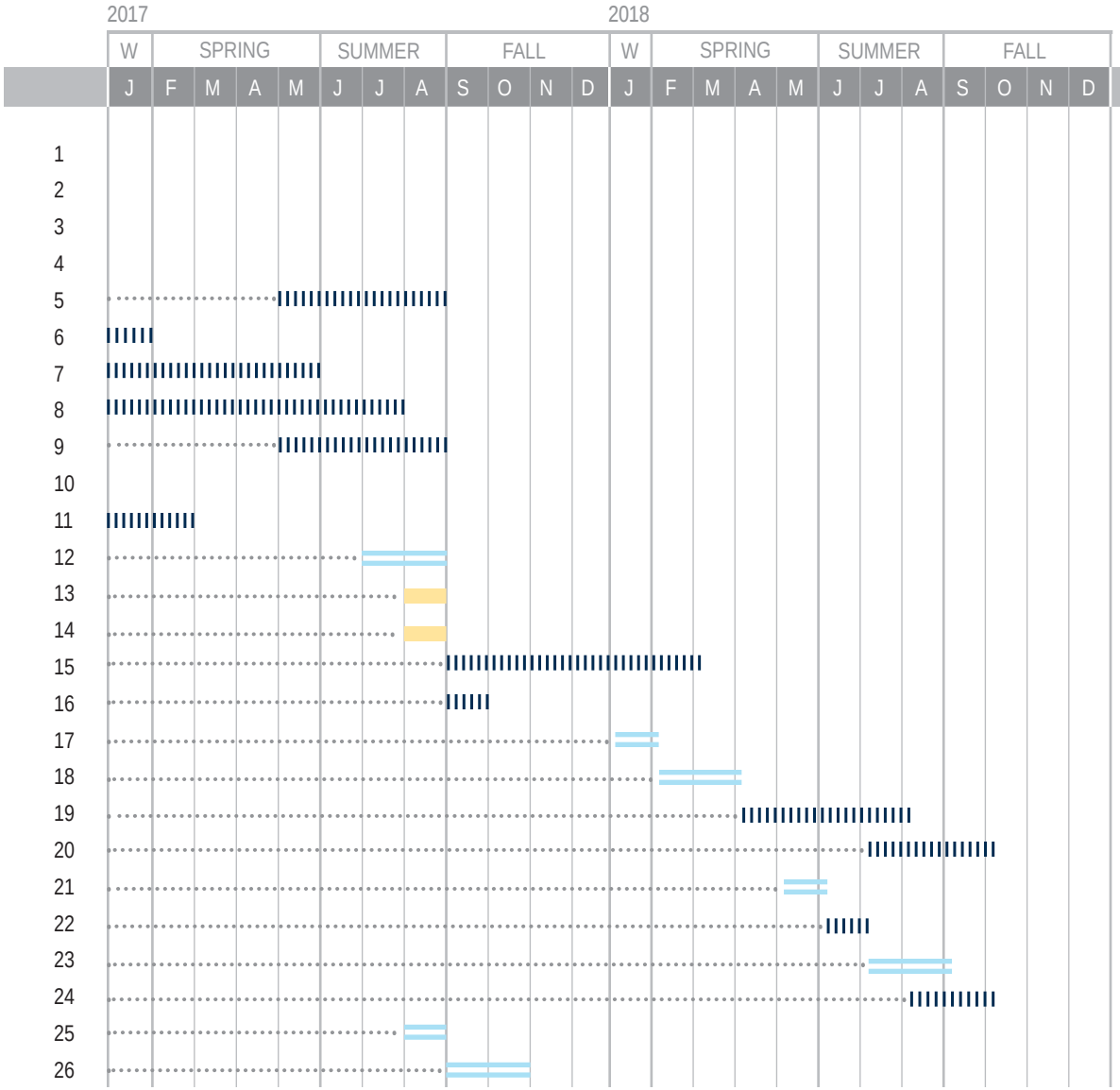
- ALTERATIONS TO 8TH FLOOR NEW TOWER

MOVE:

- INTO 8TH FLOOR NEW TOWER

DETAILED PROJECT PHASING SCHEDULE - BASE PROJECT





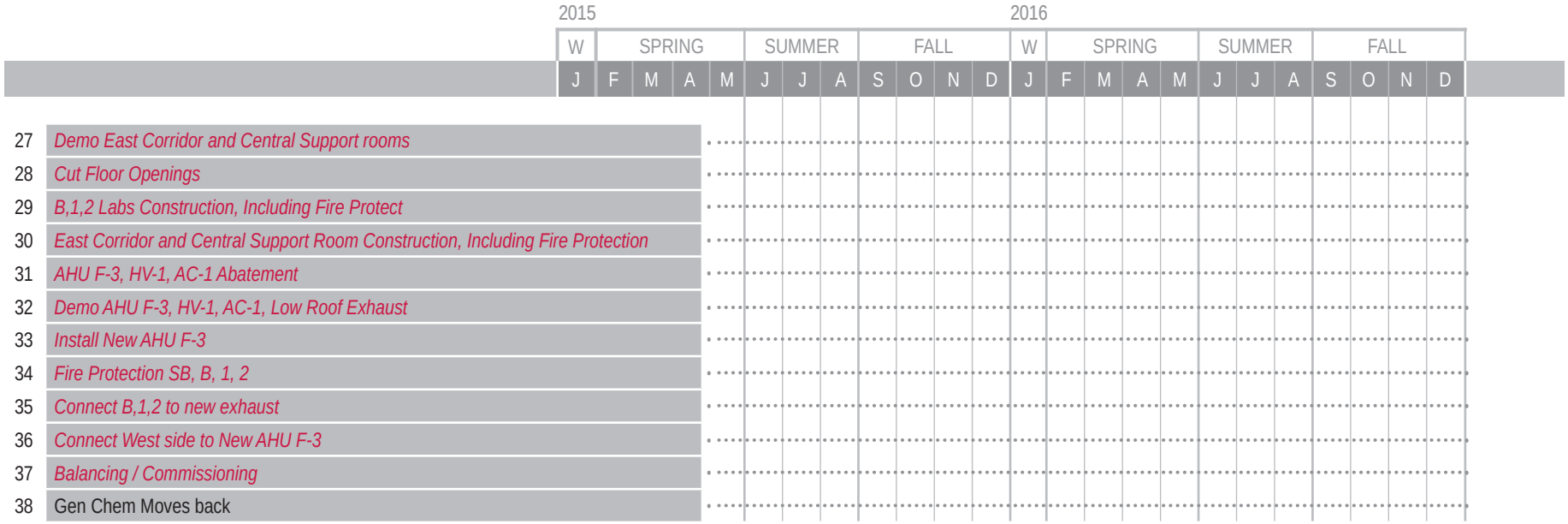
PHASING CHART KEY:

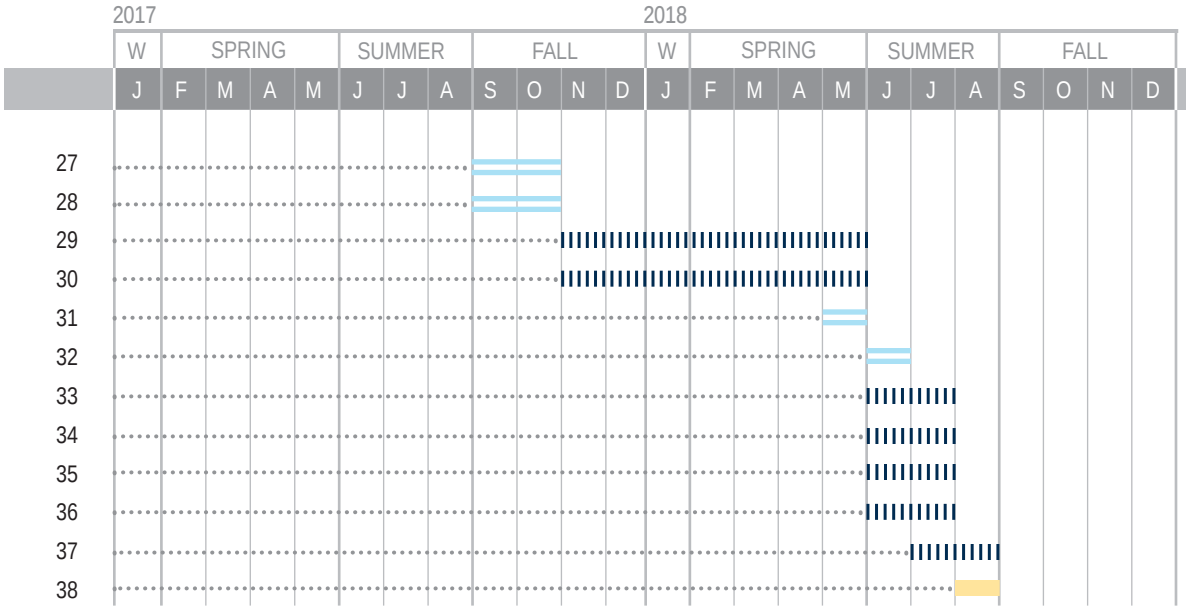
Relocation / Swing Phase

Demolition Phase - *Daniels* - Mathews

Construction Phase - New - *Daniels* - Mathews

DETAILED PROJECT PHASING SCHEDULE - BASE PROJECT - CONT.





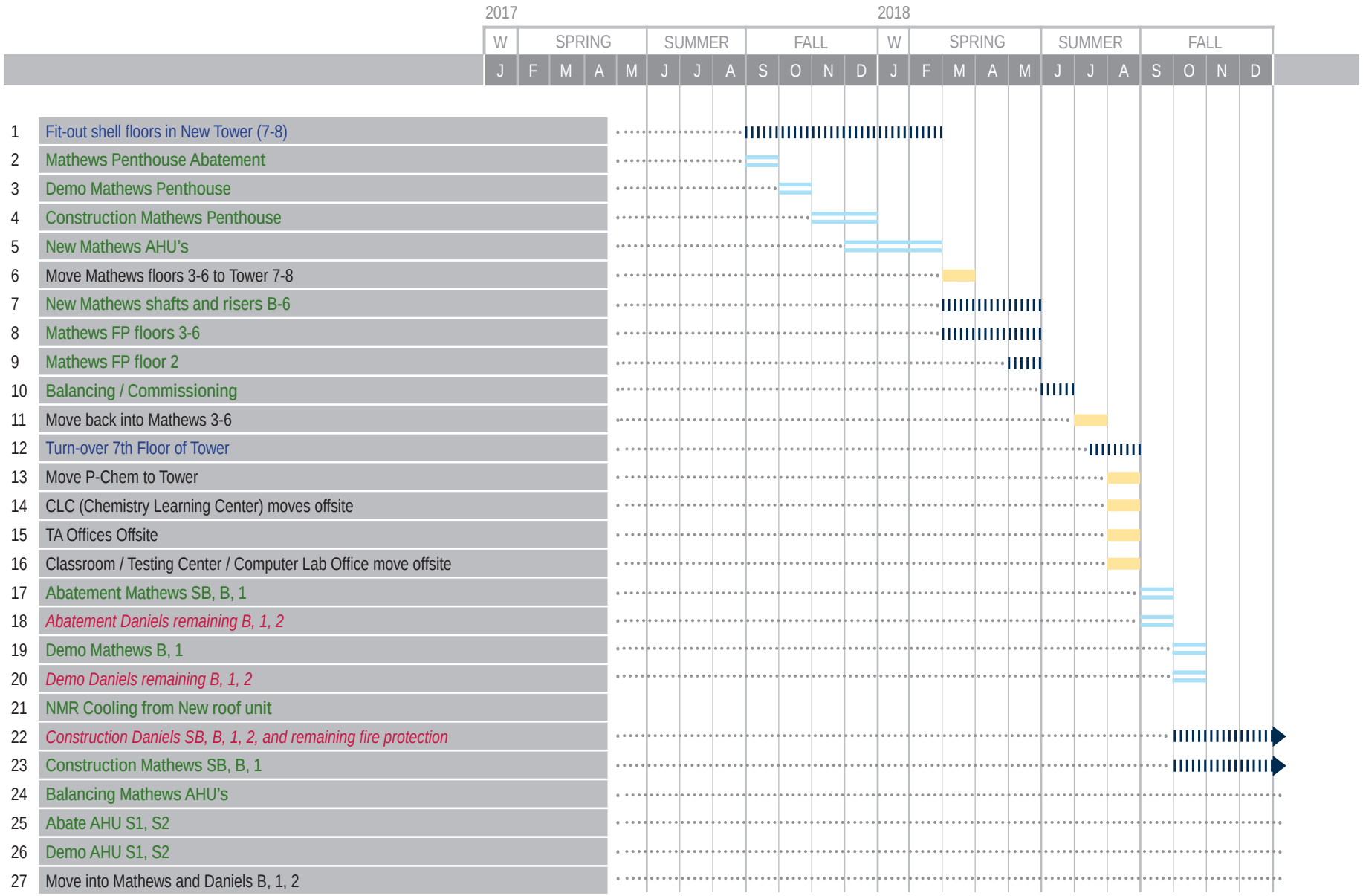
PHASING CHART KEY:

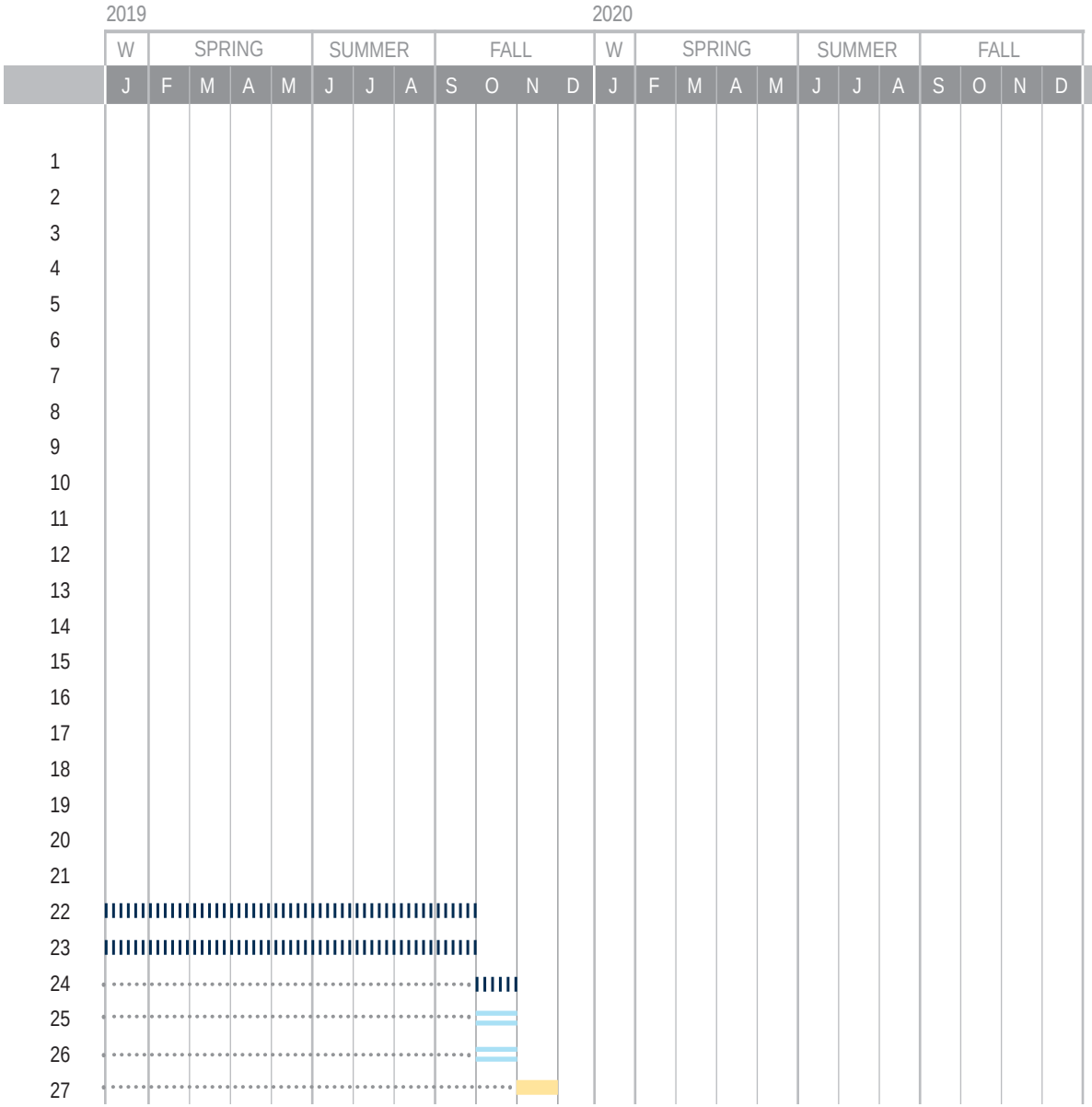
Relocation / Swing Phase

Demolition Phase - *Daniels* - Mathews

Construction Phase - New - *Daniels* - Mathews

DETAILED PROJECT PHASING SCHEDULE - FUTURE PROJECTS





PHASING CHART KEY:

Relocation / Swing Phase

Demolition Phase - *Daniels* - Mathews

Construction Phase - New - *Daniels* - Mathews

BASE PROJECT: 2013 - 2017

BASE PROJECT

DESCRIPTION	GSF	INSTRUCTIONAL SPACE	INFRASTRUCTURE IMPROVEMENTS	$ / SF
New Undergraduate Tower	170,015	$68,905,875	$610,481	$408.88
General Chemistry Daniels Renovations	41,256	$5,409,453	$7,407,427	$310.67
Daniels Mechanical Infrastructure Renovations	13,752		$3,908,399	$284.21
Construction Cost (Including escalation, insurance, bonds and fees)		$74,315,328	$11,926,307	
Project Costs 20% (Including A/E fees, DSF fees, Contingency and Moveable/Special Equipment)		$14,863,236	$2,386,392	
SUBTOTAL	225,023	$89,178,565	$14,311,699	
TOTAL BASE PROJECT COST		$103,491,263		$459.91

FUTURE PROJECTS: TO BE DETERMINED

	DESCRIPTION	GSF	INSTRUCTIONAL SPACE	INFRASTRUCTURE IMPROVEMENTS	SHELL	$ / SF
FUTURE PROJECTS	Chemistry New Tower Build-Out (7th Floor)	20,190	$6,124,262			$303.33
	Daniels & Mathews Renovations	41,449	$4,529,159	$17,182,587		$523.82
	Chemistry New Tower Build-Out (8th Floor)	20,725			$6,244,270*	$301.29
	Construction Cost (Including escalation, insurance, bonds and fees)		$10,653,421	$17,182,587	$6,244,270	
	Project Costs 20% (Including A/E fees, DSF fees, Contingency and Moveable/Special Equipment)		$2,151,992	$3,484,692	$1,261,343	
	SUBTOTAL	82,364	$12,805,412	$20,667,216	$7,505,613	
	TOTAL PROJECT COST		$40,978,240			$497.49
OTHER PROJECTS	Other Infrastructure Projects	Varies		$8,042,154		NA
	Construction Cost (Including escalation, insurance, bonds and fees)			$8,042,154		
	Project Costs 20% (Including A/E fees, DSF fees, Contingency and Moveable/Special Equipment)			$1,630,949		
	TOTAL PROJECT COST		$9,673,103			NA
TOTAL BASE / FUTURE / OTHER PROJECT COST			$154,142,606			

*Space function yet to be determined

UNIVERSITY OF WISCONSIN - MADISON
CHEMISTRY INSTRUCTIONAL ADDITION AND RENOVATION

BUILDING SYSTEMS

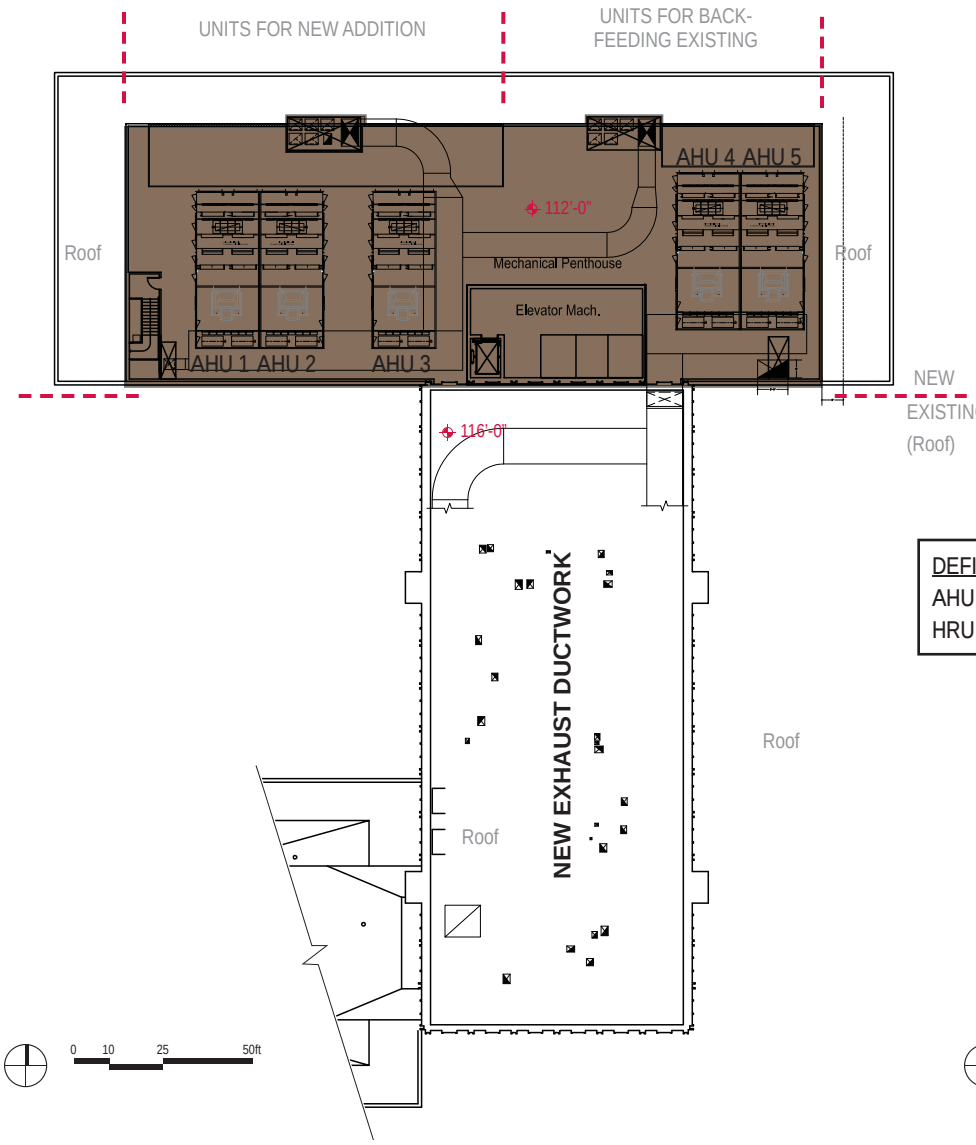
MECHANICAL SYSTEMS NARRATIVE: ADDITION + RENOVATION

NEW TOWER CONSTRUCTION AND FIT-OUT

1. Steam and Condensate System
    a. Provide new steam and condensate system from campus utilities in Charter Street to basement of new tower.
    b. Provide steam pressure reducing station (175 psig to 12 psig)
        - Serves heating hot water convertors, steam preheat coils, humidifiers and water heaters.
    c. Provide steam pressure reducing station (175 psig to 16 psig)
        - Serves autoclaves and sterilizers
2. Chilled Water System
    a. Provide new chilled water supply and return from campus utilities in Charter Street to basement of new tower.
    b Provide tertiary building chilled water pumps to serve building
        - The chilled water system will serve air handling unit cooling coils, cooling coils in fan coil units and process cooling water system heat exchangers.
3. Heating/Reheat Water System
    a. Provide new heating/reheat water system convertors, pumps and piping system specialities.
        - The heating / reheat water system will serve terminal heating devices, such as unit heaters, cabinet unit heaters, reheat coils, fin tube radiation, etc.
4. Glycol Reclaim System
    a. Glycol / water heat recovery system pump will circulate glycol water between heat recovery coils located in laboratory air handling units and heat recovery coils located in the laboratory fume hood exhaust systems to recover waste heat from the exhaust air stream. System is designed to incorporate new and existing exhaust systems serving Daniels and Mathews buildings
5. Process Cooling Water System
    a. Provide plate and frame heat exchangers to serve process cooling water system with associated system pumps and piping system specialities.
        - Process cooling water system will serve environmental room cooling units, specified laboratory equipment and chilled beams.
6. Laboratory Air Handling Systems
    a. Three new factory fabricated custom air handling units will be installed in penthouse to serve new addition in full fit-out. Discharge of units will be combined to a single system to serve new tower. Air handling units shall be sized to provide higher face velocities through the coils during times that one air handling unit is out of operation, providing full redundancy in the supply ai system.
    b. VAV supply system will be utilized to serve laboratory and non-laboratory spaces. All air to laboratory spaces will be exhausted from building while air to non-laboratory spaces will be returned to the air handling units.
    c. Three new recirculating air handling units with heat wheels shall be installed in the basement to serve the lecture halls. Each unit will serve an individual space and shall be provided with outside air from the first floor ceiling overhang space.
    d. Two new factory fabricated custom air handling units will be installed in penthouse to serve existing Daniels tower to replace existing air handling units F-1 and F-2.
        - Temporary outside air intakes shall be installed to allow existing air handling units located on level 9 of Daniels building while new tower is being constructed and new air handling units are installed in new tower. The exhaust system shall be served by three exhaust fans, sized to provide full redundancy in the exhaust system.
        - Ductwork will be installed from new tower roof and connect to existing supply distribution located in the existing Daniels ninth floor mechanical space.

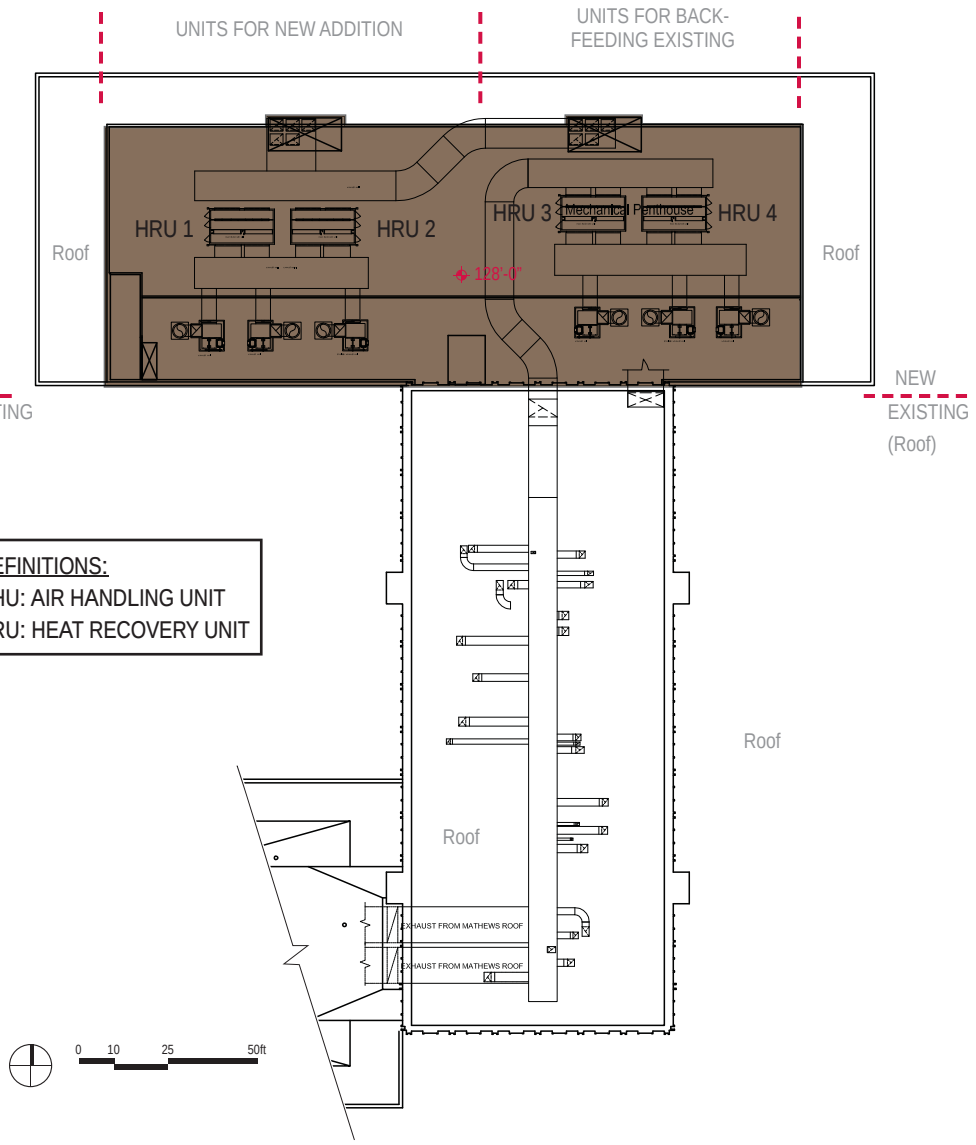
PENTHOUSE FLOOR 1

FLOOR PLAN



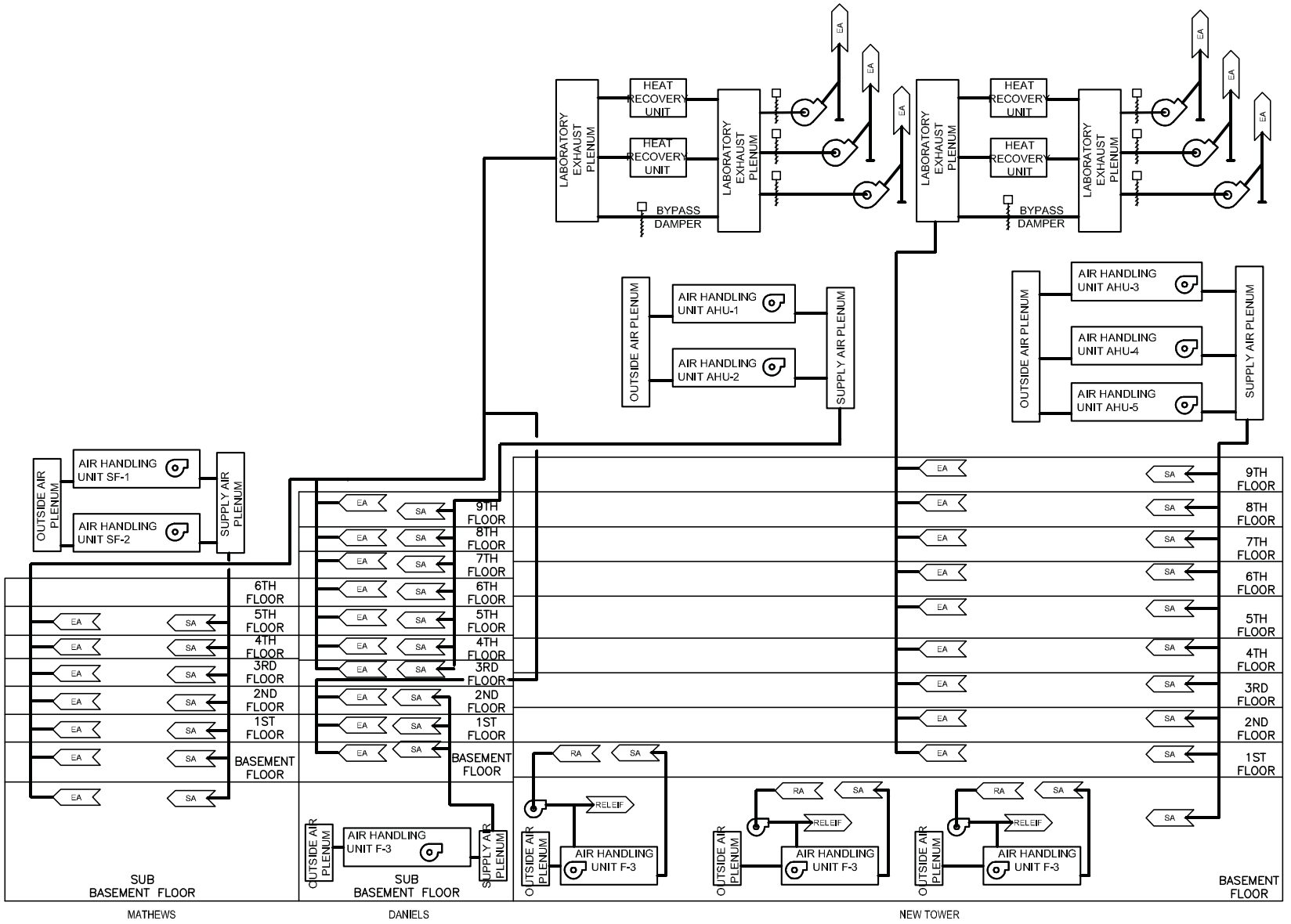
PENTHOUSE FLOOR 2

FLOOR PLAN

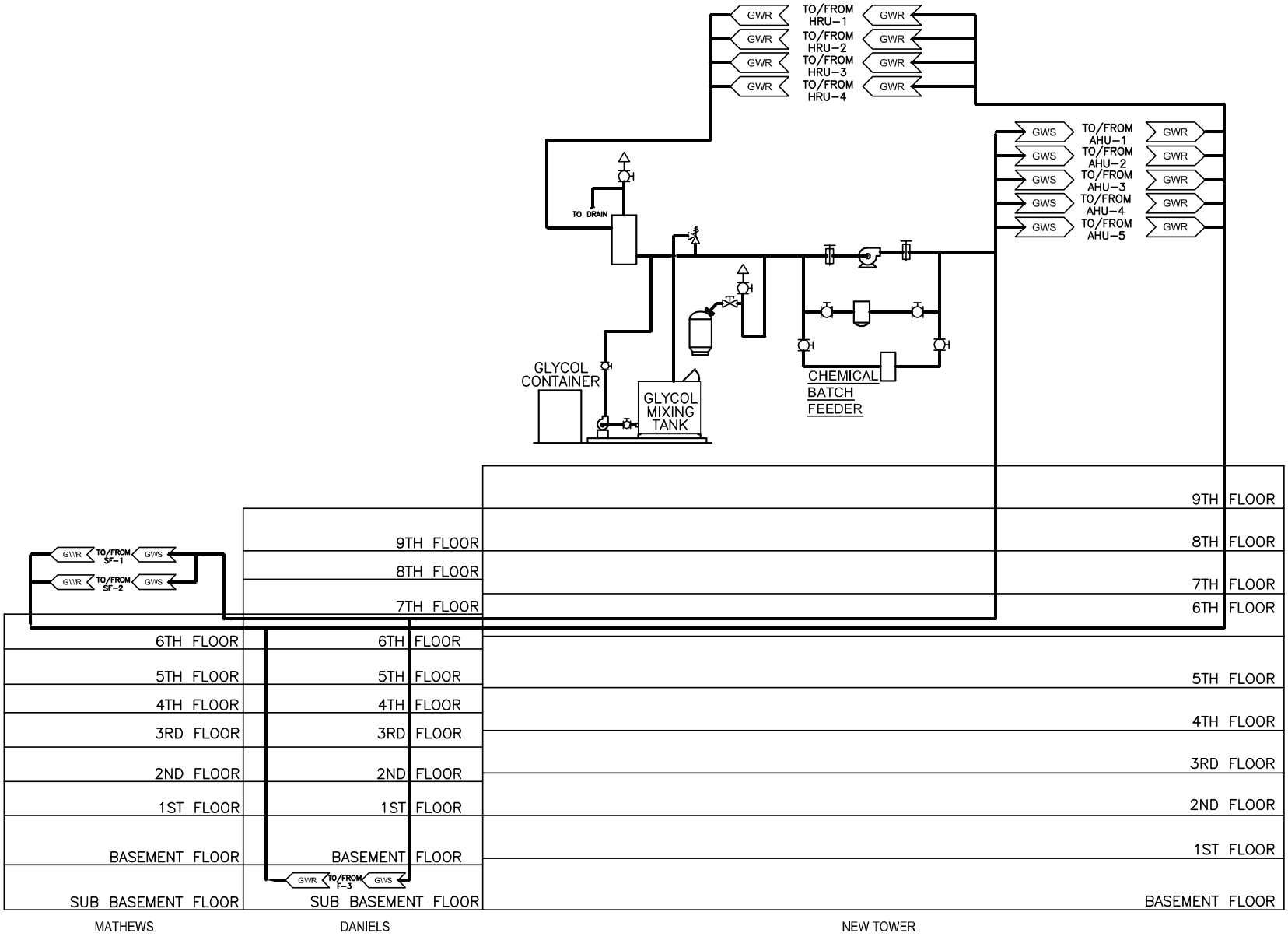


DEFINITIONS:
AHU: AIR HANDLING UNIT
HRU: HEAT RECOVERY UNIT

VENTILATION FLOW DIAGRAM



HEAT RECOVERY FLOW DIAGRAM



MECHANICAL SYSTEMS NARRATIVE: ADDITION + RENOVATION

e. Laboratory Exhaust Systems

- Two new factory fabricated custom heat recovery units and associated exhaust fans shall be installed on roof of new tower to serve laboratory general and fume exhaust from new tower.
- VAV and constant volume air terminal devices shall be installed in system to serve spaces.
- Two new factory fabricated custom heat recovery units and associated exhaust fans shall be installed on roof of new tower to serve Daniels building laboratory general and fume exhaust. The exhaust system shall be served by three exhaust fans, sized to provide full redundancy in the exhaust system.
- New ductwork will be installed from new tower roof to Daniels roof for connection to existing exhaust system.
  - Intent is to provide two new temporary exhaust mains, one located on the east side of the building and one located on the west side of the building. Existing exhaust ducts from Daniels building will be sequentially connected to new temporary exhaust ducts to allow limited and orderly shut-down of areas of the building while exhaust system transfer is performed.
  - Once all exhaust ducts are connected to new exhaust system and operating, the existing roof exhaust plenum, reclaim coils, exhaust fans and associated rooftop equipment shall be removed.
  - Once existing equipment is removed, a new permanent exhaust duct main shall be installed on roof of Daniels building. All booster fans located on ninth floor of the Daniels building and the roof of the Mathews BUilding shall be removed in a limited and orderly shut-down of systems while exhaust ducts are connected to a new exhaust main on roof of the Daniels building until all of Daniels and Mathews are served by the new exhaust system located on roof of the new tower.
- A New exhaust riser shall be installed in new tower to extend exhaust ductwork on the lower roof of the Daniels Building to roof of new tower.
  - Once new system is installed, existing exhaust ducts shall be connected to new riser to serve existing lower levels of Daniels building. Existing exhaust fans and heat recovery system shall be demolished from lower roof of Daniels building.

RENOVATION FOR GENERAL CHEMISTRY

1. Demo existing air handling unit F-3 located in the sub-basement of Daniels. Replace with new factory fabricated custom air handling unit.
2. As part of air handling unit replacement and system upgrade, it is recommended that the mechanical system revisions to all levels of Daniels be incorporated at the same time.
3. Demo all existing distribution systems (piping and ductwork) serving renovated laboratory areas of Daniels and replace with new VAV ductwork distribution system.

CONNECTION TO DANIELS TOWER

FUTURE FIT-OUT OF NEW TOWER

1. Provide distribution ductwork, piping, etc. to fit out shell space of new tower.

Future – Renovation Daniels and Mathews

1. Demo existing air handling units located in lower levels of Daniels and Mathews building.
   a. AC-1, AC-2, AC-3, AC-4, HV-1, SF-1 and SF-2.
2. Demo all existing distribution systems (piping and ductwork) serving renovated areas of Daniels and Mathews building.
3. Provide new supply air system to serve new areas of Daniels and Mathews building. New air handling units shall be installed in pieces, through the new enlarged intake plenum. Options to be pursed for new system shall be as follows:
   a. VAV supply air system with return for all non-laboratory spaces.
   b. Supply air system utilizing heat wheel to serve renovated areas of building.
   c. Supply air system, based on providing only minimum require outside air while utilizing chilled beams for supplemental cooling of spaces.

PLUMBING NARRATIVE: ADDITION AND RENOVATION

OVERVIEW

NEW TOWER CONSTRUCTION & FIT OUT

1. Provide storm drainage system with roof drains and overflow drains. Storm drainage will connect to existing exterior storm sewer. Overflow drainage system will discharge through building wall and discharge on grade.
2. Provide clearwater waste and vent system for air handling units and other equipment discharging clearwater waste. Clearwater drainage systems which cannot discharge to the storm sewer by gravity flow will be drained by gravity to a sump with duplex pumps and will be pumped into the building storm drainage system.
3. Provide subsoil drainage system to convey groundwater to a sump. Duplex sump pumps will pump waste to the storm drainage system.
4. Provide sanitary waste and vent system for all plumbing fixtures. Sanitary wastes which cannot discharge to the sewer by gravity flow will be drained by gravity to a sump with duplex sewage ejectors and will be pumped into the sanitary drainage system.
5. Provide corrosion resistant waste and vent system for all plumbing fixtures in laboratories and laboratory support spaces. The laboratory waste system will drain by gravity flow to a dilution basin located at the basement level and be discharged into the sanitary building drain.
6. A new domestic water supply will be provided from University Avenue. The water main will be a combination main for domestic water and fire protection. A triplex water pressure booster pump system will be provided to maintain adequate water pressure to all the plumbing fixtures.
7. Domestic hot water will be produced by a duplex steam-fired, semi-instantaneous water heater. Tube bundles in steam fired water heaters will be double walled.
8. The hot water system temperature will be maintained by recirculating the hot water through a continuous loop with an in-line circulating pump.
9. Duplex alternating water softeners will be installed ahead of the water heaters.
10. Tepid water to emergency fixtures will be provided by a master thermostatic mixing valve with cold water bypass device.
11. Non-potable water system will provide make-up water to mechanical (HVAC) systems. A reduced pressure backflow preventer will protect the domestic water supply.
12. The existing high purity water system will be extended to the new laboratories.
13. The existing nitrogen system will be extended to the new laboratories.
14. The existing campus laboratory compressed air system will be extended to the new laboratories. A tank and desiccant dryer will be provided in to maintain quality.
15. The existing natural gas system will be extended to the new laboratories.

RENOVATION – GENERAL CHEMISTRY

1. The existing corrosion resistant waste and vent system will be revised to accommodate new plumbing fixtures in laboratories and laboratory support spaces in the renovated areas.
2. The domestic hot and cold water system will be revised to accommodate new plumbing fixtures in laboratories and laboratory support spaces in the renovated areas.
3. The existing high purity water system will be revised to accommodate new purified water requirements in the renovated areas.
4. The existing nitrogen system will be revised to accommodate new layout in the renovated areas.
5. The existing laboratory compressed air system will be revised to accommodate new layout in the renovated areas.
6. The existing natural gas system will be revised to accommodate new layout in the renovated areas.
7. Fire protection system shall be upgraded/added in renovated areas as required

PLUMBING NARRATIVE: ADDITION + RENOVATION

RENOVATION AND CONNECTIONS TO DANIELS TOWER

1. The existing high purity water system will be replaced with a new system to produce and distribute water meeting the quality requirements for the building. The system will include media filter, water softeners, carbon filter, single RO unit, deionization exchange cylinders, storage tank, UV lights and micron filters. Pure water will be continuously circulated in closed loops.

FUTURE TOWER FIT OUT

1. The sanitary waste and vent system will be extended to all plumbing fixtures in the new tower fit out.
2. The corrosion resistant waste and vent system will be extended to all plumbing fixtures in laboratories and laboratory support spaces in the new tower fit out.
3. The domestic hot and cold water system will be extended to all new plumbing fixtures in toilet rooms, laboratories, and laboratory support spaces.
4. The high purity water system will be extended to the new laboratories in the new tower fit out.
5. The nitrogen system will be extended to the new laboratories in the new tower fit out.
6. The laboratory compressed air system will be extended to the new laboratories in the new tower fit out.
7. The natural gas system will be extended to the new laboratories in the new tower fit out.

FUTURE RENOVATION – DANIELS & MATHEWS

1. Fire protection (sprinkler) systems will be installed throughout Daniels and Mathews in areas not covered in the base project (Gen Chem Labs and Support core).
2. The existing sanitary waste and vent system will be revised to accommodate new plumbing fixtures in the renovated areas.
3. The existing corrosion resistant waste and vent system will be revised to accommodate new plumbing fixtures in laboratories and laboratory support spaces in the renovated areas.
4. The domestic hot and cold water system will be revised to accommodate new plumbing fixtures in laboratories and laboratory support spaces in the renovated areas.
5. The existing high purity water system will be revised to accommodate new purified water requirements in the renovated areas.
6. The existing nitrogen system will be revised to accommodate new layout in the renovated areas.
7. The existing laboratory compressed air system will be revised to accommodate new layout in the renovated areas.
8. The existing natural gas system will be revised to accommodate new layout in the renovated areas.

ELECTRICAL NARRATIVE: ADDITION + RENOVATION

OVERVIEW

NEW TOWER CONSTRUCTION AND FIT-OUT: BASE

1. Provide new medium voltage feeder in concrete encased ductbank and one manhole from existing manhole to new switchgear in existing subbasement of Daniels.
2. Provide new 15kV switchgear in existing subbasement of Daniels.
3. Provide a new 1500/2000kVA, 480/277v unit substation in the subbasement of Daniels
4. Provide a new 1000/1333kVA, 208/120v unit substation in the existing subbasement of Daniels
5. Provide a new 1000kW, 480/277v diesel engine generator and associated transfer switches in the basement of the new tower.
6. Provide new 480/277v distribution panels in the subbasement and penthouse of the new tower to serve new mechanical loads.
7. Provide new 480/277v lighting panels on each floor.
8. Provide new 208/120v distribution panels in electrical rooms on each floor of the new tower to serve branch circuit panels on basement through sixth floor serving receptacles and equipment loads.
9. Provide new 208/120v panelboards:
    a. On laboratory floors 4, 5 and 6 each serving 3-4 laboratory program modules.
    b. On basement and first floor each serving one half of the floor.
10. Provide empty conduit from Daniels unit substation to the new tower shelled floors 7 and 8.
11. Provide a new fire alarm system in the new tower compatible with and connected to the existing system in Daniels.
12. Provide new lighting and receptacles throughout the new tower as required by program.
13. Provide a new lightning protection system on the new tower tied to the existing building system.

RENOVATION-GENERAL CHEMISTY: BASE

1. Remove existing devices and panelboards serving the renovated area.
2. Install new distribution panels sized for the future renovation of floors basement, 1 and 2 to serve the new area panelboards.
3. Provide new 208/120v panelboards each serving 3-4 laboratory program modules on floors basement, 1 and 2.
4. Provide new lighting and receptacles throughout the renovated areas as required by program.

RENOVATION-MECHANICAL DANIELS TOWER: BASE

1. Disconnect existing mechanical motors being removed.
2. Remove existing electrical equipment no longer required due to mechanical renovation
3. Provide power to new mechanical equipment served from the new tower power distribution equipment in the tower mechanical penthouse.

FUTURE TOWER FIT-OUT

1. Provide new 480/277v lighting panels on each floor.
2. Provide new feeders in existing conduit to new 208/120v distribution panels in electrical rooms on each floor to serve branch circuit panels serving receptacles and equipment loads.
3. Provide new 208/120v panelboards:
    a. On laboratory floors 7 and 8 each serving 3-4 laboratory program modules.
4. Provide a new fire alarm system devices on each floor, connected to the tower fire alarm system control panel.

ELECTRICAL NARRATIVE: BASE + FUTURE COMPONENTS

5. Provide new lighting and receptacles throughout each floor as required by program.

FUTURE RENOVATION-DANIELS AND MATHEWS

1. Remove existing electrical panelboard and devices in the renovated area.
2. Maintain service to the existing 208/120v busway serving Daniels ground floor through 9th floor.
3. Provide new 208/120v distribution panels served from existing unit substation the existing subbasement and located in electrical rooms on each floor to serve branch circuit panels on each floor serving receptacles and equipment loads.
4. Provide new 208/120v panelboards:
    a. Laboratory area each panel serving 3-4 laboratory program modules.
    b. Non laboratory areas panels located to provide branch circuits not greater than 75 ft in length
5. Provide new 480/277v lighting panels on each floor of the renovated area.
6. Provide new 480v power to new mechanical equipment from existing subbasement unit substation.
7. Provide new lighting and receptacles throughout the renovated areas as required by program.

STRUCTURAL SYSTEMS NARRATIVE

OVERVIEW

GENERAL STRUCTURAL SCOPE

The proposed New Chemistry Tower is located adjacent to the north side of Daniels Chemistry Building. The new floors will be tie into Daniels at the basement, first, second, fourth, fifth, sixth, seventh and eighth floors. A tall penthouse at roof level with a mechanical platform will provide mechanical space. The height of the Roof is approximately 112 feet above University Avenue and top of the Penthouse is approximately 144 feet.

The structure will be a concrete building frame supported on spread footings. Steel framing will be used to support the penthouse roof and mechanical mezzanine.

EXISTING BUILDINGS AND STRUCTURES

The New Chemistry Tower will be built on the site of the current lecture hall wing of the Daniels Building. This building wing will be demolished. The University United Methodist Church is located to the west. University Avenue is along the north side and Mills Street is on the east side.

FUTURE EXPANSION

The New Chemistry Tower will not be designed for vertical expansion. The floor-to-floor heights of the New Tower are planned to align with the Shain Tower for a potential future addition connecting the two structures.

FRAMING SYSTEMS

Based on the structural performance characteristics required for laboratories, a structural concrete frame system is recommended. Proposed system is a cast-in-place concrete joist and beam system supported by concrete columns. This structural system offers the benefits of economy, floor vibration control, program planning and utility accommodation. The Typical bay spacing of 21'-0" by 31'-6"has been selected to accommodate the proposed laboratory planning module and provide economical spans for the structural system.

Typical Floors and Penthouse Floor/Roof

Floor Slab:4 ¾" thick concrete slab with 6" wide by 20" deep cast-in-place concrete one-way joists spaced at 3'-0" on center.

Beams/Girders: 2'-0 ¾" deep cast-in-place concrete beams with various widths.

Columns: 24" by 24" cast-in-place concrete columns (typical)

Shear Walls: 12" thick cast-in-place concrete walls at selected locations.

Deflections: To be less than 1/480 of the span from the total of sustained loading and live loads.

Penthouse Roof

Deck: 1 ½" deep metal roof deck.

Beams/Girders: Structural Steel wide-flange shape

Columns: Structural Steel wide-flange shape

Deflections: To be less than 1/360 of the span from the total loads.

FIRST FLOOR SLAB FRAMING

Three columns will be transferred to create a column free space for the 350 seat lecture hall at the northwest corner of the New Chemistry Tower. Three columns will be transferred to create a column free space for the 250 seat lecture hall at the northeast corner of the New Chemistry Tower. Cast-in-place concrete transfer beams will be 72" wide and 96" deep and reinforced with rebar and post-tensioning cables.

Fourth Floor Slab Framing

Three columns will be transferred to create a column free 150 seat lecture hall at the northwest corner of the New Chemistry Tower. Cast-in-place concrete transfer beams will be 72" wide and 96" deep and reinforced with rebar and post-tensioning cables.

FLOOR VIBRATION CRITERIA

The floor vibration characteristics will be designed to limit the vibratory accelerations due to walking.

For office and non-laboratory areas, the design will follow AISC Design Guide Series 11, Floor Vibrations Due to Human Activity. General Vibration Criterion (VC) curves have been developed for different types of equipment. It is recommended that the structural floor system be designed to meet the VC-A criterion which is a maximum vibratory velocity of 2,000 micro-inch per second. This is adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.

FOUNDATION SYSTEM

Gravity Loads

Based on previous soil borings and geotechnical reports for the adjacent Daniels and Mathews buildings, a foundation system of conventional spread footings can be used to support the New Chemistry Tower. The existing soil, per the previous borings, is predominantly sand and silt.

During the design phase, a Geotechnical Investigation should be performed to confirm the consistency of the soil on the site.

Soil Retention

Concrete basement walls will be used. Waterproofing membrane shall be applied to the exterior wall face. Backfill shall be free draining compacted fill with a perimeter perforated drain tile around the perimeter of the basement.

During construction, the excavation along the north, east and west sides of the New Chemistry Tower will require a soil retention system due to the proximity of the excavation to the streets and right of way.

LATERAL LOAD RESISTING SYSTEM

Wind and Seismic forces impart lateral loads on the building structure. To allow openness and future flexibility in the architectural plan, the proposed lateral bracing system is a combination of concrete shear walls and a concrete beam and column frame. The concrete beam and column frame is inherent with the structural system proposed. Concrete shear walls will be strategically placed in areas along the south portion of the building in locations where walls continue from the foundation to the roof.

SLAB-ON-GRADE

Cast-in-place concrete slab thickness is 4" and reinforced with welded wire fabric. Slab to be underlain with a vapor retarder meeting ASTM E 1745, Class A and 6" of free draining granular stone. A drain tile system will be installed to collect any ground water.

EXTERIOR CLADDING AND SUPPORT CONCEPT

The New Chemistry Tower will be mainly clad with aluminum curtainwall and insulated glazing. Portions of the east, west and south elevations, will be clad with precast panels, with either a CMU or steel frame backup system. The cladding system will be supported at selected floor levels.

FIRE RATINGS

For Type IB construction, the typical structural fire rating is 2 hours. The 4 ¾" normal weight concrete slab selected provides the E119 rating. The appropriate concrete cover to the steel reinforcement will be selected to satisfy the required fire rating.

DESIGN CRITERIA REFERENCES

Building Code:

2011 Wisconsin Commercial Building Code, IBC 2009 Edition

Industry Reference Standards:

- ACI 318 Building Code Requirements for Structural Concrete
- ACI 315 Details and Detailing of Concrete Reinforcement
- CRSI Manual of Standard Practice and Placing Reinforcing Bars
- PTI Post-Tensioning Manual
- PCI Design Handbook
- AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings
- AISI Specifications for the Design of Cold-Formed Steel Structural Members
- AWS Structural Welding Code
- SDI Design Manual for Composite Decks, Form Decks and Roof Decks

DESIGN LOADS

Roof Live Load (Ground Snow Load = 30 psf)	21 psf plus drifting
Wind Loads	
Basic Wind Speed	90 mph
Importance Factor	1.0
Exposure Category	B

Seismic Loads (approximated using adjacent soil borings)

Seismic Occupancy Category	II
Importance Factor	1.0
Site Class	D
Mapped Spectral Response Acceleration at Short Period	0.125g
Mapped Spectral Response Acceleration at Long Period	0.048g
Seismic Design Category	B
Site Coefficient Fa	1.6
Site Coefficient Fv	2.4
Response Modification Factor	4.5

Floor Live Loads

Office including partition	100 psf
Laboratories	150 psf
Stairs, Lobbies, Vestibules	100 psf
Corridors	100 psf
Mechanical Area	150 psf

Superimposed Dead Loads	
Floor (ceilings, flooring, MEP)	30 psf
Penthouse Roof	35 psf
Material Strengths	
Concrete (f'c at 28 days)	
Footings	3,000 psi
Walls	4,000 psi
Columns	6,000 psi
Slabs, Joists, Beams, Girders	4,000 psi
Transfer Beams	5,000 psi
Slab-On-Grade	4,000 psi
All concrete not noted	3,500 psi
Reinforcing Steels (Fy)	
Rebar	60,000 psi
Welded Wire Fabric	65,000 psi
Post-Tension Cables	270,000 psi
Structural Steel (Fy)	
Wide Flange Shapes (A572 or A992)	50, 000 psi
All Other Steel Shapes (A36)	36,000 psi
Hollow Structural Sections (A500, Grade B)	46,000 psi
Steel Pipes (A53, Grade B)	35,000 psi
All Bolts	A325-N
Anchor Bolts	A36
Welding Electrodes	E70XX
Light Gage Steel (Fy)	
Roof Deck	33,000 psi
Studs	50,000 psi
Tracks, studs, 18 gage and lighter	33,000 psi
Masonry (Minimum Compressive Strength)	
Concrete Masonry Units (Fm)	1,500 psi
Mortar Type S (Fm)	1,800 psi
Grout (f'c)	3,000 psi
Foundation Soils	
Assumed Allowable Soil Bearing Pressure (Daniels & Mathews)	8,000 psf