9-2020

Clemson University - Library Master Plan Study

Clemson University

CLEMSON UNIVERSITY

LIBRARY MASTER PLAN STUDY

SEPTEMBER 09, 2020



CLEMSON UNIVERSITY

COOPER CARUSI COLLINS ARCHITECTS





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CLEMSON LIBRARY MASTER PLANNING COMMITTEE:

CHRIS COX, DEAN OF LIBRARIES

TERI ALEXANDER, LIBRARY FACILITIES MANAGER

PHIL LANDRETH, ASSISTANT VICE PRESIDENT FOR ACADEMIC OPERATIONS

BARBARA SPEZIALE, DIRECTOR FOR CREATIVE INQUIRY, WATT CENTER

DUSTIN ATKINS, CLEMSON COMPUTING & INFORMATION TECHNOLOGY

ANDREW O'STEEN, STUDENT GOVERNMENT REPRESENTATIVE

GERALD VANDER MEY, DIRECTOR , PLANNING & DESIGN

PETER KNUDSEN, SENIOR PLANNER, PLANNING & DESIGN

THIS FEASIBILITY STUDY WAS MANAGED BY CLEMSON PLANNING & DESIGN FOR CLEMSON UNIVERSITY.
OWNERS REPRESENTATIVE: PETER KNUDSEN

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This is a feasibility study for the Clemson University's Cooper Library, produced in conjunction with library leadership and the Office of University Planning and Design. The purpose of this study is to develop a strategy for the improvement of the Library's physical environment that reinforces it's mission and optimizes its ability to service the Library's users evolving learning and research needs.

Originally, the scope of of this study was to investigate opportunities to reinvent the existing Cooper Library within the limits of the existing footprint. During the course of investigation, the scope of the study expanded to include expansion opportunities that will meet the needs of the library in the next 15 years.

VISION

A guiding principle in the development of this master plan study is the Libraries' mission statement, which defines their aspirational future as an institution:

> "Clemson Libraries provide innovation and inclusive programs, services, and technologies that support Clemson University Goals and the information of all."

Complementary to the mission statement are tactical strategies that the Library must focus on to achieve their goals. Each of these tactics has implications for spaces and services. These strategies, per the Brightspot Strategies' report, are as follows:

- Make collections more visible. Revisit collection projection.
- Create targeted programming to attract faculty, staff, graduate and PhD students to the pilot research Center at Cooper.
- Verify Outreach efforts with the Libraries' partners to provide direct pathways to services.
- Reduce barriers to entry through a variety of strategically spaced service points and visible staff.
- Explore new workplace models to provide equitable workspace with sufficient front -of-house and back-of-house support resources.
- Build flexible space scenarios around the transition of space based on 5, 10, & 15 years, renovations aligned to Libraries and Campus Master Plan.

COOPER LIBRARY

The Cooper Library is an approximate 180,000 SF facility that was constructed in three phases. The initial Library was constructed in 1964/65 and was designed in the modernist style that was composed of three levels above grade and a basement level. The exterior was defined with an arcade that wrapped the entire building in the manner of an antebellum porch. The main entry to the building is on the north facade facing the reflection pool with access off of an elevated bridge that spans between two hills. This bridge is a major pedestrian path across campus. Circulation between the floors was achieved with a monumental stair that connects the ground level with the 1st and 2nd levels, the current 3rd, 4th and 5th levels.

The 1964/65 drawings indicated planning for a future expansion by adding a floor between the original basement level and the ground level (current 3rd level). The expansion was executed in 1978 adding 84, 415 sf to the building. The third phase was the construction of the mezzanine above the second level (current 5th level). The mezzanine was constructed with a tube steel frame, metal pan floor with column supports approximately 4'-6" oc aligning with the shelving system below. The expansion added 17,432 sf to the Library.

There have been subsequant renovations within the Library, most notably the creation of the Adobe Suite and the additon of the Starbuck's Cafe and seating mezzanine.

The Library is in the process of assessing their collections and moving "low use / high value" collections to the off site storage facility at the Library Depot. The reduction in area dedicated to stacks provides the Library with the opportunity to create a new vision and environment that serves their mission. This master plan study reviews the existing building systems and infrastructure as well as the fact that these renovations and upgrades will have to be implemented while the Library continues to serve the students and faculty of Clemson University.

As a part of the programming effort, the Planning Committee established the following goals for the Cooper Library:

- Increase the amount and variety of student study space
- Create a graduate student / research commons
- Provide a dedicated "Front Door" for Faculty Services
- Provide a dedicated faculty study space with service support
- Consolidation of staff office space using new workstation and office standards
- Provide new secure entrance on south side of building
- Strategic location and organization of key service points
- Provide new event space
- Re-design open stair to be more inviting and allow for better transparency
- Provide a more welcoming entry sequence without diminishing building security

EXECUTIVE SUMMARY

PROGRAM SUMMARY

The preliminary program generated in the December 2019 Brightspot Report was used as the starting point for a series of meetings held with the Library Planning Committee. The program has been divided into six major categories as follows:

Public Event -
Characterized by unrestricted access for faculty, students, staff, and the general public

User Space -
Spaces where individuals or groups can work, study, or collaborate, including instructional spaces.

Collections -
Space for storage of collections, typically shelving areas.

Partner Spaces -
Spaces for campus partners that provide student services but are outside of the library's organizational structure

Library Workspace
Service desks, offices, meeting rooms, and amenities for staff

Support -
Support spaces include general facilities storage and associated work areas as well as server rooms

A detailed program of spaces was not generated for this study. The University will need to prepare a detailed program in subsequent development of the Library renovations and/or expansions.

EXECUTIVE SUMMARY

DESIGN APPROACH

The Cooper Library is located in the heart of the Clemson campus along a major pedestrian path that is the major connector between the east and west sides of campus. A bridge connects the two ends of the path in front of the Library, providing a level walk between the two hills that frame the views to the Reflection Pond. The bridge provides the singular entry into the library on the 4th level. Beneath the bridge, which is a barrier between the pond and the Library, there is an underutilized plaza.

To the south, the Library creates the northern edge of the South Campus Green. It's neighbors and academic partners, the Watt Center and the Academic Success Center provide edges to the Green on the east and west of the lawn. The Library as it currently is configured, turns it's back to the Green with minimal engagement and no access. And to the west is the staff parking and service spaces between the library and adjacent buildings.

Designed in the modernist style of the 1960's, the Library is an inward-looking structure, as many Libraries were of this time, a vault for the protection and storage of books. Windows ring the building but are small and comprise a small percentage of the exterior façade, reinforcing this inward focus.

Library Ecosystem

Expansion of the Libraries offers the opportunity to extend the footprint of the Library into the campus, creating stronger connections with more transparent facades that offer visitors views to the surrounding campus spaces, bring daylight into the library core, create new entrances that are accessible and inviting, and create new interior spaces that strengthen the University community.

As shown in the planning diagrams, there is not a singular space adjacent to the Library to allow for an expansion large enough to meet future needs. There is the ability to create the needed square footage with smaller expansions to the north, south and west edges of the building. Each of these footprints can respond to program elements and present complimentary facades that reflect the adjacent campus environments.

To the north, expanding the Library to the edge of the Reflection Pond will necessitate the relocation of the bridge, allowing the east west path to become a part of the library experience, instead of just passing by. With the northern exposure, it is then possible to open the façade with large expanses of glass, making the interior spaces apart of the student's movement across campus, and reinforcing the Libraries presence as the heart of campus.

As they enter the Library, students, faculty and staff are welcomed with a large day lit space, which becomes the social center of the Library, with multi-level terraces designed for active social learning, using furniture to provide varied opportunities to share and collaborate.

An organizational "street", that will run through the Library from north to south, connecting the new community-oriented Pond entries on the north with the new Library entrance from the South Campus Green. The street will incorporate the existing monumental stair and be layered on all 6 floors of the library, providing consistent orientation as students, faculty and staff access the different program spaces and service points. Along the "street" on the Campus Green entry level, it is possible to open the floor slabs to the 1st and 2nd levels below, bouncing shared daylight downstairs and to create a connection so that these levels will not feel so isolated from the balance of the Library.

From the "street", new neighborhoods can be organized that house the different program elements such as a faculty research space, technology spaces, social and quiet study areas, study rooms, classrooms, and community rooms. Library collections, while mostly located on the lower levels, can also be introduced into the "neighborhoods" on the upper levels and laid out with study rooms in a manner to create different study environments.

As the street moves south through the building, to the quieter South Campus Green, the atmosphere of the spaces may also become quieter, more reflective spaces as they lead to the new South Expansion. The new addition provides the opportunity to create a two-story presentation room with the ability to step out onto a portico that overlooks the South Campus Green.

A new south entry into the Library located on the 3rd level below the presentation room opens directly onto the South Campus Green. Immediately adjacent to the entry are the Coffee Shop, and POD, providing food and drink that can be enjoyed in the library or on the Green. Flanking the entry, are the Learning Commons (Research Support, Consultation, and Collections Check Out) and Partner Spaces such as the Writing Center and Drop-in Peer Tutoring both with easy access to their partners in the Academic Success Center.

The architectural expression of the south expansion is another opportunity to bring daylight into the library. With south facing glass, it will be necessary to control and filter the daylight, which could be done in a manner that that compliments the architecture of the Watt Center.

The connection to the Watt Center can be more than just visual. From the new west expansion, there is a bridge connection between the two buildings on the fourth level. As indicated on the plans, locating the Digital User Spaces (Adobe Lab, Makerspace, GIS, etc.) adjacent to the bridge offers a direct connection between the complimentary programs in Watt and those within the Library.

People thrive in environments with natural light, and the existing library, with a portico that surrounds the building, has very little glass to bring in daylight. The expansions on the other faces of the building offer the opportunity to open the building up to sunshine and views. Expansion to the east is limited by the planned expansion of Daniel Hall, but it is possible to open the existing concrete walls and expand the library out to the limits of the portico on the east side, creating a wall of glass that allows the morning light to reach deep into the library and offer views onto the outdoor space created by Daniel Hall.

PROGRAM SUMMARY

DEFINITION OF PROGRAM SPACE TYPES

[SPACES & SERVICES]

PUBLIC SPACE

CHARACTERIZED BY UNRESTRICTED ACCESS FOR THE FACULTY, STUDENTS, STAFF, AND THE GENERAL PUBLIC

USER SPACE

SPACES WHERE INDIVIDUALS OR GROUPS CAN WORK, STUDY, OR COLLABORATE, INCLUDING INSTRUCTIONAL AREAS

COLLECTIONS

SPACES FOR THE STORAGE OF THE COLLEC-TION, TYPICALL SHELVING AREAS

PARTNER

SPACES FOR CAMPUS PARTNERS THAT PROVIDE STUDENT SERVICES BUT ARE OUTSIDE OF THE LIBRARY'S ORGANIZATIONAL STRUCTURE

LIBRARY WORKSPACE

SERVICE DESKS, OFFICES, MEETING ROOMS, AND AMENITIES FOR STAFF

SUPPORT

SUPPORT SPACES INCLUDE GENERAL FACILI-TIES, STORAGE, AND ASSOCIATED WORK AREAS AS WELL AS SERVERS

PUBLIC SPACE

LOBBY, FOOD FACILITY, MECHANDISING, WAYFINDING, EXHIBIT, SEATING

USER SPACE

OPEN STUDY SPACES, ENCLOSED STUDY SPACES, RESEARCH SUITE (PHD, STAFF, FACULTY), INSTRUCTIONAL SPACES, SPECIALTY LAB

COLLECTIONS

GENERAL COLLECTION 6 SHELVES HIGH, GENERAL COLLECTION 3 SHELVES HIGH, GENERAL COLLECTION COMPACT SHELVING, BOUND JOURNALS COM-PACT SHELVING, GOVERNMENT DOCS COMPACT SHELVING, OTHER

PARTNER

ALL PARTNER SERVICE DESK, DROP IN SPACE, CCIT TECH SANDBOX, TECH DESK, CCIT PRINTING), WRITING CENTER, LEARNING COMMONS, OFFICE OF TEACHING EFFECTIVENESS AND INNOVATION

LIBRARY WORKSPACE

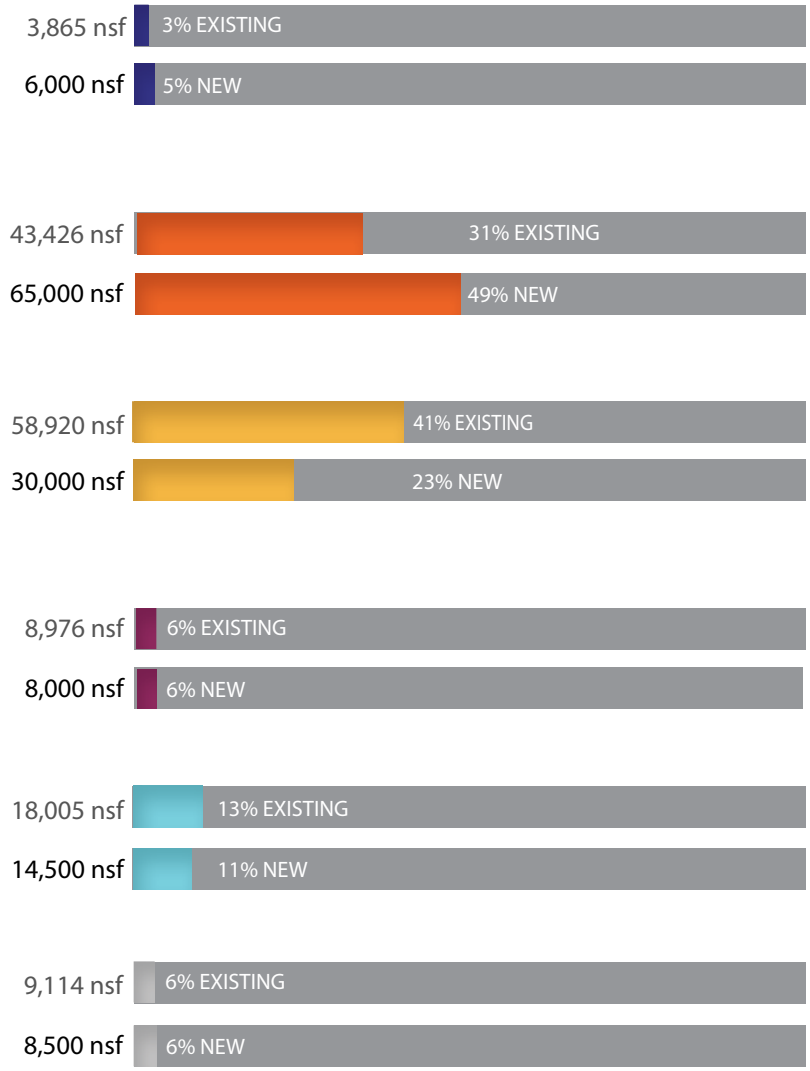
OFFICES, WORKSTATIONS, STUDENT WORKSTATIONS, MEETING ROOMS, STORAGE & PRINTING, LOUNGE / BREAKROOM, FRONT OF HOUSE SERVICE AREAS

SUPPORT

TOILET ROOMS, HOUSEKEEPING, MECHANICAL ROOMS, FAN ROOMS, ELECTRICAL SWITCHGEAR, ELECTRICAL ROOMS, SERVER ROOMS, DATA ROOMS, GENERAL LIBRARY STORAGE, HOUSEKEEPING STORAGE, LOADING DOCK

PROGRAM SUMMARY
COOPER LIBRARY

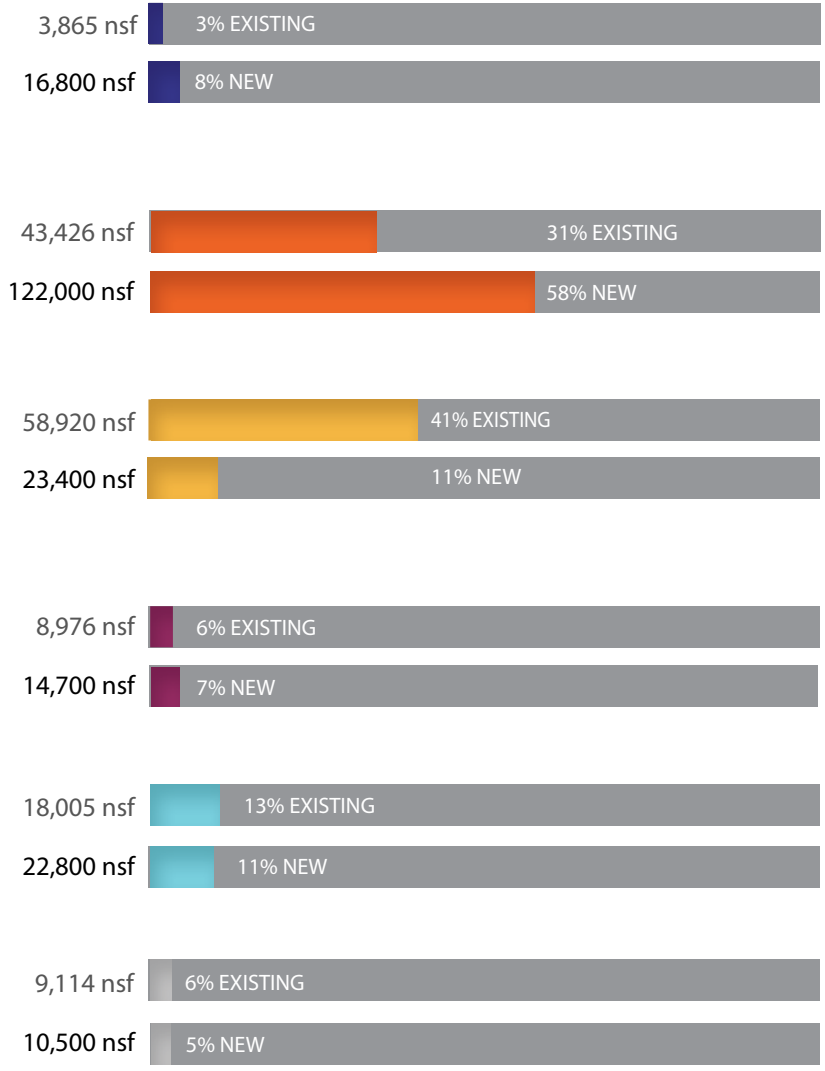
EXISTING VS. NEW 5 YEAR
*AS A PERCENT OF TOTAL BUILDING SQUARE FEET



132,000 nsf Assignable SF
179,970 gsf Renovated Gross SF

PROGRAM SUMMARY
COOPER LIBRARY

EXISTING VS. NEW 15 YEAR
*AS A PERCENT OF TOTAL BUILDING SQUARE FEET



210,000 nsf Assignable SF
323,538 gsf Renovated + Expansion Gross SF

METHODOLOGY

DEFINE & REDEFINE PROGRAM

The Master Plan Study was a collaboration with Brightspot and consisted of eleven phases of work for the execution of the study. They are as follows:

Groundwork and Project Management
Peer Research
Physical Condition Assessment
Interviews and Workshops
Visioning and User Experience
Services and Partner Strategy
Category Level Space Program
Design Concepts and Space Planning
Phasing Strategy
Cost Estimating
Final Reports and Stakeholder Feed back

The Phases indicated in bold represent the Phases documented in this section of the Master Plan Study.

CONCEPT STUDIES

Brightspot developed a Category Level Space Programs for 5 and 15 year growth. They are not detailed space programs, but provide anticipated square foot requirements for major program groups. These programs serves as the basis for the conceptual planning diagrams

Initially the focus of this study was for renovation within the footprint of the existing Cooper Library. Options were developed and presented to the Library Master Planning Committee for review and comment, with a preferred diagram being developed and was used for cost analysis and phasing.

Given the complexities of keeping the Library operational during such a major renovation, the team explored the benefits of expanding the library to meet it's need in the year 2034. Several scenarios were discussed with the decision to focus on the expansion of the existing Cooper Library. Master Planning committee meetings were held to review conceptual space diagrams. After several iterations the conceptual planning diagrams received approval from the committee.

IMPLEMENTATION

Following the approval of the conceptual plans the Cooper Library was evaluated for:

- Mechanical, Electrical, Plumbing, Fire Protection and Infrastructure
- Accessibility
- Code and egress requirements

Project phasing plans were developed based on goals and priorities identified by the Master Planning committee. The phasing diagrams provide the Library with an understanding of available spaces for Library use during construction, and inform the hard construction costs.

EXISTING PLANS

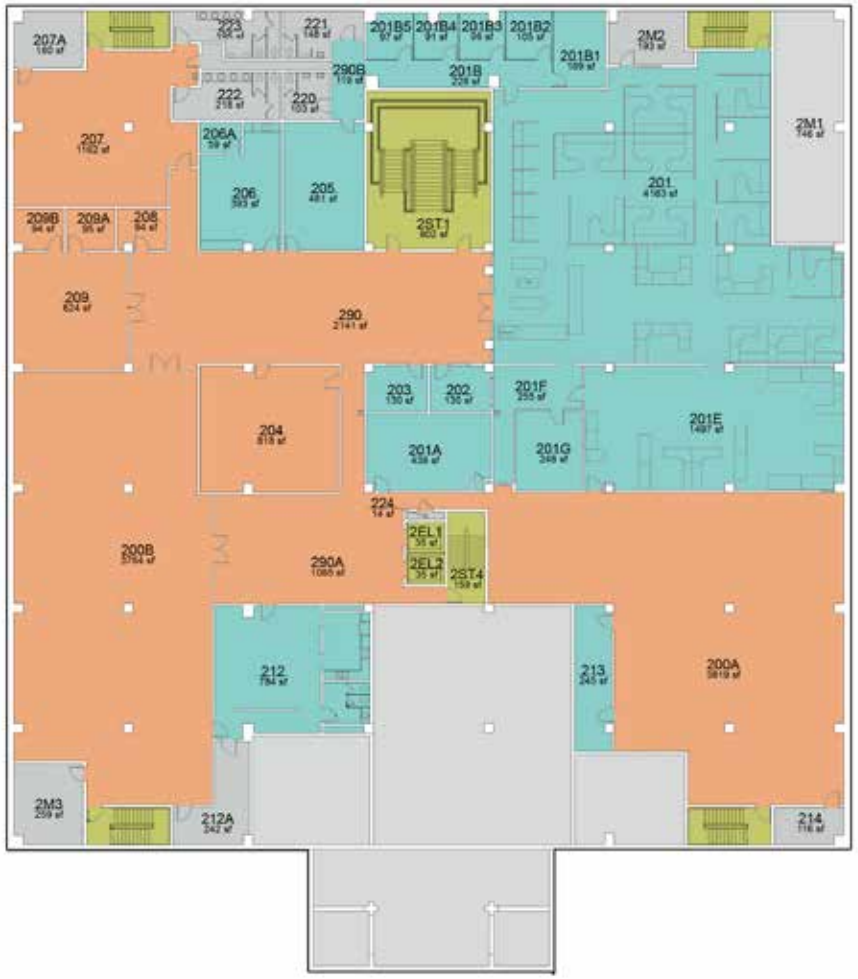
COOPER LIBRARY: 1ST FLOOR

KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space

0 26 52 78

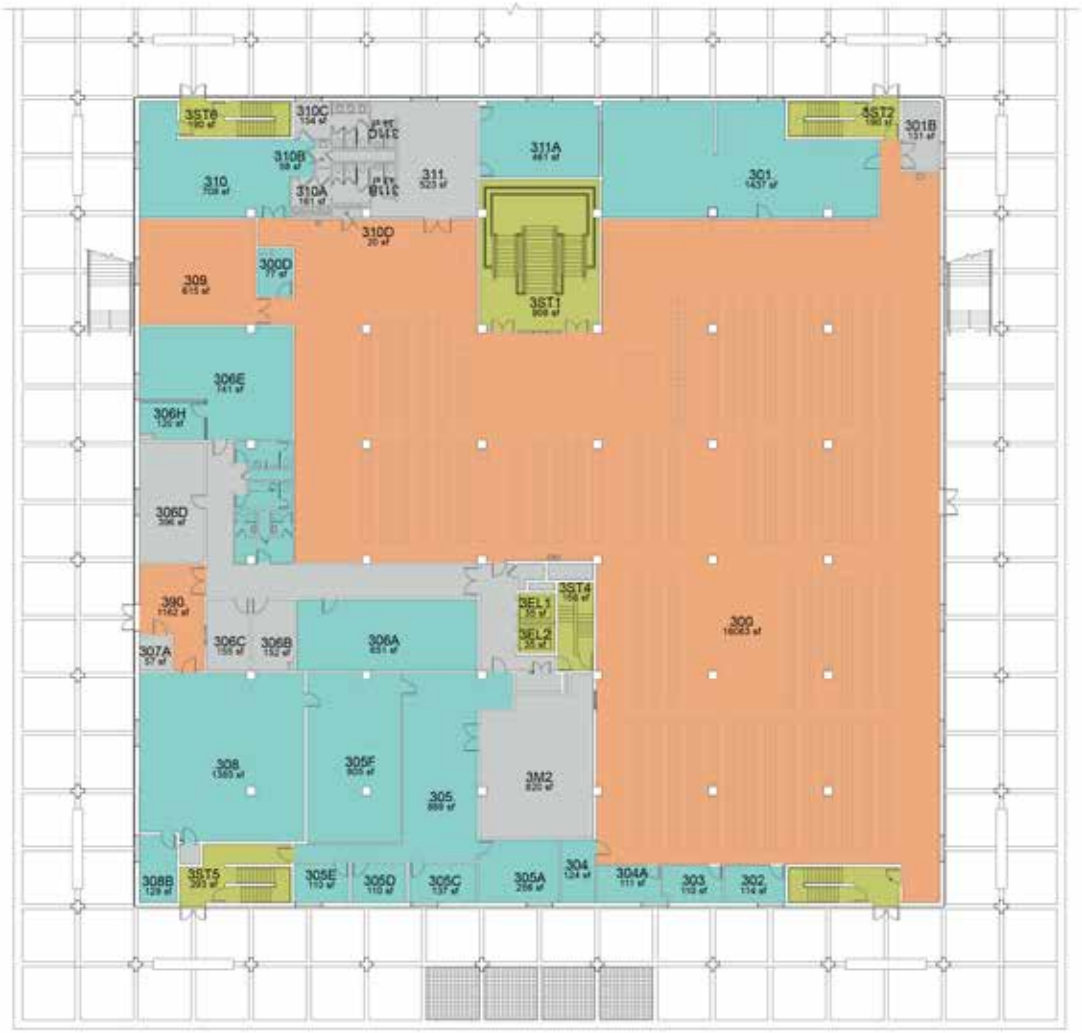
COOPER LIBRARY: 2ND FLOOR



KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space

COOPER LIBRARY: 3RD FLOOR



KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space

0 26 52 78

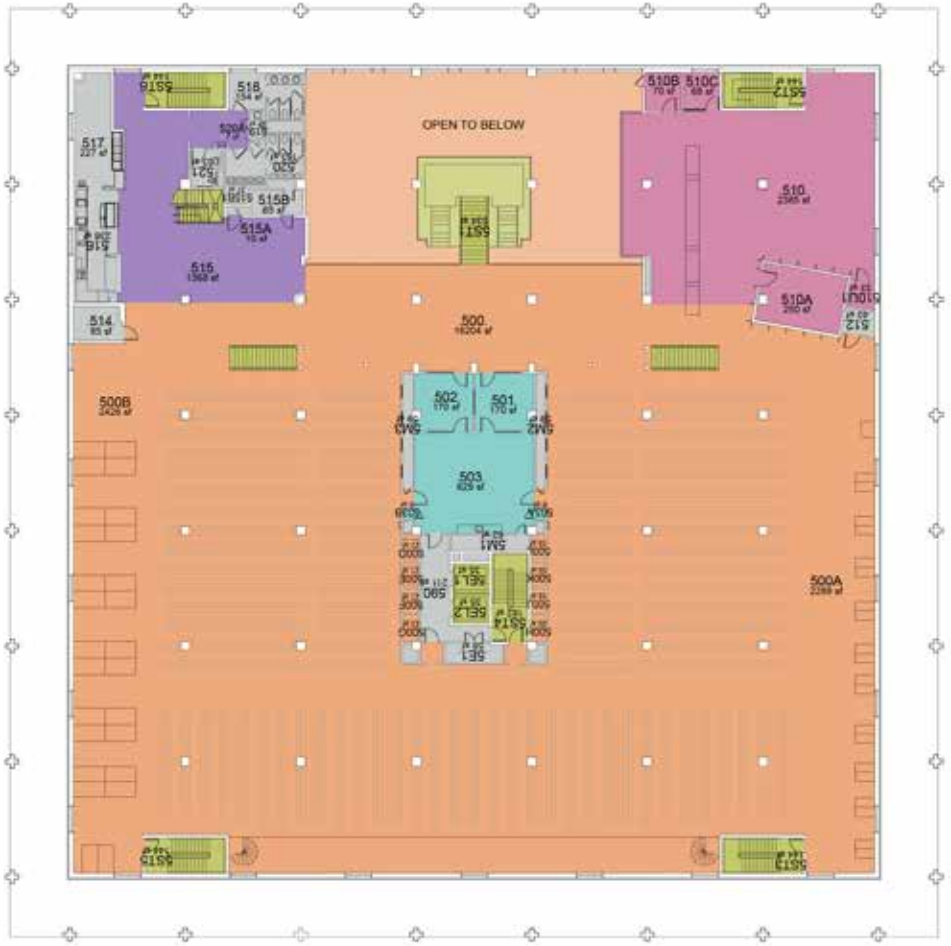
COOPER LIBRARY: 4TH FLOOR

KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space

EXISTING PLANS

COOPER LIBRARY: 5TH FLOOR

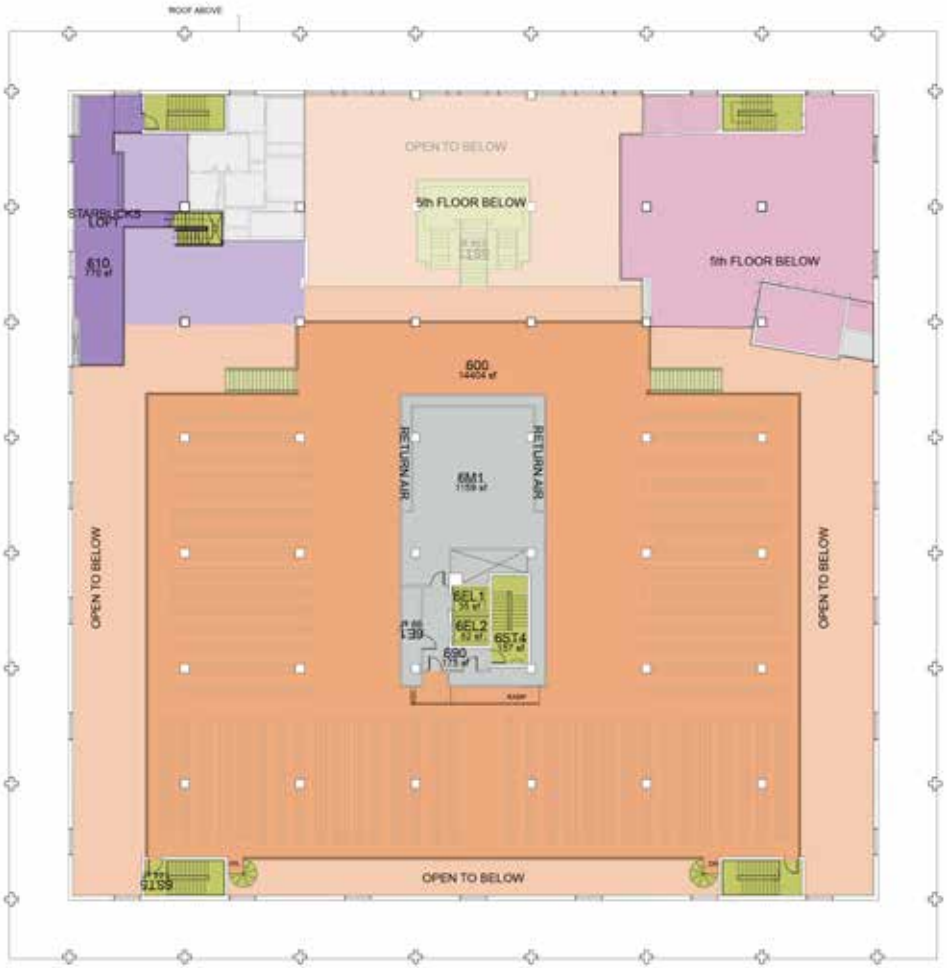


KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space

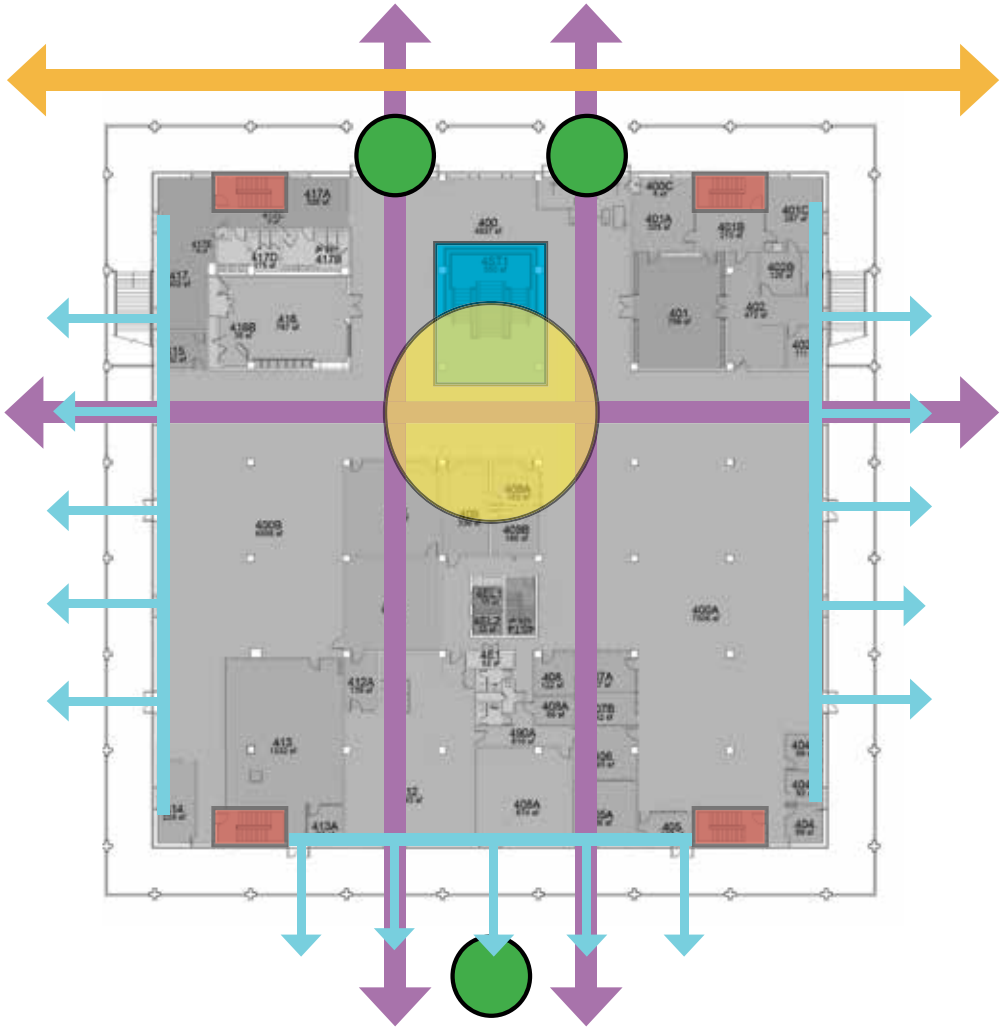
0 26 52 78

COOPER LIBRARY : 6TH FLOOR



KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space



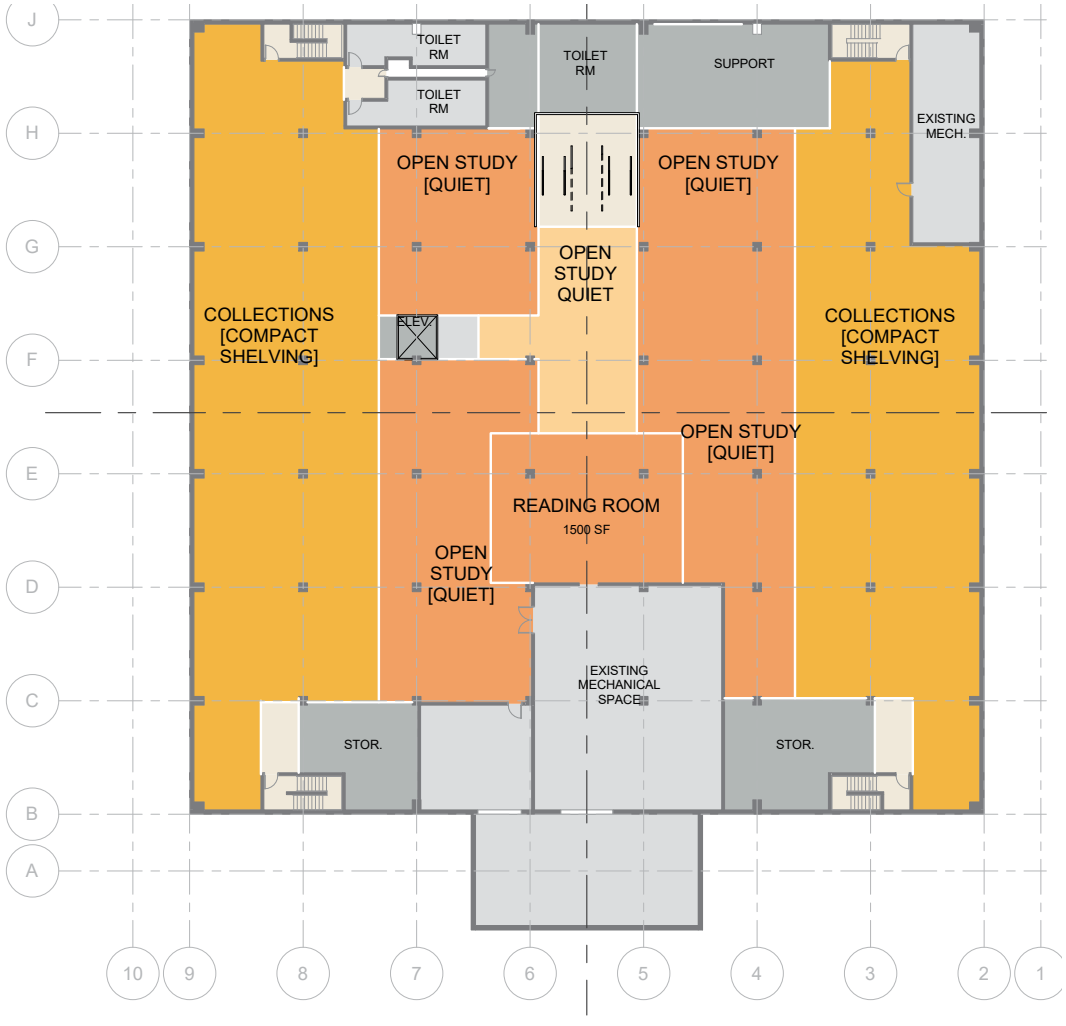
RENOVATION CONCEPTS

In studying the renovation of the Cooper Library, the following key organizational concepts guided the design studies. They are as follows:

- Create new south entry from the South Campus Green, reinforcing connection to the Watt Center and the Academic Success Center.
- Locate key service points so that they are easily visible from the entry points or the monumental stair.
- Development of a clear organization concept that allows easy wayfinding and circulation through the Library.
- With introduction of the new South Entry, creation of a “street” that creates a visual conection through the Library from the Library Reflection Pond to the South Campus Green
- Organize spaces to allow daylight from the perimeter walls to penetrate deeper into the Library interior spaces
- Open the monumental stair on levels 1, 2, and 3 with a glass enclosure to bring more daylight into the lower levels of the Library
- Create openings in the 3rd Level floor slab to create connection to the 2nd level.

CONCEPT PLANS - RENOVATION

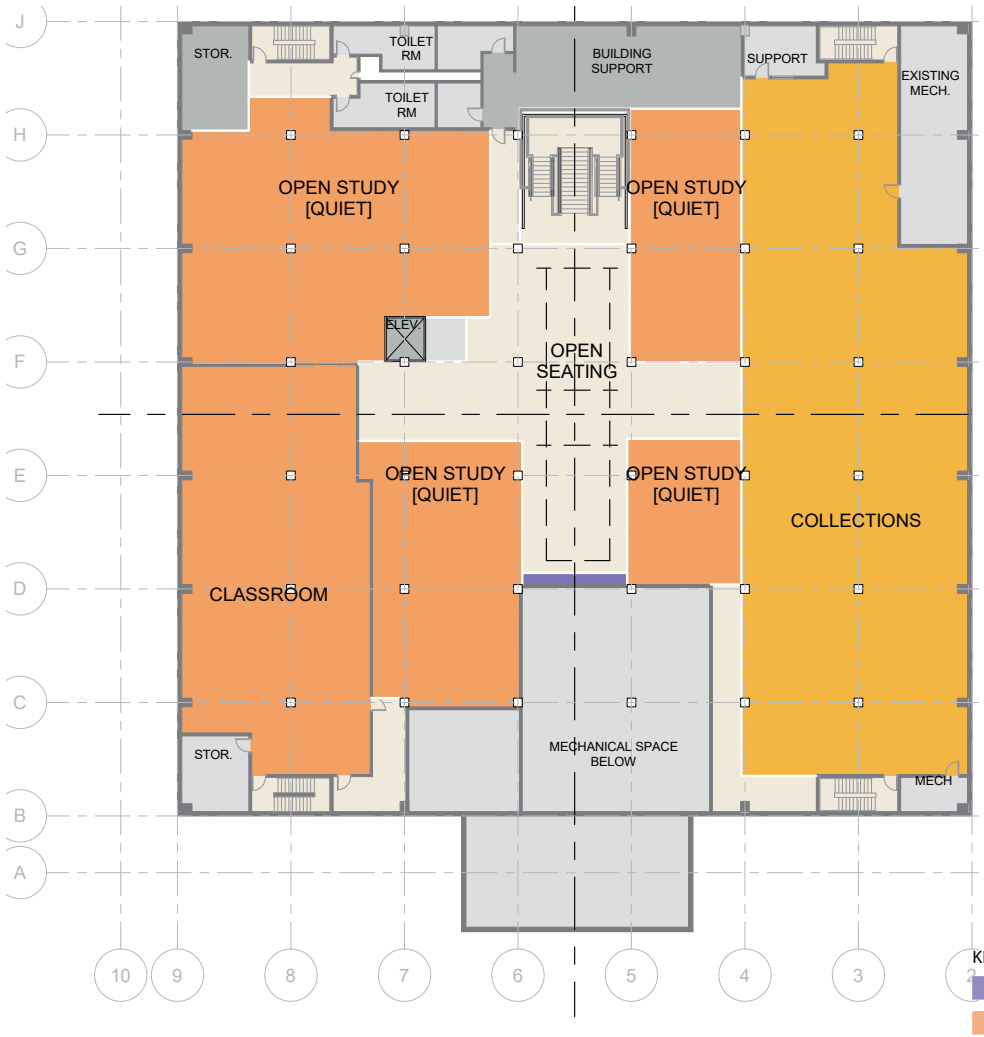
COOPER LIBRARY: 1ST LEVEL



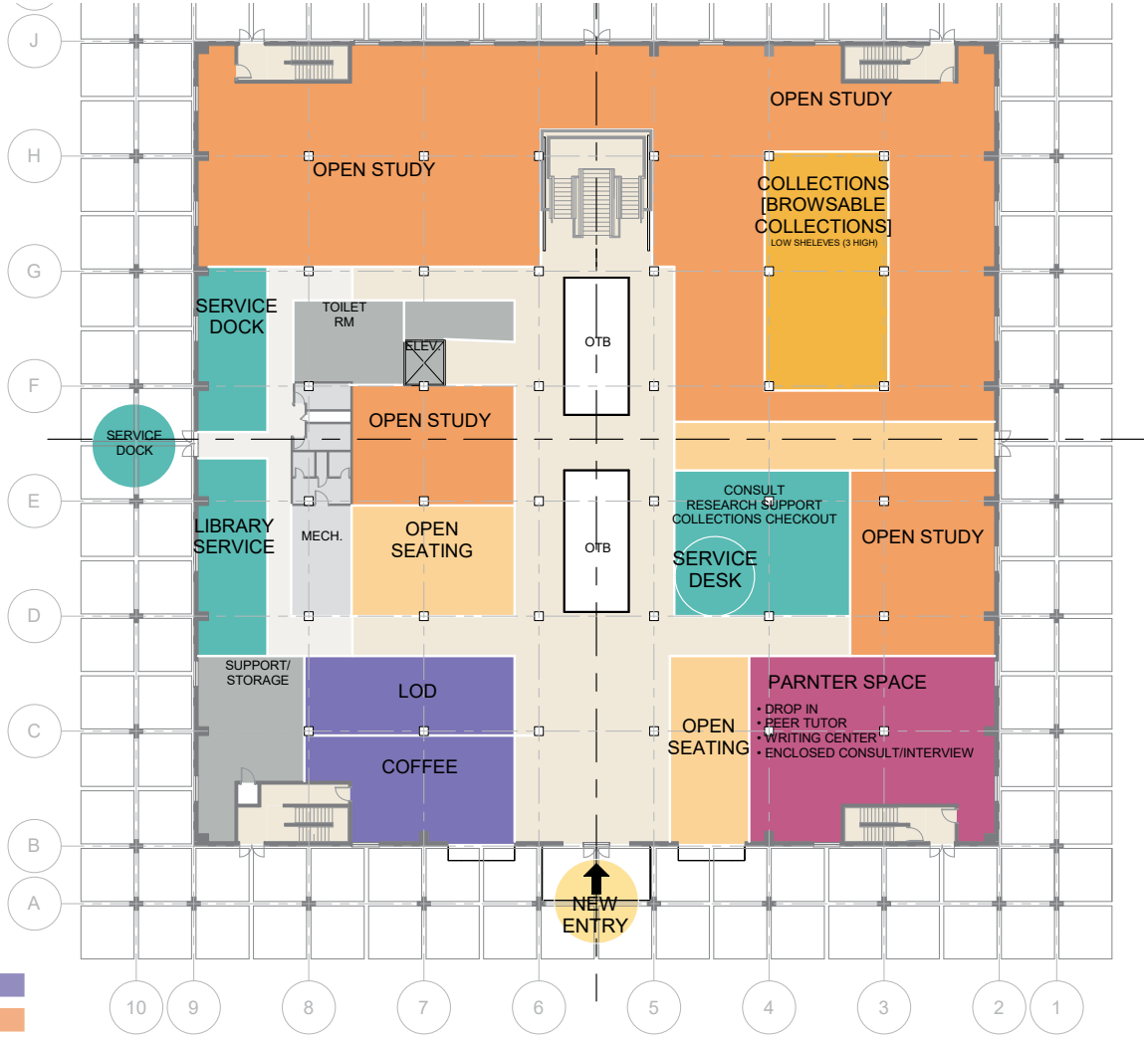
KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space

COOPER LIBRARY : 2ND LEVEL



COOPER LIBRARY: 3RD LEVEL



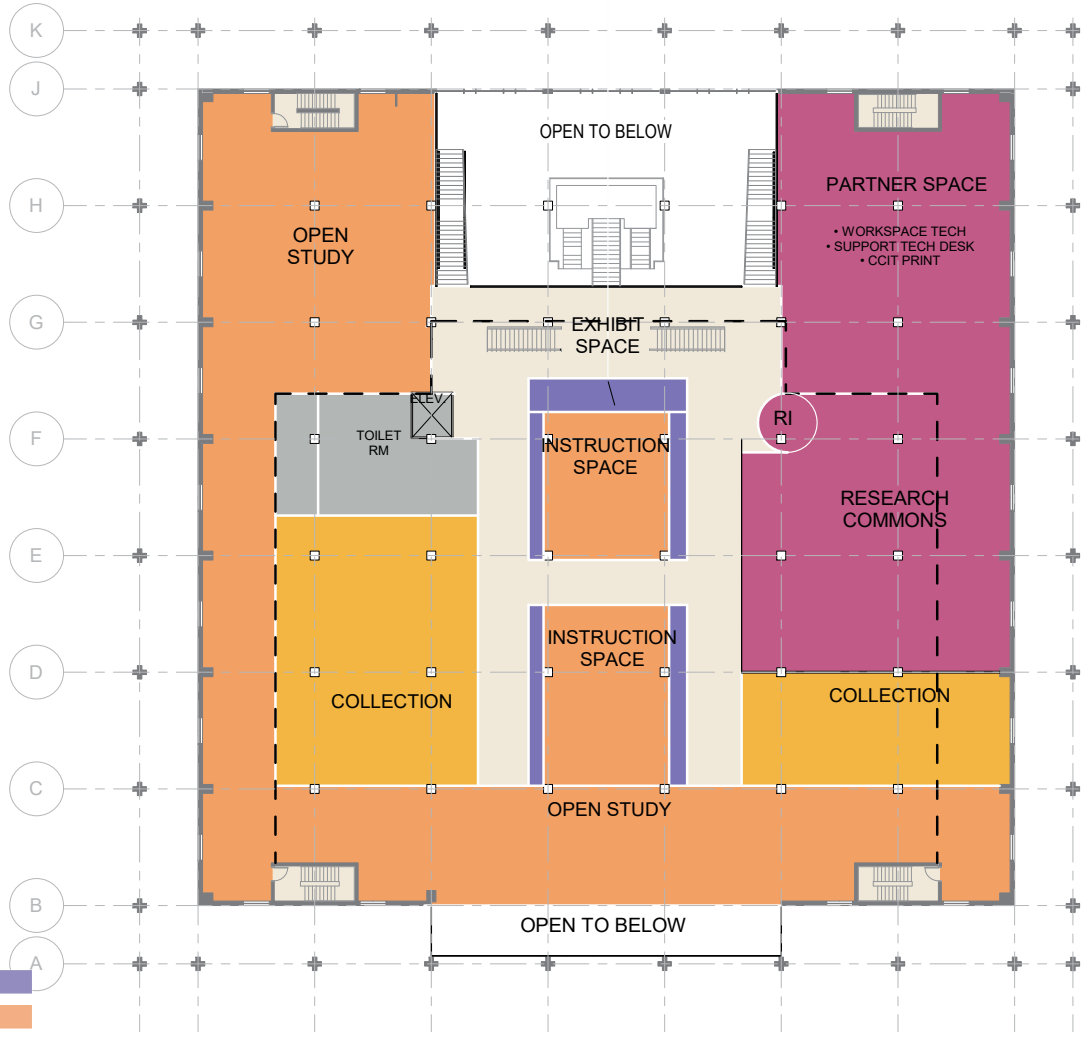
KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space

COOPER LIBRARY : 4TH LEVEL

CONCEPT PLANS - RENOVATION

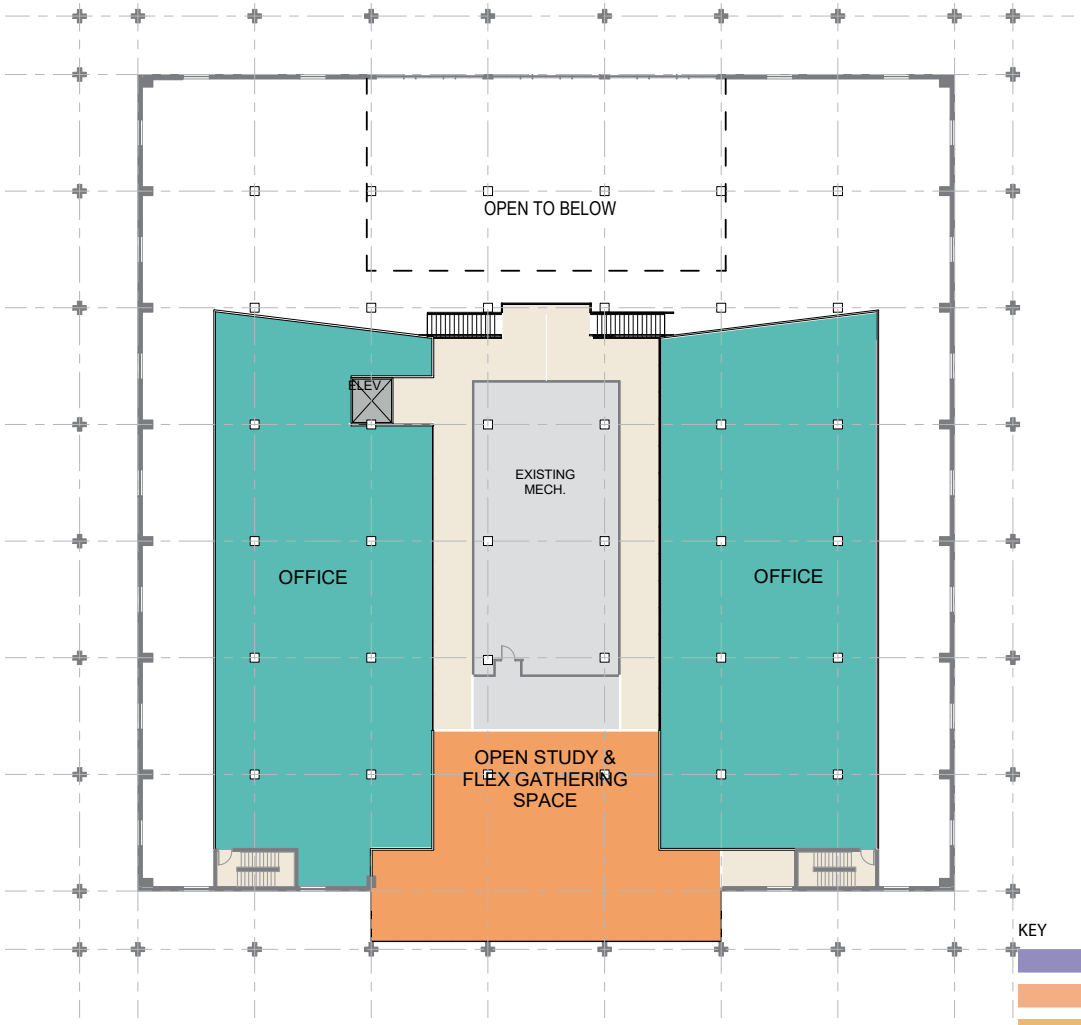
COOPER LIBRARY: 5TH LEVEL



KEY

- Public Space
- UserSpace
- Collections
- Partner Space
- Library Work Space
- Support Space

COOPER LIBRARY : 6TH LEVEL



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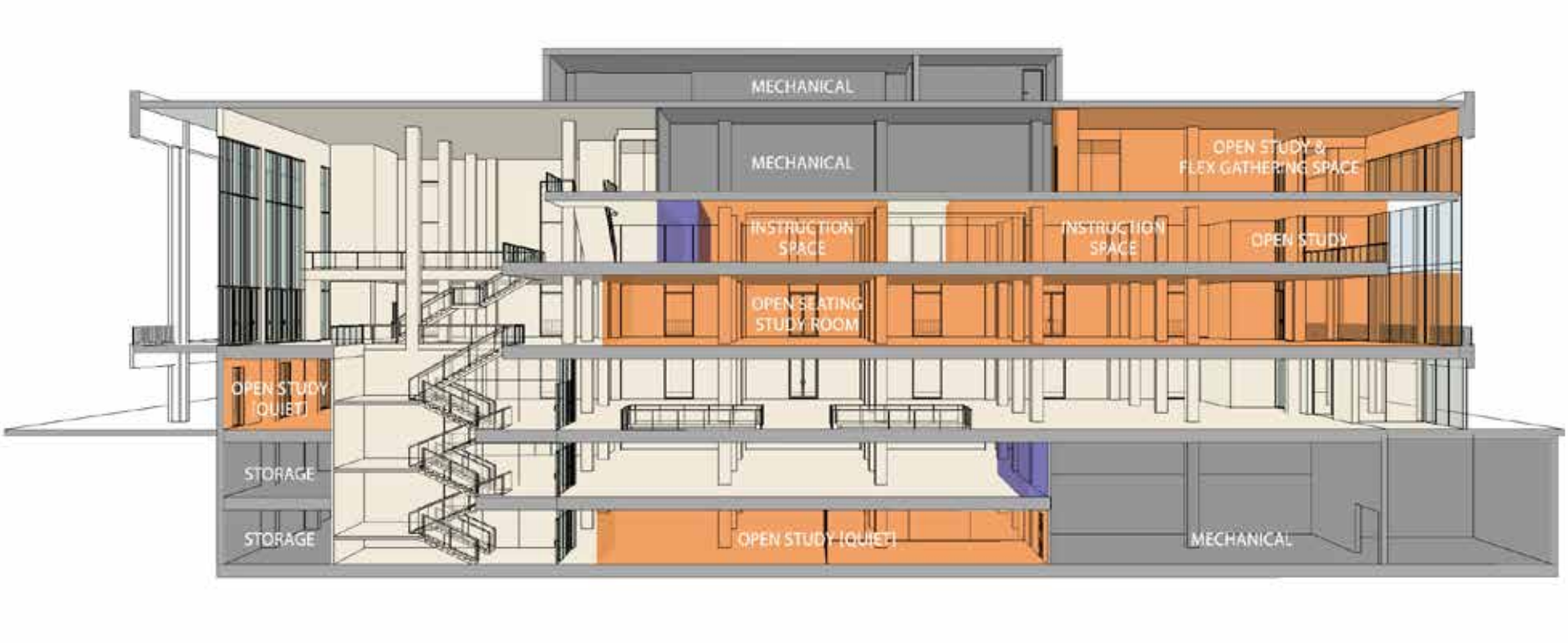
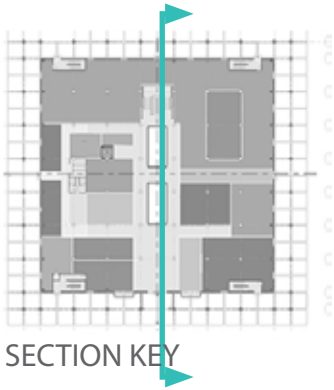


North - South Section thru Centerline of the Building



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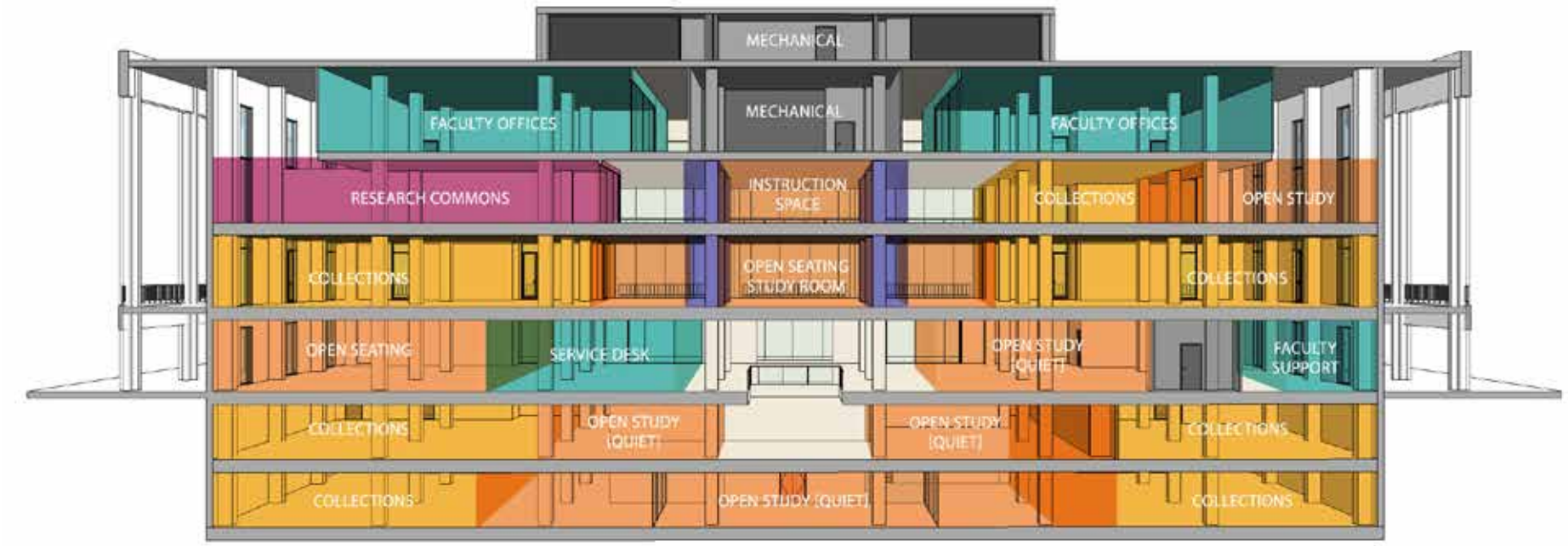
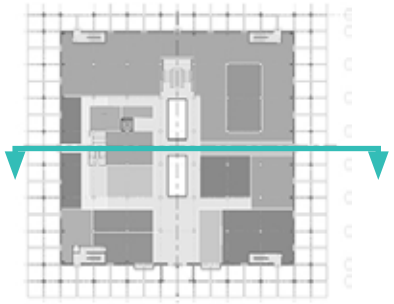


East - West Section thru Centerline of the Building



SECTION KEY

KEY

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- UserSpace
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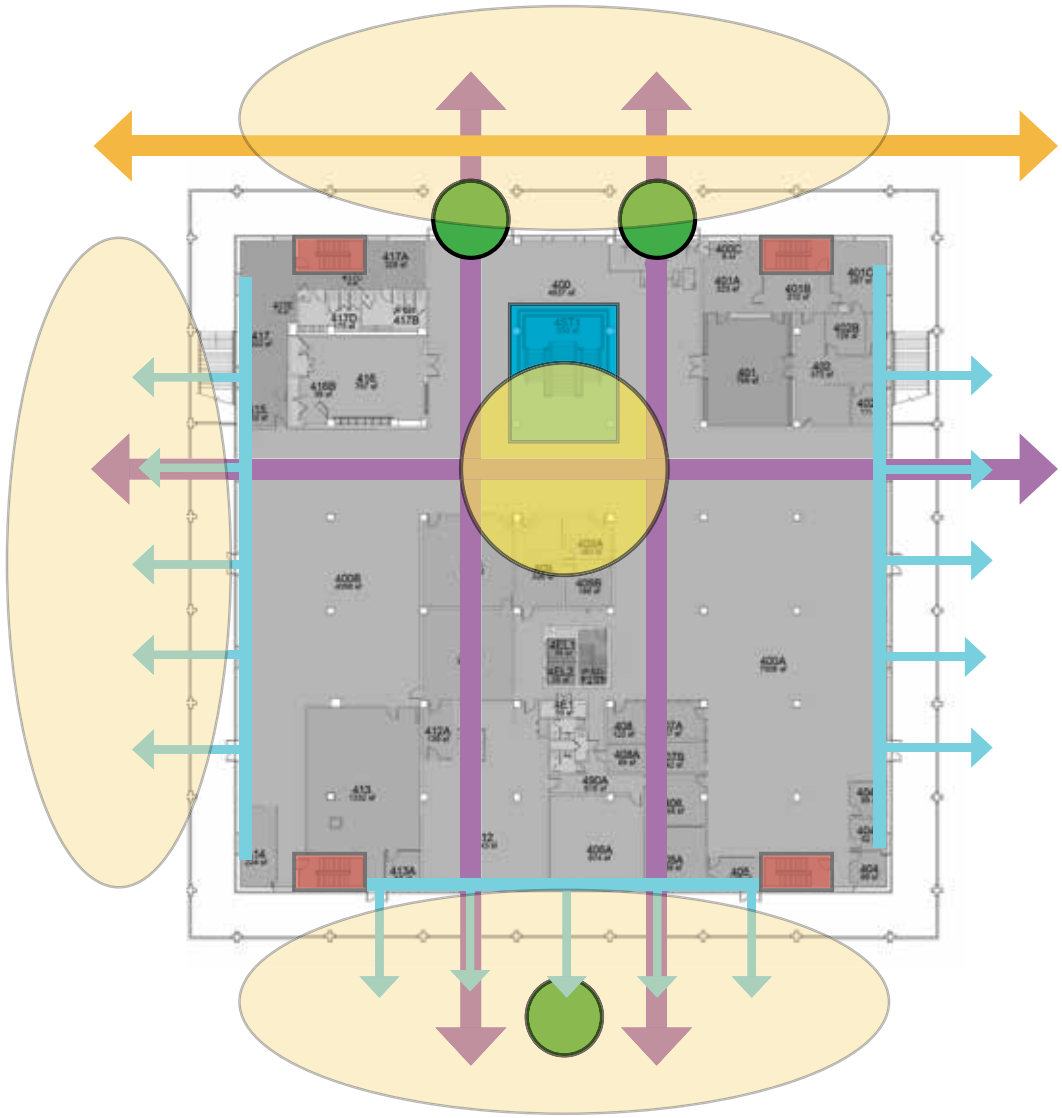


RENOVATION / EXPANSION CONCEPTS

Per the Brightspot Report, for the Libraries to meet the Univerity's growth needs in 2035, it will need to expand appproximately 144,000 GSF. This study investigated the possibility of expanding and renovating the Cooper Library.

Given its location in the heart of campus and the surrounding density, it is not possible to create a singular building expansion for a 144,000 gsf. The site does offer smaller expansion opportunities around the perimeter. These include:

West - Expand into the existing parking lot. This location provides an opportunity for the largest expansion footprint. With its alignment to the Watt Center, a bridge opportunity between the two buildings is possible.

South - Respecting the Watt Center, expand south into the South Campus Green, providing a new Library entrance and greater connection to the Watt Center

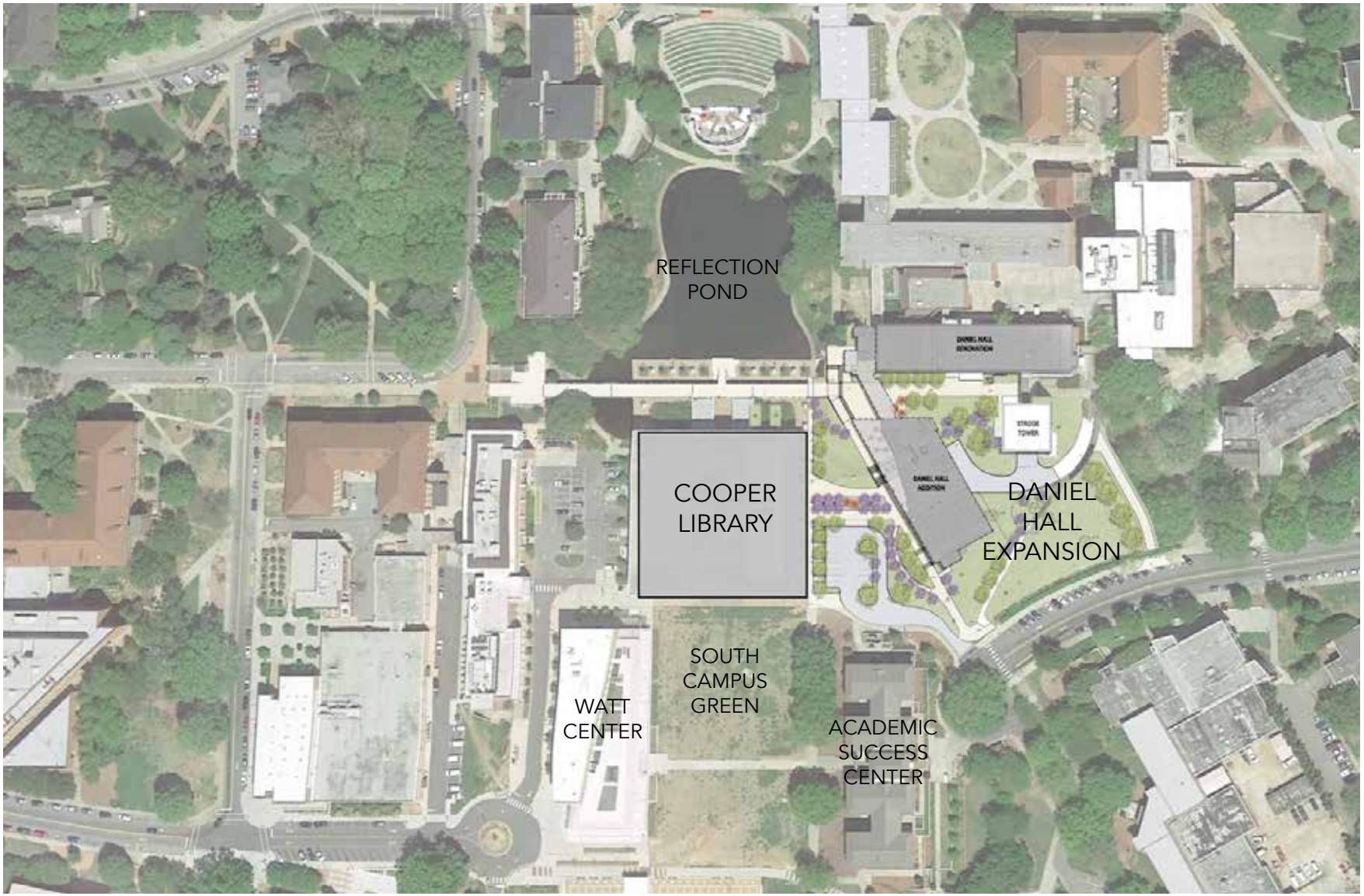
North - Pushing north to the edge of the Library Reflection Pond, create three levels of new space and a new entry into the Library. This will require the demolition of the existing pedestrian bridge and building a new bridge along the edge of the pond.

East - The new Daniel Hall expansion will limit Library expansion to the east. There is potential to expand within the limits of the existing balcony.

- The organizational concepts for the renovation and expansion are the same as in previous renovation concepts and are as follows:
- Create new south entry from the South Campus Green, reinforcing connection to the Watt Center and the Academic Success Center.
- Locate key service points so that they are easily visible from the entry points or the monumental stair.
- Development of a clear organization concept that allows easy wayfinding and circulation through the Library.
- With introduction of the new South Entry, creation of a "street" that creates a visual conection through the Library from the Library Reflection Pool to the South Campus Green
- Organize spaces to allow for daylight from the perimeter walls to penetrate deeper into the Library interior spaces
- Open the monumental stair on levels 1, 2, and 3 with a glass enclosure to bring more daylight into the lower levels of the Library
- Create openings in the 3rd Level floor slab to create connection to the 2nd Level.

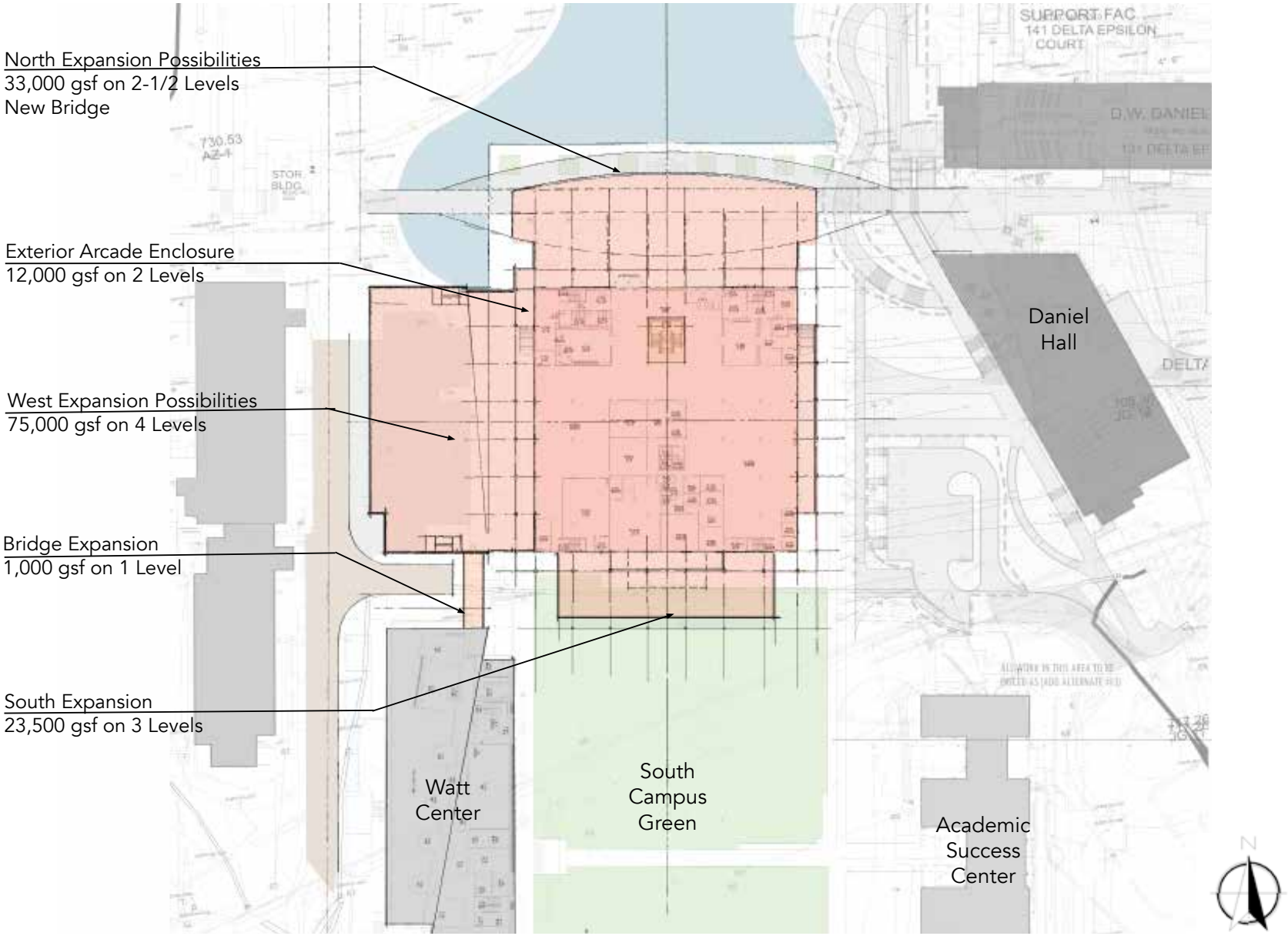
EXISTING SITE

COOPER LIBRARY



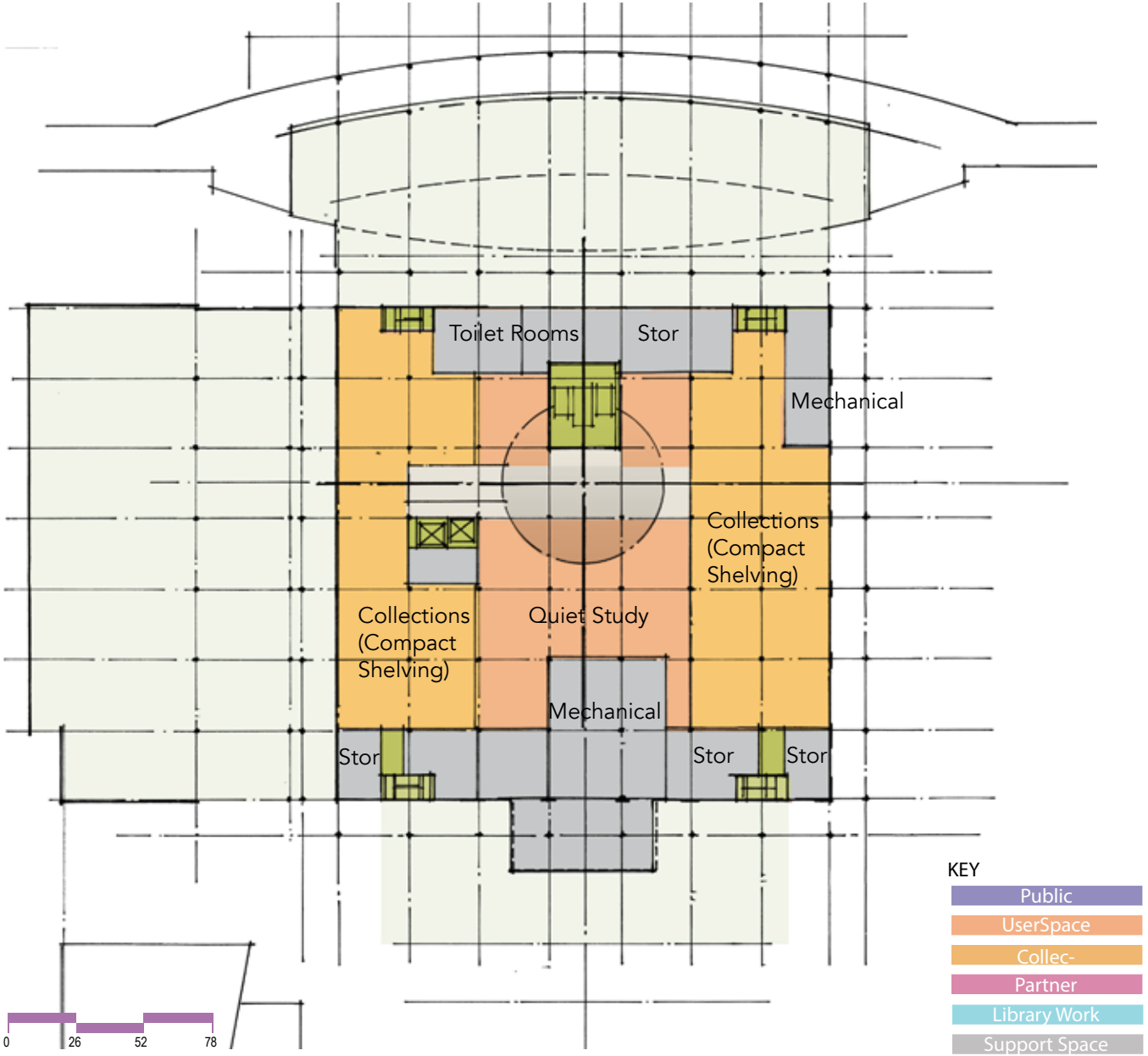
EXISTING SITE W/ EXPANSION POSSIBITIES

COOPER LIBRARY

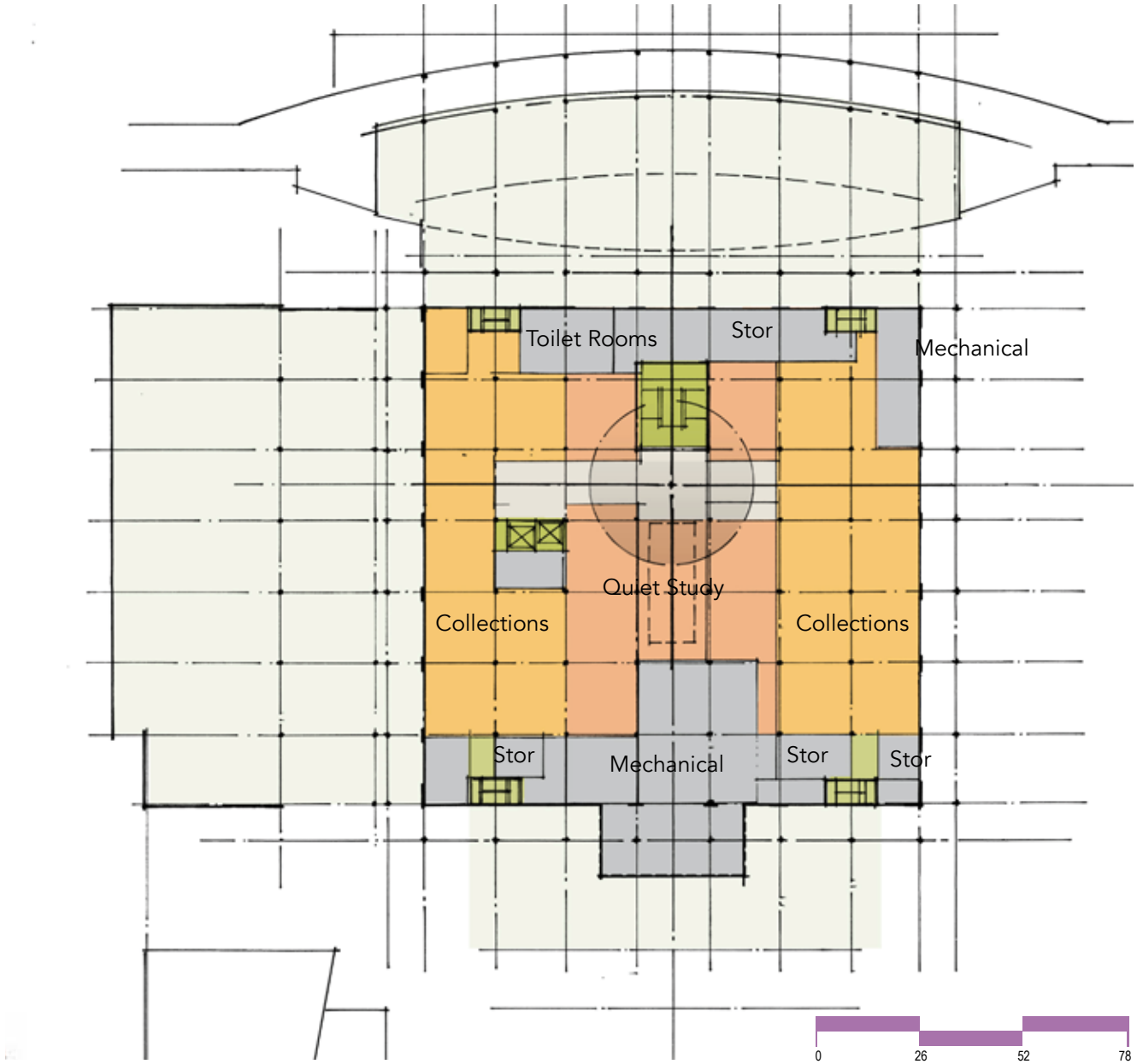


CONCEPTUAL DIAGRAMS - EXPANSION

COOPER LIBRARY: FIRST LEVEL

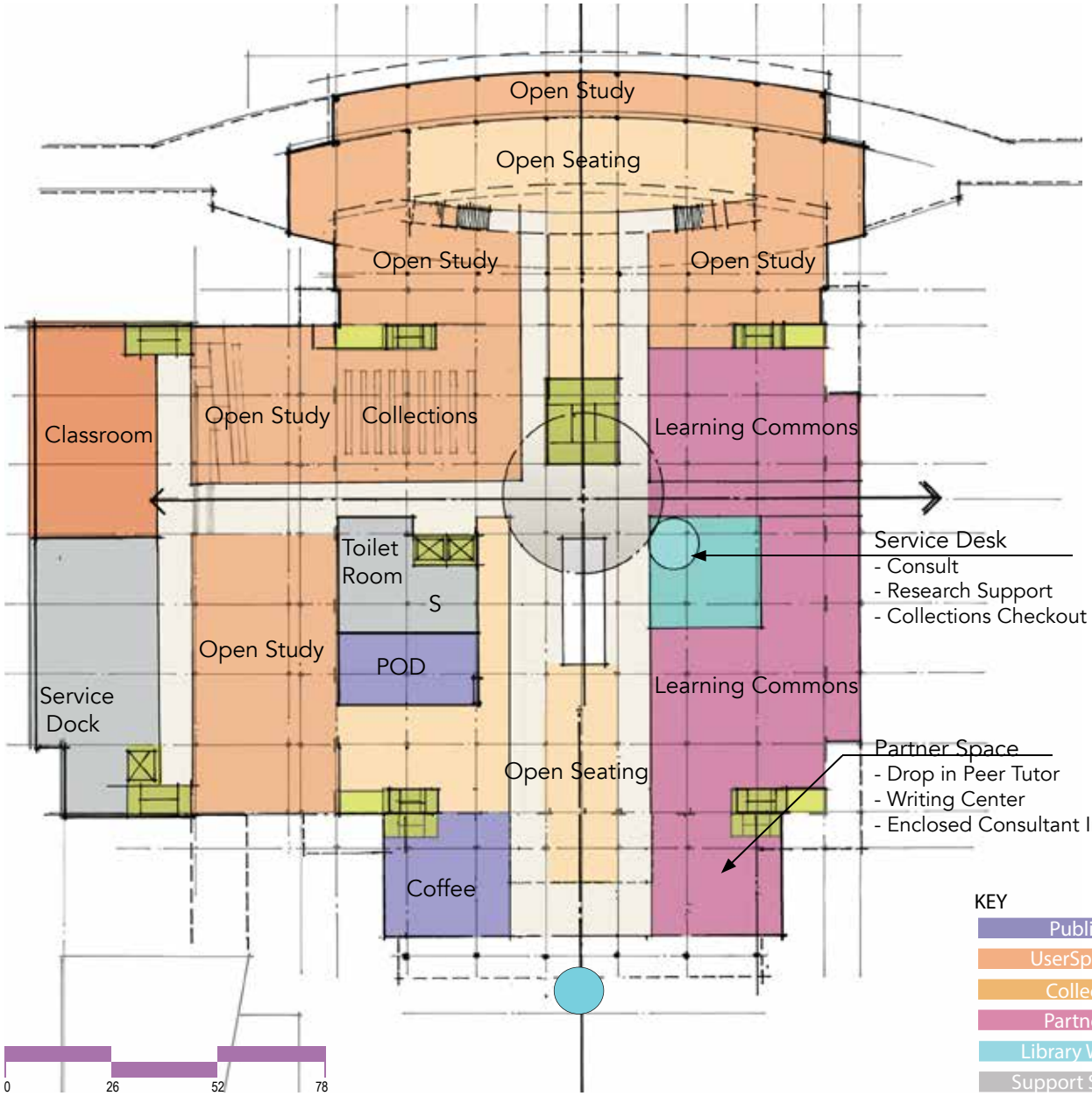


COOPER LIBRARY: SECOND LEVEL

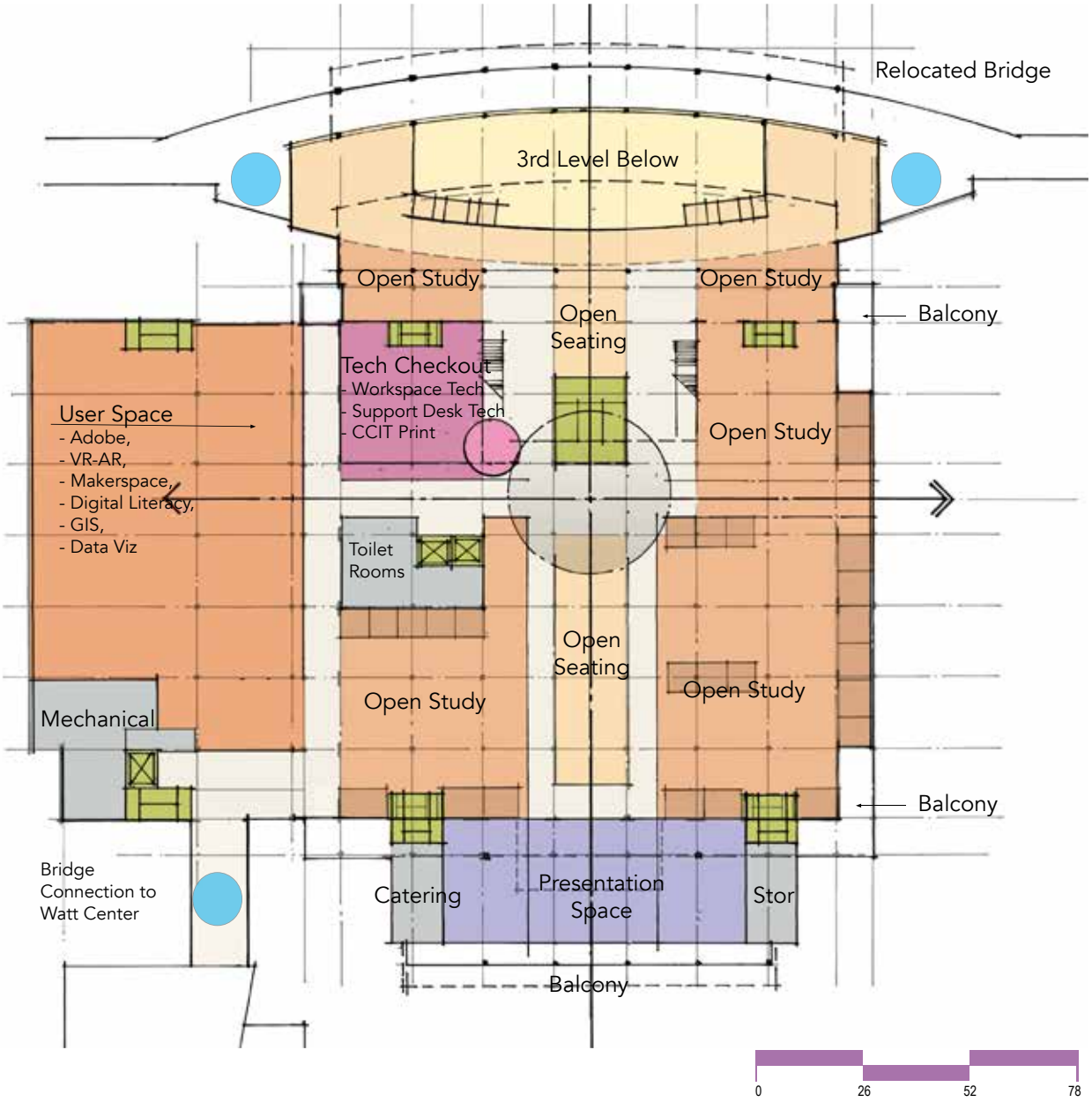


CONCEPTUAL DIAGRAMS- EXPANSION

COOPER LIBRARY: THIRD LEVEL

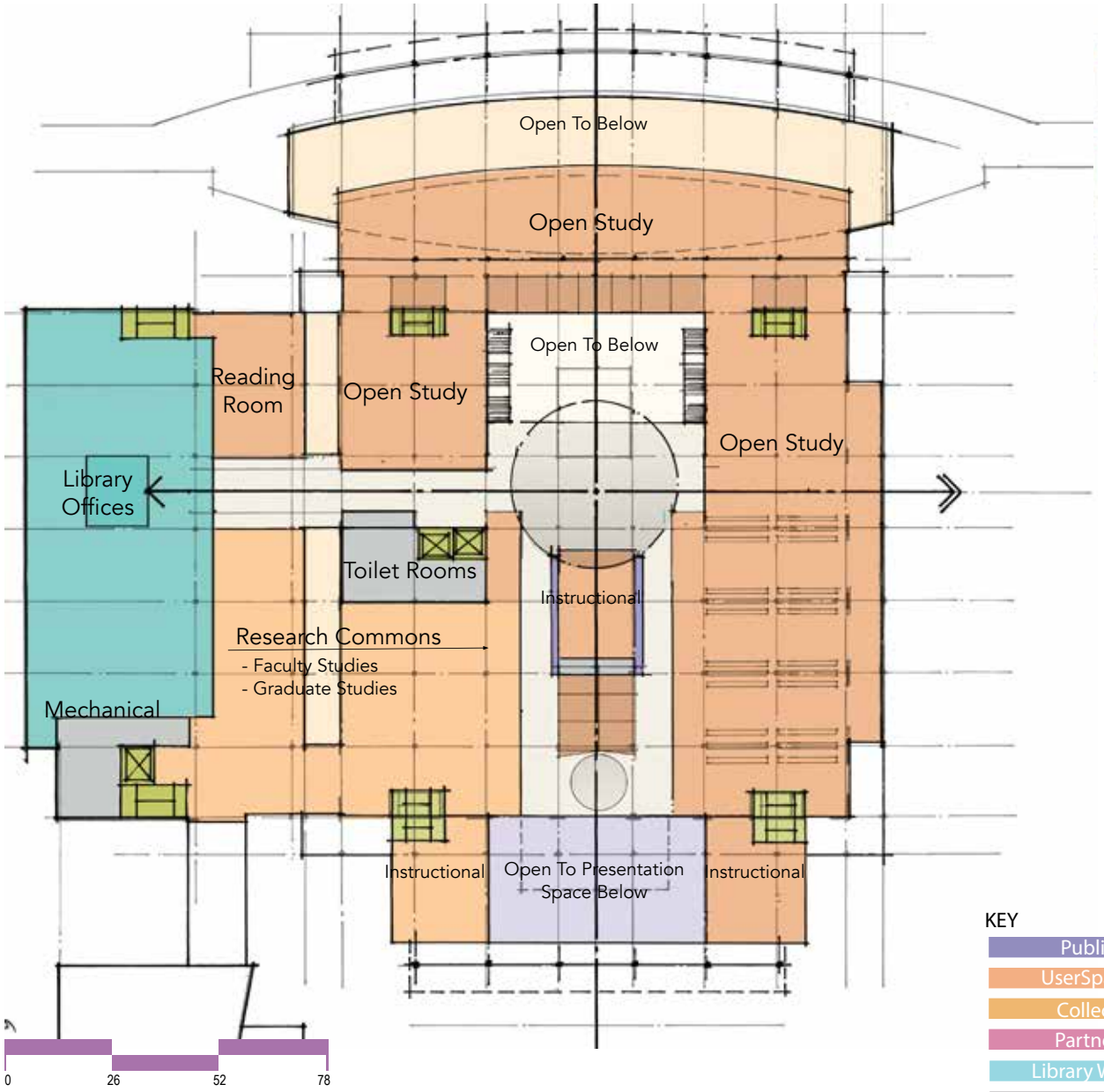


COOPER LIBRARY: FOURTH LEVEL

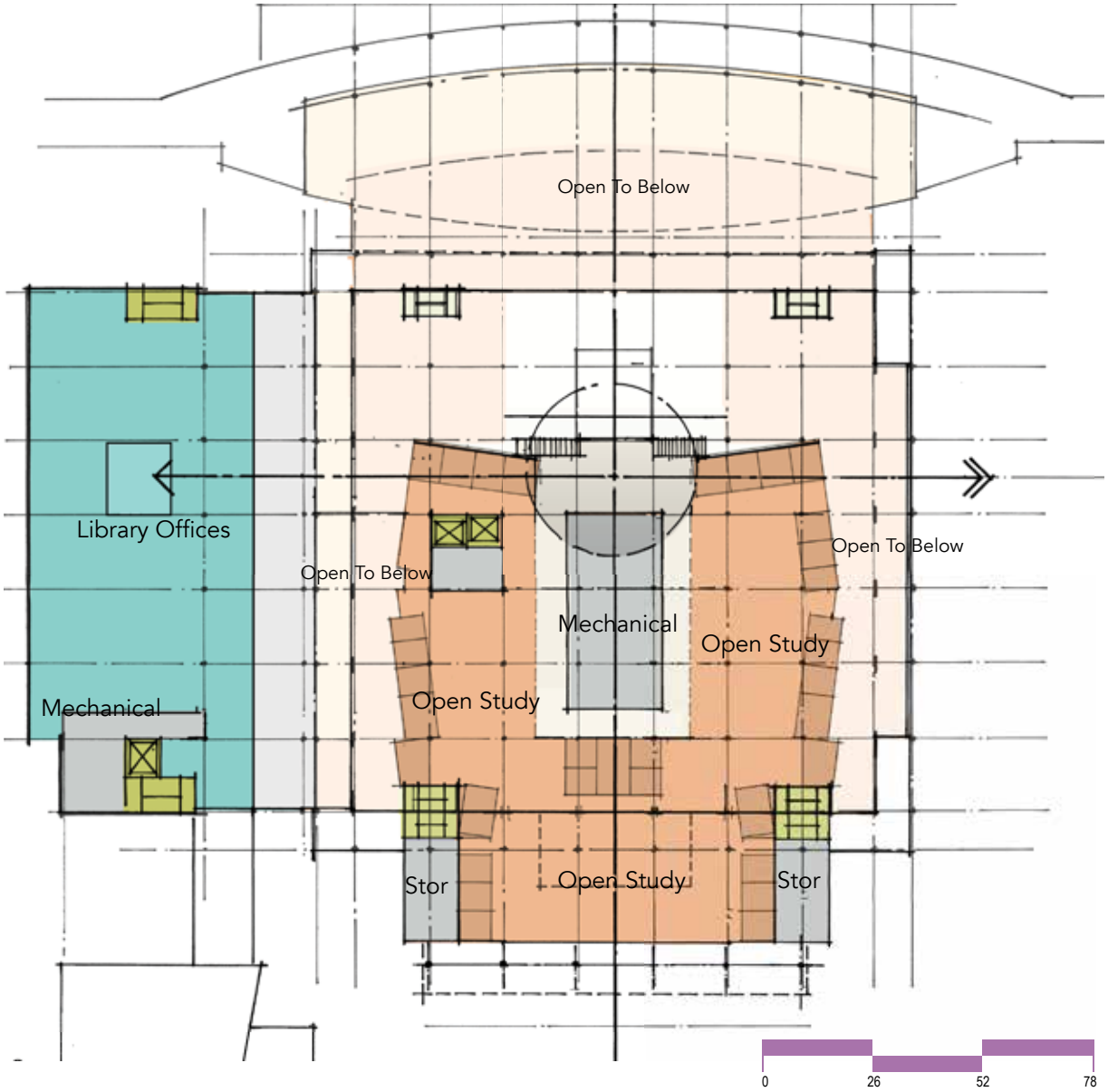


CONCEPTUAL DIAGRAMS- EXPANSION

COOPER LIBRARY: FIFTH LEVEL

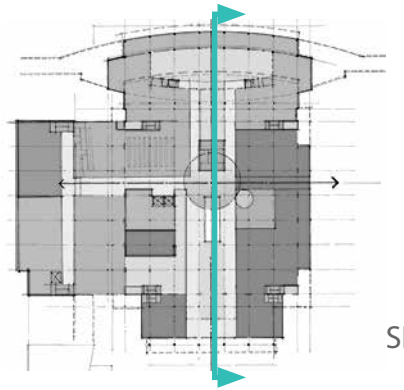


COOPER LIBRARY: SIXTH LEVEL



CONCEPTUAL DIAGRAMS- BUILDING SECTION

COOPER LIBRARY



SECTION KEY

CONCEPTUAL DIAGRAMS - BUILDING ELEVATIONS

COOPER LIBRARY

North Elevation

East Elevation

0 26 52 78

South Elevation

West Elevation

0 26 52 78

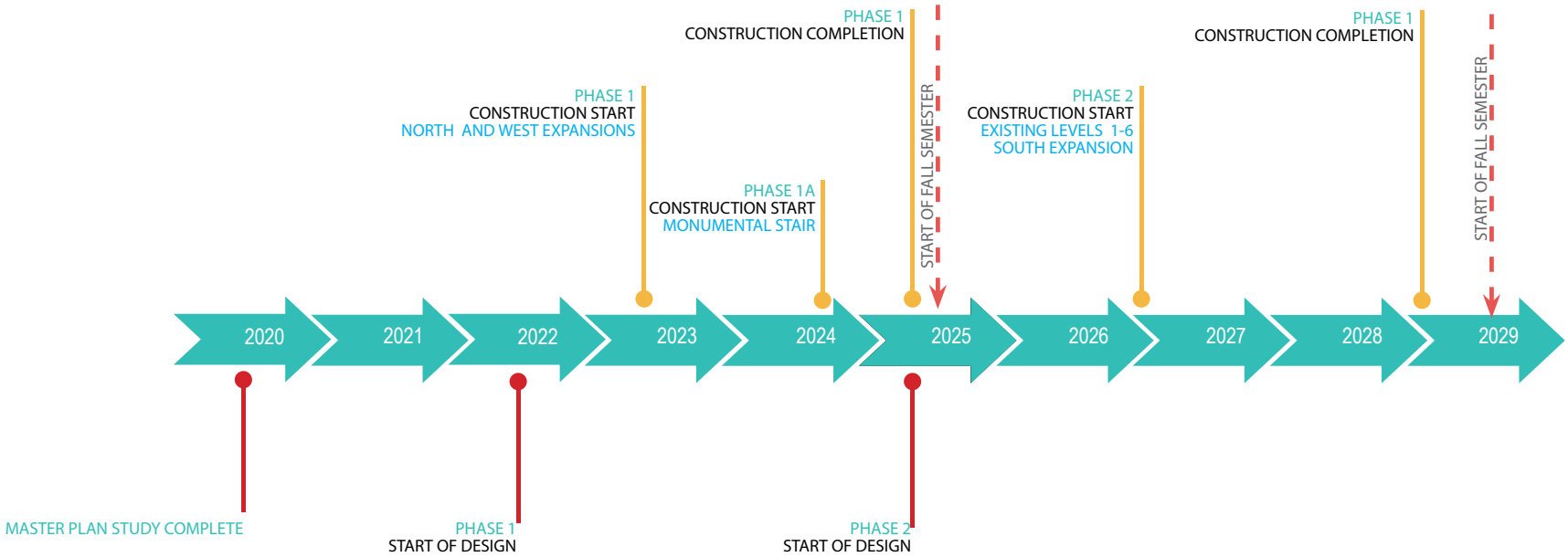
New South Entry from the South Campus Green

New North Library Expansion looking over the Library Reflection Pond

PROJECT PHASING - COOPER LIBRARY

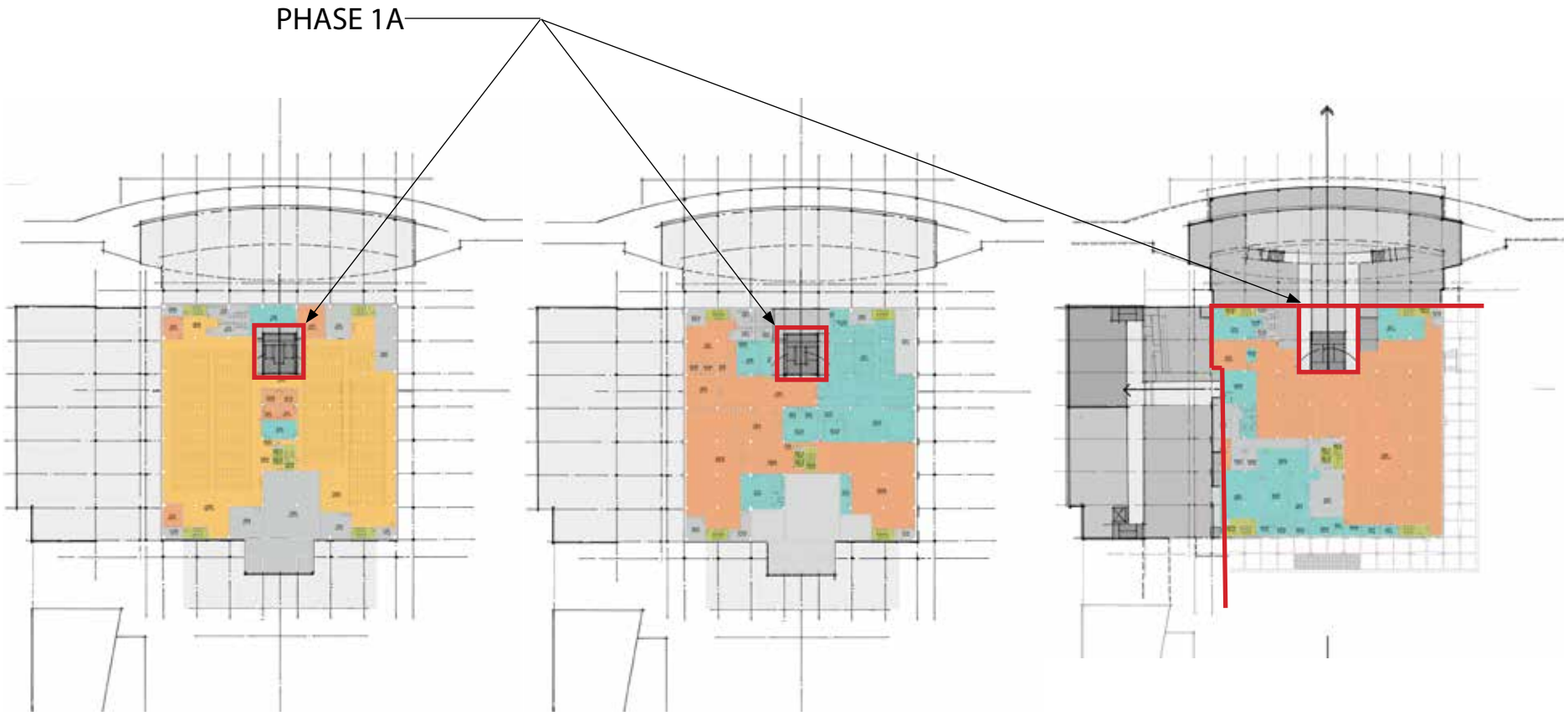
The following diagrams illustrate the implementation of the proposed Cooper Library renovation and expansion. These diagrams show a scenario that allows the Library to maintain operations during the periods of renovation and construction. The phasing diagrammed was used to inform the pricing exercise, final phasing plans will be determined when budgets, schedules, and Library priorities are finalized.

PROJECT PHASING - COOPER LIBRARY



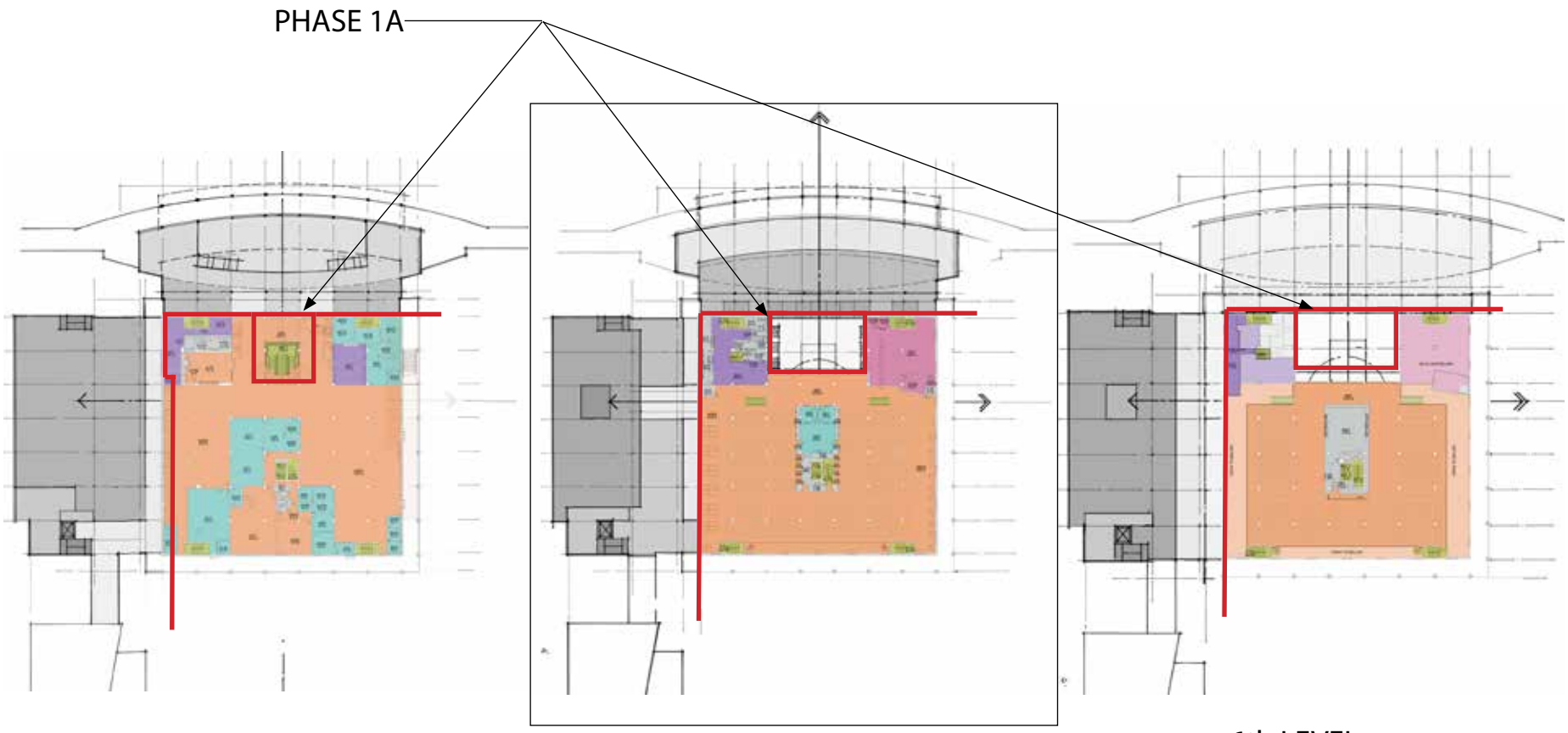
Note: The provided schedule is hypothetical and used to inform cost estimates by anticipating cost escalations due to inflation. A final schedule will need to be developed that is informed by the University's priorities and budgeting.

COOPER LIBRARY - CONSTRUCTION PHASE 1



Grey tones denote areas under construction and / or renovation

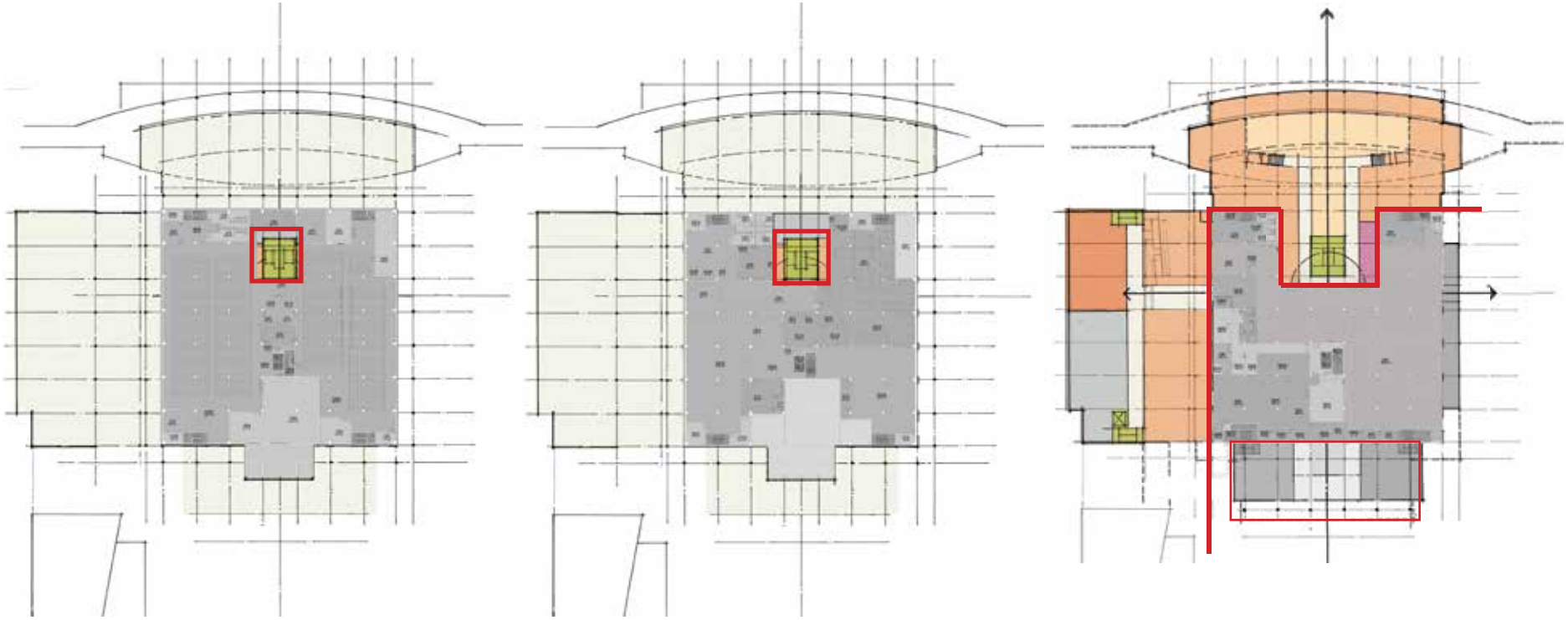
Areas with color denote spaces available for use by students, faculty, and staff during Phase 1 construction



Phase 1A is the renovation and construction of the existing monumental stairs after the west and north expansion construction has been completed. This will provide vertical circulation throughout the library during the construction of Phase 2.

PHASE 2C

PHASE 2B



1st LEVEL

2nd LEVEL

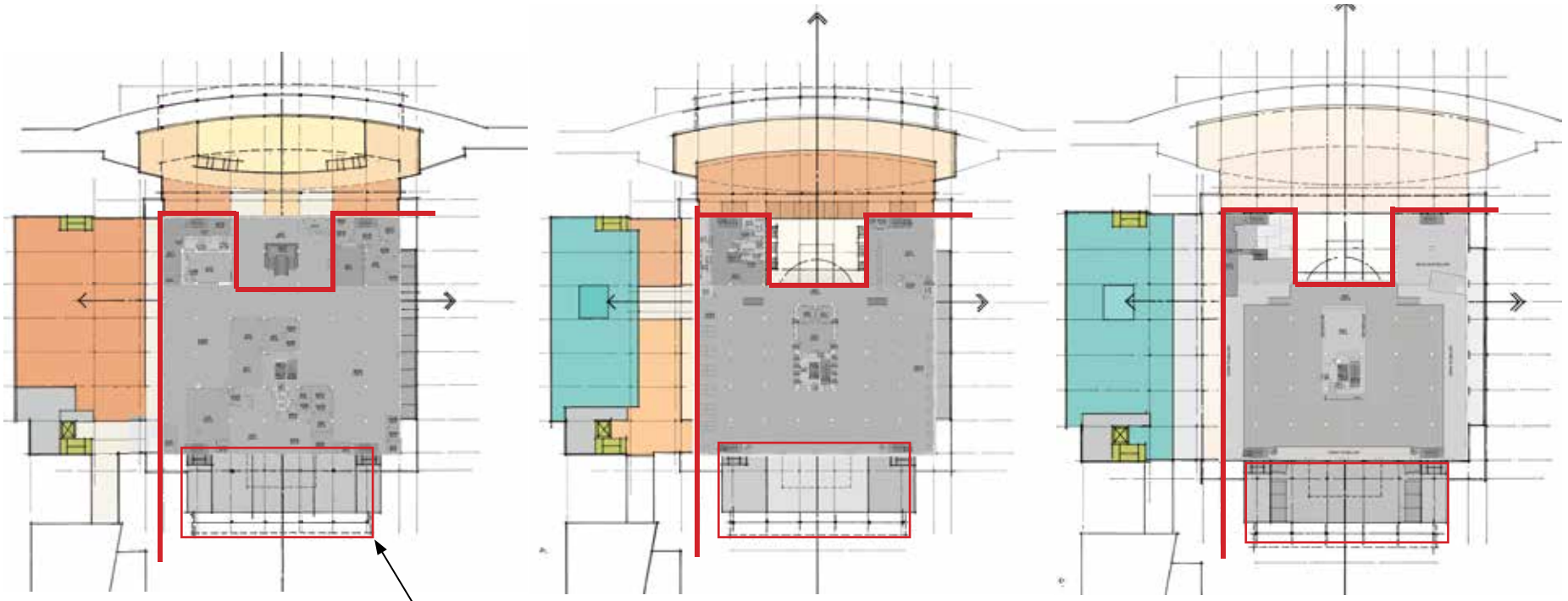
3rd LEVEL

Grey tones denote areas under construction and / or renovation

Areas with color denote spaces available for use by students, faculty, and staff during Phase 2 construction

PHASE 2B

PHASE 2A



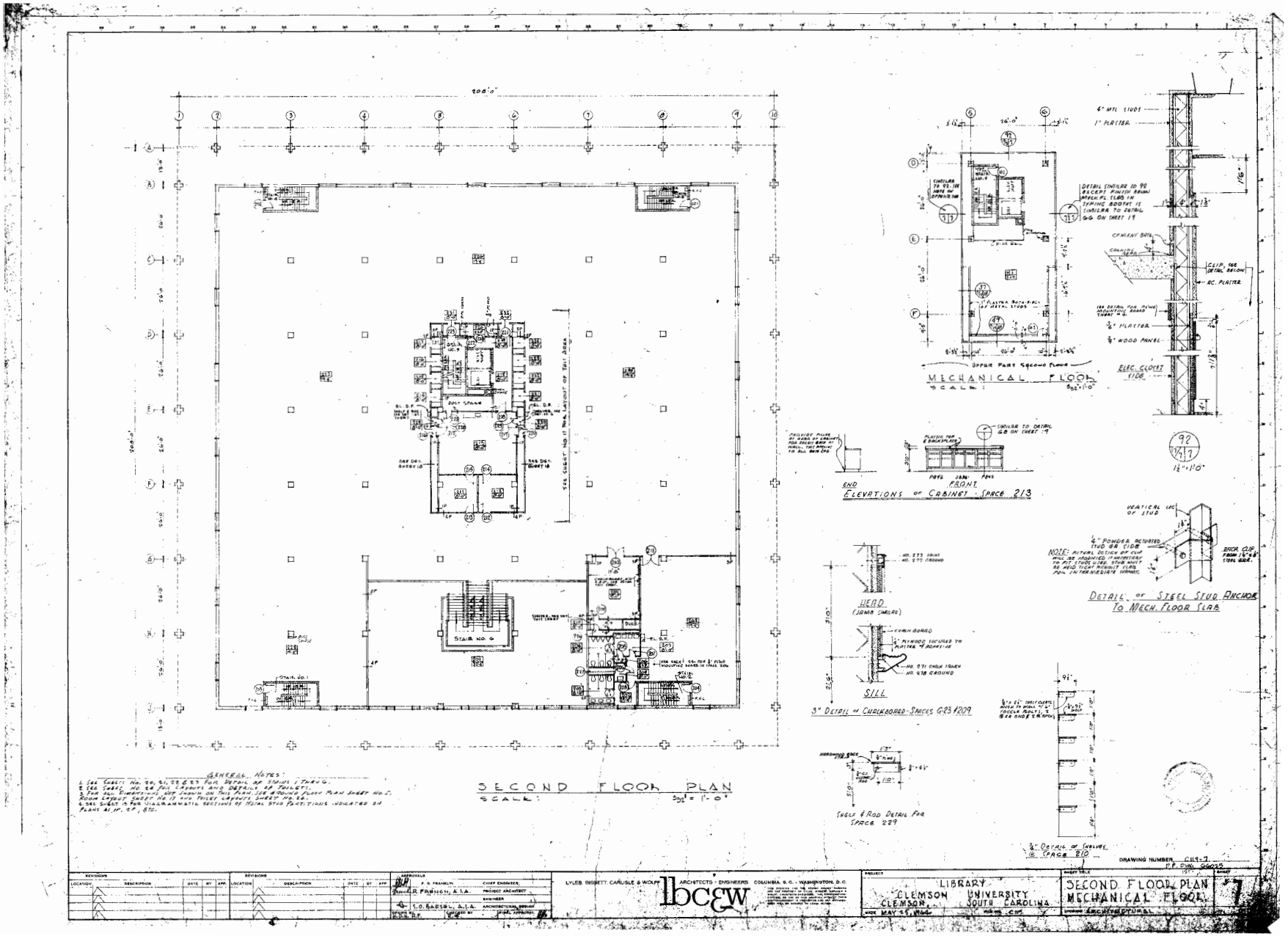
4th LEVEL

South Expansion

5th LEVEL

6th LEVEL

Phase 2 is primarily the renovation of the existing Cooper Library structure with the inclusion of the South Addition. These diagrams are showing a potential phasing of that work to allow existing spaces to be used by students, faculty and staff. For example, levels 1 and 2 could be open and used during the construction of the 5th and 6th levels.


SECOND FLOOR PLAN
SCALE: 1/32" = 1'-0"
MECHANICAL FLOOR
ELEVATIONS OF CABINET SPACE 213
DETAIL OF STEEL STUD ANCHOR TO MECH. FLOOR SLAB
HEAD
SILL
3" DETAIL OF CHALKBOARD SPACES 208 & 209
SHELF & ROD DETAIL FOR SPACE 229
3/4" DETAIL OF SHELVES IN SPACE 210
GENERAL NOTES
LYLES, BISSETT, CARLISLE & WOLFE
ARCHITECTS - ENGINEERS COLUMBIA, S. C. - WASHINGTON, D. C.
lbc&w
LIBRARY
CLEMSON UNIVERSITY
CLEMSON, SOUTH CAROLINA
SECOND FLOOR PLAN
MECHANICAL FLOOR
DRAWING NUMBER CU9-7

BUILDING CODE & LIFE SAFETY ANALYSIS

1. APPLICABLE CODES (AT TIME OF THE STUDY)

2018	International Building Code w/ SC Amendments
2018	International Fire Code w/ SC Amendments
2018	International Plumbing Code w/ SC Amendments
2018	International Mechanical Code w/ SC Amendments
2018	International Fuel Gas Code w/ SC Amendments
2017	National Electrical Code (NFPA 70) w/ SC Amendments
2009	South Carolina Energy Conservation Code
2010	ADA Standards for Accessible Design (120-3-20 effective 01.01.2015)

Note: These are the Codes at the time of the Feasibility Study. Depending on the execution of the construction, it should be anticipated that the Authorities Having Jurisdiction will adopt a newer version of the Codes. A Code Review should be executed with the commencement of each Phase of the Project.

2. CODE SUMMARY/EXISTING CONDITIONS – COOPER LIBRARY

Occupancy Classification (IBC)	Assembly A-3 (Libraries)
Construction Type	Type I-B
Sprinkled	Fully Sprinklered
Maximum Allowable Bldg Height	Unlimited
Maximum Number of Stories	11 Stories
Maximum Building Area per floor	Unlimited

Total Building Area - Existing

1st Floor	32,205sf
2nd Floor	32,322sf
3rd Floor	32,520sf
4th Floor	32,520sf
5th Floor	28,418sf
6th Floor	17,432sf
Penthouse (Starbucks)	563sf
Total Building Square Footage	179,970sf

Dead End Corridor Limit	20 ft
Maximum Common Path of Travel	75 ft Assembly
Maximum Travel Distance to Exit	250 ft total

NOTES ON THE CODE SUMMARY

With the conversion of stack space to study areas, the occupancy load doubles the number of occupants for those areas as the load calculation goes from 100 sf per person to 50 sf per person. The total occupancy is also increased with the reduction of office space and conversion to student space. We have reviewed the existing building exiting and have concluded that the existing exits will accommodate the increase in building population.

BUILDING OCCUPANCY (RENOVATION)

Level	Existing Occupancy	New Occupancy
1st	260	390
2nd	443	390
3rd	290	595
4th	305	610
5th	267	534
6th	174	349
Total Occupancy	1,779	2,868

EXITING

There are 4 fire exit stairs located in the four corners of the building. Each stair is 44" wide, the code minimum and have an exit capacity of 146 people per stair. The four stairs have a combined exit capacity of 584. Levels 3 and 4 are the only levels that exceed this capacity, but they have additional exit capacity at the bridge level and ground level to accommodate this increased capacity.

The expanion of the Library will require additional exit stairs and doors to accommodate the increased building population.

PLUMBING COUNTS (RENOVATION)
With the increase in the building occupancy by 1,089 people, it is necessary to review the existing toilet counts in the Library. Currently, there are

Gender	WC	Urinals	Lavatories
Male	21	14	28
Female	22	-	25
Unisex	1	-	1

The existing toilet rooms are distributed on levels 1 - 5 of the library.

Per the 2018 Plumbing Code, minimum plumbing counts are as follows:

Gender	WC	Urinals	Lavatories
Male	4	8	8
Female	22	-	8

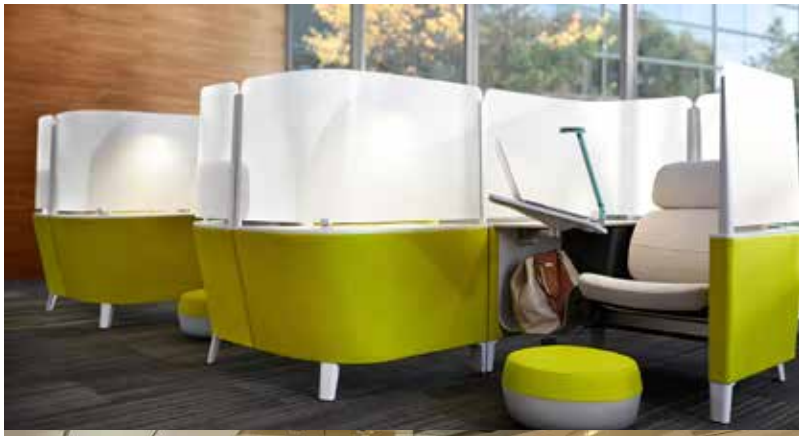
The required minimum is significantly smaller than the existing plumbing count. In part this is due to toilet rooms added in the1976 addition and unisex toilet rooms in the 1967. With the renovation of the existing toilet rooms to make them accessible, it will be possible to reduce the number of toilets to provide accessibility within the existing confines of the existing toilet rooms.

3. ADA ANALYSIS
Generally the building is compliant with ADA requirements and these minor issues will be corrected with the moving of program elements and renovation work. The toilet rooms located in the original 1965 library and 1977 renovations were not designed per today's accessible standards and will be required to be updated to meet ADA requirements.

Existing elevators are undersized per current code, and are not located in proximity to the building entrances, It is recommended that a new accessabile elevators be provided in a location that is discoverable.

FURNITURE

Observation and student feedback has illustrated that the library is used in a wide range of capacities from a stop between classes to a place groups gather for collaborative work. The wide frame of work taking place within the library throughout a semester requires a comprehensive range of spaces. The furniture selection for the Cooper Library begins to define a language of variety with flexibility to evolve with ones needs.



COOPER LIBRARY - STRUCTURAL DESIGN NARRATIVE

Michael M. Simpson + Associates, Inc. (MMSA) is pleased to submit this structural evaluation/feasibility report for the existing 5th and 6th floors of the R.M. Cooper Library. Structural evaluation of the floors is being completed in anticipation of potential renovation of the space to allow for open assembly area seating space, collaborative study area or reading room. Accordingly, this study addresses the ability for the existing library building frame and foundation system to safely support the additional live load generated by the potential future study area and open seating plans.

This structural evaluation/feasibility study and corresponding findings are based upon review of the existing R.M. Cooper Library drawings provided by Collins Cooper Carusi Architects. No material sampling, destructive measures or testing were used to view the existing building conditions or validate/confirm the as-built building documents provided for MMSA's use.

Existing Building | Structural Framing

Constructed in 1964, the R.M. Cooper Library, a four-story above-grade concrete (main-frame) structure with a two-level basement, is located between the existing Strom Thurmond Institute (North of R.M. Cooper Library) and the existing Watt Family Innovation Center (South of R.M. Cooper Library). The building's basic structural system consists of a concrete frame system with two-way beam/slab rib pan joist construction and concrete columns.

The existing 6th floor structural system, added to the existing building around 1976, utilizes a stack mezzanine steel frame beam and "post-up" column system (4'-6" x 4'-6" on center within the 5th floor shelving system) supported by the 5th floor concrete beam/slab system and building mainframe columns.

Structural Evaluation Findings - Live Load Capacity | 5th and 6th Floors

The existing 5th floor stack area concrete beam and slab system has the capacity to support open student assembly area seating or a study area on the 5th floor, with or without removal of the remaining 5th floor shelving/stacks. The existing stack 5th floor framing system is designed for a live load capacity of 250 psf.

However, the existing 6th floor mezzanine steel framing system, with or without removal of the 5th floor shelving/stacks, does not have the capacity to support use of the space for open student assembly area seating or a study area on the 6th floor. The 6th floor mezzanine framing is supported by the 5th floor concrete beam/slab system and building mainframe columns and designed for a 60 psf live load capacity. These future open assembly area seating and study area additions to the 6th floor will require a design live load of 100 psf.

Live Load Capacity | 6th Floor Mezzanine Steel (As-Built System): No Structural Modification(s) Option

If the existing as-built book stack shelving room is removed, the existing mezzanine steel frame system can be used as a library reading room (60 psf live load). This option would require no structural modification(s) to the existing as-built mezzanine steel frame floor area support system.

Live Load Capacity | 6th Floor – Mezzanine Steel Post/Beam System: Structural Modification(s) Option

If the space is to be used for student assembly seating, an increase in the 6th floor design live load is needed. To increase the 6th floor design live load, the existing 5th floor mezzanine steel "post-up" and beam system may be replaced with a new "non-post-up" structural steel sub-frame system at the 6th floor. The sub-frame system, utilizing a clear span structural framing layout, will connect the new system to the existing

concrete column 26' x 26' grid layout system. Post-installed anchors and/or collars will also be used, functioning as a mechanical anchor support system between the concrete frame and new sub-frame system.

Live Load Capacity | Main Library Building – Concrete Columns and Pile Foundation System
The existing concrete columns have the capacity to carry the additional future, optional sub-frame system live load. The allowable capacities of the existing pile foundation system are not provided in the as-built documents. However, the new sub-frame system will increase the foundation system design live load by 5%, and is considered to be marginally acceptable.

Building Code Change(s)
In the absence of changing the existing building occupancy or dead load, changes to the existing building code will not be required.

Summary
The existing 6th floor does have the capacity to support reading rooms, not exceeding a live load capacity of 60 psf. Use of the space for this function will not require structural modification to the as-built steel floor support system as long as the existing post-up system remains in place that are supported on the 5th floor beams.

However, if anticipated use of the space includes open student assembly area seating or a study area, the existing 6th floor does not have the capacity to accommodate the additional live load, with or without removal of the 5th floor shelving/stacks. To accommodate the additional 6th floor live load, it is feasible to install a new 6th floor "non-post-up" elevated structural steel sub-frame system to support the 6th floor structural floor system. The existing main frame concrete columns and pile foundation system has the capacity to support the new, future floor system. The new sub-frame system will increase the foundation system design live load by 5%, and is considered to be marginally acceptable.

In conducting this study, reasonable assumptions have been made regarding the future open seating and collaborative study area plans for this space. Accordingly, the structural findings provided are rendered in anticipation of no changes being made to the existing building concrete framing system.

1.1 OBJECTIVE

A. The purpose of this study is to perform an assessment of the existing mechanical, plumbing, electrical, and fire protection equipment in stalled in Cooper Library.

1.2 BACKGROUND

A. Cooper Library is a six-story academic and library building located on the campus of Clemson University in Clemson, South Carolina. The building currently houses Clemson's library along with various study and student spaces.
B. The building underwent a significant HVAC renovation, which started in 2003 and was completed in 2009.
C. RMF reviewed the existing documentation for the building to understand the existing mechanical, electrical, plumbing and fire protection systems currently installed within the building.
D. RMF performed a site visit to perform a visual inspection of the existing building system equipment and compare it to the existing drawings.

1.3 EXISTING SYSTEM SUMMARY

A. The current building is served by campus steam and chilled water from the existing campus utility tunnel.
B. Campus chilled water is distributed through the building from two (2) chilled water pumps located in the Level 1 mechanical room.
C. Campus steam is used to create heating water to serve the building through a steam-to-water heat exchanger and three (3) heating water pumps located in the Level 1 mechanical room.
D. Four (4) air handling units serve the building, two (2) located in the Level 1 mechanical room and two (2) located in the 5th floor mechanical room below the mechanical penthouse.

1.4 FUTURE LOAD

A. For the purpose of this analysis it is assumed that the existing load of the building will not change significantly from it's current configura tion.

1.5 RECOMMENDATIONS

A. Existing fire protection equipment and infrastructure appears to be in good working order for any future renovation work to occur.
B. The existing domestic water system appears to be in good working order and does not warrant replacement of equipment at this time. Depending on the scope of any future renovations, existing equipment capacities will need to be evaluated, which may require existing equipment to be replaced.
C. Existing mechanical equipment and systems within the building are in good shape as they were recently replaced as part of a significant mechanical systems upgrade. Most of the equipment is nearing the half-way point of its useful life, therefore, depending on the timing and complexity of any future renovations, it may be prudent to replace some of the existing mechanical equipment as part of significant renova tions to help prolong the use of the building.
D. Recommend replacing the older branch panelboards located throughout the building. May of these are now beyond their useful life and warrant replacement.
E. Recommend replacing both interior and exterior light fixtures and exit signs with LED type fixtures.
F. Recommend replacing the existing lighting controls with a building wide lighting control relay panel system for time schedule control of all lighting.

DIVISION 2 - EXISTING SYSTEM

2.1 GENERAL

A. The Clemson Cooper Library is a six-story, library and academic building located on the campus of Clemson University in Cleson, South Carolina. The building was originally constructed in 1964. An expansion of the first level was done in 1977 and significant, multi-phase upgrades to the building HVAC systems starting in 2003 and completed in 2007. Several other small renovations and maintenance projects have occurred within the last 10 years.

2.2 FIRE PROTECTION SYSTEM

A. A 6" fire water service enters the Level 1 mechanical room, goes through a backflow preventer, then splits to 4" standpipes located in each of the four (4) enclosed stairwells within the building. Standpipes travel from the first level up through the entire building. The standpipe in the stairwell nearest the internal building elevators extends up to the building elevator machine room.

2.3 WATER SYSTEM

A. Water enters the building from the campus utility tunnel, located underground behind the existing library, at the Level 1 mechanical room. The 3" main from the utility tunnel goes through a backflow preventer located in the Level 1 mechanical room and then water service is distributed throughout the building.

B. Domestic hot water is provided by a single, tank-type water heater located in the Level 1 mechanical room.

C. A separate electric water heater is provided to serve the Starbucks, located on Level 5.

2.4 CHILLED WATER SYSTEM

A. Chilled water service for the building comes into the building at the Level 1 mechanical room from the campus utility tunnel through 8" chilled water supply and return main piping. Chilled water pumps (CP-1 and CP-2), located in the Level 1 mechanical room, then circulate chilled water throughout the building to various air handling units located throughout the building. Each pump is provided with a dedicated variable speed drive.

2.5 HEATING WATER SYSTEM

A. Steam service comes into the building from the campus utility tunnel through a 3" high pressure steam main which enters the Level 1 mechanical room, goes through a pressure reducing station to take the pressure from 115 psi down to 15 psi. The 5" low pressure steam line then goes to steam-to-water heat exchanger to provide heating water service to the building.

B. Condensate is taken from the steam-to-water heat exchanger to a duplex condensate return unit which then pumps steam conden sate back to the campus utility pump condensate main through a 2" pumped condensate line from the Level 1 mechanical room back to the utility tunnel.

C. Heating water, created at the steam-to-water heat exchanger, is distributed through the building by three (3) heating water pumps, CP-3, CP-4, and CP-5. Each pump is provided with a dedicated variable speed drive.

2.6 AIR HANDLING SYSTEMS

A. Levels 1, 2, and 3 are served by AHUs-1 and 2 located in the Level 1 mechanical room.
   1. AHU-1 serves ductwork on Levels 1 and 2 along with fan powered terminal units located on level 3.
   2. AHU-2 serves ducts on Level 1 and fan powered terminal units located on Levels 2 and 3.
   3. AHUs 1 and 2 consist of supply and return fans, 6" panel pre-filters, 24" bag final filters, chilled water cooling coil, and economizer con trol.
   4. Air handling system fans are provided with variable frequency drives.

B. Levels 4, 5, and 6 are served by AHUs-4 and 4A, which are manifolded together, and located in the Level 6 mechanical room. Both units serve fan powered terminal units on Level 4, low pressure ductwork on Level 5, and fan powered terminal units and variable air volume terminal units located on levels 5 and 6.
   1. AHUs 4 and 4A consist of supply and return fans, 6" panel pre-filters, 24" bag final filters, chilled water cooling coil, and economizer control.
   2. Air handling system fans are provided with variable frequency drives.

2.7 EXHAUST SYSTEMS

A. Restrooms located on Levels 1 and 2 are exhausted through an inline exhaust fan located above ceiling on Level 2.

B. Restrooms located on Levels 3, 4, and 5 are served by an existing inline exhaust fan located above the restroom on Level 5.

C. The existing Starbucks located on Level 5 is served by a new rooftop mounted exhaust fan.

2.8 ADDITIONAL MECHANICAL EQUIPMENT

A. Equipment remaining that was original to construction of the building currently housed in a basement mechanical room, B-1, has been aban doned in place and is no longer used.

2.9 ELECTRICAL DISTRIBUTION SYSTEM

A. The existing electrical service includes two medium voltage transformers that provide 120/208 volt three phase electrical power. The transformers are dry type substation transformers that appear to be recently installed. The transformers are connected to the existing switchboards. One switchboard is relatively new (Eaton) and the other is older (Square-D). The switchboards appear to be in good condition.

B. There are numerous electrical panels in the main electric room. Some of these are newer and are in good condition. A few are older panels that have exceeded their useful life and should be replaced.

C. The pump room located at the southwest corner of the building contains numerous disconnect switches and motor starters to serve the pumps. The electrical equipment in the pump room is old and beyond their useful life and should be replaced.

D. 2nd floor - There is a small electrical closet that contains the electrical panels that serve the second floor. These panels are setup with lighting contactors that control power to the entire panel(s). This allows all the lighting to be turned off using the contactor. The panels and contactors are old and beyond their useful life and should be replaced.

E. 3rd floor - There is a small electrical closet that contains the electrical panels that serve the third floor. These panels are setup with lighting contactors that control power to the entire panel. This allows all the lighting to be turned off using the contactor. The panels and contactors are old and beyond their useful life and should be replaced.

F. 4th floor - There is a small electrical closet that contains the electrical panels that serve the fourth floor. These panels are setup with lighting contactors that control power to the entire panel. This allows all the lighting to be turned off using the contactor. The panels and contactors are old and beyond their useful life and should be replaced.

G. 5th floor - There is a small electrical closet that contains the electrical panels that serve the fifth floor. These panels are setup with lighting contactors that control power to the entire panel. This allows all the lighting to be turned off using the contactors. The pan els and contactors are old and beyond their useful life and should be replaced.

H. The 5th floor closet also contains the remote ballasts for the metal halide pendant lights installed in the lobby space at the main entrance. The ballasts appear to be relatively new and in good condition.

I. 6th floor - There is a small electrical closet that contains the electrical panels that serve the sixth floor. There are two electrical pan els in the closet. Panel H6 is a relatively new panel and in good condition. Panel H6 serves the HVAC fan terminals. Panel MLA is old and beyond its useful life and should be replaced.

J. The 6th floor closet also contains the remote ballasts for the metal halide pendant lights installed in the lobby space at the main entrance. The ballasts appear to be relatively new and in good condition.

K. The mechanical room on the sixth floor contains an electrical distribution panel H6M that was installed about 10 years ago when the air handler was replaced. The panel is a Square-D I-Line type panel and is in good condition.

L. Penthouse - The penthouse contains the elevator machine room. There are several disconnect switches in the room that serve the elevators. There are two transformers in the room that serve the elevator motors. It appears that the transformers boost the voltage from 208 volts to 480 volts for the elevator motors. The transformers and in good condition. The disconnect switches appear to be in good condition.

M. Roof - There are a couple of condensing units and an exhaust fan located in the room. The conduits containing the electrical circuits appear to be relatively new and in good condition. The roof sleepers that support one of the conduits have been damaged and/or degraded by exposure to the sun. These sleepers should be replaced.

N. There is a lightning protection system installed on the roof.

2.10 LIGHTING SYSTEM

A. Lighting in the building primarily consists of linear fluorescent light fixtures on all floors. In general, the lights appear to be in good working order. The decorative lighting in the lobby has a metal halide light source with remote ballasts installed in the 5th floor electrical closet. These lights appear to be functional and in good working order. Renovation of the building should incorporate LED replacements for reduced energy use

DIVISION 3 - SYSTEM ANALYSIS

3.1 OBJECTIVE

A. The purpose of the equipment assessment is to determine the capabilities of the existing mechanical, plumbing, electrical, and fire protection systems to accommodate a future building renovation.

3.1 ANALYSIS METHODOLOGY

A. RMF performed a site visit to verify the conditions of the existing equipment within the building to determine age and suitability for continued use.

B. RMF reviewed the existing documentation for the building to further understand the existing systems, compare the documents to existing the installed conditions, and note any changes between the current installation and existing condition drawings.

3.2 FIRE PROTECTION SYSTEM

A. The existing fire protection backflow preventer appears to be serviceable at this time and could continue to be used as part of any future renovation.

B. The existing sprinkler layout would need to be modified accordingly to accommodate any changes to the current architectural layout of the building.

C. New sprinkler heads will be needed throughout any renovated areas.

3.3 DOMESTIC WATER SYSTEM

A. The existing building backflow preventer appears to be serviceable at this time and could continue to be used as part of any future renovation. Should the overall fixture counts within the building be increased the incoming water service size will need to be evaluated and potentially increased to accommodate the additional domestic water flow required.

B. The existing water heater located in the Level 1 mechanical room appears to be new and can continue to be used as part of any future renovation. Should the overall domestic hot water load within the building increase because of a future renovation the existing water heater, associated recirculation pump, and domestic hot water piping size will need to be investigated to determine if it will meet the needs of the renovation.

C. The current hot water heater serving the Starbucks located on Level 5 was installed in 2017 and does not warrant replacement or modification at this time.

3.4 CHILLED WATER SYSTEM

A. The current building chilled water pumps were installed as part of a large mechanical system renovation that occurred in 2007. ASHRAE anticipates the useful life of base mounted pumps to be approximately 20 years, so the existing pumps are just over half their anticipated useful life. Both pumps appear to be in good condition and do not warrant replacement at this time. Depending on the timing of the next building renovation replacement of the pumps may be warranted as they will meet the end of their useful life by 2027.

3.5 HEATING WATER SYSTEM

A. The current building heating water pumps were installed as part of a large mechanical system renovation that occurred in 2007. ASHRAE anticipates the useful life of base mounted pumps to be approximately 20 years, so the existing pumps are just over half their anticipated useful life. All three pumps appear to be in good condition and would not warrant replacement at this time. Depending on the timing of the next building renovation replacement of the pumps may be warranted as they will meet the end of their useful life by 2027.

B. ASHRAE's expected life expectancy for steam-to-water heat exchangers is 24 years. The current steam-to-water heat exchanger was installed as part of a significant mechanical systems replacement that occurred in 2007, making the existing stem-to-water heat exchanger at half it's expected life. Depending on the timing of the next building renovation replacement of the pumps may be warranted as they will meet the end of its useful life by 2031.

C. The existing condensate return unit is nearing the end of its useful life. ASHRAE's expected life for this kind of equipment is typically 15 years meaning it will reach the end of its useful life by 2023. Currently, the existing unit is in good working condition and does not warrant replacement. Depending on the timing of the next significant building renovation it may be prudent to replace the existing condensate return unit should the project budget allow.

3.6 AIR HANDLING SYSTEMS

A. Existing AHU-1 and AHU-2 were installed as part of a significant mechanical system's replacement that occurred in 2007. ASHRAE's expected life for indoor air handling systems is 25 to 30 years, making these air handlers just short of half their expected life. Their capacities should be investigated as part of any new building renovation, but the system would not warrant replacement at this time.

B. AHU-4 and 4A were installed at the same time as AHUs-1 and 2 and have a similar life expectancy. AHU-4 and 4A are installed in the below the mechanical penthouse, on Level 6. When the units require replacement it will require the removal of the penthouse and rigging the existing units out through the top of the building. Given the complexity of their future replacement, should a significant renovation occur for Levels 4, 5, and 6 the replacement of these units should be considered. The units could also potentially be retrofitted with new coils, fans, seals, and other means to extend their life until a full replacement of the units can be performed. Ductwork from these two units goes up through the existing penthouse and is exposed to exterior conditions in covered areas on the roof. During RMF's field survey it was noted that the ductwork is not provided with exterior jacketing for exposed, outdoor use and some insulation appears to have been damaged by weather or birds and likely warrants attention by campus maintenance staff to ensure good system operation.

3.7 EXHAUST SYSTEMS

A. The existing exhaust fans are beyond their useful life per ASHRAE and would warrant replacement should the restrooms be renovated as part of any future project.

3.8 ADDITIONAL MECHANICAL EQUIPMENT

A. Any mechanical equipment that has been abandoned in place and is no longer used should be removed as part of any future renovation projects. Space can then be re-used for new building equipment or repurposed for other building program.

3.9 ELECTRICAL DISTRIBUTION SYSTEM

A. Recommend replacing the older branch panelboards located throughout the building. The equipment is original to the building construction and is past its expected end-of-life of 30 years. Replacement parts are difficult, if not impossible to obtain. Proper maintenance is difficult.

3.10 LIGHTING SYSTEM

A. Recommend replacing both interior and exterior light fixtures and exit signs with LED type fixtures. New LED light fixtures will reduce the lighting energy consumption by at least 50%. LED type light fixtures last longer, which will reduce maintenance costs. They will also allow for spaces to have the capability of being dimmed without the need of expensive ballasts.

B. Recommend replacing the existing lighting controls with a building wide lighting control relay panel system for time schedule control of all lighting. There are no automatic controls installed as required by the International Energy Conservation Code (IECC).

DIVISION 21 - FIRE PROTECTION ENGINEERING

21.1 INTRODUCTION

A. This document summarizes the fire protection systems for the Cooper Library expansion proposed as part of the Library Master Plan Study. The narrative provides a description of the design and understanding of the Owner's design intent for fire protection systems.

B. This section establishes the basic design criteria for the fire protection system for the proposed building renovation and expansion and shall be used to supplement local, state, and national codes and laws which are applicable to the work being undertaken and those laws dealing with environmental protection, occupational safety and health.

C. System selection, sizing, and estimated loads are based on the best information available at the time of the master plan study, which currently includes basic architectural floor plans, preliminary programmatic planning, and associated square footage information.

21.2 CODES AND STANDARDS

A. All fire protection systems will be designed and constructed to comply with the following codes and standards:

1. 2018 International Mechanical Code (IMC)
2. 2018 International Building Code (IBC)
3. 2018 International Plumbing Code (IPC)
4. 2018 International Fire Code (IFC)
5. 2009 International Energy Conservation Code (IECC)
6. NFPA 13 - 2013
7. NFPA 72 - 2013
8. NFPA 90A - 2012
9. NFPA 101 - 2012
10. ASHRAE Standards and Handbooks (latest editions)
11. ANSI A117.1 - 2017 - Standard for Accessible and Usable Buildings and Facilities
12. Americans with Disabilities Act – 1992
13. ASCE 7 - 2010
14. State and Local Codes and Regulations
15. Owner's Insurance Underwriter Standards

B. The codes and standards applicable to this project at the time of this study. Depending on the execution of the construction, it should be anticipated that the Authority Having Jurisdiction (AHJ) will adopt new versions of the Codes. A code review should be executed with the commencement of each phase of the project.

21.3 FIRE PROTECTION

A. The existing building is currently provided with an automatic wet standpipe system served from a 6" fire main that comes into the building from the adjacent utility tunnel.

B. Per the 2018 edition of the International Building Code, the existing building and the proposed building expansions shall be provided with an automatic sprinkler system.

C. The new automatic sprinkler system shall be designed and installed per NFPA 13.

1. Class I automatic wet standpipes shall be provided at each exit stairway within the building and shall be interconnected on the first level of the building.

21.4 FIRE PUMP CRITERIA

A. A preliminary flow test was not available at the time of this report, however based on the surrounding buildings, it is anticipated that a fire pump is not required.

21.5 SPRINKLER SYSTEM CRITERIA

A. Sprinkler system shall conform to requirements stated in NFPA 13. Sprinkler systems requirements are defined in Chapter 7 and installation requirements are defined in Chapter 8 for wet and dry pipe systems in the building. Based on these requirements, hydraulically calculated sprinkler piping and sprinkler heads will be provided at a minimum frequency such that the protection area does not exceed 225 per square feet per head per Chapter 8 of NFPA 13.

B. Various areas shall be sprinklered to the following densities:

1. Light Hazard areas such as classrooms, offices, open study areas, learning commons, corridors and, lobbies will have a minimum design density of 0.10 gallons per minute per square foot over the hydraulically most remote 1,500 square feet.
2. Ordinary Hazard Group 1 areas such as storage rooms, mechanical rooms, and electrical rooms will have a minimum design density of 0.15 gallons per minute per square foot over the hydraulically most remote 1,500 square feet.
3. Ordinary Hazard Group 2 areas will have a minimum design density of 0.20 gallons per minute per square foot over the hydraulically most remote 1,500 square feet.

21.6 AIR SYSTEM CRITERIA

A. Fire dampers, smoke dampers and combination fire/smoke dampers will be provided in accordance with the requirements of NFPA 90A. Smoke detectors in HVAC systems shall be installed and controlled as required in NFPA 90A. A fire control panel will be located in a location accessible by the fire department where the status of all combination fire/smoke dampers, smoke isolation dampers and air system fans can be monitored and adjusted.

21.7 FIRE DEPARTMENT CONNECTIONS

A. Fire suppression/sprinkler FDC location for fire department access shall be provided. Fail-Safe FDC caps shall be installed on the sprinkler fire department connection.

21.8 SPECIALTY SYSTEMS

A. Building Smoke Control

1. In accordance with IBC 2018, the 3-story open seating/open study areas and monumental stair constructed as part of Phase 1A and the north addition area of Phase 2 shall be provided with a mechanical smoke control system.
2. The architectural study documents do no identify any additional areas requiring active smoke control, stair pressurization, or hoist way pressurization.

B. Clean Agent Fire Suppression Systems

1. The current program does not identify areas that will require a special fire protection system similar to an FM-200, halon, or CO2 tank system.

DIVISION 22 - PLUMBING ENGINEERING

22.1 INTRODUCTION

A. This document summarizes the plumbing process systems for the Cooper Library expansion proposed as part of the Library Master Plan Study. The narrative provides a description of the design and understanding of the Owner's design intent for plumbing process systems.

B. This section establishes the basic design criteria for the plumbing systems for the proposed building renovation and expansion and shall be used to supplement local, state, and national codes and laws which are applicable to the work being undertaken and those laws dealing with environmental protection, occupational safety and health.

C. System selection, sizing, and loads are based on the best information available at the time of this narrative, which currently includes proposed plumbing fixture counts, basic architectural floor plans, preliminary programmatic planning, and associated square footage information. Necessary adjustments to the project documents will be made as the design process continues and more information is received.

22.2 CODES AND STANDARDS

A. All plumbing and process systems will be designed and constructed to comply with the following codes and standards:

1. 2018 International Mechanical Code (IMC)
2. 2018 International Building Code (IBC)
3. 2018 International Plumbing Code (IPC)
4. 2018 International Fire Code (IFC)
5. 2009 International Energy Conservation Code (IECC)
6. NFPA 13 - 2013
7. ASHRAE Standards and Handbooks (latest editions)
8. ANSI A117.1 - 2017 - Standard for Accessible and Usable Buildings and Facilities
9. Americans with Disabilities Act – 1992
10. State and Local Codes and Regulations
11. Owner's Insurance Underwriter Standards

B. The codes and standards applicable to this project at the time of this study. Depending on the execution of the construction, it should be anticipated that the Authority Having Jurisdiction (AHJ) will adopt new versions of the Codes. A code review should be executed with the commencement of each phase of the project.

22.3 PLUMBING SYSTEMS

A. All plumbing and piping work shall be executed in the proposed facility in accordance with local, state, and national codes and laws applicable to the work being undertaken.

B. Sanitary and Vent System

1. The existing building sanitary and vent system within the current library shall be modified to accommodate the proposed renovations of the existing Library building.
2. Fixtures within the North Expansion shall be connected to the existing Library sanitary system.
3. Fixtures within the South Expansion shall be connected to the existing Library sanitary system.
4. The West Expansion shall be provided with a dedicated sanitary connection to the civil sanitary system outside of the building footprint. Venting to fixtures within the West Expansion shall terminate in the new roof area.

5. Sanitary drainage piping will be routed from the plumbing fixtures to vertical pipe risers then be collected horizontally below the building and discharge by gravity to the site sanitary sewer. Cleanouts shall be provided in accordance with the plumbing code.
6. Plumbing code drainage fixture units will be used to determine the sanitary system load.
7. Floor drains will be provided in all mechanical rooms and toilet rooms, and shall be piped to the building sanitary system. Floor drains in toilet rooms and janitorial closets shall be primed via a connection to the nearest water closet flush valve, and drains in the mechanical rooms shall be primed via automatic multi-zone trap priming station.
8. An oil minder sump pump shall be provided for each elevator pit to comply with ASME A17.1 - Safety Code for Elevators and Escalators.

C. Storm Drainage
1. Primary drainage system shall utilize commercially available drains of style, size, and quantity consistent with the area being drained. The piping shall be routed from the roof drains to vertical pipe risers then be collected horizontally below the building and discharge by gravity to the site storm sewer.
2. A secondary overflow roof drain system will be provided. The piping shall be routed from the overflow drains to vertical pipe risers then be discharged above grade with downspout nozzles.
3. Each new expansion shall be provided with new roof and overflow drains based on their associated roof area with piping run interior to the building and then connected to the civil storm water system outside of the building footprint
4. Sizing of the roof drains and piping shall be per the International Plumbing Code and based on a rainfall rate of 4.1 inches per hour (Greenville, SC) for a storm of 1-hour duration and a 100-year return period.
5. The existing roof drain sizing no longer meets current code. All existing roof drains (8 total) shall be expanded to minimum 6" diameter drains and be connected to the existing 6" piping currently installed.
6. North Expansion
   a. The existing 6" storm riser located near the restrooms at the Starbucks shall be removed and replaced with a new 10" riser.
   b. The new roof drains and storm drain piping shall be extended into the new building area and tied into a new 10" riser located near the existing restrooms at the Starbucks.
   c. The new 10" riser shall be connected to the civil storm water system per the existing pipe routing.
7. South Expansion
   a. The roof drains and storm drain piping for the new south expansion shall tie into the existing 10" riser currently installed in the existing building near the existing elevator shaft.
8. West Expansion
   a. The West Expansion shall be provided with a new connection to the civil storm water system with a new 8" riser and distributed piping to new roof drains located by the architect.
9. All underslab and below ground piping shall be sloped at a minimum ¼" per foot.
10. Cleanouts shall be provided in accordance with the plumbing code.

D. Domestic (Potable) Water System
1. The existing 3" incoming domestic water service shall be reused for the building renovation. A new backflow preventer shall be provided.
2. A new steam heat exchanger domestic water heater shall be provided in the existing mechanical room to serve the building.

3. A new hot water recirculation pump shall be provided for the domestic hot water return system.
4. New domestic cold water, hot water, and hot water return piping shall be run throughout the building to serve new plumbing fixtures per the architectural fixture count.
5. For the potable hot water system, the 130°F water will be tempered down to 120°F supply temperature at the fixtures using integral faucet mixing valves. The piped recirculation system will be sized to maintain the 120°F supply temperature at all times.
6. Domestic hot water quantities will be estimated by fixture counts and code required fixture units for water.

E. Plumbing Fixtures

1. Plumbing fixtures will be provided where indicated on the architectural drawings. All plumbing fixtures shall be low flow, commercial grade of the type, style, and material consistent with the intended use. Infrared controls will be used on all fixtures where practical. Plumbing fixtures will generally be as follows:
   a. Water closets – Vitreous China, elongated, wall mounted, top spud, flush valve, open front seat, 1.28 gallons per flush.
   b. Urinals – Vitreous China, wall mounted, back outlet, top spud, flush valve, 0.125 gallons per flush. Mounting heights shall comply with ADA requirements.
   c. Lavatories – Enameled cast iron, wall hung with sensor faucet, 0.5 gallons per minute.
   d. Sinks – stainless steel, counter mounted with gooseneck faucets and wristblade handles.
   e. Mop Sink – Wall mounted, enameled cast iron service sink with rim guard, service sink faucet with 8" centers, vacuum breaker, pail hook, and wall brace.
   f. Water Outlet Box – 20 gauge box with faceplate and ¼ turn ball valves with sweat connections and hammer arrestors.
2. Isolation valves shall be provided above the ceiling for each toilet room/bathroom group. Water hammer arrestors shall be provided for each toilet/urinal with a flush valve.
   a. Isolation valves shall be bronze or iron ball valves.
      1) Two-piece bronze ball valves with full port ball and stainless steel trim shall be provided for piping 3" and smaller.
      2) Class 125, iron body valves with full port stainless steel ball and trim shall be provided on piping larger than 3".
   b. Water hammer arrestors shall comply with ASSE 1010 or PDI-WH 201 with copper tube and piston.
      1) Shock absorbers shall be the same size as the line on which they are installed, up to 1" pipe size. Pipe sizes larger than 1" shall have 1-inch shock absorbers installed.
3. Non-freeze wall hydrants shall be located around the perimeter of the building, one (1) per exposure or one (1) per 100 linear feet, which ever is greater, for landscape use and shall be supplied from the domestic water system.
   a. A non-freeze roof hydrant shall be provided on the roof near each AHU for maintenance.
   b. Exterior, non-freeze wall hydrants shall comply with ASME A112.18.1 with a pressure rating of 125 psi, constructed of stainless steel, with vacuum breaker, and keyed operation.

22.4 PIPING SYSTEMS

A. Pipe Materials

1. Domestic Water Piping
   a. Above ground piping, NPS 2" and smaller shall be hard copper tube, ASTM B 88, Type L; wrought copper, solder joint fittings and soldered joints.
   b. Above ground piping, NPS 2-1/2" and larger shall be hard copper tube ASTM B 88, Type L; wrought copper, solder joint fittings and soldered joints.

c. Aboveground, trap-seal primer piping shall be hard copper tube, ASTM B 88, Type L; wrought copper, solder joint fittings and soldered joints.

2. Sanitary Drainage, Vent, and Storm Water Piping
   a. Above ground sanitary drainage, vent, and storm water piping shall be hubless, cast iron soil pipe and fittings; heavy-duty, hubless piping couplings and coupled joints. Dissimlar pipe material couplings shall be shielded nonpressure couplings.
   b. Underground sanitary drainage, vent, and storm water piping shall be hub and spigot, cast iron soil pipe and fittings, service glass; gaskets; and gasketed joints.

B. Pipe Insulation Materials
   1. Domestic Cold Water:
      a. NPS 1 and Smaller: Insulation shall be one of the following:
         1) Flexible Elastomeric: 1/2 inch thick.
         2) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch.
      b. NPS 1-1/4 and Larger: Insulation shall be the following:
         1) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      c. Domestic Hot and Recirculated Hot Water:
         1) NPS 1 and Smaller: Insulation shall be one of the following:
            a) Flexible Elastomeric: 1/2 inch thick.
            b) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch.
         2) NPS 1-1/4 and Larger: Insulation shall be the following:
            a) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   2. Domestic Potable Chilled Water (Drinking Fountains):
      a. All Pipe Sizes: Insulation shall be the following:
         1) Flexible Elastomeric: 1 inch thick.
   3. Stormwater and Overflow (First Ten Feet From Drain Body and All Horizontal Pipe):
      a. All Pipe Sizes: Insulation shall be the following:
         1) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   4. Roof Drain Bodies:
      a. All Pipe Sizes: Insulation shall be the following:
         1) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   5. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities (ADA):
      a. All Pipe Sizes: Insulation/protection shall be the following:
         1) Protective Shielding Pipe Covers or Protective Shielding Piping Enclosures.
   6. Sanitary Waste Piping Where Heat Tracing Is Installed:
      a. All Pipe Sizes: Insulation shall be the following:
         1) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
   7. Floor Drains, Traps, and Sanitary Drain Piping within 20 Feet of Drain Receiving AHU/FCU Condensate and Equipment Drain Water below 60 Deg F:
      a. All Pipe Sizes: Insulation shall be the following:
         1) Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

8. Hot Service Drains:
   a. All Pipe Sizes: Insulation shall be the following:
      1) Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
9. Hot Service Vents:
   a. All Pipe Sizes: Insulation shall be the following:
   1) Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
10. For piping smaller than 1 1/2 inches and located in partitions within conditioned spaces, reduction of the scheduled thickness by 1 inch shall be permitted, but not to a thickness less than 1 inch.
11. All unions, flanges, and valves shall be insulated with removable blanket wraps such that the insulation can be removed for maintenance and operation, and then replaced.
12. Domestic water piping concealed in walls and cabinets will be insulated with closed cell elastomeric tubular insulation with built-in vapor barrier.

C. Indoor, Field Applied Jackets
1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
2. Exposed piping shall be provided with a 30 mil thick PVC jacket, color coded by system.
3. Exposed equipment shall be provided a woven glass fiber fabric jacket.

22.5 PLUMBING VIBRAION CONTROLS

A. Vibration isolation equipment shall consist of elastomeric isolation pads and mounts, restrained elastomeric isolation mounts, freestanding and restrained spring isolators, housed spring mounts, elastomeric hangers, spring hangers, spring hangers with vertical-limit stops, thrust limits, pipe riser resilient supports, resilient pipe guides, restrained vibration isolation roof-curb rails, seismic snubbers, restraining cables, steel and inertia vibration isolation equipment bases. The installation of HVAC and piping systems shall comply with the SMACNA Seismic Hazard Design Guide with the appropriate seismic restraint applied to hazardous and life safety systems based on the building seismic zone.

B. Attachments and supports for domestic water piping systems shall be designed to meet the force and displacement requirements based on the seismic loads above and shall be in accordance with IBC and ASCE 07.

C. Plumbing equipment require seismic bracing and shall be in accordance with IBC and ASCE 07.

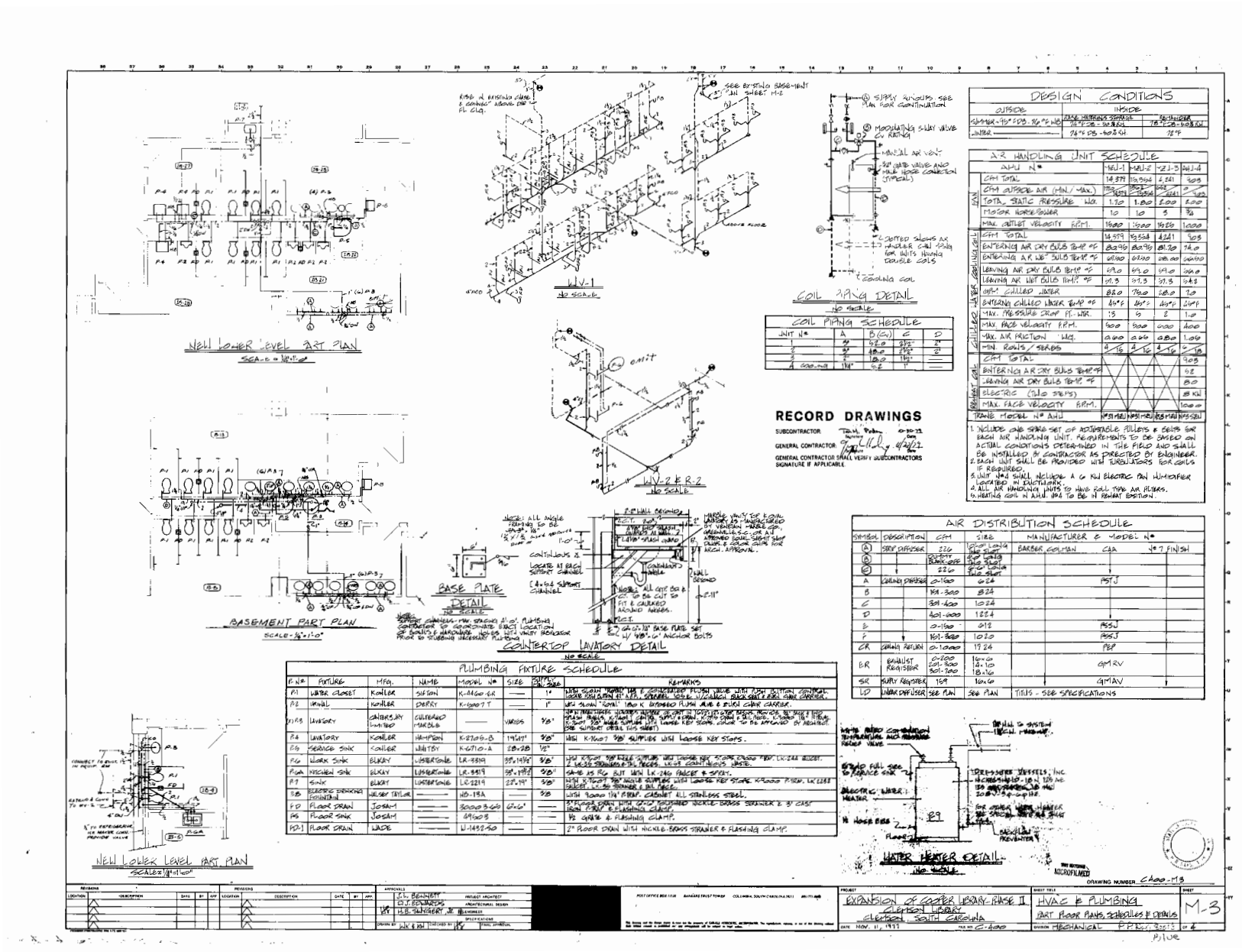
22.6 TESTING AND BALANCING

A. All water distribution systems will be balanced and equipment performance will be tested by an independent balancing agency and an approved member of the Associated Air Balance Council (AABC).

22.7 COMMISSIONING

A. Fundamental and enhanced commissioning of the entire HVAC, plumbing and electrical systems shall be provided by a 3rd party commissioning agent.

B. The contractor shall provide all necessary tools, services, instruments, and consumables required to adjust and remediate documented deficiencies during and subsequent to the commissioning process.


NEW LOWER LEVEL ART PLAN
SCALE: 1/4"=1'-0"
BASEMENT PART PLAN
SCALE: 1/4"=1'-0"
NEW LOWER LEVEL PART PLAN
SCALE: 1/4"=1'-0"
WV-1
NO SCALE
WV-2 & R-2
NO SCALE
COIL PIPING DETAIL
NO SCALE
BASE PLATE DETAIL
NO SCALE
COUNTERTOP LAVATORY DETAIL
NO SCALE
WATER HEATER DETAIL
NO SCALE
RECORD DRAWINGS
SUBCONTRACTOR
GENERAL CONTRACTOR
GENERAL CONTRACTOR SHALL VERIFY SUBCONTRACTORS SIGNATURE IF APPLICABLE
DESIGN CONDITIONS
AIR HANDLING UNIT SCHEDULE
COIL PIPING SCHEDULE
AIR DISTRIBUTION SCHEDULE
PLUMBING FIXTURE SCHEDULE
EXPANSION OF COOPER LIBRARY-PHASE II
CLEMSON LIBRARY
CLEMSON, SOUTH CAROLINA
HVAC & PLUMBING
PART FLOOR PLANS, SCHEDULES & DETAILS
M-3

DIVISION 23 - MECHANICAL ENGINEERING

23.1 INTRODUCTION

A. This document summarizes the mechanical systems for the Cooper Library expansion proposed as part of the Library Master Plan Study. The narrative provides a description of the design and understanding of the Owner's design intent for mechanical systems.

B. This section establishes the basic design criteria for the mechanical systems for the proposed project and shall be used to supplement local, state and national codes, and laws which are applicable to the work being undertaken and those laws dealing with environmental protection, occupational safety and health.

C. System selection, sizing, and loads are based on the best information available at the time of Design Development, which currently includes architectural layout drawings, preliminary programmatic information, and associated square footage information. Necessary adjustments to the project documents will be made as the design process continues and more information is received.

23.2 CODES AND STANDARDS

A. All mechanical systems will be designed and constructed to comply with the following codes and standards:

1. 2018 International Mechanical Code (IMC)
2. 2018 International Building Code (IBC)
3. 2018 International Plumbing Code (IPC)
4. 2018 International Fire Code (IFC)
5. 2009 International Energy Conservation Code (IECC)
6. NFPA 13 - 2013
7. NFPA 90A - 2012
8. NFPA 99 - 2012
9. ASHRAE Standards and Handbooks (latest editions)
10. ANSI A117.1 - 2017 - Standard for Accessible and Usable Buildings and Facilities
11. Americans with Disabilities Act – 1992
12. ASCE 7 - 2010
13. State and Local Codes and Regulations
14. Owner's Insurance Underwriter Standards

B. The codes and standards applicable to this project at the time of this study. Depending on the execution of the construction, it should be anticipated that the Authority Having Jurisdiction (AHJ) will adopt new versions of the Codes. A code review should be executed with the commencement of each phase of the project.

23.3 DESIGN CRITERIA

The heating, ventilating and air conditioning (HVAC) systems shall be designed to produce the desired space temperature, humidity, pressurization, and air quality conditions while employing the following design criteria.

A. Outdoor Ambient Conditions

1. The cooling and dehumidification values are based 0.4% annual cumulative frequency of occurrence and the heating design values are based on 99.6% annual cumulative frequency of occurrence. Climate data for Anderson Regional, SC as indicated in the 2017 ASHRAE Handbook – Fundamentals, unless otherwise directed by Clemson University (denoted with an asterisk).

	Cooling	Dehumidification	Heating
Design Temperature, Dry Bulb	95.1°F	80.9°F	15.0°F*
Design Temperature, Wet Bulb	74.4°F	76.2°F	--
Mean Wind Speed	8.2 MPH	8.2 MPH	5.3 MPH
Prevailing Wind Direction	250° True	250° True	270° True

B. Indoor Design Conditions

1. The following indoor design temperature and humidity conditions are required for all interior program spaces. Temperature will be generally controlled to plus/minus 2°F and humidity to plus/minus 10% RH from the stated values. When a maximum or minimum value is noted, that implies the limit of system operability.

Program	Summer	Winter
Open Seating	74°F DB/50% RH	70°F DB
Open Study	74°F DB/50% RH	70°F DB
Quite Study	74°F DB/50% RH	70°F DB
Classrooms	74°F DB/50% RH	70°F DB
Learning Commons	74°F DB/50% RH	70°F DB
User Spaces	74°F DB/50% RH	70°F DB
Tech Work Areas	74°F DB/50% RH	70°F DB
Presentation Space	74°F DB/50% RH	70°F DB
Library Offices	74°F DB/50% RH	70°F DB
Instructional	74°F DB/50% RH	70°F DB
Reading Room	74°F DB/50% RH	70°F DB
Collections	74°F DB/50% RH	70°F DB
Lobby/Corridor	74°F DB/50% RH	70°F DB
Storage Rooms	74°F DB/50% RH	70°F DB
Electrical rooms	85°F DB/50% RH	60°F DB

2. Whenever it is economically and technically feasible, night setback features will be utilized to allow temperatures to drop to 65°F.
3. Elevator machine rooms and Tele/Data rooms will be served by independent hydronic, floor mounted fan coil units. Indoor design conditions shall be as required by the equipment manufacturer's recommendations. Rooms less than 60-sf with no heat producing equipment, such as transformers and electronic panels with date processing boards, shall be conditioned with transfer air.
4. The representative rates at which heat is given off by occupants shall be based on Chapter 18, Table 1 in the 2017 ASHRAE Handbook – Fundamentals. Generally, the degree of activity shall be "seated, very light work" which corresponds to 245 BTU/hr sensible heat and 155 BTU/hr latent heat. As the programming is further defined these values will be revised based on the space.

C. Noise and Vibration Control Parameters

1. Spaces shall be designed based on ASHRAE Applications Handbook, Chapter 49, Table 1.

Room Types	Octave Band Analysis (NC Level)	Approximate Overall Sound Pressure Level (dBA)
Libraries	30	35

D. Ventilation Design Parameters

1. Spaces shall be ventilated per ASHRAE Standard 62.1 "Ventilation for acceptable Indoor Air Quality, using the Ventilation Rate Procedure Method.
2. Outdoor air intakes for ventilation airflows shall be located a minimum of 25 feet from any hazardous or noxious contaminant, including unclean building exhaust, plumbing vents, boiler flues, streets, parking lots and loading docks.
3. The occupancy density will be based on the formal program for the facility, the furniture/seating layout, or the printed ASHRAE values whichever is greater.
4. In accordance with ASHRAE Standard 62.1, the building HVAC systems will utilize CO2-based demand controlled ventilation (DCV) with ventilation reset to modulate the design outdoor-air intake flow and/or space or zone airflow as operating conditions change, thus reducing the energy used to condition the outside air. Using this strategy, CO2 sensors shall be installed in zones that are densely populated with widely varying patterns of occupancy. The sensors shall be used to reset the ventilation requirements for their respective zones. The other zones – which are not densely populated and/or do not experience significant variations in occupancy – shall be assumed to require their design ventilation rates whenever the spaces are occupied. The Building Automation and Temperature Control System (BAS) shall utilize the ventilation-reset equations in Appendix A of Standard 62.1 to determine the required system-level intake flow of outdoor air to satisfy all of the zones served and modulate the outside air damper accordingly.

E. Exhaust Criteria

1. Exhaust airflow shall be provided as required by ASHRAE 62.1.
2. Exhaust air shall be discharged outdoors at a point where it will not cause a nuisance and from which it cannot again be readily drawn in by a ventilation system (a minimum of 25 feet). Other factors, such as wind direction, wind velocity, stack effect, system sizes, and building height will be evaluated and locations of intake and exhaust outlets adjusted as required.

F. Pressurization Criteria

1. Building air systems will be balanced to achieve positive building pressure and to minimize infiltration. Air handling system will return and/or exhaust approximately 10% less air than they are supplied to ensure a positively pressurized building.
2. Air systems will be designed to provide air movement from clean to less clean or potentially contaminated areas. Where hazardous gases or chemicals may be present or used (housekeeping areas, copy/printing rooms), spaces shall be exhausted to create negative pressure with respect to adjacent spaces with the doors to the room closed.
3. All public toilet rooms, janitor's closets, and kitchenette/break areas shall be negative with respect to the corridor and internal occupied zones.

G. Filtration Criteria

1. All central HVAC systems will be provided with MERV 8 prefilters and MERV 13 final filters.

H. Building Operating Schedule

1. The Library is expected to operate twenty-four (24) hours per day, seven (7) days a week, while some office and staff areas are expected to operate twelve (12) hours per day, five (5) days a week.
2. Programmable system shutdown and night setback modes shall be provided for all air terminal units to reduce energy use during periods of non-use.

I. Internal Heat Gains
   1. Equipment heat gains and occupancy loads for general use spaces will be as defined by the programming documents and Owner furnished load criteria. Equipment loads shall be derived from equipment listed in the program and a minimum of one and one-half (1.5) watt per square foot will be.
   2. Lighting loads will be based on the design standards defined hereinafter and the minimum requirements of ASHRAE 90.1.

J. Envelope Load Criteria
   1. Building skin/conduction loads for the existing portion of the library will be based on the existing architectural wall, roof and window constructions.
   2. Envelope construction for the proposed expansions has not been fully detailed by the architect at the time of this narrative. Once the expansion envelope criteria has been determined, detailed load analysis of the expansions can be de termined and equipment sizing refined.

K. Flexibility Criteria
   1. Building objectives frequently change and require changes in operations and program spaces. Therefore, engineering systems will be flexible and adaptable without significant modifications to system infrastructure. The utility systems will be flexible enough to accommodate reasonable changes in internal loads and process needs without major modifications.
   2. Air distribution systems shall be designed to afford flexibility for future redesign, primarily by providing accessibility to the duct systems throughout the air distribution system and by providing symmetry and uniformity in the branch duct layout.

23.4 INFRASTRUCTURE AND UTILITY SYSTEMS

A. The proposed building expansion will require changes to the existing building chilled water and steam connections to the existing library.

B. The infrastructure and utility systems will be sized to serve the existing and new buildings as currently defined with approximately 5-10% additional capacity for future renovations and program changes. Component sizing parameters and reliability/redundancy provisions will be defined hereinafter for each system.

C. Existing Site Infrastructure and Utility Systems
   1. The Cooper Library is currently connected to the campus central utility systems for steam and chilled water from an existing utility tunnel that runs to the south behind the existing library.
   2. Chilled Water: 8-inch chilled water supply and return piping from the campus chilled water system enters the library at the existing first level mechanical room.
   3. Steam: 3-inch high pressure, 125 psi steam and 2” pumped steam condensate is connected to the library from the existing utility tunnel at the first level mechanical room.

D. New Site Infrastructure and Utility Systems
   1. Chilled Water: New 14” chilled water supply and return piping shall be run from the existing campus utility tunnel into the first level mechanical room. The pipe sizes indicated are based on ASHRAE 90.1 – 2010 Table 6.5.4.5 - Piping System Design Maximum Flow Rate, for systems operating more than 4400 hours/year.
   2. Steam: New 4-inch high pressure steam (HPS), 2-inch high-pressure return, and 2-inch pumped condensate shall be run from the campus utility tunnel to the first level mechanical room.

E. Demolition Building Infrastructure and Utility Systems
   1. The existing building chilled water system within the building shall be demolished in its entirety and replaced with new piping and equipment.

2. The existing building steam system within the first level mechanical room shall be demolished in its entirely and replaced with new piping and equipment.
3. The existing building heating water system within the building shall be demolished in its entirety and replaced with new piping and equipment.

F. New Building Infrastructure and Utility Systems
1. The existing Cooper Library first level mechanical room shall house the chilled water, steam, and heating water systems.
2. The chilled water system shall consist of steam tertiary chilled water pumps and associated trim.
3. The steam system shall consist of a pressure reducing station, electric powered condensate return unit, and associated trim.
4. The heating water system shall consist of steam-to-water heat exchangers, heating water pumps, and associated trim.

G. Building Chilled Water
1. The campus chilled water system shall be provided chilled water for the air handling unit chilled water coils. 14-inch chilled water supply and return piping will be connected to the existing campus chilled water loop and extended into the first level mechanical room.
2. Existing campus chilled water conditions are minimum summer supply water temperature 48°F, and the cooling coils will be designed for variable flow, constant temperature differential with a return temperature of 58 degrees F (10°F delta-T) for all new equipment.
3. The new chilled water loop shall be provided with a secondary bridge connection between the distribution mains and the building system by means of a low pressure loss pipe common to both circuits with a shut-off valve and check valve to prevent campus supply flow directly to the return loop.
4. A bridge return temperature control valve shall be designed to control the temperature and limit the flow of water from the building secondary system to the primary distribution system.
5. A new variable tertiary chilled water pumping system shall be designed for the distribution of chilled water for the Cooper Library air handling units and miscellaneous cooling, with all cooling coil control valves being 2-way for variable flow pumping.
6. CHP-1, 2, 3: Three (3) 1,225 GPM base mounted end-suction variable speed chilled water pumps will circulate chilled water to the air handling units and fan coil units. Each pump shall be sized for 50% of the building cooling coil water load for N+1 redundancy.
7. A chilled water flow meter will be installed on the chilled water return line in the mechanical room.
8. A line-size air/dirt separator will be provided on the chilled water supply piping, upstream of the chilled water tertiary pumps.

H. Building Steam System
1. The campus central steam system will be utilized to satisfy the heating load of the building and the associated expansions.
2. A 4-inch high pressure steam pipe (85-115 psig), 2-inch high-pressure return, and 2-inch pumped condensate pipe will be branched from the existing campus steam system that is routed through the mechanical room.
3. The high-pressure steam will be reduced to low pressure (15 psig) in a single-stage 1/3-2/3 steam pressure reducing station for service to the domestic water heating system and steam-to-water heat exchangers for heating water service.
4. High pressure steam condensate drips will be connected to the high pressure return pipe. Low pressure steam condensate will be flashed (via flash tank) to atmospheric pressure. The atmospheric return from the flash tank will be gravity drained to an electric powered condensate return unit, where it will be collected with the low pressure returns and pumped back to the tunnel via a pumped condensate line.
5. Steam system specialties, including a steam flow metering system, flash tank, separator, steam traps and relief valves are provided. Inverted bucket steam traps will be used on high pressure systems. Float and thermostatic traps will be used on low pressure systems.
6. A steam flow meter will be installed on the incoming high pressure steam line in the mechanical room.
7. The steam relief pipe termination shall be coordinated with the Architect, and shall either terminate above roof level with an exhaust vent head.

I. Building Heating Water System

1. A new building heating water system shall be provided in the first level mechanical room for serve to air handling unit pre heat/reheat coils, terminal units, and miscellaneous space heating for the Cooper Library. A variable speed primary heating water pumping system will be designed for the distribution of heating water, with all heating water coil control valves being 2-way for variable flow pumping. The distribution system will be provided with outdoor air temperature reset controls to maximize energy efficiency.
2. HX-1, HX-2: Two (2) 1,500 MBH, 150 GPM shell and tube steam converters will generate heating water design temperatures of 160 degree Fahrenheit supply with a 140 degree Fahrenheit return. Each convertor shall be sized for 50% of the building heating water load.
3. HWP-1, 2, 3: Three (3) 150 GPM TDH end-suction heating water pumps, located in first level mechanical room, will circu late the heating water through the building. The pumps will serve the air handling units and VAV reheat. Each pump shall be sized for 50% of the building heating water load for N+1 redundancy and will have variable frequency drives to match the required pump horsepower. Approximately ten percent of the design system flow will recirculate through an end-of-loop differential pressure control valve to maintain minimum circulation to avoid excessive pressure at low load and pump minimum speed.
4. The heating water system will be designed with a 20°F temperature difference (160°F to 140°F) and will be operated on an adjustable proportional reset schedule down to 120°F (adjustable) based on outdoor temperature to maximize energy efficiency.
5. The heating water system will be provided with a 1-inch metered make-up water connection, line-size air/dirt separator with strainer and expansion tank. The heating water system will not contain any glycol in solution.

23.5 HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS

A. Existing Heating, Ventilating, and Air Conditioning Systems

1. The existing Cooper Library is served by four (4) existing air handling units. The first second and third levels are served by two (2) air handling units located in the first level mechanical room. Levels 4, 5, and 6 are served by two (2) air handling units located in the sixth level mechanical room.

B. Demolition of Existing Heating, Ventilating, and Air Conditioning Systems

1. All air handling units currently serving the Library shall be demolished and replaced with new units.

C. New Heating Ventilating and Air Conditioning Systems

1. Existing Library
   a. To accommodate the proposed expansion at the North and South of the Library, the existing air handling units within the build ing should be replaced with new equipment.
   b. New air handlers located in the first level mechanical room will serve the first, second, and third levels.
      1) Each unit shall be a 35,000 CFM, fully custom, mixed-zone recirculating variable volume air handling unit. Medium pressure supply air ductwork shall extend from the first level mechanical room up through the building via vertical shafts and distribute to VAV terminal units serving each program space. The units will be fully custom, institutional quality and shall consist of structural base, galvanized steel double wall insulated casing, access doors, multiple supply fan array, multiple return fan array, motors, variable speed drives, economizer, heating and cooling coils, MERV 8 and 13 filters, dampers, controls, components and accessories.

c. The fourth, fifth, and sixth levels shall be served from new air handling units installed in the existing sixth level mechanical pent house.
1) Each unit shall be a 40,000 CFM, fully custom, mixed-zone recirculating variable volume air handling unit. Medium pressure supply air ductwork shall extend from the sixth level mechanical room down through the building via vertical shafts and distribute to VAV terminal units serving each program space. The units will be fully custom, institutional quality and shall consist of structural base, galvanized steel double wall insulated casing, access doors, multiple supply fan array, multiple return fan array, motors, variable speed drives, economizer, heating and cooling coils, MERV 8 and 13 filters, dampers, controls, components and accessories.

2. North Expansion
a. The North Expansion will be served by a new, roof-top mounted air handling unit.
1) The new Unit shall be a 36,000 CFM rooftop mounted, fully custom, mixed-zone recirculating variable volume air handling unit. Medium pressure supply air ductwork shall extend from the unit down through the building and distribute to VAV terminal units serving each program space. The unit will be fully custom, institutional quality and shall consist of structural base, painted exterior grade double wall insulated casing, access doors, multiple supply fan array, multiple return fan array, motors, variable speed drives, economizer, heating and cooling coils, MERV 8 and 13 filters, dampers, controls, components and accessories.

3. South Expansion
a. The South expansion will be served from the new air handling units that will be provided to serve the existing library building.

4. West Expansion
a. The West Expansion shall be provided with new air handling units located on the fourth, fifth, and sixth levels. The unit located on the fourth level will serve the third and fourth levels, while the other units will serve their respective floors.
1) Each unit shall be a 30,000 CFM, fully custom, mixed-zone recirculating variable volume air handling unit. Medium pressure supply air ductwork shall extend from the each mechanical room across the building floor plate and distribute to VAV terminal units serving each program space. The units will be fully custom, institutional quality and shall consist of structural base, galvanized steel double wall insulated casing, access doors, multiple supply fan array, multiple return fan array, motors, variable speed drives, economizer, heating and cooling coils, MERV 8 and 13 filters, dampers, controls, components and accessories.

D. Air Distribution
1. Supply ductwork downstream of air handling units to the terminal units shall be insulated and sized for medium pressure (4-inch w.g.). Medium pressure supply ductwork shall be sized as follows:
a. In shafts: 0.25”/100’ pressure drop with a not to exceed 2,000 FPM air velocity.
b. Above ceiling: 0.25”/100’ pressure drop with a not to exceed 1,700 FPM air velocity for rectangular ductwork.
c. Above ceiling: 0.25”/100’ pressure drop with a not to exceed 2,000 FPM air velocity for circular and oval ductwork.

2. Supply ductwork downstream of terminal units shall be insulated and sized for low pressure (2-inch w.g.). Return and exhaust ductwork shall be uninsulated and sized for low pressure (2-inch w.g.). Low pressure supply, return, and exhaust ductwork shall be sized as follows:
a. In shafts: 0.10”/100’ pressure drop with a not to exceed 2,000 FPM air velocity.
b. Above ceiling: 0.25”/100’ pressure drop with a not to exceed 1,400 FPM air velocity for rectangular ductwork.
c. Above ceiling: 0.08”/100’ pressure drop with a not to exceed 1,600 FPM air velocity for rectangular ductwork.

3. Distribution ductwork for supply and return shall be constructed of ASTM grade, first quality galvanized steel of gauges as called for in the SMACA Duct Manual.
4. Duct Insulation
   a. Indoor:
      1) Concealed (above ceiling) supply and outdoor air ductwork will be insulated with two (2) inch thick, 1-lb per cubic foot nominal density blanket type lightweight fiberglass duct insulation with vapor barrier facing.
      2) Concealed (within shafts) supply and outdoor air ductwork will be insulated with two (2) inch thick, 6-lb per cubic foot nominal density mineral fiber board insulation with vapor barrier facing.
      3) Concealed (within shafts) return air ductwork will be insulated with two (2) inch thick, 6-lb per cubic foot nominal density mineral fiber board insulation with vapor barrier facing.
      4) Concealed, exhaust air ductwork between isolation damper and penetration of building exterior will be insulated with two (2) inch thick, 1-lb per cubic foot nominal density blanket type lightweight fiberglass duct insulation with vapor barrier facing.
      5) Concealed, supply air, outdoor air, and exhaust air plenums shall be insulated with two (2) inch thick, 6-lb per cubic foot nominal density mineral fiber board insulation with vapor barrier facing.
      6) Exposed (unfinished areas) supply air and outdoor air duct will be insulated with two (2) inch thick, 6-lb per cubic foot nominal density mineral fiber board insulation with vapor barrier facing.
      7) Exposed (unfinished areas) return air duct will be insulated with one (1) inch thick, 6-lb per cubic foot nominal density mineral fiber board insulation with vapor barrier facing.
      8) All exposed ductwork, in mechanical rooms and service spaces, in addition to the insulation jackets specified, shall be covered with an additional UL listed jacket of eight (8) ounce canvas.
      9) All exterior ductwork shall be additionally covered with a sixteen (16) mil embossed aluminum weatherproof jacket with an integrally bonded polysurlyn moisture retarder over the entire surface in contact with the insulation.
      10) Concealed, supply air devices shall be insulated with with one (1) inch thick, 1-lb per cubic foot nominal density blanket type lightweight fiberglass duct insulation with vapor barrier facing.
      11) Exposed ducts and plenums shall be provided with a woven, glass-fiber fabric field applied jacket. Jacket shall be installed over insulation materials. For insulations with factory-applied jackets, the field applied jacket shall be installed over the factory applied jacket.
   b. Aboveground, Outdoor
      1) Concealed, supply and outdoor air ductwork shall be insulated with two (2) inch thick polyisocyanurate sheathing.
      2) Concealed, return air ductwork shall be insulated with two (2) inch thick polyisocyanurate sheathing.
      3) Exposed, supply and outdoor air ductwork shall be insulated with two (2) inch thick polyisocyanurate sheathing.
      4) Exposed, return air ductwork shall be insulated with two (2) inch thick polyisocyanurate sheathing.
      5) Exposed, supply and outdoor air plenums shall be insulated with two (2) inch thick polyisocyanurate sheathing.
      6) Exposed, return air plenums shall be insulated with two (2) inch thick polyisocyanurate sheathing.

7) Exposed ducts and plenums up to 48 inches in diameter or with flat surfaces up to 72 inches shall be provided with an aluminum, stucco embossed 0.040 inch thick field applied jacket. Jacket shall be installed over insulation materials. For insulations with factory-applied jackets, the field applied jacket shall be installed over the factory applied jacket.

8) Exposed ducts and plenums larger than 48 inches in diameter or with flat surfaces larger than 72 inches shall be provided with an aluminum, stucco embossed 0.040 inch thick field applied jacket with 1-1/4 inch deep coorigations. Jacket shall be installed over insulation materials. For insulations with factory-applied jackets, the field applied jacket shall be installed over the factory applied jacket.

5. Supply Air Terminals: Single duct variable volume air terminal units will be provided for each space or group of similar spaces to provide individual room temperature control. Primary heating for each space will be provided by hydronic reheat coils at each supply terminal unit. Air terminals will be commercial grade with interior sealed liner. Casing shall be single wall construction with 22-gauge galvanized steel. Casing liner shall be flexible elastomeric duct liner fabricated and preformed cellular, closed-cell, sheet materials complying ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B. Damper shall be 16-gauge thick galvanized steel with peripheral gasket and self-lubricating bearings. Terminal sound attenuators will be provided on the occupant side of all supply terminal units. Sound attenuators shall be constructed of 22-gauge steel sheets. Hydronic heating coils shall be constructed of copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering water temperature of 220 °F. Air terminals will be equal to Titus DESV.
6. Fire dampers and smoke dampers shall be installed in supply, return, and exhaust ductwork where required by wall or floor rating. Combination fire/smoke dampers will be installed at the duct/shaft penetrations to isolate the smoke zone from the shaft. Fire dampers shall be rated and labeled according to UL 555, smoke dampers shall be rated and labeled according to UL 555S, and fire/smoke dampers shall be rated and labeled according to both UL 555 and UL 555S.
7. Air device selections will be coordinated with the Architect to ensure that the program spaces have the intended appearance. Air devices located in areas where there may be moisture, i.e. toilet rooms, janitor's closets, etc. will be constructed of aluminum.

23.6 MISCELLANEOUS HEATING AND AIR CONDITIONING

A. Elevator Machine Rooms: 2-ton cooling only floor mounted hydronic fan coil units will be provided to provide independent 24/7 year round cooling.
B. Tele/Data, Main Electrical, EM Switch Rooms: 2-ton cooling only floor mounted hydronic fan coil units will be provided to provide independent 24/7 year round cooling.
C. Floor Electrical Rooms: Rooms less than 60 square feet with no heat producing equipment, such as transformers and electronic panels with data processing boards, will not be heated, cooled or ventilated. Room with heat producing equipment shall be provided with constant air volume terminal units without reheat coils to provide cooling for the rooms.

23.7 MISCELLANEOUS EXHAUST/VENTILATION CRITERIA

A. One (1) rooftop, centrifugal upblast, belt-driven exhaust fans will be provided for service to the existing Cooper Library and the proposed North and South expansion toilet rooms, janitor closets, break areas, kitchenettes, copy rooms, etc. Fan shall be located on the roof.
B. One (1) rooftop, centrifugal upblast, belt-driven exhaust fans will be provided for service to the proposed West expansion toilet rooms, janitor closets, break areas, kitchenettes, copy rooms, etc. Fan shall be located on the roof.
C. Building Smoke Control
   1. In accordance with IBC 2018, the 3-story open seating/open study areas and monumental stair constructed as part of Phase 1A and the north addition area of Phase 2 shall be provided with a mechanical smoke control system.

2. The smoke control fan shall be a rooftop mounted fan specifically designed for Smoke Control. Fan sizing shall be determined per calculations based on the final area and configuration of the open seating/open study areas within the proposed building expansion.
3. The architectural study documents do no identify any additional areas requiring active smoke control, stair pressurization, or hoist way pressurization.

D. There are no requirements for a commercial kitchen exhaust hood.
E. Currently the emergency generator is planned to be located outdoors on grade, therefore generator ventilation is not required.
F. The building is not a high rise and the elevator hoistway is not more than 75 feet in height, therefore elevator hoistway protection or pressurization is not required.

23.8 PIPING SYSTEMS

A. Pipe Materials

1. Chilled Water:
   a. Aboveground, NPS 2 inches and smaller shall be hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings and solder joints.
   b. Aboveground, NPS 2-1/2 inches and larger, shall be schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   c. Underground direct buried chilled water piping shall be ductile iron.
   d. System components shall be minimum class 150 rated.
2. Steam:
   a. Low Pressure Steam:
      1) LP Steam Piping, NPS 2 inches and smaller shall be Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
      2) LP Steam Piping, NPS 2-1/2 inches and larger shall be Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
      3) Condensate piping above grade, NPS 2 inches and smaller shall be Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
      4) Condensate piping above grade, NPS 2-1/2 inches and larger shall be Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
      5) Underground direct buried high-pressure steam piping, high pressure condensate return and pumped condensate shall be Super Temp-Tite® double wall preinsulated pipe system as manufactured by Thermal Pipe Systems, Inc.
   b. High Pressure Steam:
      1) HP Steam Piping, NPS 2 inches and smaller shall be Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
      2) HP Steam Piping, NPS 2-1/2 inches and larger Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3) Underground direct buried high-pressure steam piping, high pressure condensate return and pumped condensate shall be Super Temp-Tite® double wall preinsulated pipe system as manufactured by Thermal Pipe Systems, Inc.
4) Condensate piping above grade, NPS 2 inches and smaller Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
5) Condensate piping above grade, NPS 2-1/2 inches and larger shall be Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

c. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
d. Vacuum-Breaker Piping: Outlet, same as service where installed.

3. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.
4. Heating Water:
   a. Aboveground, NPS 2 inches and smaller shall be hard copper tube, ASTM B 88, Type L; wrought copper, solder-joint fittings and soldered joints.
   b. Aboveground, NPS 2-1/2 inches and larger shall be schedule 40 steel piping, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
5. Makeup-water piping installed aboveground shall be hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
6. Condensate-Drain Piping: Type M or Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
7. Air-Vent Piping:
   a. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manu facturer's written instructions.
   b. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
8. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

B. Indoor Pipe Insulation Materials
1. All insulation shall have composite (insulation jacket and adhesive used to adhere the jacket to the insulation) Fire and Smoke Hazard ratings as tested under procedure ASTM E-84, NFPA 225 and UL 723 not exceeding a Flame Spread of 25 and a Smoke Development of 5. Exposed piping in the rooftop penthouses and mechanical rooms shall be painted.
2. Pipe supports on piping 2-inch and larger shall be provided with equal thickness 12-inch long sections of Foamglas with jacket carried continuously over Foamglas and vapor sealed as appropriate.
3. Chilled Water
   a. NPS 1-1/4 inch and smaller shall be one of the following:
      1) Flexible Elastomeric: 1 inch thick.
      2) Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
   b. NPS 1-1/2 inch to NPS 6 inches shall be the following:
      1) Cellular Glass: 1-1/2 inches thick.
   c. NPS 8 inches and larger shall be the following:
   1) Cellular Glass: 2 inches thick.

4. Steam, Steam Relief and Steam Condensate, 250 Deg F and Below (0-15 psig):
   a. NPS 3 inches and smaller shall be the following:
      1) Mineral-Fiber, Preformed Pipe, Type I or II: 2-1/2 inches thick.
   b. NPS 4 inches and larger shall be the following:
      1) Mineral-Fiber, Preformed Pipe, Type I or II: 3 inches thick.
5. Steam, Steam Relief and Steam Condensate, 251 to 350 Deg F (16-125 psig):
   a. NPS ¾ inch and smaller shall be the following:
      1) Calcium Silicate: 3 inches thick.
   b. NPS 1 inch to NPS 1-1/4 inches shall be the following:
      1) Calcium Silicate: 4 inches thick.
   c. NPS 1-1/2 inches and larger shall be the following:
      1) Calcium Silicate: 4-1/2 inches thick.
6. Heating Water Supply and Return:
   a. NPS 1-1/4 inches and smaller, insulation shall be the following:
      1) Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.
   b. NPS 1-1/2 inches and larger, insulation shall be the following:
      1) Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
   c. All unions, flanges, and valves shall be insulated with removable blanket wraps such that the insulation can be removed for maintenance and operation, and then replaced.

C. Equipment Insulation
   1. Steam-to-hot-water converter insulation shall be:
      a. Mineral-Fiber board: 2 inch thick and 3-lb/cu. ft. nominal density
      b. Mineral-Fiber Pipe and Tank: 2 inches thick.
   2. Chilled-water pump insulation shall be the following:
      a. Flexible Elastomeric: 2 inches thick.
   3. Steam condensate pump and boiler feedwater pump insulation shall be one of the following:
      a. Mineral-Fiber Board: 2 inch thick and 3-lb/cu. ft. nominal density
      b. Mineral-Fiber Pipe and Tank: 2 inches thick.
   4. Chilled-water expansion/compression tank insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.
   5. Heating-hot-water expansion/compression tank insulation shall be one of the following:
   a. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
   b. Mineral-Fiber Pipe and Tank: 1 inch thick.
   6. Heating-hot-water air-separator insulation shall be one of the following:
      a. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
      b. Mineral-Fiber Pipe and Tank: 2 inches thick.
   7. Steam condensate tank and receiver insulation shall be one of the following:
      a. Mineral-Fiber Board: 2 inch thick and 3-lb/cu. ft. nominal density
      b. Mineral-Fiber Pipe and Tank: 2 inches thick.

8. Steam flash-tank, flash-separator, moisture-separator, and blow-off-tank insulation shall be one of the following:
   a. Mineral-Fiber Board: 2 inch thick and 3-lb/cu. ft. nominal density
   b. Mineral-Fiber Pipe and Tank: 2 inches thick.

D. Indoor, Field Applied Jackets
1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
2. Piping, Concealed:
   a. None.
3. Piping, Exposed:
   a. PVC, Color-Coded by System: 30 mils thick.
4. Equipment, Concealed:
   a. None.
5. Equipment, Exposed Within Mechanical Rooms:
   a. Woven Glass-Fiber Fabric.
6. Ducts and Plenums, Concealed:
   a. None.
7. Ducts and Plenums, Exposed:
   a. Woven Glass-Fiber Fabric.

E. Outdoor, Field-Applied Jackets
1. Piping, Exposed:
   a. Aluminum, Stucco Embossed with Z-Shaped Locking Seam. Minimum jacket thickness shall be based on the outer insulation diameter:
      1) 8-inches and smaller: 0.024 inches thick.

23.9 BUILDING AUTOMATION AND CONTROL SYSTEMS

A. The existing building automation system (BAS) is a Johnson Controls Incorporated (JCI) Metasys system. The existing system shall be modified accordingly for the proposed, phased renovation and shall monitor and control the air handling units, fans, building cooling and heating, air terminal units, domestic water, and all miscellaneous mechanical equipment associated with the building.

B. The project shall consist of and provide all new Direct Digital Controlled (DDC) panels, power supplies, wiring, conduit, solenoid valves, relays, differential pressure transmitters, differential pressure switches, RTDS, pressure sensors, etc. necessary for a complete and operable automatic control system and DDC field panels and connecting LAN to extend the existing system into the new tower.

C. The control system shall be provided with a LAN based interface that can be accessed through a data port within the building by a portable PC. The user that interfaces the DDC at that point shall be able to receive all diagnostic information from system and modify all user input setpoints.

D. Control for the building systems shall be DDC based with digital electronic actuators for all valves and dampers. Terminal reheat units will be provided with electronic controls.

E. For energy savings the control system shall allow for the air handling units to have scheduled shut downs and/or temperature set backs during unoccupied hours.

F. Air handling units shall be provided with smoke detectors in the supply and return ductwork and smoke dampers in accordance with IMC 2018 and NFPA 90A.

G. Several building automation/control systems strategies will be provided to improve the overall performance of the building, including the HVAC equipment:
   1. Programmable electronic thermostats for standalone HVAC equipment will be provided to allow facility managers to reset heating and cooling set points for different operating modes. Daytime, nighttime, and weekends typically have different target temperatures in order to allow the building temperature to drift appropriately when unoccupied, then return automatically to occupied mode.
   2. Occupancy sensors to control terminal units will be provided to detect whether people are present by sensing heat (infrared), motion (ultrasonic), or sound.
   3. Optimum start/stop controls for HVAC equipment will be provided to delay bringing equipment online until the latest possible time.
   4. Temperature setback/setup will be provided to save energy by allowing building conditions to drift (within predefined limits) during unoccupied periods.
   5. Supply temperature reset for heating water systems will be provided to modulate the circulating water temperature based on load sensors and program logic.
   6. Carbon dioxide (CO2) sensors, monitoring and demand based ventilation strategies will be provided to improve energy efficiency and minimize the outdoor air cooling and heating loads.
   7. Digital energy metering equipment shall be furnished by ATC contractor and installed by Division 26. Meters shall be monitored and trended by the DDC system.
   8. Steam meters and chilled water meters shall be installed and provided with connectivity to the existing campus Johnson Control Metasys system.

23.10 MECHANICAL VIBRATION CONTROLS

A. Vibration isolation equipment shall consist of elastomeric isolation pads and mounts, restrained elastomeric isolation mounts, freestanding and restrained spring isolators, housed spring mounts, elastomeric hangers, spring hangers, spring hangers with vertical-limit stops, thrust limits, pipe riser resilient supports, resilient pipe guides, restrained vibration isolation roof-curb rails, seismic snubbers, restraining cables, steel and inertia vibration isolation equipment bases. The installation of HVAC and piping systems shall comply with the SMACNA Seismic Hazard Design Guide with the appropriate seismic restraint applied to hazardous and life safety systems based on the building seismic zone.

B. Attachments and supports for suspended ductwork, HVAC piping, domestic water piping and fire protection systems shall be de signed to meet the force and displacement requirements based on the seismic loads above and shall be in accordance with IBC and ASCE 07.

C. Mechanical and plumbing equipment require seismic bracing and shall be in accordance with IBC and ASCE 07.

23.11 TESTING AND BALANCING

A. All air and water distribution systems will be balanced and equipment performance will be tested by an independent balancing agency and an approved member of the Associated Air Balance Council (AABC).

23.12 COMMISSIONING

A. Fundamental and enhanced commissioning of the entire HVAC, plumbing and electrical systems shall be provided by a 3rd party commissioning agent.

B. The contractor shall provide all necessary tools, services, instruments, and consumables required to adjust and remediate docu mented deficiencies during and subsequent to the commissioning process.

DIVISION 26 - ELECTRICAL ENGINEERING

26.1 INTRODUCTION

A. This document summarizes the electrical systems for the Cooper Library expansion proposed as part of the Library Master Plan Study. The narrative provides the Basis of Design and understanding of the Owner's Design Intent for the electrical systems. As such, the document can be used to develop a construction cost model/budget with associated general requirements for the facility.

B. This section establishes the basic design criteria for the electrical systems for the proposed facility and shall be used to supplement local, state and national codes and laws which are applicable to the work being undertaken and those laws dealing with environmental protection, occupational safety and health.

26.2 CODES AND STANDARDS

A. All electrical work in this division shall be provided in accordance with the following codes and standards:

1. Americans with Disabilities Act (ADA)
2. American National Standards Institute (ANSI)
3. Electronics Industry Association/ Telecommunications Industry Association (EIA/TIA)
4. EPA Regulations
5. Illuminating Engineering Society of North America (IESNA)
6. Institute of Electrical and Electronics Engineers (IEEE)
7. Insulated Power Cable Engineers Association (IPCEA)
8. International Building Code (IBC), 2018 edition, with SC modifications
9. International Energy Conservation Code (IECC), 2009 edition, with SC modifications
10. National Fire Protection Association (NFPA)
11. National Electrical Code, 2017 edition (NFPA 70)
12. National Fire Alarm and Signaling Code, 2013 edition (NFPA 72)
13. National Electrical Manufacturers Association (NEMA)
14. Underwriters Laboratories, Inc. (UL)
15. Clemson University Guidelines for Commissioned Architects and Engineers referred to as the "Green Book".
16. All local code supplements

B. The electrical work shall be coordinated with the requirements of all other Divisions including architectural, structural, civil and mechanical.

26.3 SCOPE OF WORK

A. The scope of work for the project includes the provision of all electrical systems including power, lighting, and special systems. The following is a listing of the systems to be provided under the electrical division:

1. 15kV Electrical Service from the Clemson Distribution System
2. Secondary Power Distribution System
3. Emergency Generator
4. Emergency Power Distribution System
5. Receptacles and Equipment Connections
6. Surge Protection Devices

7. Power Metering
8. Interior Lighting
9. Emergency Lighting
10. Exterior Site Lighting
11. Lighting Controls
12. Fire Alarm System
13. Telecommunications Raceway Distribution System
14. Grounding System
15. Security System Raceway
16. Lightning Protection System
17. Seismic Bracing

26.4 POWER

A. The following paragraphs provide a general description of the requirements for all systems under the electrical division.

B. 15kV Medium Voltage Distribution Electric Service

1. The proposed building addition will receive primary electric service from the Clemson University 12,470-volt medium volt age campus distribution system. The electric service will include a pad mounted transformer located adjacent to the building addition. The transformer will deliver 480/277 volt, three phase, four wire secondary service to the building. Concrete encased ductbanks shall be provided for the secondary electrical service feeders. Transformer concrete pad and secondary wire shall be provided by the electrical contractor.

C. Building Distribution

1. The secondary electrical distribution system will consist of a main distribution panel, distribution feeders, distribution panelboards, and standard panelboards as necessary to supply the electrical loads throughout the building. The following is a list of the unitary electrical loads utilized for preliminary sizing of the electrical service and distribution system.

LOAD TYPE	VA/SF
Lighting	3.0
Receptacles	2.5
Miscellaneous	1.5
Mechanical	10.0
TOTAL	17.0

2. The preliminary design identifies approximately 144,000 GSF of building addition space. Applying the unitary loads listed above, results in an estimated connected electrical load of approximately 2,448 kVA.
3. The pad mounted transformer feeding the building addition shall be rated 2500kVA.
4. The 480-volt main switchboard for the building addition shall be rated 3000 Amps, 480/277V, 3 phase, and 4 wire. The preferred gear manufacturer is Square D. Other acceptable manufacturers are Cutler Hammer, General Electric and Siemens.
5. The electrical distribution system will consist of main switchboards, distribution feeders, distribution paneboards, dry type transformers, and standard and electronic grade panelboards as necessary to supply the electrical loads throughout the building.

6. The main switchboards shall be sectional, free-standing, indoor, dead front and shall be equipped with group-mounted, solid-state feeder circuit breakers. The preferred gear manufacturer is Square D. Other acceptable manufacturers are Cutler Hammer, General Electric and Siemens.
7. Branch circuit panelboards shall be located throughout the building to serve the lighting, receptacle, equipment, mechanical and miscellaneous loads. Energy efficient dry type transformers shall be provided in the Electrical room and in Electrical Closets to step the voltage from 480 volts to 208/120 volt, three phase, four wire for supply to the receptacle and equipment loads. K-rated transformers shall be used to connect computer panelboards to the distribution system.
8. Branch circuit panelboards for receptacle, equipment, and miscellaneous loads shall be standard type panels. The branch circuit panelboards shall be located in Electrical Closets.
9. All distribution feeders and branch circuit wiring shall be copper with type THHN/THWN insulation. Wiring shall be installed in electrical metallic tubing (EMT). Connections to vibrating equipment shall be sealtite, flexible metallic conduit. Final connections to lighting fixtures shall be flexible metallic conduit.
10. Voltage drop in the building will be limited to 2% for feeders and 3% for branch circuits, for a maximum of 5% overall.

D. Receptacles and Equipment Connections
1. General purpose, specification grade receptacles shall be provided in the following areas:
   a. Open Study, floor boxes 10 foot on center.
   b. Classrooms, 12 foot on center at least two per wall.
   c. offices, 12 foot on center at least two per wall.
   d. Storage rooms.
   e. Electrical and mechanical rooms.
   f. Lobbies and wide corridors, 10 foot on center for displays, check-in, etc.
   g. Corridors, 50 foot on center for cleaning. One per corridor minimum.
   h. Restrooms, GFI type.
   i. Communications Room 8 foot on center, at least one per wall.
   j. Roof, GFI type within 25 foot of all mechanical equipment.

E. Surge Protection Devices
1. Surge Protection Devices (SPD) shall be provided. The service switchboard shall be protected with “service entrance” type device, IEEE category C3 rated. There shall be one device for the main switchboard. The surge protection devices shall be mounted externally from the service switchboard and shall not be integrated into or manufactured by the switchboard manufacturer.
2. Provide Surge Protection Devices on all electrical panels feeding computer equipment.

F. Power Metering and Monitoring
1. Square D Powerlogic or similar shall be installed in the main switchboard.

26.5 EMERGENCY POWER (SMOKE EVAC) SERVICE

A. Provide an emergency generator to provide backup power for the smoke evacuation system.
1. The generator will be sized for a smoke evacuation system capable of meeting the requirements. The generator size cannot be determined at this time. The generator size will be determined once programming and conceptual design has progressed to a point where the motor sizes of the smoke evacuation system can be determined.

26.6 INTERIOR LIGHTING

A. All interior spaces in the building shall be provided with lighting fixtures designed to enhance the aesthetics and to provide illumi nation levels consistent with current standards as defined by the Illuminating Engineering Society of North America (IESNA) "Lighting Handbook, 10th Edition." In general, interior lighting fixtures will utilize LED type light sources wherever practical. The LED drivers shall utilize solid state electronics with no more than 10% THD. Fluorescent light sources shall not be used. Where acrylic lenses are specified, they shall be 0.125 inches nominal thickness.

B. Exit lights shall be specified with energy efficient, non-visible type, light emitting diode (LED) source with red letters.

C. Incandescent lighting sources are inefficient and shall not be used.

D. All lighting shall be designed to conform to the lighting power densities outlined in ASHRAE Standard 90.1-2007.

E. The following table lists the various areas along with the associated lighting levels and lighting systems:

AREA	FOOTCANDLES	DESCRIPTION
Offices	50-70	2' x 4' recessed LED volumetric
Study Areas	30-50	Decorative LED pendants to be selected by the Architect
Classrooms	50	Linear recessed LED
Toilets	30	2' x 4' recessed LED volumetric
Breakrooms	30	2' x 4' recessed LED volumetric
Storage/Unassigned/Supply	30	2' x 4' recessed LED volumetric
Corridor – General	5-20	Linear recessed LED
Mechanical/Electrical	40	1' x 4' LED industrial with wireguard
Telecommunications Rooms	40	Surface mounted LED industrial fixture with wireguard

26.7 LIFE SAFETY LIGHTING

A. The life safety lighting will consist of low wattage LED lighting fixtures along the paths of egress, corridors, stairs, electrical rooms, and toilets. Light fixtures shall be powered from central inverters located in area electrical closets to provide emergency lighting as required by IBC. Battery backups in individual light fixtures are not allowed.

B. Illuminated exit signage will be used at all designated/code required exits as well as strategic locations along the path of egress. The units shall be provided with battery backup. The lamps will be LED types for long life and lower maintenance.

C. Exterior lighting located at egress doors shall be powered from central inverters to provide emergency lighting as required by IBC.

26.8 EXTERIOR LIGHTING

A. New site lighting will consist of pole mounted LED exterior lighting fixtures and building mounted lighting.

B. Average maintained horizontal foot-candle (FC) levels, measured at ground level, will be as follows:

1. Main Entrances 5 FC
2. Service entrance 5 FC
3. Walkways 1- 2 FC. Minimum .5 FC

26.9 LIGHTING CONTROLS

A. In general, most interior lighting fixtures will be locally switched utilizing line voltage switches.
B. Lighting systems shall be specified with a BACnet interface with the building automatic system.
C. A lighting control system shall be provided to automatically turn off all interior lighting fixtures during non-business hours. This system provides a centralized way of controlling the lighting by time-of-day with an integral astronomical time clock. The system will flash the lights five minutes before any scheduled off sequence. Occupants can override the automatic off sequence by pushing the local reset switch and the lights will stay on until the next programmed off sequence.
D. An architectural dimming system similar to those manufactured by Lutron may be used to control the lighting in large classrooms or conference spaces.
E. All exterior lighting will be controlled by the building automatic system (BAS) via BACnet protocol.
F. Multiple level switching utilizing multiple ballasts and switches will be used in areas 200 square feet and greater and in areas requiring multiple lighting levels for aesthetic purposes. All classrooms shall have bi-level switching and daylight harvesting for the row of light fixtures mounted adjacent to the exterior wall. 0-10 volt dimming shall be continuously dimmable down to 5 percent light output.
G. Occupancy sensors will be placed throughout the building in accordance with ASHRAE 90.1 standards. Areas include classrooms, administrative offices, staff break rooms and conference rooms.
H. Large mechanical spaces will have an automatic timed off sequence after a programmable time delay of approximately 2 hours. The system will flash the lights 5 minutes before any scheduled off sequence. Occupants can override the automatic off sequence by pushing the local reset switch, and the lights will stay on until the next programmed off sequence. The lights can be turned off at any time by pushing the off switch.

26.10 FIRE ALARM SYSTEM

A. A complete multiplexed addressable voice/evacuation fire alarm system shall be provided throughout the building in accordance with the requirements of IBC, NFPA and ADA.
B. The fire alarm system shall include a control panel located in the main electrical room and a remote annunciator panel located at the main entrance to the building. Provide drill function at the panel to enable administrative personnel to initiate fire drills without operating an initiating device or activating fire department notification apparatus.
C. Manual pull stations, smoke detectors, thermal detectors, duct detectors, signaling devices (strobes), voice speakers, sprinkler flow switches, and sprinkler tamper switches shall be provided as required by NFPA and ADA. The latest "intelligent" detectors shall be provided. Concealed duct detectors shall have remote alarm lights located in corridors mounted 84" above the floor.
D. Provide strobes in all toilet rooms.
E. All fire alarm wiring shall be installed in EMT conduit.

26.11 GROUNDING SYSTEM

A. A power system ground grid will serve as a reference point for equipment grounding for all building systems. Grounding systems will be installed in accordance with the National Electrical Code.
B. Provide a grounding grid around the perimeter of the main electrical rooms (normal and emergency), the emergency generator area, and the main telecommunications room. The grounding grid shall consist of a #4/0 AWG bare stranded copper grounding conductor and ¾ inch diameter by 10 ft long copper clad steel ground rods 12 ft on center.
C. The ground grid shall be buried a minimum of 12 inches in undisturbed earth below concrete floor slabs. Connections made below slab shall be exothermically welded.

D. Ground connections shall be extended to the main water service, all service switchboards, and the lightning protection system. At least two connections from each room's grid mentioned above shall be made to the lightning protection system.
E. Copper ground buses 24"x2"x1/2" shall be provided in the main electrical rooms and main telecommunication rooms. The ground buses shall be interconnected with the ground grid with a #4/0AWG conductor. All connections to the ground bus shall be bolted.
F. For an all-concrete building, a ground riser shall be provided through the electrical rooms throughout the floor for connection of transformers and sensitive equipment. Provide a 12"x2"x1/2" copper ground bus in each closet.
G. An insulated ground conductor will be provided with all power feeders and branch circuits, for equipment grounding purposes.

26.12 INFORMATION TECHNOLOGY

A. The building shall be provided with a raceway system and power connections for Owner provided information technology systems. All information technology systems shall be installed in accordance with the Clemson Technology Design Specifications.
B. Each telecommunications room shall be provided with cable tray installed around the perimeter of the room. Each telecommunication room shall be connected together with 4-4inch conduits. Provide plywood backboards for wall mounted equipment. Each telecommunication room shall be provided with a #6 ground connected to the main electrical service ground.
C. A cable tray system shall be provided in all corridors. Run cable tray adjacent to corridor walls above suspended ceiling. Provide fire rated penetrations through any fire rated walls. Cable tray shall be flexible wire basket type. Minimum dimensions shall be 12" wide by 4" deep.
D. Provide fire rated EZ Path sleeves at all IT rooms.

26.13 SECURITY/SURVEILLANCE SYSTEM

A. The building shall be provided with a raceway system and power connections for Owner provided security system to control and monitor access to the building. The system shall include card readers at all exterior entry doors, lab access doors, electrical rooms and mechanical rooms. Provisions for CCTV cameras will be provided by all exterior doors. All security and surveillance systems shall be design in accordance with the Clemson University requirements.

26.14 SEISMIC BRACING

A. Electrical seismic requirements are based on the seismic loads listed below:
    1. Site Classification = D
    2. Seismic Use Group = II
B. Attachments and supports for conduits shall be designed to meet the force and displacement requirements based on the seismic loads above and shall be in accordance with IBC 2018 Section 1621.
C. Electrical equipment requires seismic bracing and shall be in accordance with IBC 2018 Section 1621

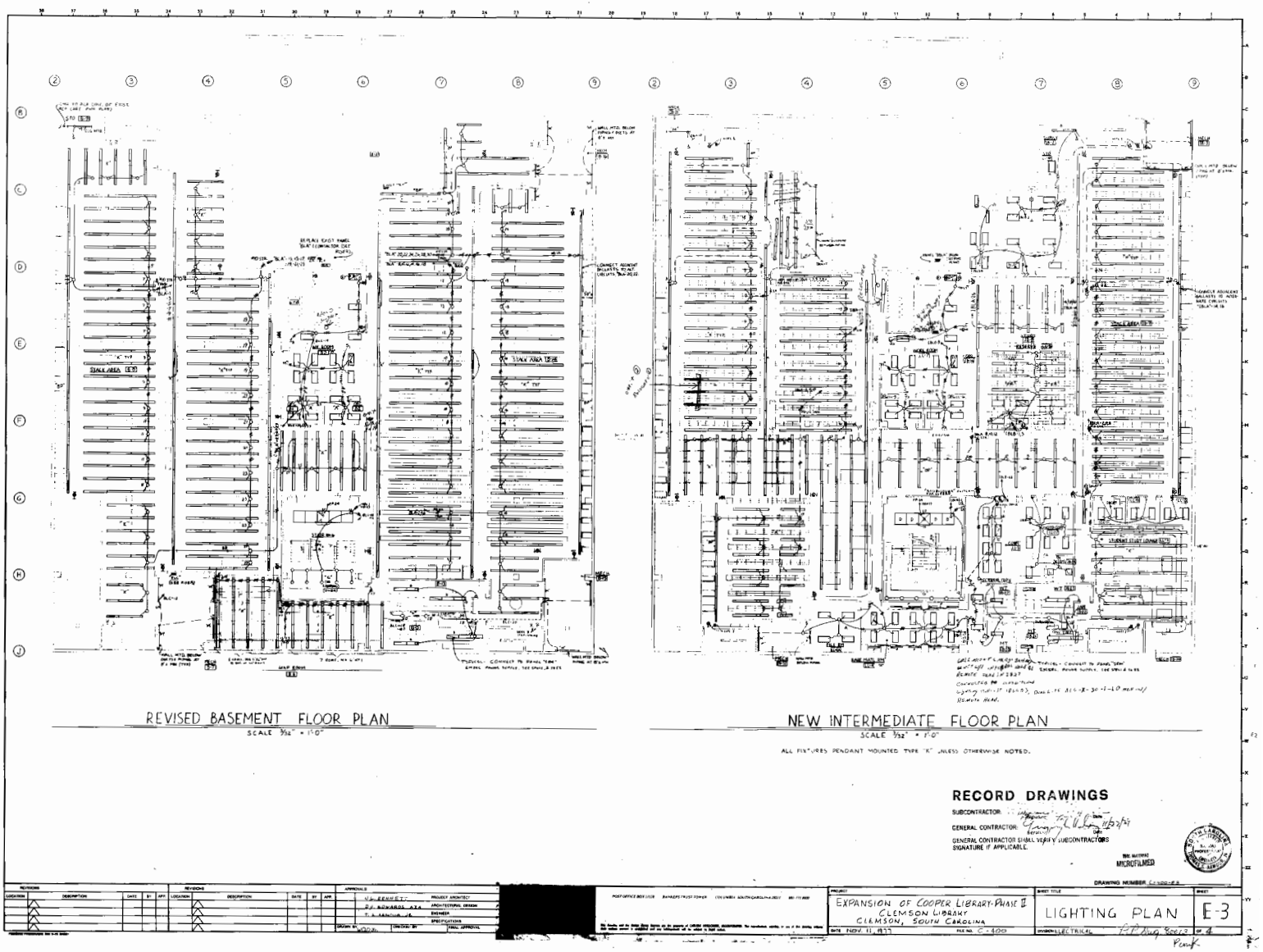
26.15 COMMISSIONING

A. Fundamental and enhanced commissioning shall be provided by a 3rd party commissioning agent.

B. The following systems shall be commissioned:

1. Lighting Systems
2. Electrical Distribution
3. Security Systems
4. Renewable Energy Systems
5. Emergency Generator

C. The contractor shall provide all necessary tools, services, instruments, and consumables required to adjust and remediate documented deficiencies during and subsequent to the commissioning process.


REVISED BASEMENT FLOOR PLAN
SCALE 3/32" = 1'-0"
NEW INTERMEDIATE FLOOR PLAN
SCALE 3/32" = 1'-0"
ALL FIXTURES PENDANT MOUNTED TYPE "K" UNLESS OTHERWISE NOTED.
RECORD DRAWINGS
SUBCONTRACTOR:
GENERAL CONTRACTOR:
GENERAL CONTRACTOR SHALL VERIFY SUBCONTRACTORS SIGNATURE IF APPLICABLE.
MICROFILMED
EXPANSION OF COOPER LIBRARY-PHASE II
CLEMSON LIBRARY
CLEMSON, SOUTH CAROLINA
LIGHTING PLAN
E-3

Project Cost Estimates

Year of Construction		2021*	2023*
Cooper Library Renovation	(179,970 gsf)	$40,963,030.	**$44,305,613.00**

*The cost estimate generated by the Palacio Group was based on 2021 midpoint of construction dollars. At the time of this study, inflation was anticipated at 4% escalation per year. Per the anticipated schedule, midpoint of construction would be fourth quarter of 2023. Budget estimate is based on these escalated prices.

Cooper Library Expansion and Renovation

Phase I		2021*	2024*
-North Expansion	(37,800 gsf)	$15,917,142.00	$17,904,620.00
-West Expansion	(76,300 gsf)	$23,573,401.00	$26,516,870.00
-Interiors / Stair Renovation	(28,391 gsf)	$ 6,108,900.00	$ 6,871,682.00
Total Phase I Cost	(142,491 gsf)	$45,599,433.00	**$51,293,172.00**

Phase II		2021*	2027*
-Levels 5-6 Renovation	(49,800 gsf)	$12,408,822.00	$15,701,118.00
-Levels 3-4 Renovation	(58,900 gsf)	$12,833,267.00	$16,887,704.00
-Levels 1-2 Renovation	(57,000 gsf)	$ 9,611,992.00	$12,162,236.00
-South Expansion	(24,100 gsf)	$10,029,133.00	$12,690,027.00
Total Phase II Cost	(189,800 gsf)	$44,883,214.00	**$57,441,085.00**

Total Project Cost	(332,291 gsf)	$90,482,647.00	**$108,734,257.00**

*The cost estimate generated by the Palacio Group was based on 2021 midpoint of construction dollars. At the time of this study, inflation was anticipated at 4% escalation per year. Per the anticipated schedule, midpoint of construction for Phase I would be first or second quarter of 2024. Phase II midpoint of construction would be fourth quarter 2027. Budget estimate is based on these escalated prices.

CONSULTANT TEAM

ARCHITECT
COLLINS COOPER CARUSI ARCHITECTS
3391 PEACHTREEE RD. SUITE 400
ATLANTA, GA 30326
ERIC RICHARDSON, PRINCIPAL
JEFF JULIANO, PRINCIPAL

MECHANICAL/ PLUMBING ENGINEEERS
RMF ENGINEERING, INC.
194 SEVEN FARMS DRIVE SUITE G
CHARLESTON , SC 29492
GREGORY HUDSON, PROJECT MANAGER

STRUCTURAL ENGINEER
MMSA
30 PATEWOOD DRIVE #100
GREENVILLE, SC 29615
MICHAEL SIMPSON, PRESIDENT

COST ESTIMATOR
PALACIO COLLABORATIVE
400 GALLERIA PKWY SE, S-1500
ATLANTA, GA 30339
MICHAEL PALLACIO, PRESIDENT

BRIGHTSPOT STRATEGIES
434 WEST 33RD STREET SUITE 1101
NEW YORK, NY 10001
ABIGAIL SMITH HANBY, DIRECTOR
TATIANA GARCIA, SENIOR STRATEGIST