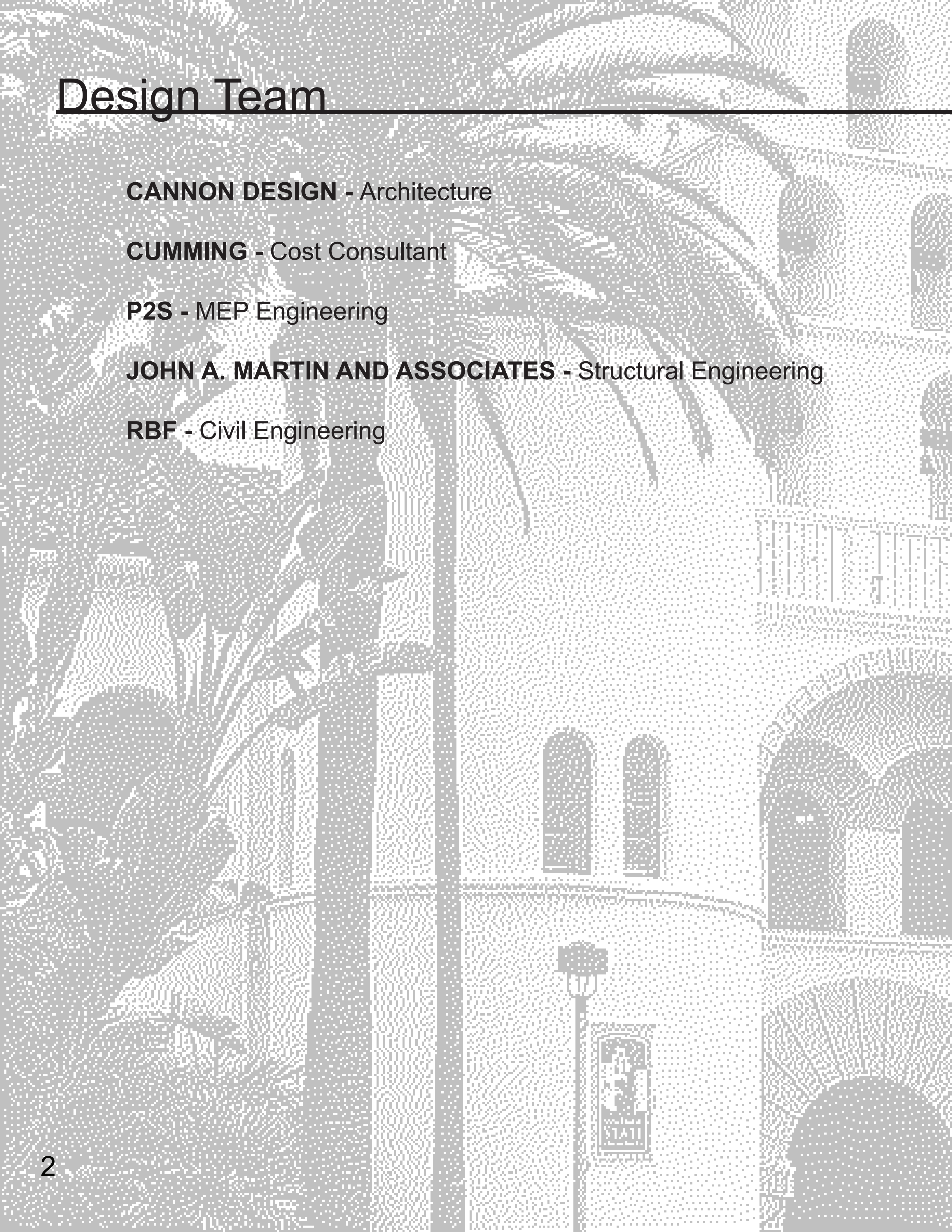
# San Diego State University

*Leadership Starts Here*

## Engineering and Interdisciplinary Sciences Building Study

Process Document
October 17th, 2014

CANNONDESIGN



# Design Team

**CANNON DESIGN -** Architecture

**CUMMING -** Cost Consultant

**P2S -** MEP Engineering

**JOHN A. MARTIN AND ASSOCIATES -** Structural Engineering

**RBF -** Civil Engineering

# Table of Contents

# Vision

## Engineering and Interdisciplinary Sciences Building

Cannon Design was engaged by SDSU to create a conceptual design and cost study for the new Engineering and Interdisciplinary Science building at San Diego State University.

The purpose of the study was to develop a general programmatic site campus plan, architectural character, building systems and cost model that establishes a project scope framework for SDSU.

The process included two, three-day intensive charrette workshops, where Cannon Design and SDSU discussed and developed the program intent, building design and the cost model. The project challenged the team to envision 'future proof' research and hybrid teaching/research labs. In addition, the architectural building expression was to be true to SDSU's Architectural Guidelines, rooted in its Spanish mission revival style architectural heritage.

The following document represents the process of design, workshop interaction, and refinement of options. It should be noted that the enclosed architectural solutions and planning diagrams are a graphic representation of SDSU's project objectives and not final design solutions. This document does not represent design criteria, nor have the designs been vetted for code compliance.

Key Project Objectives:

- Design of a new interdisciplinary facility to house Engineering and Science research, as well as Engineering Teaching Labs.
- A facility that will enhance the campus's core architectural character and heritage through a thoughtful Spanish mission revival style.
- A facility to evoke a new center for the STEM area of campus, bringing together all STEM disciplines.
- Creation of a STEM quad as part of the project for centralized activities and socialization.
- Creation of flexible spaces that can easily adapt as the building ages and program areas of interest change.
- Strengthening of connection and presence of the School of Engineering.
- *Creation of a "best value" facility within a total project budget of $90,000,000.
- Determination of available ASF within project objectives and budget.

*Facility Design/Construction cost not to exceed $66,000,000

# Architectural Intent


Conrad Prebys Aztec Student Union
First new building built on SDSU campus reflective of campus architectural character

# *site context*

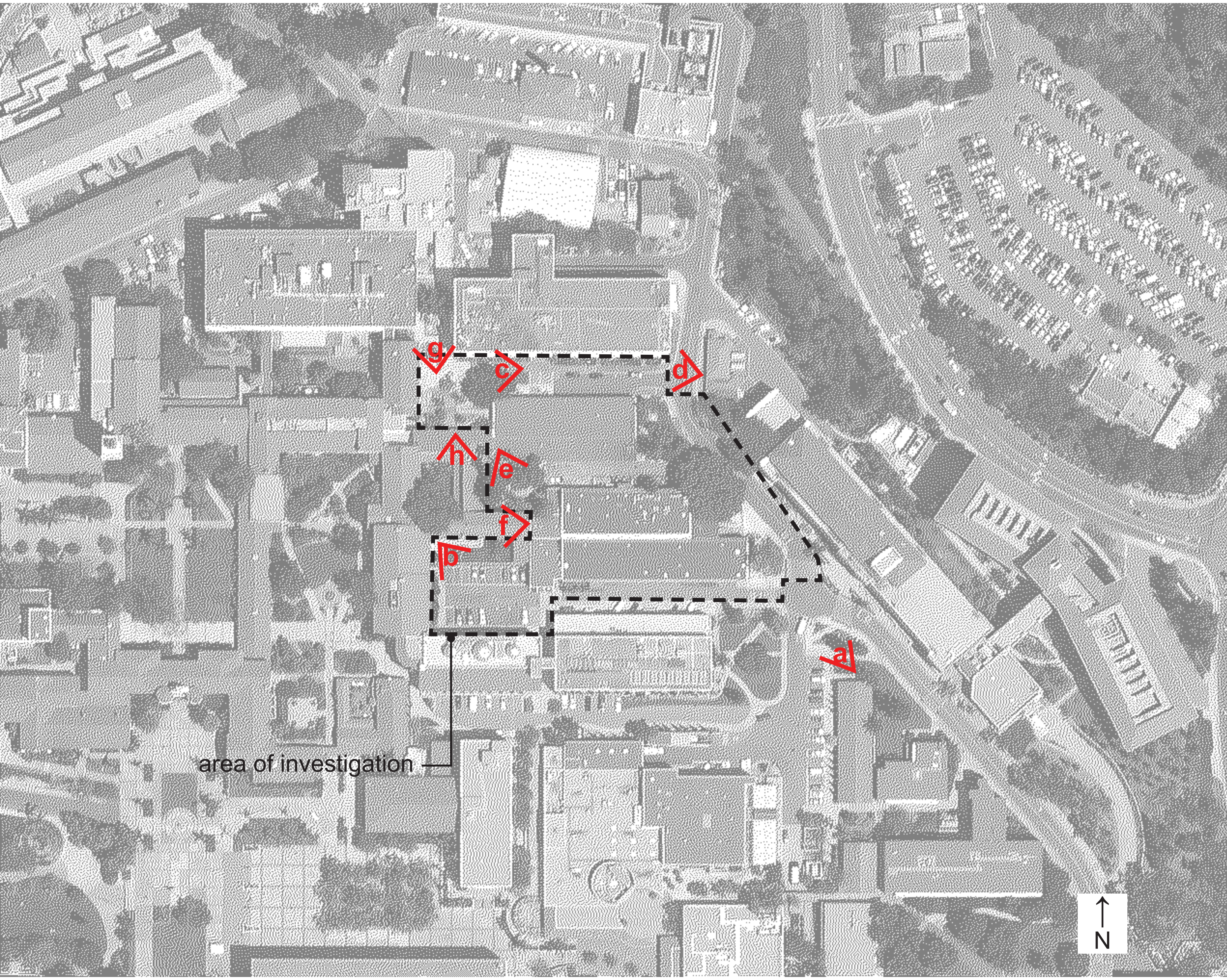
SDSU's campus is rooted in its Mission and Spanish Colonial Revival styles popular in the 1930s.

Architectural elements common to this style include:

- Courtyards and arcades
- Horizontal massing
- Wood, plaster, and stucco
- Clay tile roofs
- Projecting eaves
- Punched windows

It is the intent of SDSU to continue this tradition and vocabulary in the planning, architecture and detail of the new Engineering & IS facility.

# Architectural Intent

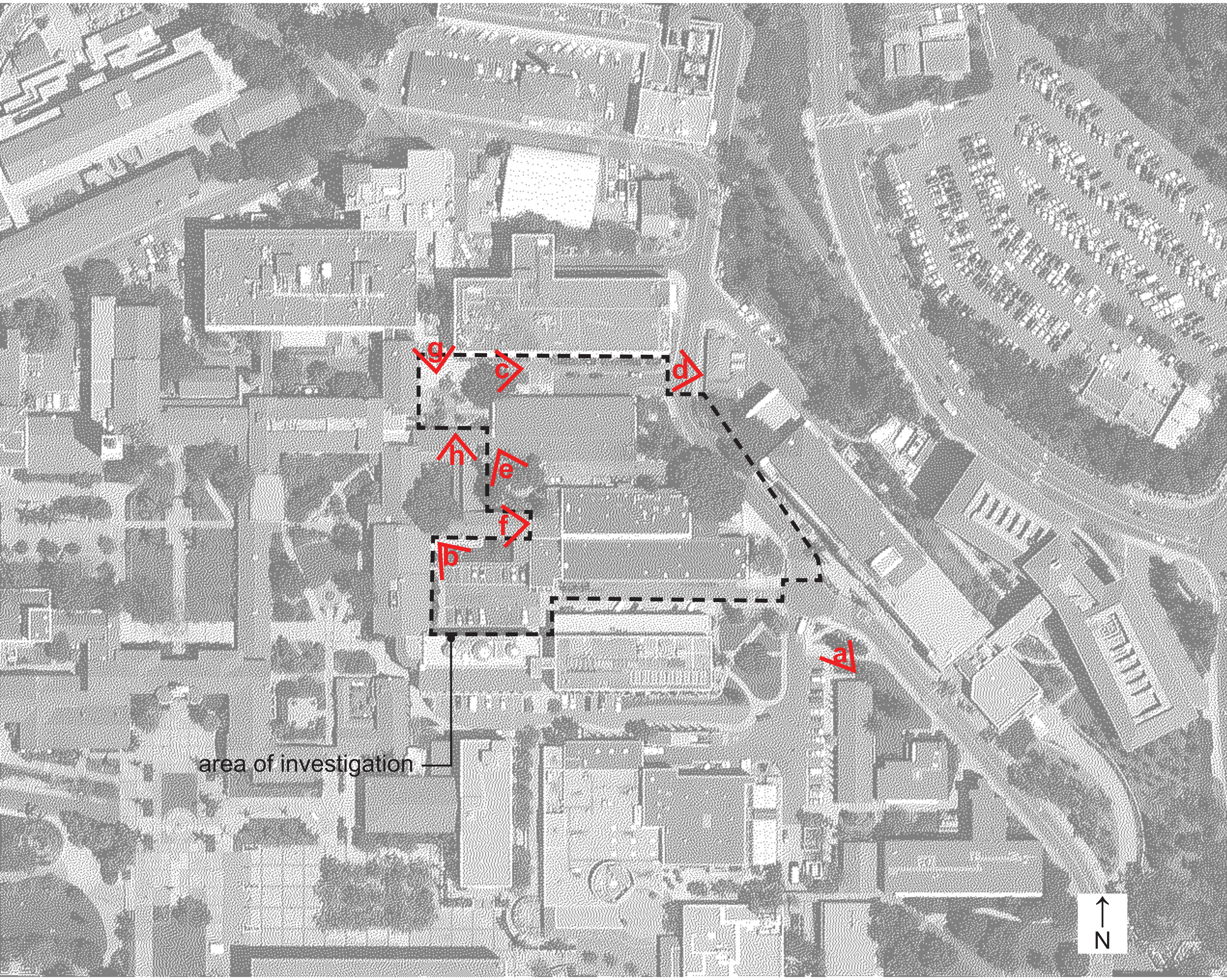



**Site Photo Locations**

**a** **view from southeast of site**

**b** **view of existing parking**

# Architectural Intent




**Site Photo Locations**

c view of northwest corner

f view of existing corridor

d view of existing engineering building

g view of north area

e view of existing courtyard

h view of existing courtyard to remain

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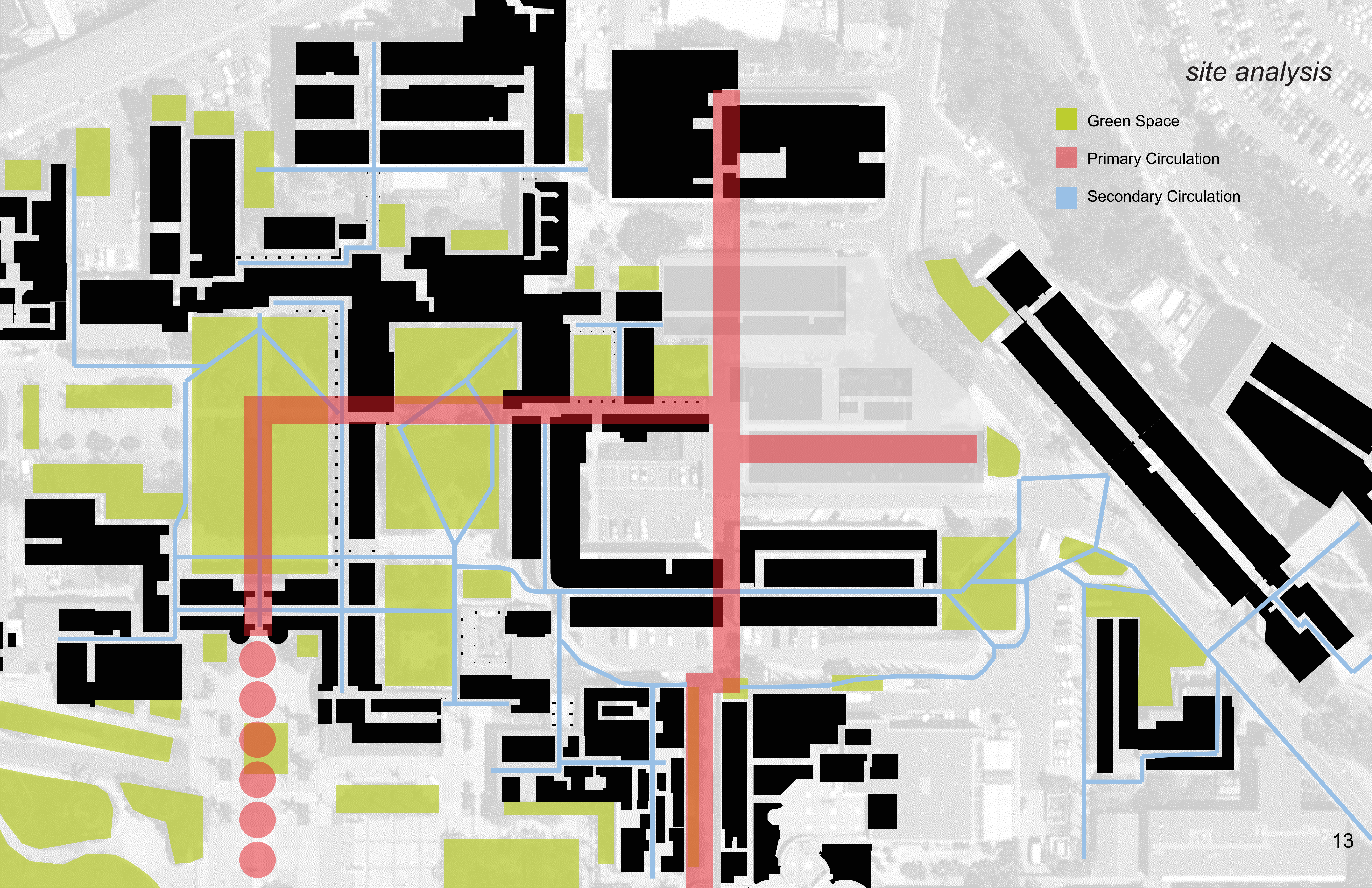
site analysis
Green Space
Primary Circulation
Secondary Circulation

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# Architectural Intent



1. Central STEM Quad to provide landscaped and hardscaped area for a variety of activities to bring the STEM disciplines together.
2. Desire to make a physical connection and improved entry to the existing Engineering building.
3. Provide strong pedestrian connections in north/south and east/west directions by continuation of existing pathways.
4. Existing parking lot shall be transformed into usable landscaped courtyard.
5. Existing courtyard is unusable due to overcrowding of steps and ramps. Courtyard to be redesigned and ADA access to be provided in thoughtful way.
6. Desire to create plaza at east side of building entry. Plaza should create meaningful connections to the GMCS building across the road.
7. Building shall have gateway entrance.
8. Service access
9. Service & fire access.

All design objectives must be investigated relative to ADA accessibility, fire, life safety, service, maintenance access and circulation.

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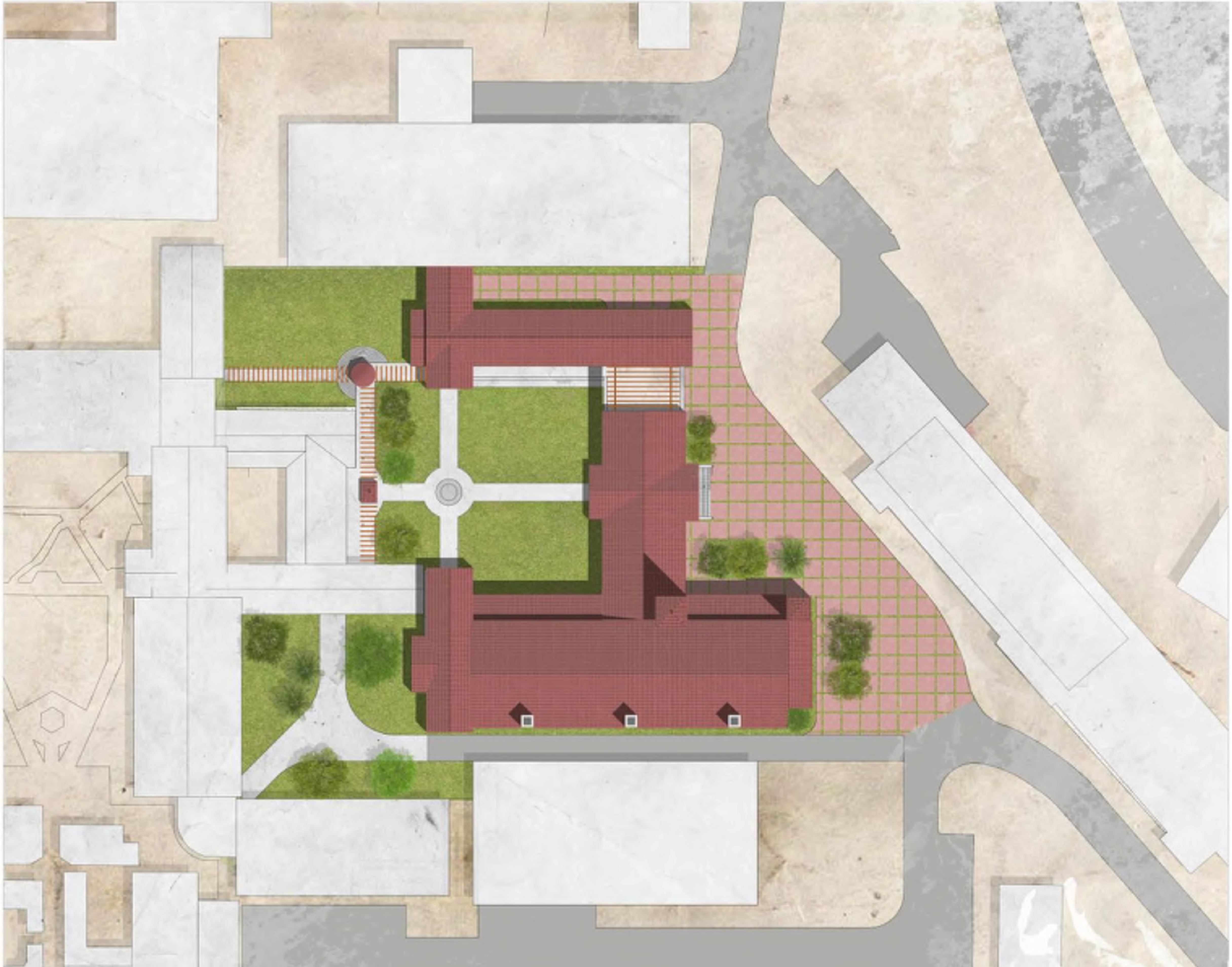
*site plan*



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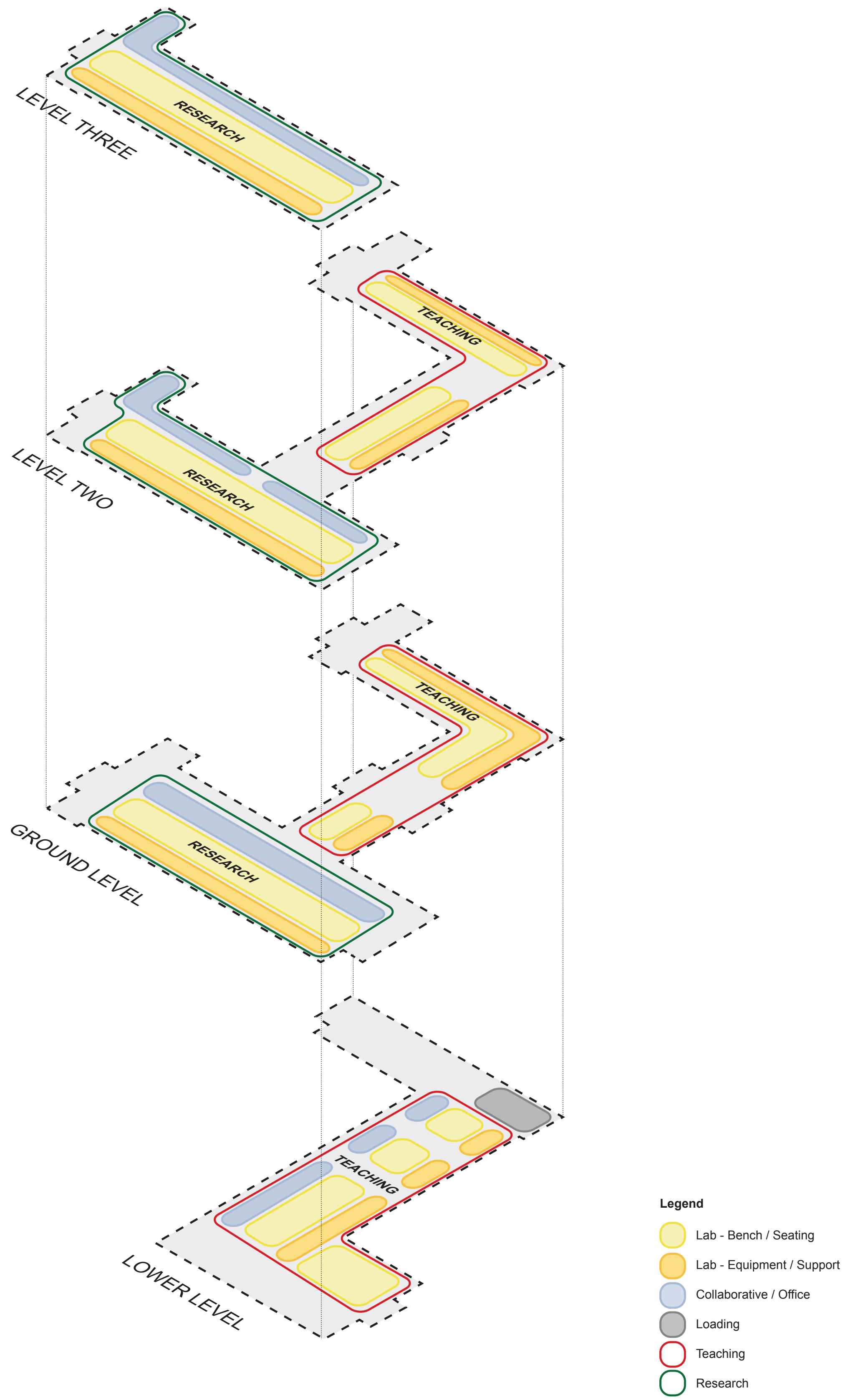
# *conceptual layout*



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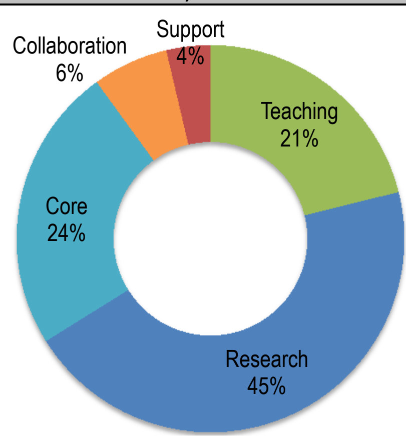
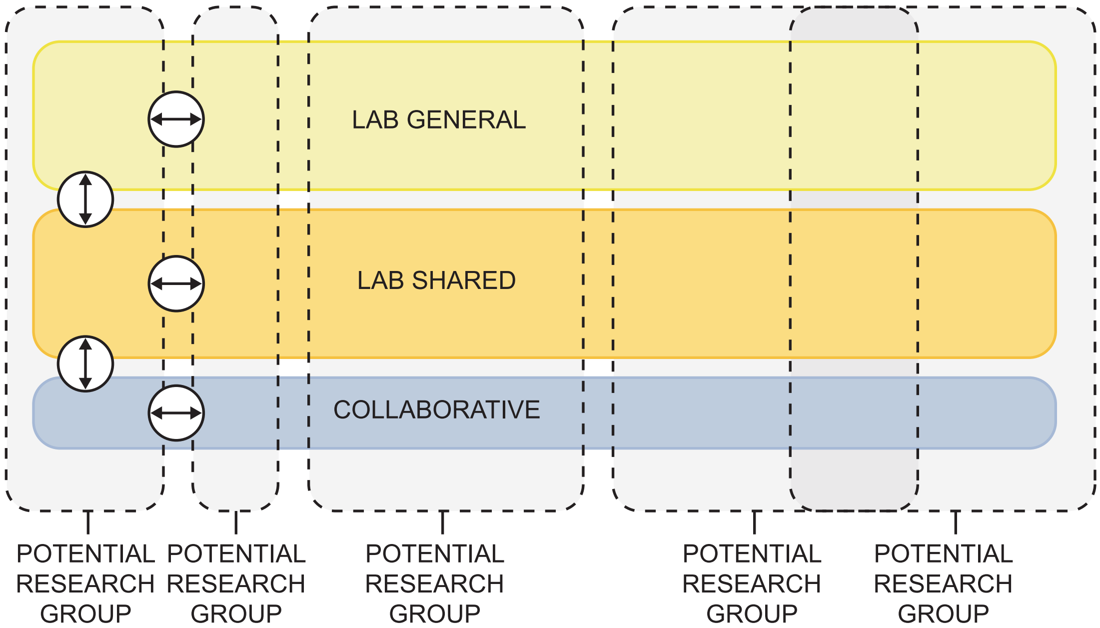
| | Headcount | Quantity | SQFT | Total | Total Seats | Notes |
|---|---|---|---|---|---|---|
| **Learning** | | | | | | |
| Hydraulics/Fluid Mechanics Labs | 25 | 2 | 40 | 2,000 | 50 | |
| Mechanical Engineering Lab | 50 | 1 | 50 | 2,500 | 50 | Divisible to 25 people |
| Soils Lab | 25 | 1 | 40 | 1,000 | 25 | |
| Environmental Lab | 25 | 1 | 40 | 1,000 | 25 | |
| CAM Lab | 30 | 1 | 50 | 1,500 | 30 | |
| Project Space/Teaching Labs | 25 | 2 | 40 | 2,000 | 50 | Space for yet to be determined |
| Group Learning/ Teaching Lab | 30 | 1 | 50 | 1,500 | 30 | program. Space allocation to allow |
| **Total** | | | | **11,500** | **260** | for maximum flexibility. |
| **Research** | | | | | | |
| PI Office | 19 | 1 | 110 | 110 | | |
| Post Docs | 38 | 3 | 40 | 120 | | |
| Students | 38 | 3 | 40 | 120 | 7 | |
| Open Lab | | 7 | 60 | 420 | 50sqft pp | |
| Support Lab | | | | 420 | | |
| **subtotal per PI** | | | | ***1,190*** | ***170*** | |
| Collaboration (shared) | | | | 1,890 | | |
| **Total Net Area** | ***19*** | | | **24,500** | | |
| **Centers & Specialty Space** | | | | | | |
| Clean Room | 15 | 1 | 50 | 750 | | |
| Wind Tunnel | 15 | 1 | 50 | 750 | | |
| Imaging Center | | 1 | | 4,000 | | |
| Phage Center | | 1 | | 4,000 | | |
| Zahn / Lavin Center | | 1 | | 3,500 | | |
| **Total** | | | | **13,000** | | |
| **Collaboration** | | | | | | |
| Meeting Rooms | 15 | 8 | 22 | 2,640 | | |
| Café | 20 | 2 | 20 | 800 | | |
| **Total** | | | | **3,440** | | |
| **Building Support** | | | | | | |
| Loading Dock | | 1 | 1000 | 1,000 | | |
| Chemicals, Gas Etc | | 1 | 1000 | 1,000 | | |
| **Total** | | | | **2,000** | | |
| **Total Net Area** | | 63% | | 54,440 | | |
| **Net To Gross** | | 38% | | 32,664 | | |
| **Total GSF** | | | 1.60 | **87,104** | GSF | |




**Area Ratios as a % of Net**

# Programmatic Intent

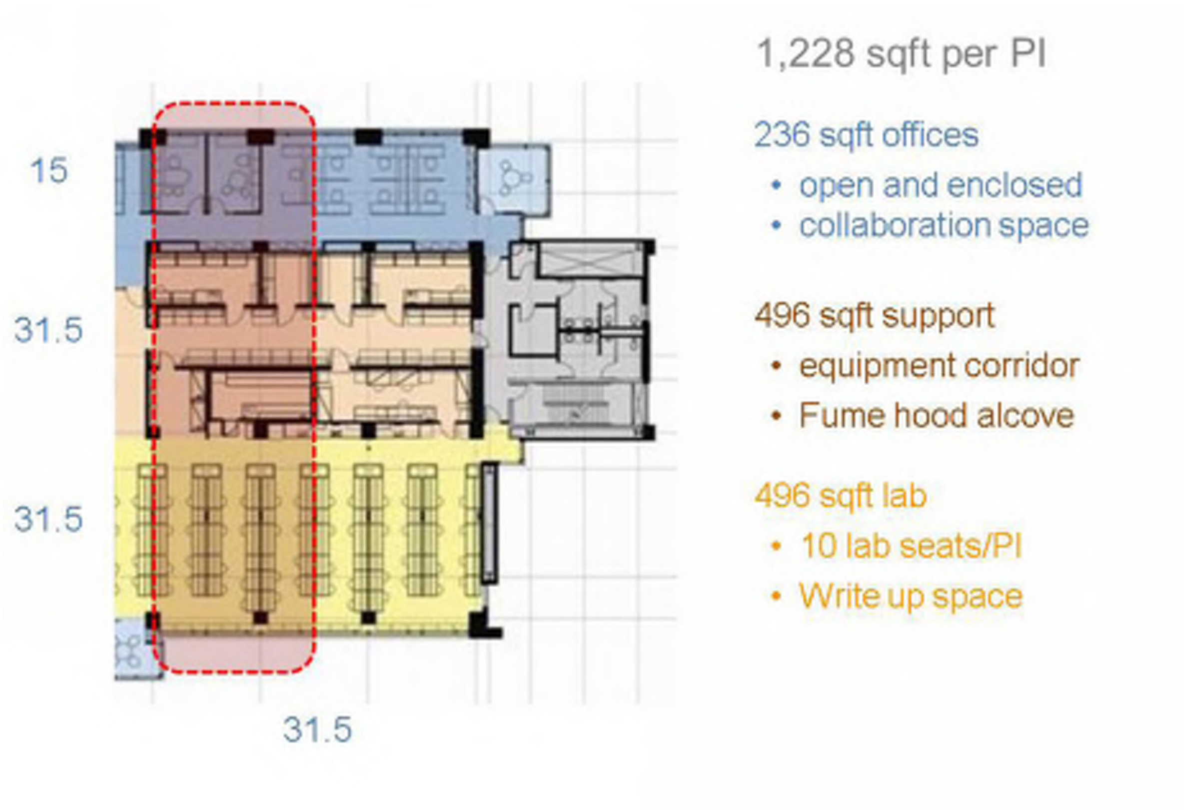
Research Planning Module

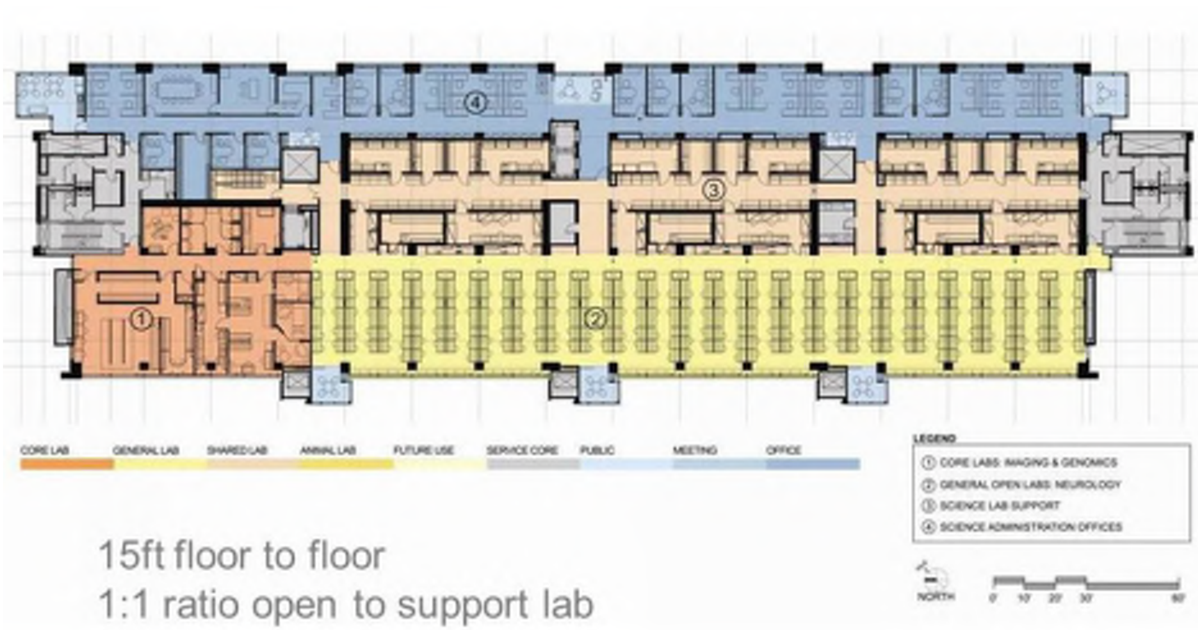



Program Objectives:

1. Building to provide approximately 85,000 gsf total.
2. Research space to accommodate 19 PI teams.
3. Teaching Labs to provide replacement for demolished buildings.
4. Provide some growth for teaching/research needs.
5. Research and teaching spaces are to be designed with maximum flexibility/adaptability in mind.
6. Collaboration/meeting/social spaces are to be incorporated throughout building at a variety of scales and types.
7. Lower level to have direct access to loading area for large equipment.
8. Quad will need to be able to accommodate a variety of programmatic activities, as well as provide comfortable seating and shaded areas.
9. Spaces on grade shall have opportunities to connect directly to the outdoors/ Quad.

Research Institution Precedents

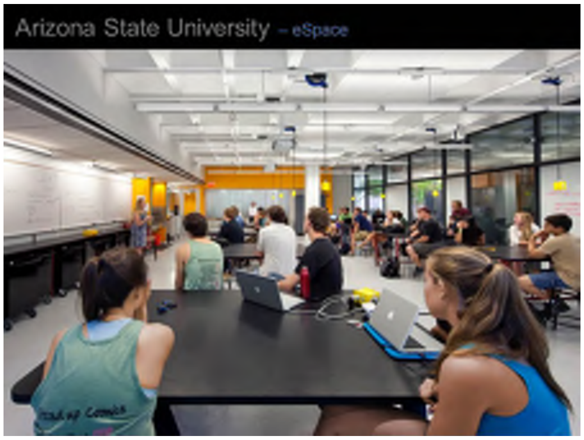


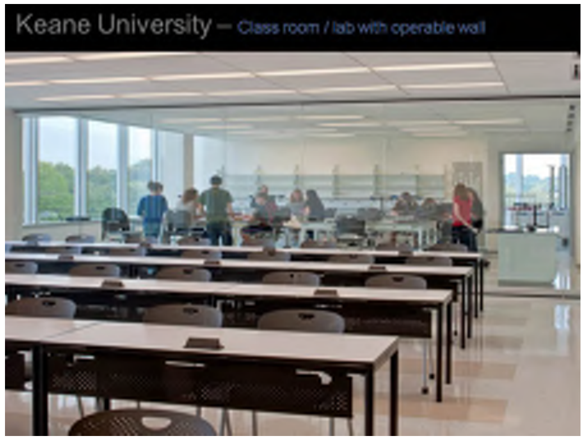



# Programmatic Intent *research precedents*



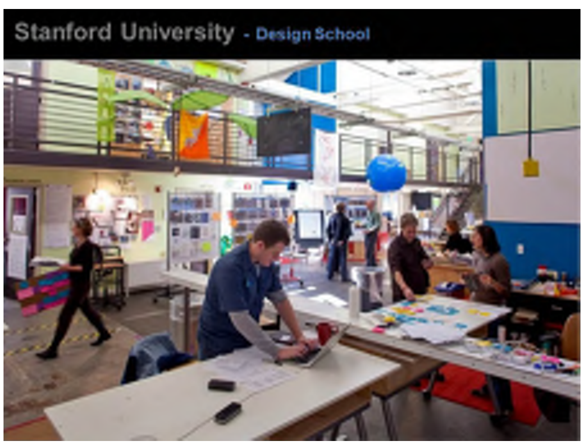




Arizona State University – eSpace


Keane University – Class room / lab with operable wall


University of Kansas – Energy and Environment Building

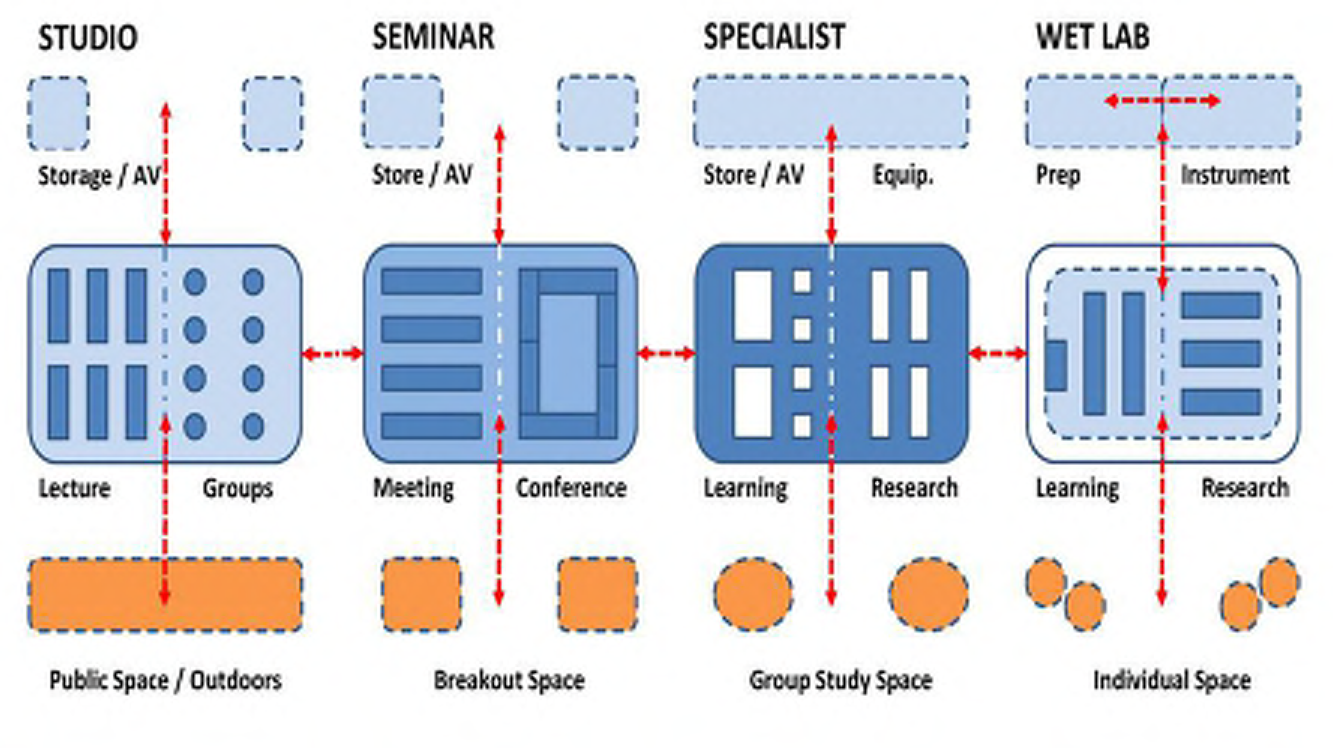

Iowa State University - Student Innovation Center


Stanford University - Design School

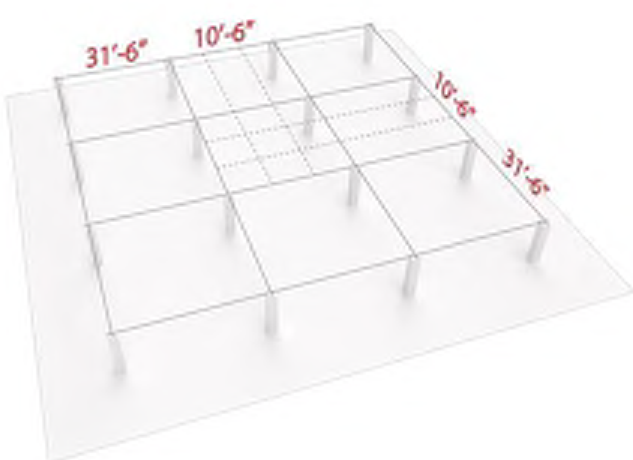

Iowa State University Student Innovation Center
Learning Commons

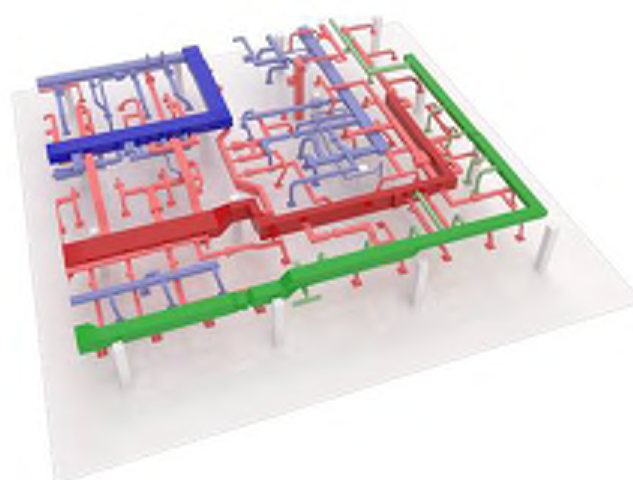
# Programmatic Intent

Flexible / Adaptable Spaces

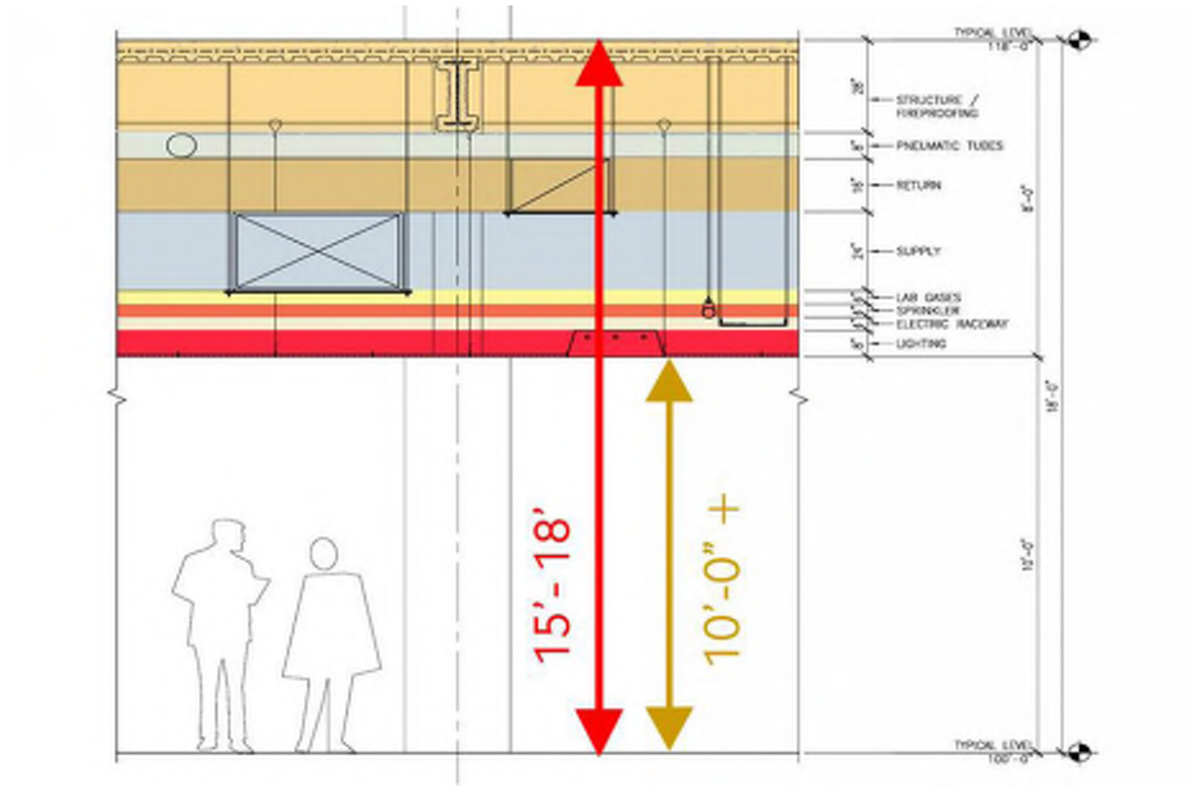



Utilizing the Universal Grid for Flexibility



Floor to Floor Height

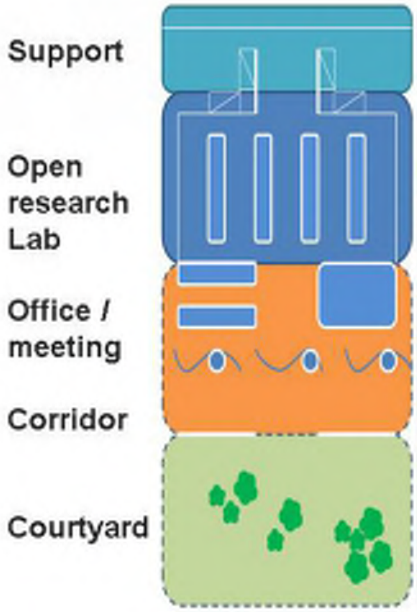



Universal Grid Purposes:

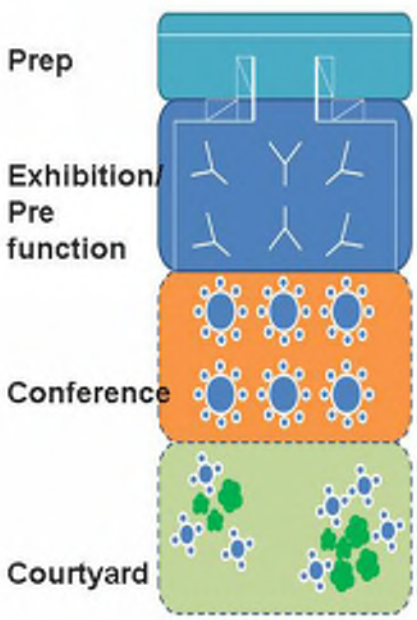
- planning and structural module of 31’-6”x31’-6”x18”
- cost effective
- advantage of speed to market
- flexibility of furniture arrangement
- future adaptability of building layout
- ease of MEP layout and upgrades

# Programmatic Intent

Research Labs




Social Space

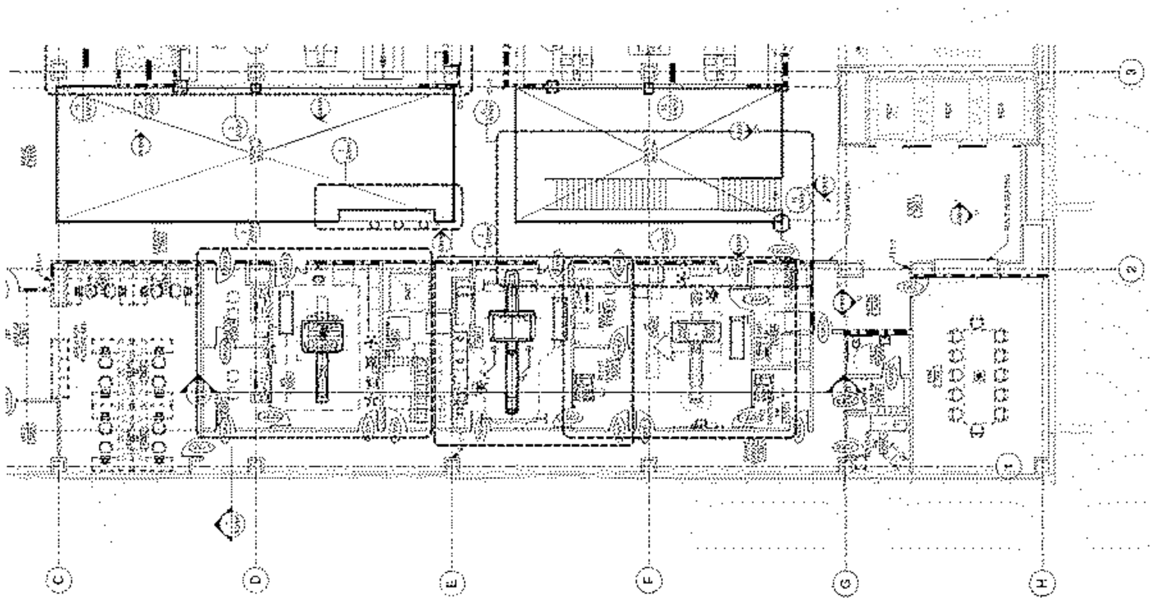



## Teaching Labs

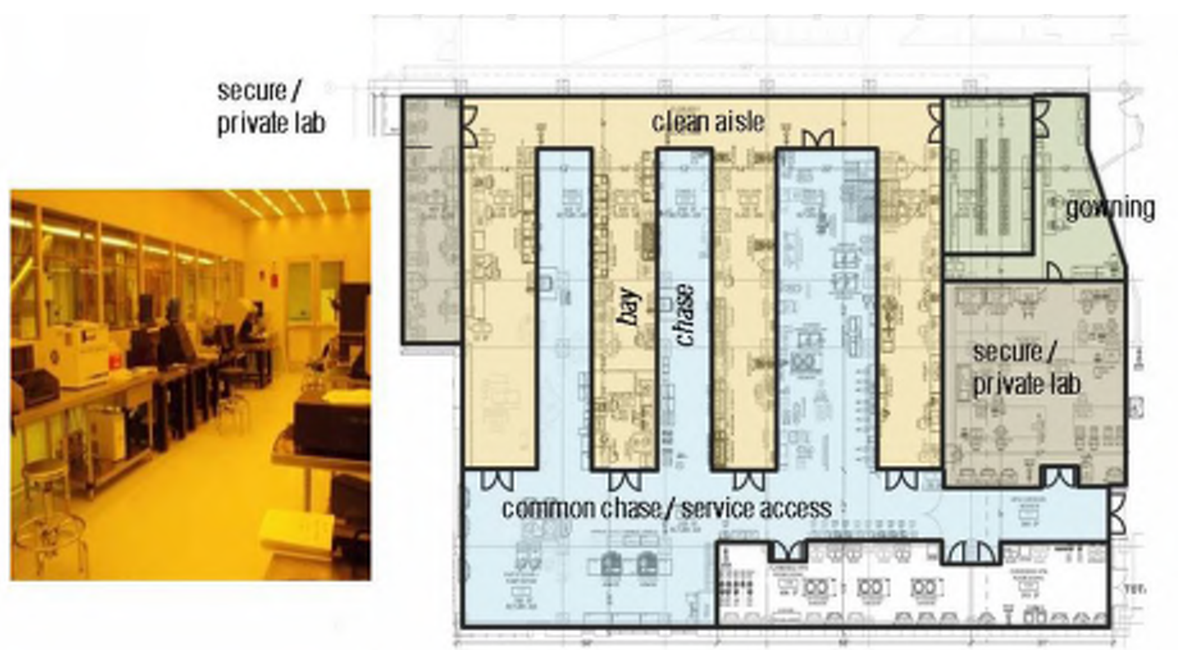

## Hybrid Project Labs

# Programmatic Intent

## Imaging



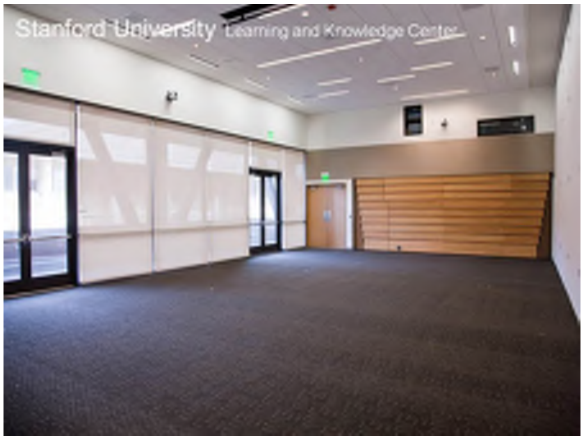
## Clean Rooms



Lassonde Studios (Entrepreneur Garage Space) at University of Utah

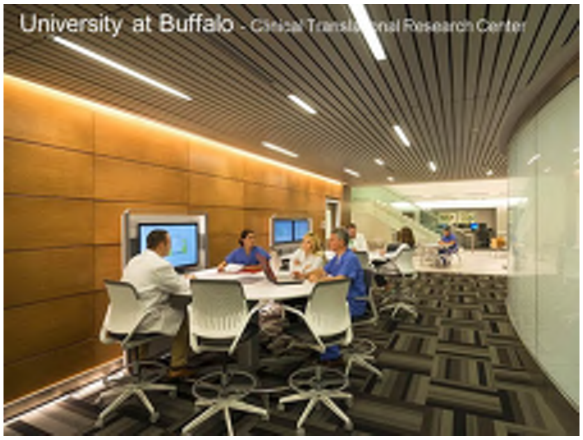
Wind Tunnel

# Programmatic Intent



Stanford University
Learning and Knowledge Center


Stanford University
Learning and Knowledge Center


Stanford University - Learning and Knowledge Center


University at Buffalo


Santa Clara University - Learning Resource Center

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Utilities

Most existing utility mains run north-south to the east of the project site in the campus loop road and shall be protected. Chilled water service also comes from the west side of the site. No capacity studies have been completed. The existing utility systems are assumed to be of adequate size and pressure to service the new site.

Water

- Domestic and Fire water come from a combined 6” private looped main in the campus loop road.
- New domestic and fire services for the new buildings shall come off this line.
- Meters and backflows shall be provided as required by the University.
- Fire hydrants, Backflow preventers, Fire-Dept Connection, and Post-indicator valves shall be provided as required by the Authority Having Jurisdiction (The City of San Diego and State Fire Marshall).
- Domestic water service for both the Engineering Building is served from a 6” water line running along the south side of the building to a POC at the southwest corner of the building. Water service to the Engineering Building will need to be maintained and relocated as necessary to provide service.
- There is no recycled water service available at the site

Sanitary Sewer

Sewer shall be served from the 6” private sewer main east of the project site in the campus loop road. The sewer main flows north out of the project site.

Chilled Water

There are two chilled water service lines in the project site on both the west and east side of the Engineering Labs. On the west side a 6” CW main connects to Life Sciences with two laterals one 6” and one 4”. On the east side a 12” CW connects to the Industrial Technology Building south east from the Engineering Labs. An 8-inch chilled water line serves the physics building on the north side of the building and shall be protected.

Steam

The main steam line runs north-south to the east of the project site in the campus loop road and shall be protected. However, the existing buildings are served from the west through the adjacent buildings.

Gas

A low pressure gas main runs north-south to the east of the project site in the campus loop road. The University shall confirm if this a private gas line or owned by SDG&E.

# Systems Design Intent

Electrical, Communications

The physics building is a main hub for communications. Connectivity to the northwest shall be protected. Confirm from record drawings if there are main runs and if any systems are franchise. The telecomm provided by COX runs along Aztec Circle Drive to the east of the project site.
Storm Water Management

The site drains from southwest to northeast. Storm flows are collected in underground piping and leaves the site in a 8-inch storm drain that heads east from the northeast corner of the site. The site appears to be the end of the system, with no offsite flows entering.
The project will need all new storm drain piping and inlets and connect to the existing 8-inch line at the northeast corner of the site.

The storm water treatment system shall be designed to the latest local and state regulations.

As required by the SUSMP design standards, Low Impact Development (LID) systems will be utilized to provide all stormwater treatment on the site. Systems to be used will be bioretention planters and/or modular wetlands.

Regarding total peak flow rate and run-off volumes, it is assumed that the project will not increase the total impervious area within the project limits as the site is pre-developed. Increasing the impervious area would result in increased flow rates leaving the site. This would require the use of onsite flood control and hydromodification devices to ensure that flow rates are not increased as a result of the project, which could potentially exceed the capacity of the existing storm drain and/or increase flooding potential.

LEED

SS-6.1 - As the existing site is greater than 50% impervious, LEED credit 6.1 requires a reduction in both volume and flow rate of 25%. Due to the poor soil infiltration characteristics typical of the San Diego region, any reduction in stormwater volume is largely infeasible. In addition, a reduction in stormwater flow rate would require construction of significant detention facilities which would present challenges given the available area for such a device on the site. As such, it is assumed that the point for LEED credit 6.1 will not be attained for the project.

SS-6.2 - The new treatment areas and devices fufill this requirement.

Site Grading

The site drops approximately 10-14 feet from south to north, and approximately 5-ft from west to east. The grade on the north side of the new building shall match that of the existing Engineering Building, while the grade on the south side shall match that of the existing Physics Building. A courtyard will sit in the middle of the new building at an elevation between the two and match grade of the buildings to the west. The campus loop road runs along the east side of the site and shall be reconfigured as part of the project, keeping in mind the several existing utility mains underneath.

Site Accessibility

ADA access shall be provided by all new and disturbed facilities and site work in accordance with the 2013 California Building Code Chapter 11B Accessibility Standards. ADA access shall be provided to the nearest parking lot and public Right-of-Way.

Fire Access

Fire access shall be provided for the new building as required by the State Fire Marshall and Authority Having Jurisdiction (The City of San Diego). Fire Access to existing buildings shall not be negatively impacted by the new building. It is assumed that this will be achieved by maintaining fire truck access between the Physics Building and new building and constructing a hammerhead turnaround at the west courtyard to enhance fire access and provide a turn-around due to the length of the access road. Also, access maintained on the north side of the new building between the Engineering Building. Access to the center of the new building and buildings to the west provided by an enhanced campus loop road near the center of the building and sufficient breezeway access provided for hose pull and ladder work to the center courtyard.

# Systems Design Intent

The structural design for the SDSU Engineering Building Addition project will provide a structural system integrated with the program requirements for space layout and the architectural and building service needs. User needs, in terms of possible future adaptability of the spaces and current flexibility of use, will be carefully considered.

The building will have approximately 90,000 square feet of framed area and contain three levels above grade. The floor to floor height will be 15 feet. The northeastern corner of the site is approximately 15 feet below the southwestern corner; therefore, the central portion of the building steps down one level. The Engineering Addition building resembles a “C” shape in plan and has connections to the existing Engineering building to the north and the Life Sciences building to the west. The Engineering Addition building will require seismic isolation joints at all connections to the existing buildings. Foundations adjacent to the existing building foundations will be designed eccentrically and will not surcharge the existing building.

Structural design will be in accordance with current code standards, California Code of Regulations, Title 24, for resisting vertical, seismic and wind loadings. Additionally the California State University seismic design criteria will be utilized.

Consideration will be given to locating areas with heavy loads and vibration sensitive areas at the slab-on-grade level to avoid the need for heavy structural framing.

Since the building is located in an active seismic zone, earthquake resistance will be an important objective of the structural design. The building will be designed with a lateral force resisting system that provides ductility for dissipation of energy generated during an earthquake. Structural systems will be detailed to limit the effects of earthquake damage to both structural and nonstructural components of the building. Seismic restraints are to be provided for all equipment.

## STRUCTURAL FRAMING AND FOUNDATION

The building is planned to have an area of approximately 85,000 gross square feet. The structural framing will relate to the architectural layout of the space. Both a concrete frame and a structural steel frame will be considered for the building, depending on the most cost efficient system that meets not only the structural requirements, but also the architectural and user requirements. The selection of the structural frame will take into consideration the floor to floor height requirements, the mechanical requirements for ductwork and plenums, the acoustic and vibration requirements, and the architectural aesthetics for the building. The structural system depth for the floor and roof levels will depend on the floor to floor heights, M/E/P requirements and the ceiling heights. Final selection of the system may be driven by current market conditions, architectural considerations, or cost evaluation.

Reinforced concrete systems and structural steel systems should be configured to satisfy the project program goals, architectural design and user requirements. The following should be considered when assessing the viability of each system:

The lateral force resisting system should balance the need for maximizing seismic safety, layout functional and architectural considerations, and economy. Lateral force resisting systems that should be considered include reinforced shear walls, ductile concrete frames, steel concentric and eccentric braced frames, and steel moment-resisting frames. Some advantages and disadvantages to these systems are summarized in the following table:

| Lateral Force Resisting System | Program Flexibility | Architectural Flexibility | Relative Cost | Structural Performance |
|---|---|---|---|---|
| 1. Reinforced Concrete Shear Walls | Low | Low | Low | Adequate |
| 2. Ductile Concrete Frames | High | High | High | Adequate |
| 3. Concentric Steel Braced Frames | Low to Medium | Medium | Low | Adequate |
| 4. Eccentric Steel Braced Frames | Medium | Medium to High | Medium | Adequate |
| 5. Steel Moment Resisting Frames | High | High | Medium | Adequate |

Architectural and program flexibility which is desirable for this building, can be achieved in all of the systems by configuring the lateral force resisting systems within the exterior perimeter and interior elevator/stair core walls of the building. Based on our understanding of the program and functional requirements for the building, any of the systems appear to be viable options.

If reinforced concrete shear wall or steel braced systems are pursued, care should be taken to locate these elements to suit the space requirements and maintain program flexibility. Layout of the structural grid will be coordinated with the planning module established for the various building functions. The layout of the lateral load resisting elements, such as shear walls or braced frames, will be carefully planned to maintain flexibility of the interior spaces and to provide an efficient structural system.

These options should be studied in detail in schematic design. The applicable alternate vertical and lateral force-resisting systems that are responsive to architectural and functional needs should be studied and estimated in the schematic design phase.

The geotechnical and foundation investigation for this specific site has not been performed as of this date. Based on experience with buildings in the area, the foundations are assumed to be reinforced concrete footings. A geotechnical and foundation investigation for this specific site must be performed to confirm these assumptions and prior to the structure being designed. The settlements and differential settlements of the footing foundations are to be analyzed as the structural design progresses.

# Systems Design Intent

STRUCTURAL/SERVICE COORDINATION

Layout of the structural grid will be coordinated with the planning module established for the various building functions. During schematic design, distribution of services will be carefully coordinated with the structural elements, particularly at framing intersections and major crossover points in order to avoid conflicts, limit penetrations of major structural members, and to optimize the use of available height within the building.

The layout of the lateral load resisting elements will be carefully planned to maintain flexibility of the interior spaces and to provide an efficient structural system. Currently, a typical column grid spacing of 31’-6” by 31’-6” feet is being considered.

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## Mechanical Systems

### HVAC Performance

#### Indoor Design Conditions & Zones:

Table 1: Interior Design Conditions

| Building Space | Cooling Temp | Heating Temp | Pressurization | $CO_2$ Sensor (DCV) |
|---|---|---|---|---|
| Teaching Lab | 75°F | 70°F | Varies [1] | Yes [2] |
| Research Lab | 75°F | 70°F | Varies [1] | No |
| Core/Circulation | 75°F | 70°F | Varies [1] | No |
| Lab Support | 75°F | 70°F | Varies [1] | No |
| Office | 75°F | 70°F | Neutral | No |

Notes:

1. It is assumed that approximately 30% of the lab spaces, both teaching and research, will require once-through air meaning that all air provided to these spaces will be directly exhaust from the building. All spaces with once-through air will be negatively pressurized relative to adjacent spaces. For the core/circulation spaces which are adjacent to once-through air lab spaces, the space will be positively pressurized relative to the adjacent lab space.
2. For those spaces identified as once-through air, CO2 sensors will not be provided as the driving factor in this space is to remove chemical contaminants from the space.

Table 2: Interior Gains:

| Building Space | Occupant Density (SF/Occ) | Sensible Occupant Heat Gains (BTUH) | Latent Occupant Heat Gains (BTUH) | Plug Load (W/sf) | LPD (W/sf) |
|---|---|---|---|---|---|
| Teaching Lab | 20 | 250 | 200 | 2.5 | 1.0 |
| Research Lab | 60 | 275 | 275 | 4.0 | 1.0 |
| Core / Circulation | 100 | 250 | 250 | 0.5 | 0.8 |
| Lab Support | 60 | 275 | 275 | 1.5 | 1.0 |
| Office | 100 | 250 | 200 | 1.5 | 1.0 |

Table 3: Exhaust Rates

| Building Space | Exhaust Rate (ACH) – Occupied Mode | Exhaust Rate (ACH) – Unoccupied Mode |
|---|---|---|
| Teaching Lab | 6 [1] | 4 [1] |
| Research Lab | 6 [1] | 4 [1] |
| Core/Circulation | N/A | N/A |
| Lab Support | 6 [1] | 4 [1] |
| Office | N/A | N/A |

Notes:

1. It is assumed that approximately 30% of the lab spaces, both teaching and research, and 30% of the lab support spaces will require once-through air meaning that all air provided to these spaces will be directly exhaust from the building. For these spaces, an exhaust rate as identified in this table will apply. For the remainder of the labs, air will be recirculated and the space will be provided with OSA and relief based on the ventilation requirements of Title 24-2013.

## Primary HVAC Systems

The total building square footage is approximately 88,000 GSF. At the present time, a detailed breakdown of space types and usage is not known. For this reason, the following assumptions have been made regarding the building which will identify how the HVAC equipment has been sized.

| Building Space | Percentage of Overall Building Area | Assigned Building Area (GSF) |
|---|---|---|
| Once-through Air Laboratories | 18% | 15,840 |
| Recirculating Air Laboratories | 42% | 36,960 |
| Once-through Air Lab Support | 6% | 5,280 |
| Recirculating Air Lab Support | 14% | 12,320 |
| Core/Circulating | 10% | 8,800 |
| Office | 10% | 8,800 |

The building HVAC system will be a thermally decoupled system, which will consist of a rooftop air handling units to address ventilation and latent loads in the labs as well as all loads in the office and core areas. Chilled beams will be provided in the lab spaces, as required, to address the high sensible loads. It is assumed that the lab spaces requiring once-through air are not fume hood intensive.

# Systems Design Intent

**Air Handling Unit System**

Three custom air handling units (AHUs) will be utilized to serve the building. These units will be located on the roof and will be sized for approximately 20,000 CFM each. Each unit will include a supply and return fan operating on variable frequency drives. The units will be provided with 100% outside air economizers with demand control capabilities. The units will include a chilled water coil and if required due to the mixed air temperature, a heating hot water coils. Coils have aluminum fins and copper tubes; stainless steel casing and stainless steel condensate drain pans. Chilled water calls with have a minimum of 8 rows, 10 fins per inch maximum, and a wall thickness of 0.02". Heating hot water calls will have a minimum of 2 rows, 10 fins per inch maximum, and having a wall thickness of 0.02". All AHUs will be provided with an Ebtron outdoor airflow measuring station to monitoring outdoor airflow CFM.

**Chilled Beam**

As required to provide supplemental cooling in any high-sensible labs and lab support spaces, chilled beams will be provided to address these needs. The chilled water temperature will be elevated from that distributed to the campus to eliminate the risk of condensation from the chilled beam. This will be done via dew point monitoring in the lab and lab support spaces.

**Telecom Rooms**

The telecom building distribution frame (BDF) and inter-building distribution frame (IDF) should be air conditioned by cooling only chilled water fan coil units.

**General Exhaust Systems**

General building exhaust will be provided for the restrooms and janitorial closets. General exhaust ductwork shall be galvanized sheetmetal.

### Lab Exhaust System

It is estimated based on 1 CFM per square foot of research space (27,000 square feet) that a Strobic (or approved similar) laboratory exhaust system will be installed on the roof.  Exhaust ductwork will extend across the surface of the roof and penetrate down connecting to fume hoods in research labs. The fans speed will be controlled by duct static pressure sensor.  A single redundant fan will be need in the array of fans. The exhaust system will include a bypass air damper and will be controlled to provide a minimum discharge velocity. All laboratory exhaust ductwork containing chemicals shall be type 304L stainless steel. Lab spaces will include valves for control of supply and exhaust airflow.

## Hydronic Systems

Chilled water and steam service from the central plant will serve this building.  Local energy metering will include Onicon System-10-LON Btu meter for heating hot water and chilled water.

The existing 12" chilled water (CHW) supply and return piping that is currently routed along the north side of the existing Industrial Technology building will be removed during demolition back to the existing valve vault.  Further, the existing 6" CHW supply and return pipes serving the existing Engineering Lab on its west side will be removed back to the valve vault during that building's demolition.

New 6" CHW supply and return pipes should be routed buried from the existing 12" valve vault to the new Building.

The existing 5" 125 psi steam pipe and 2-1/2" condensate pipe that are routed below the existing Industrial Technology Building from a manhole west of the building should be removed back to the man hole and temporarily capped during demolition of the existing building.  This same piping should be routed to the building and connected to a steam to hot water shell and tube heat exchanger. A 5-HP base mounted-end suction centrifugal Heating Hot Water (HHW) pump should be installed in the building to circulate HHW throughout the facility. The HHW plant should include an expansion tank, make up water and a water treatment system.

**Piping Materials**

Underground chilled water piping will be pre-insulated Polyvinyl chloride (PVC) pipe with high-density polyethylene (HDPE) jacket, push-on joints, with Mega-lug connections.

Steam piping will be pre-insulated steel with HDPE jacket.   Pipe material for condensate return is Type K copper.

Chilled water and heating hot water piping within the building:  3" and larger, Schedule 40 black welded steel pipe ASTM A53.

Chilled water and heating hot water piping within the building:  2-1/2" and smaller Type "L", hard drawn copper tube.

### Vibration Isolators

All rotating and reciprocating equipment should be provided with vibration isolation systems including seismic restraint to prevent transmission of vibration to structure.  Air handlers should only have the fans isolated.

### Controls

The building automation/energy management system (BMS) will be compatible with the existing energy management system, namely Tridium (Vykon) Niagara JACE AX 600 from Distech Integration.

## Plumbing Systems

Our design of the proposed project at San Diego State University's, Engineering-Interdisciplinary Sciences Building will incorporate the objective of providing a system that complies with the occupant needs and provides a more efficient and safer environment.

## Applicable Codes

The Plumbing Systems will be designed in accordance with listed applicable Codes, Standards and Authorities Having Jurisdiction, the Owner's insurance underwriters and in accordance with current good engineering practices.

- California Building Standards Administrative Code (Title 24, Part 1), 2013
- California Building Code (Title 24, Part 2), 2013
- California Mechanical Code (Title 24, Part 4), 2013
- California Plumbing Code (Title 24, Part 5), 2013
- California Energy Code (Title 24, Part 6), 2013
- California Fire Code (Title 24, Part 9), 2013
- California Referenced Standards Code (Title 24, Part 12), 2013

## National Fire Protection Association

- NFPA 13: Installation of Sprinkler Systems, 2013 Edition
- NFPA 24: Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 2013 Edition

## Domestic Water System

Domestic Cold water will be supplied from the existing on-site system with modification. The service line and new backflow prevention for the building will provide for all fire sprinkler service and domestic cold water demands. Separate backflow prevention devices will service the domestic and fire water services independently. Domestic water will be distributed to plumbing fixtures, hose bibs and water heaters via city street main water pressure.

Domestic Hot water will be generated using high efficient gas fired, tank type water heaters that will provide for all domestic hot water needs to the entire building and located inside a common shared room with HVAC equipment. A hot water recirculation system will also be provided and re-circulated by a closed loop domestic in-line pump with no more than 3/4 horsepower capacity. A seven (7) day twenty four (24) hour programmable time clock, aquastat and temperature sensors will maintain the hot water temperature within 105°F to 120°F range. All hot water distribution piping will be insulated with appropriate thickness of insulation and fire retardant jacket.

### Sanitary Drainage and Vent Systems

A complete sanitary sewer, waste and vent system will be provided. The system will serve the restrooms, general classrooms, mechanical equipment and floor drains. The system shall be run by gravity whenever possible. Building drains or floor sinks that cannot be discharged by gravity flow (if any), will be collected into a duplex sewage ejector system from which the effluent shall be lifted and discharged into gravity drainage system. Vent terminations through roof will be coordinated so as to avoid any light monitors, clearstory, and interference with PV panels (if any) and/or HVAC equipment outside air intakes.

Sump pumps shall be provided as required for low grade areas and be submersible, duplex with guide rail for easy removal. This system is pending final layout of the building in relation to utility line depths.

### Indirect Waste and Condensate Drainage Systems:

HVAC condensate drainage piping will be provided to each HVAC unit. Such piping will drain to an indirect waste connection to the sanitary soil/waste system via approved receptor, tailpiece connection at the nearest lavatory or sink, or a fixed air gap mounted within a stainless steel panel in wall. Roof air handler condensate shall drain to roof mounted floor sinks adjacent to air handlers. Floor sinks shall have elevated rims above roof level to prevent drainage of rainwater.

## Acid Waste System

Laboratory waste at Lab classrooms where corrosive chemicals will be used shall be piped with Polypropylene Plastic (PPC) piping and shall be sloped at min of 2%. Point-of-use neutralization tanks located under lab sinks shall be used to treat corrosive or harmful waste before discharging into the municipal sewer system. The interceptor shall be constructed of corrosion-resistant plastic material with removable gastight, bolted cover containing neutralizing limestone chips. An alternate to point-of-use is a central neutralization tank located outside the building collecting discharge from all the Lab sinks and with a pH monitoring control panel located inside the building. This system is pending final programming.

The following lab fixtures will be connected with acid waste piping:

- Fume hoods with cup sinks in Chemistry Labs
- Lab sinks for both Student and Instructor use in Chemistry Labs
- Floor drains serving emergency eye wash / showers in Chemistry labs
- Lab sinks with Purified water dispensers
- Lab sinks, floor drains or any other fixture collecting waste discharge from cleanup and dish washing in Prep Rooms adjacent to Chemistry Labs

## Storm Drain System

A complete gravity storm drainage system connecting to each roof drains and overflow drain shall be provided. Roof drains will be collected and connected to separate risers and will be discharged to 5'-0" of the building before connecting to the underground on-site storm drainage system. The Civil Engineer will collect the roof drainage system from the building to central collection points including any perimeter exterior drains.  Overflow drains shall daylight and terminate thru face of outside wall at 12" to 18" above finished grade.

## Natural Gas System

A new gas connection will be provided for the building comprising of a) sub-gas meter assembly (at clients request) b) gas pressure regulator c) automatic gas seismic shut-off valve. The sub-gas meter will give the Campus Facilities the capability to monitor the buildings gas consumption. Gas supply into the building, downstream of the regulator assembly will be distributed at low pressure to all natural gas appliances and any other equipment with gas requirements inside the Lab Classrooms.

## Piping Materials

### Domestic Water - Interior

Copper tubing: Conforming to ASTM B88, Type L, hard copper tubing, cast bronze or wrought copper fittings and brazed or soldered joints.

### Natural Gas – Above Ground

Black Steel, Schedule 40 pipe and fittings; Low pressure 2" & smaller shall be threaded malleable iron. 2-1/2" and larger shall be welded. Medium pressure gas shall be welded. Unions: Malleable iron type - 250 psi brass to iron seat, ground joint. Flange and gaskets.

### Sanitary / Vent / Storm – Above Ground

Cast Iron Pipe, CISPI 301, hubless, service weight. Fittings: Cast Iron, CISPI 301 or ASTM A74. Joints: CISPI 310, no hub couplings. Minimum 1/4" per foot slope or as indicated on drawings.

### Acid Waste / Vent

Above ground: PP drainage piping with socket-fused joints 1-1/2" to 4" and PP pressure piping, schedule 80 with fusion fittings and heat fusion joints 2" to 8".

Below ground: PP/PP double-contained piping assembly with socket-fused joints 1-1/2" to 4" and PP/PP double-contained piping assembly with heat fusion joints 2" to 8".

## Fire Protection System

This section applies to the design of the building automatic fire sprinkler and standpipe systems.

### Fire Sprinkler System

The sprinkler system shall be hydraulically designed to meet the following densities:

2. Light Hazard — 0.1 GPM per ft2 over the most remote 1500 ft2
3. Ordinary Hazard — 0.2 GPM per ft2 over the most remote 1500 ft2
4. Protection Area per head
    a. Light Hazard — 200 ft2 – smooth ceiling; 168 ft2 – other type of construction
    b. Ordinary Hazard — 130 ft2
5. Application
    a. Light Hazard — Offices, classrooms,
    b. Ordinary Hazard — Mechanical rooms, storage rooms,

All isolating and sectionalizing valves on the fire protection system shall be provided with tamper switches that shall be annunciated at the life safety control panel.

The system shall have a central control panel with digital read-out as part of the Fire alarm system. The system should be installed so that it may be connected to an automation system. A remote graphic or digital annunciation panel should be located at the firefighter's entrance. The location of the panel shall be reviewed and coordinated with the University security personnel, and City Fire Department.

The system components shall include the following:

1. A double detector check backflow preventer with a listed indicating OS&Y gate valves check valve and fire department pumper connection shall be provided outside the building.
2. Valve and water-flow switch monitoring.

3. Audible sprinkler flow alarms on the exterior and interior of the building. The fire protection system shall be monitored by the central fire alarm system in the building.
4. Hand-held fire extinguishers shall also be provided to comply with NFPA 10.

## Water Supply

A fire main shall be connected to the existing underground potable water system. Refer to Civil Section for details.

### Design reference

Piping shall be concealed above ceilings and within walls except for non-public equipment rooms without ceilings.

Sprinkler heads shall be spaced for symmetry with ceiling features. This shall require additional heads that shall be provided in base bid. Basis of head location shall be:

- Equal distance between lights.
- Equal distance between lights and wall.
- Equal distance between lights and air inlets and outlets.
- Equal distance between wall, lights, and air inlets and outlets.
- Locate in center of ceiling tiles.
- Lab module head layout shall be repeated.
- Provide coverage for rooms, void spaces, overhangs and as required by code.

### Materials

Sprinkler heads in ceilings shall be completely recessed pendant type with white or chrome finish cover plate flush with ceiling. Sprinkler heads will generally be concealed heads, but exposed in non-finished spaces such as mechanical rooms. Provide high temperature sprinkler heads in electric rooms. Provide OS&Y gate or butterfly valves with tamper switches to isolate heads at these rooms.

Piping shall be ASTM A 795 steel piping schedule 40 black steel-pipe. Connections or fittings shall be threaded, flanged, grooved or welded.

## Electrical System

### Proposed Electrical Service

- Medium voltage 1500kVA, 12kV-480/277V substation.
- Four Electrical Rooms, one on the north and one on the south of each floor.

### Proposed Normal Electrical Distribution System

- 480/227V, 2000-ampere switchboard, 2000-ampere main circuit breaker, ground fault protection, 65,000 amperes interrupting capacity and 25% spare capacity.
- 200A, 480V, 3phase, 4 wire panel boards in each electrical room to serve mechanical equipment.
- 100A, 480/277V 3P, 4W panel boards to serve lighting on each floor.
- 480-120/208V dry type transformer in each electrical room.
- 120/208V, 3 phase, 4wire distribution board in each electrical room.
- 225A, 120/208V, 3phase, 4wire panel boards for general purpose receptacles and power loads.
- 120/208V panel boards for each lab space in the corridor.
- Digital metering system for the kW and kWh usage to allow metering of various load types (lighting, mechanical, power, etc) as required by Title 24.

### Power Wiring

- Power wiring to all motors, fans, and pumps.
- Maximum (4) duplex receptacles will be connected to one 20A/1P circuit.
- Dedicated 20A, 1P, 120V, outlets to serve multi-media equipment.
- Floor outlets in conference rooms.

### Grounding

- New grounding system per NEC.
- A separate equipment ground conductor will be provided for all circuits.

### Lighting Performance

- The illumination levels will conform to the latest edition of Illuminating Engineering Society (IES) guidelines, and will be as follows:

| Area | Average Foot Candles |
|---|---|
| Offices | 30-50 fc |
| Conference Rooms | 50 fc |
| Lobby | 30 fc |
| Classrooms | 30-50 fc |
| Restrooms | 15-25 fc |
| Electrical / Mechanical Rooms | 20-30 fc |
| Telecom Rooms | 50 fc |
| Corridors | 15 fc |
| Exterior | 1-5 fc |

- Offices lighting: LED recessed or suspended indirect/direct.
- Main lobby lighting: decorative LED, dimmable pendant fixtures.
- Corridor and restroom lighting: LED Linear recessed light fixtures and LED down lights.
- Mechanical and Electrical room lighting: LED industrial strip fixtures.
- Classroom lighting: LED recessed 2x4 fixtures.
- Stairwell lighting: LED dimmable fixtures.
- Exterior Lighting: LED or Metal Halide.

### Lighting Control System

- Lighting controls will be designed to meet the 2013 Title 24 requirements with a distributed digital lighting control system.
- Classroom controls: 2 control zones: presenting, general; dimming; occupancy sensors.
- Office controls: dimming; occupancy sensors; receptacle control.
- Restroom and back of house controls: occupancy sensors.
- Corridors controls: dimming; occupancy sensors.
- Exterior controls: photo cell and time clock. For fixtures mounted lower than 24 feet and more than 75 watts, dimming and occupancy sensors are required.

### Emergency System

- Centralized inverter system to serve egress and exit lighting throughout the facility.

### Fire Alarm System

- Manual/automatic, addressable fire alarm system conforming to current

## Telecommunications System

The telecommunications infrastructure for the building will provide infrastructure to support voice, data, wireless, security and video services. It will be designed according to the University design standards that were based on the California State University Telecommunications Infrastructure Planning Standards (TIP), EIA/TIA 568B and 569 standards and BICSI publications (TDMM and OSPDRM).

### Design reference

The telecommunications design reference for the major telecommunications infrastructure components are listed below:

#### Intra-Building Spaces

The building will require dedicated telecommunications rooms (2) per floor, for the ground, second, and third floors, to house the cable terminations and equipment to support voice, data, wireless, security, and video services. Room requirements include:

- The main telecommunications room shall be a minimum size of 150' sq.ft. located on the ground floor and additional satellite rooms (IDF) on all floors shall be a minimum size of 100' sq.ft.
- Electrical – main telecommunications room shall be provide with 225 amp dedicated panel within the room. The IDF's rooms shall each be provided with dedicated 100 amp panel. Each room requires 120v, 20 amp dedicated circuits and 208 volt, 30 amp circuits at equipment racks for telecom equipment. Provide 30-minute battery backup system (uninterruptible) power with capacity to support 3 times the planned capacity for all telecom rooms. Dedicated groud bus bars required in all telecom rooms.
- Cooling - all telecom rooms require a 24/7 controlled environment that is separate from the building HVAC system.
- IT Racks - Equipment in the telecom rooms will be rack mounted on a minimum of three 7'x19" equipment racks

**Intra-Building Pathway**

- Distribution of outlet cabling and backbone cabling linking telecom rooms shall be run in cable trays of approximately 12" in width 4"high in size. Other types of support systems such as wire hangers, conduit, and wire mold will be utilized in areas with a small service demand or special pathway requirements due to the building design.
- Each telecommunications outlet will support the wiring for voice, data, wireless and video. The standard outlets shall consist of a 4-11/16" x 2-1/8" square receptacle flush mount in the wall with 1 ¼" conduit stubbed to the space above the ceiling or to the cable tray.
- Wall and floor penetrations will need to be sealed with fire-stop systems for conduit and sleeve penetrations.

**Intra-Building Media**

- Backbone fiber and copper riser cable systems will be installed from the main telecommunications room (BDF) to all of the satellite telecommunications rooms (IDF's). Cabling shall include riser cable between rooms shall be coordinated with the University prior to design but a minimum will be a 100 pair copper riser cable and twelve single-mode optics/ twelve multimode fiber optics cable from the BDF. Fiber optic cables will be terminated on LC Type connectors. The number of telecommunications outlets in each space will be determined on the square footage, the number of occupants and type of use. There will also be special applications that will utilize the campus copper cable and fiber cable networks to monitor systems at the remote campus locations.
- Horizontal cabling will include the installation of Category 6, 4 pair, plenum rated copper station cables. Horizontal cabling will be installed from each outlet jack to the BDF or IDF rooms.

**Wireless Communications**

- Data outlets will be included in selected locations for owner provided wireless access points. A minimum of one outlet will be provided with two data jacks above the dropped ceiling that is easily accessible through the removal of ceiling tiles or within easy access from an access hatch.

**Security System:**

Physical security system installations will include the following:

- Access Control system consisting of door contacts, card readers release to exit, and automatic door openers.
- IP based video surveillance system with interior and exterior camera locations.
- Emergency phone stations.

**Inter-Building Pathways**

- The new building will be connected by (4) four inch diameter underground conduits from the new BDF into an existing communications manhole nearest to the property line.

**Inter-Building Media**

Campus backbone cabling connecting the building to existing campus services will include the following:

- 600 Pair outside plant copper cable terminated onto 110 wall mounted terminal blocks.
- 24 single-mode/24 multimode hybrid fiber cable run from the campus MDF located in the Administration Building to the new building BDF. Cable will terminate in rack mounted fiber enclosure panels.
- A .540 CommScope Quantum coaxial cable to be tapped from existing coaxial cable feeder in existing communications manhole for Cox Cable and CATV services to new BDF.