

RESEARCH

Existing Building Systems

Building Envelope

-Envelope consists primarily of solid brick masonry and glazing

-Insulation is minimal, as there is only one inch of rigid insulation on the roof and no insulation in the walls

-Upstairs windows were replaced in the 90s and are double-glazed; all other windows in the shelter are single-pane

| | Area (ft ²) | Current type | R-value (ft ² ·°F·hr / Btu) |
|---------------------|-------------------------|------------------------------------|--|
| Roof | 5,670 | 1" rigid r 5 per inch | 5.60 |
| Window 1 | 1,674 | Double-pane | 1.82 |
| Window 2 | 842 | Single-pane | 0.91 |
| Door 1 | 60 | Main entrance (single-pane glass) | 2.00 |
| Door 2 | 23 | Metal Insulating (2in w/ urethane) | 15.00 |
| Exterior walls, net | 5,866 | 12" brick | 4.85 |
| Total | 14,134 | | 3.45 |

Plumbing

-Water closets operate at 3.5 gallons per flush--over double current plumbing standards

-Urinals meet code at 1.0 gallons per flush, but more efficient systems are available on the market and are reasonably easy to implement

-Showers have unreliable water pressure and no personal temperature controls



Electrical System

-Electrical system was sized to meet the needs of college students in the 1960s and lacks the ability to handle modern load requirements

-Past retrofits have increased the number of available outlets, but tripping circuits has become more frequent

-Members of the fraternity may be ignorant of their personal contributions to energy consumption

| Item | Duration (hrs) | KWH | Avg Power (Watts) | Annual Cost (\$) |
|-----------------------|----------------|-------|-------------------|------------------|
| Personal Space Heater | 125 | 47.77 | 382.16 | 363.84 |
| K Fridge | 888 | 253 | 284.91 | 271.25 |
| Ice Machine | 41.15 | 11.65 | 283.11 | 269.54 |
| DR Fridge | 2 | 0.32 | 160.00 | 152.33 |
| PC | 165 | 20.98 | 127.15 | 121.06 |
| LR TV | 164 | 16.29 | 99.33 | 94.57 |
| Beverage Dispenser | 287 | 25.64 | 89.34 | 85.05 |
| Printer | 43.53333333 | 2.54 | 58.35 | 55.55 |
| K Freezer | 112 | 6.43 | 57.41 | 54.66 |
| Microwave | 174 | 6.69 | 38.45 | 36.60 |
| Dryer | 166 | 4.29 | 25.84 | 24.60 |
| LCD TV | 130 | 3.18 | 24.46 | 23.29 |
| Cow | 112 | 2.64 | 23.57 | 22.44 |
| Washer | 72.58333333 | 1.54 | 21.22 | 20.20 |
| LCD Monitor | 213 | 2.63 | 12.35 | 11.76 |
| Toaster | 174 | 1.45 | 8.33 | 7.93 |
| External HD | 7.466666667 | 0.02 | 2.68 | 2.55 |

Mechanical Systems

-Radiant fin tubing lines the perimeter of the first and second floors; many of the fins are no longer effective, and the system has no working control system aside from being turned on or off

-There is no insulation on the boiler or the pipes supplying the radiant heating system

-Boiler currently operates at only 80% efficiency

-The exhaust fan in the center of the building is no longer fully effective and often has problems functioning

-There is no active cooling system, and the building's layout is not conducive to effective cross ventilation or other passive strategies

Proposed Solutions

Building Envelope

-Permanently seal all dysfunctional operable windows on the first floor until replacement

-Replace all windows with more thermally resistant choices when enough funds are available

-Replace the existing roof in order to improve thermal resistance and to repair ponding and minor leaks that the shelter currently experiences

Plumbing

-Installation of dual-flush toilets would reduce water consumption by more than 50%

-Replace urinals with water-less varieties, which use zero water and require easy, routine maintenance

-Replace shower supply with adjustable temperature in order to comply with current expectations among students in dorm-living situations

Electrical System

-A presentation outlining power use may help raise awareness and educate members as to their impact



Mechanical Systems

-Radiant floor retrofit has the potential to decrease wasted energy currently due to objects blocking the radiant fin tubes

-Solar thermal panels could occupy the unused space on the roof in order to supplement the boiler; payback is estimated at 25 years

-An energy monitoring system could record specific energy use data of all systems in order to help track how energy use is being distributed day-by-day

| Description | Initial cost (\$) | Savings (therms/yr) | Unit price (\$/therm) (\$/kWh) | Savings (\$/yr) | Simple payback (yr) | Lifetime (yr) | SIR |
|--|-------------------|---------------------|--------------------------------|-----------------|---------------------|---------------|------|
| | | | 1.1 | | | | |
| Insulate heating water and DHW pipes | 800 | 1875.0 | 1.1 | 2062.5 | 0.4 | 25 | 64.5 |
| Air-seal, insulate roof to R-38 | 8,030 | 2259.0 | 1.1 | 2484.9 | 3.2 | 30 | 9.3 |
| Air-seal, insulate all exterior walls R-12 | 125,000 | 4041.0 | 1.1 | 4445.1 | 28.1 | 50 | 1.8 |
| replacing 1st floor windows | 60,000 | 1718.4 | 1.1 | 1890.2 | 31.7 | 30 | 0.9 |

| | 25% | 50% |
|----------------------|--------------|--------------|
| Estimated Cost | \$229,556.76 | \$459,113.52 |
| Post Incentive Cost | \$129,268.80 | \$534.77 |
| Avg. Monthly Savings | \$267.39 | \$534.77 |
| 25 Year Savings | \$133,626.81 | \$267,253.62 |
| 25 Year ROI | 103.37% | 100.65% |
| Break Even | 24.47 years | 24.90 years |

Implemented Solutions

Part of the IPRO team's budget was spent to implement easily accomplished solutions to some of the shelter's most pressing issues. Brothers spent the day insulating the boiler tank and pipes which supply the shelter's radiant heating system--and which, previously, were entirely uninsulated. Secondly, new weather stripping was applied to the first floor's operable windows to help reduce air infiltration. Lastly, the industrial refrigerators in the kitchen were cleaned in order to optimize performance and reduce energy use.

In addition to these improvements, a presentation was prepared and conducted by a member of the team to inform the fraternity members of ways to reduce their personal energy consumption. The presentation emphasized the direct monetary benefits of taking such actions and encouraged members to be conscious of their impact on the earth.



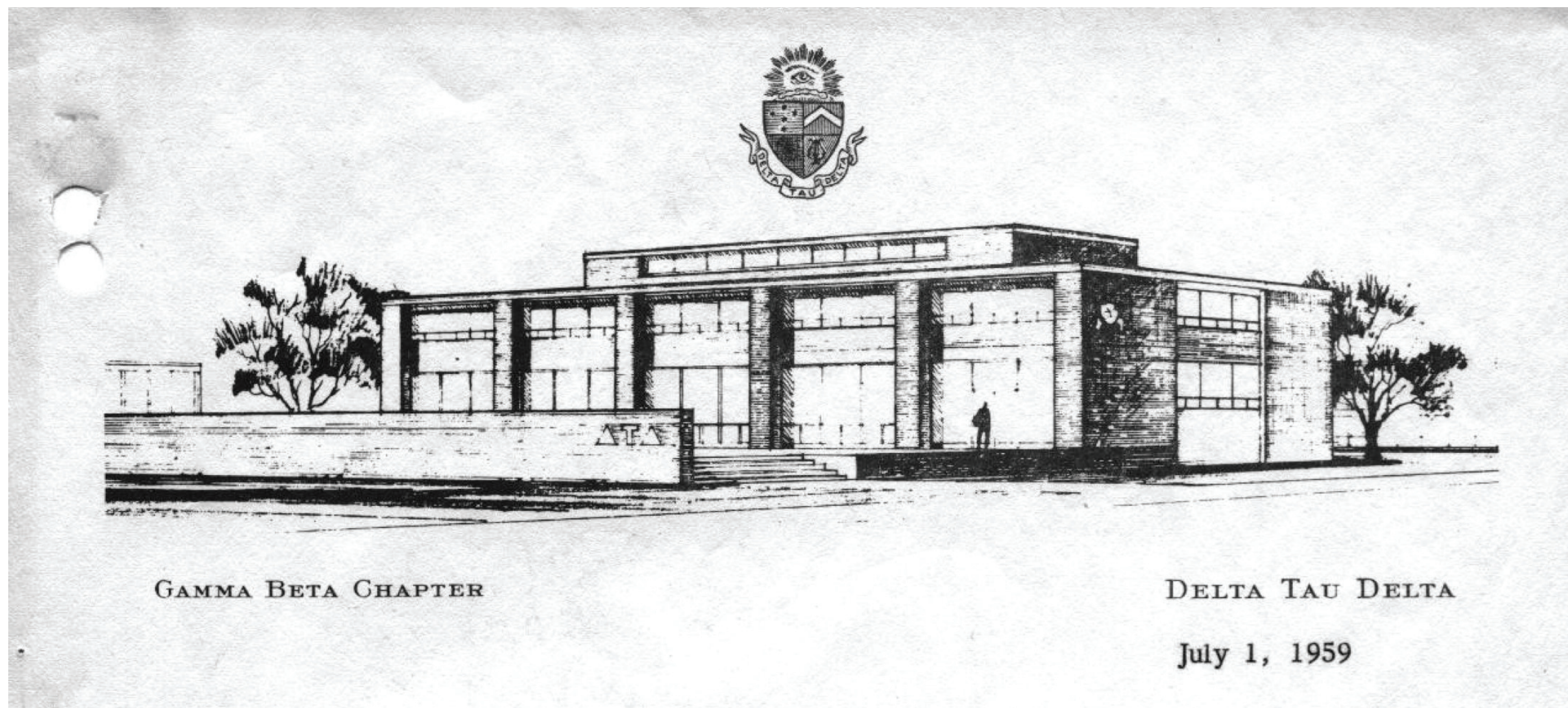
Instructor:
Nancy Hamill-Governale

Team Members:
Joshua Bradley, Noah Cahan, Daniel Dobbin, Jacob Dohm,
Jeffrey Hallenbeck, Kent Hoffman, Davyd Jordan,
Woong-Kyo Lee, Brad Strandquist, Nathan Waisath

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THE SHELTER

Chapter History at a Glance



Initial proposal rendering, 1959

-Gamma Beta chapter of Delta Tau Delta was founded in 1901

-After approximately 60 years of living among the surrounding city, fraternities began to move onto IIT's main campus

-The first bid for the shelter was in 1959

-Construction was completed in 1961

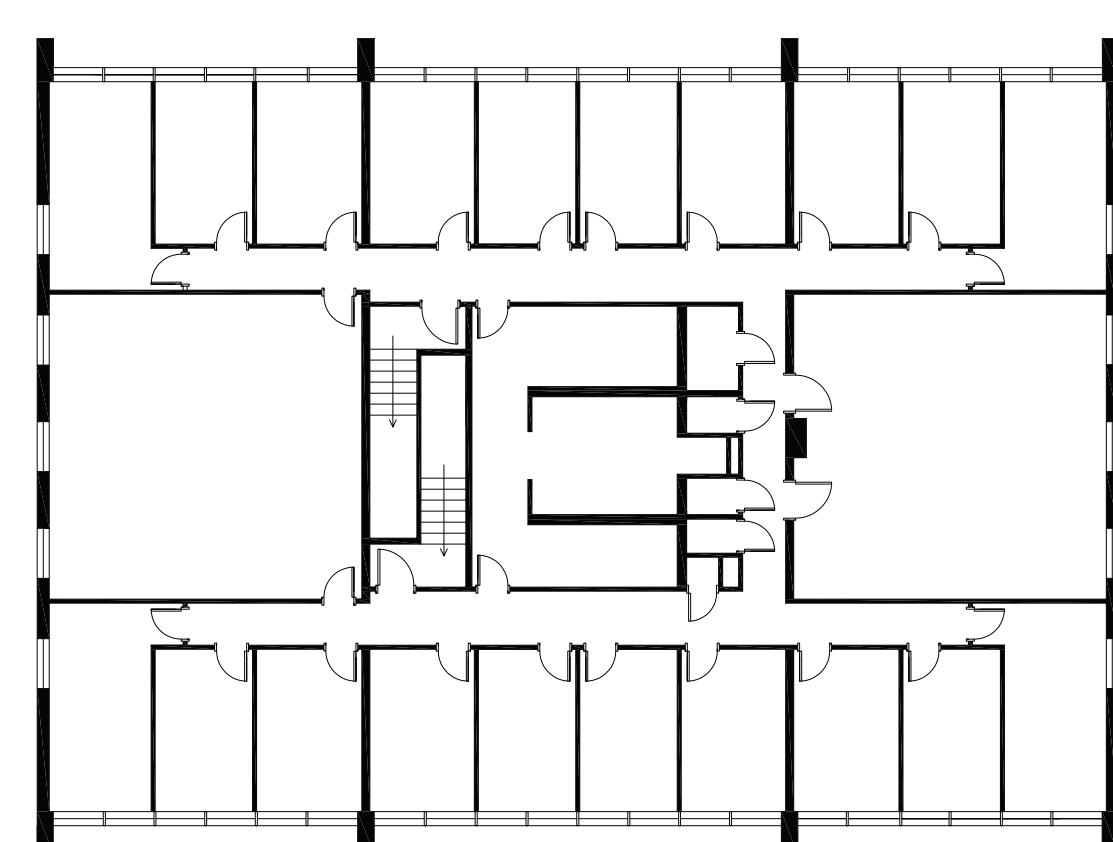
-Purely Modernist in nature, the building has four structural load-bearing brick walls which are clearly expressed on the exterior; the brick color matches fellow fraternity and sorority houses and the academic buildings on Mies's Main Campus

-As the shelter approaches 50 years of age, problems are surfacing; energy performance and the expectations of today's college students, particularly, must be addressed

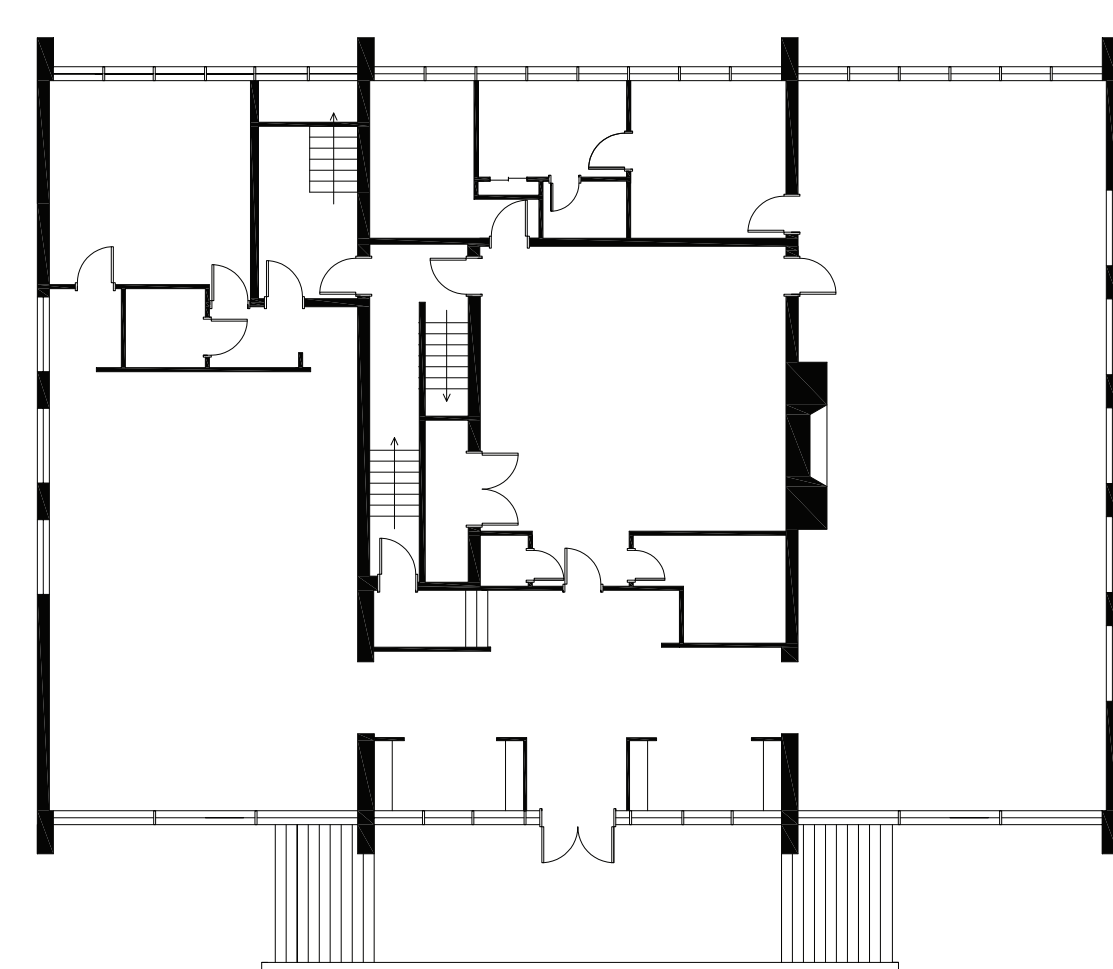


Delta Tau Delta, Gamma Beta shelter as it currently exists

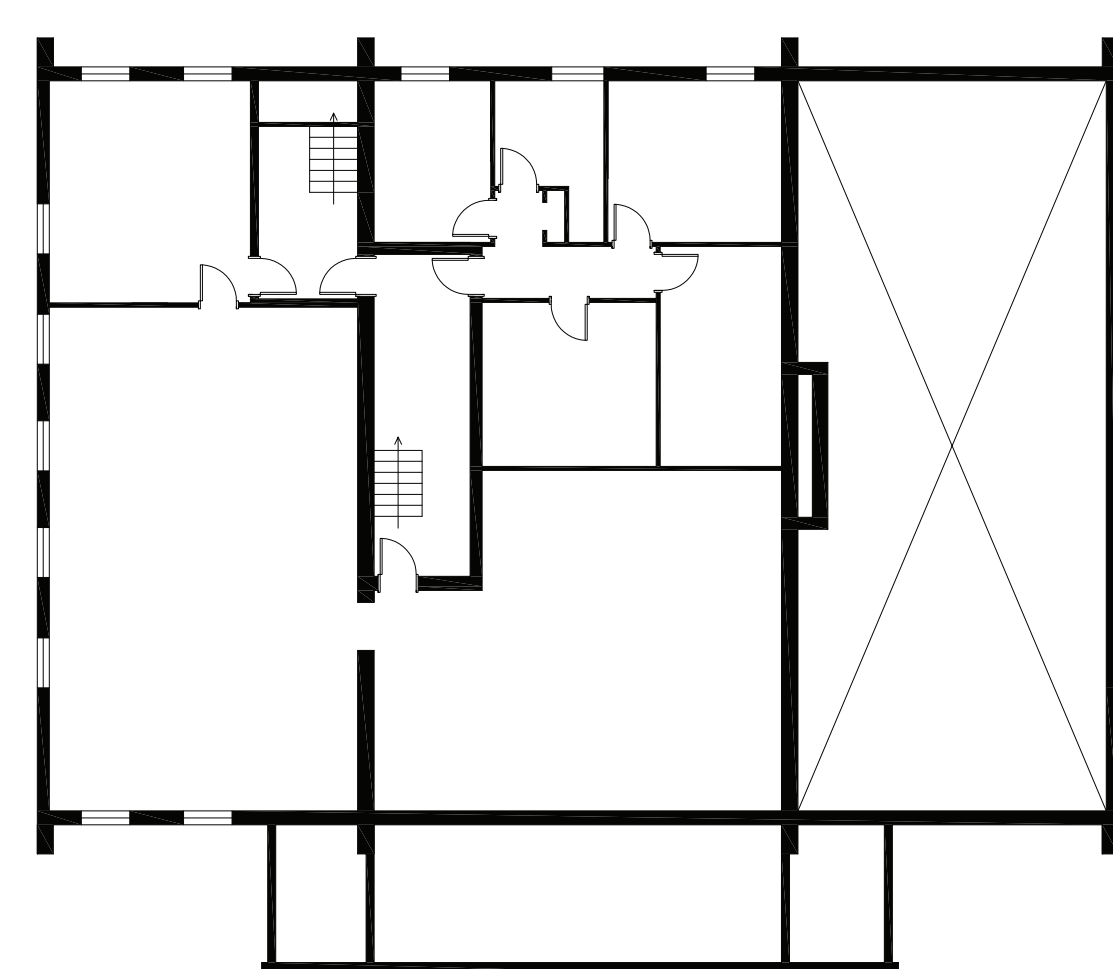
Existing Architectural Plan



Second Floor
Scale: 1/16"=1'-0"



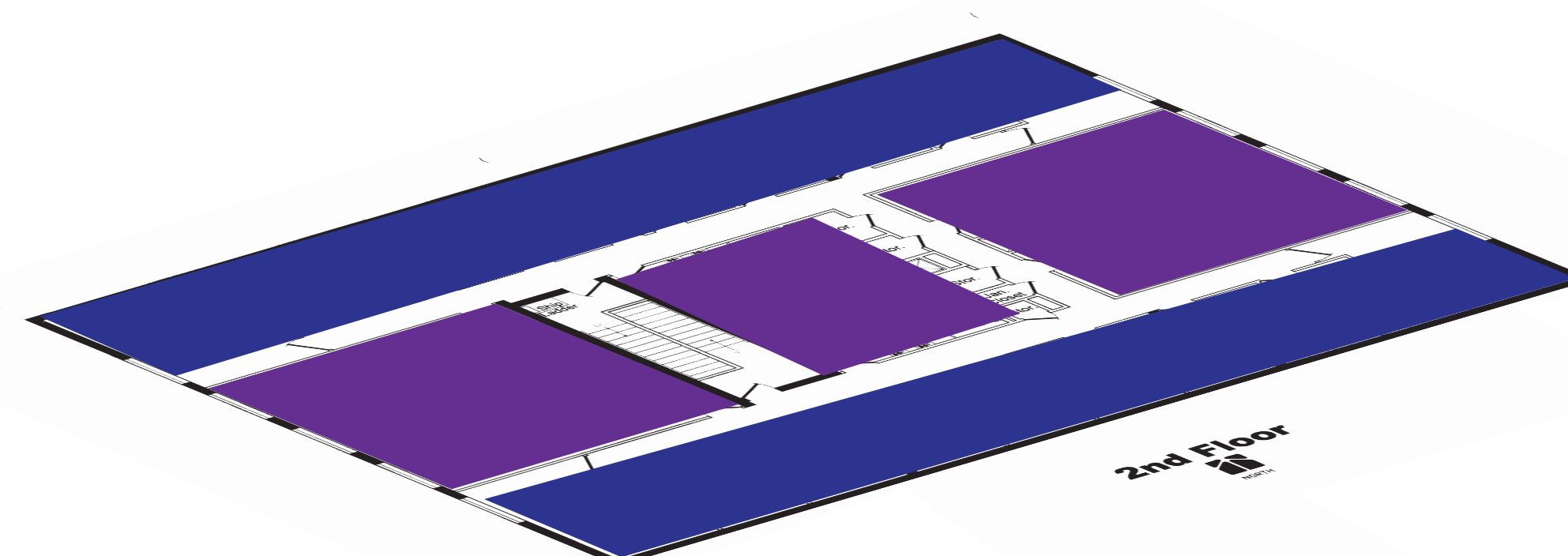
Ground Floor



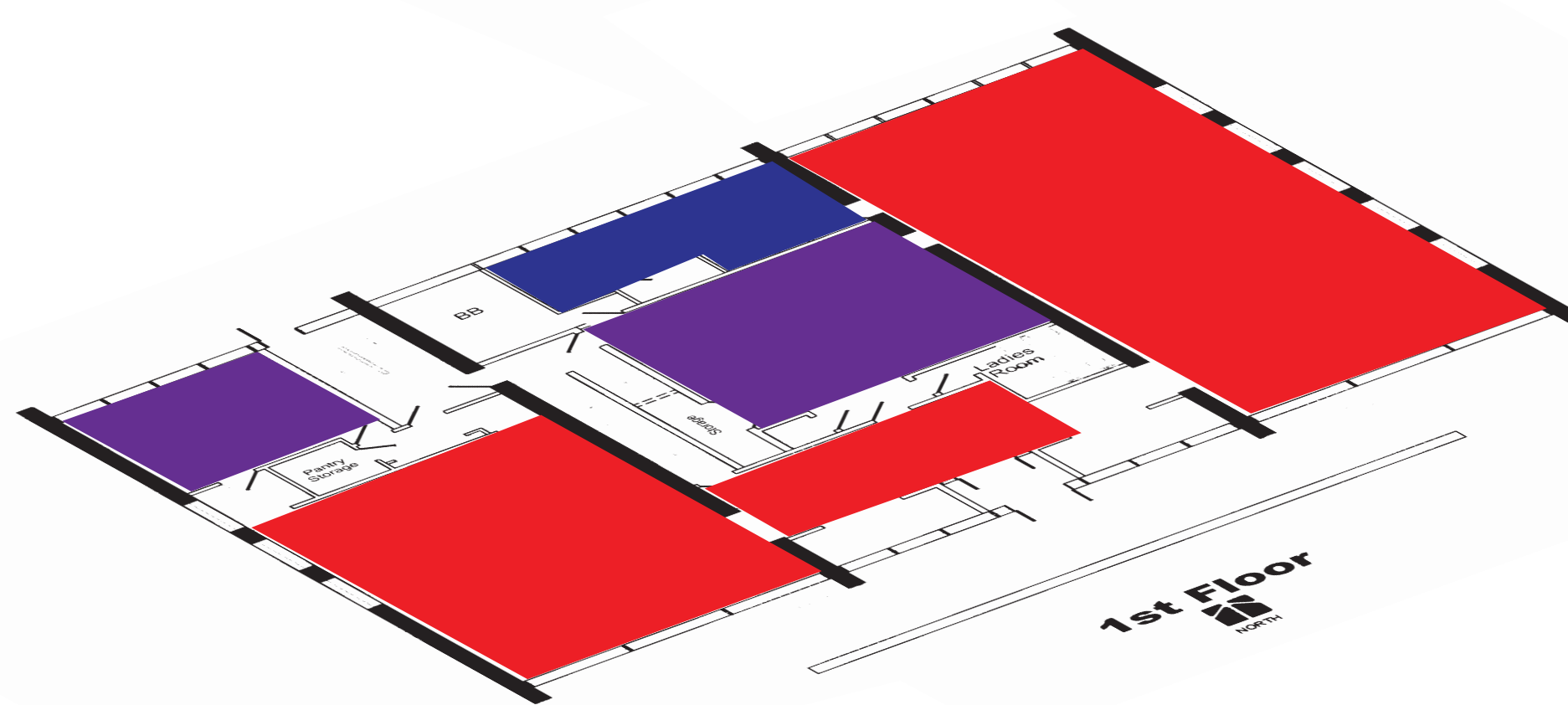
Basement

Current Space Use

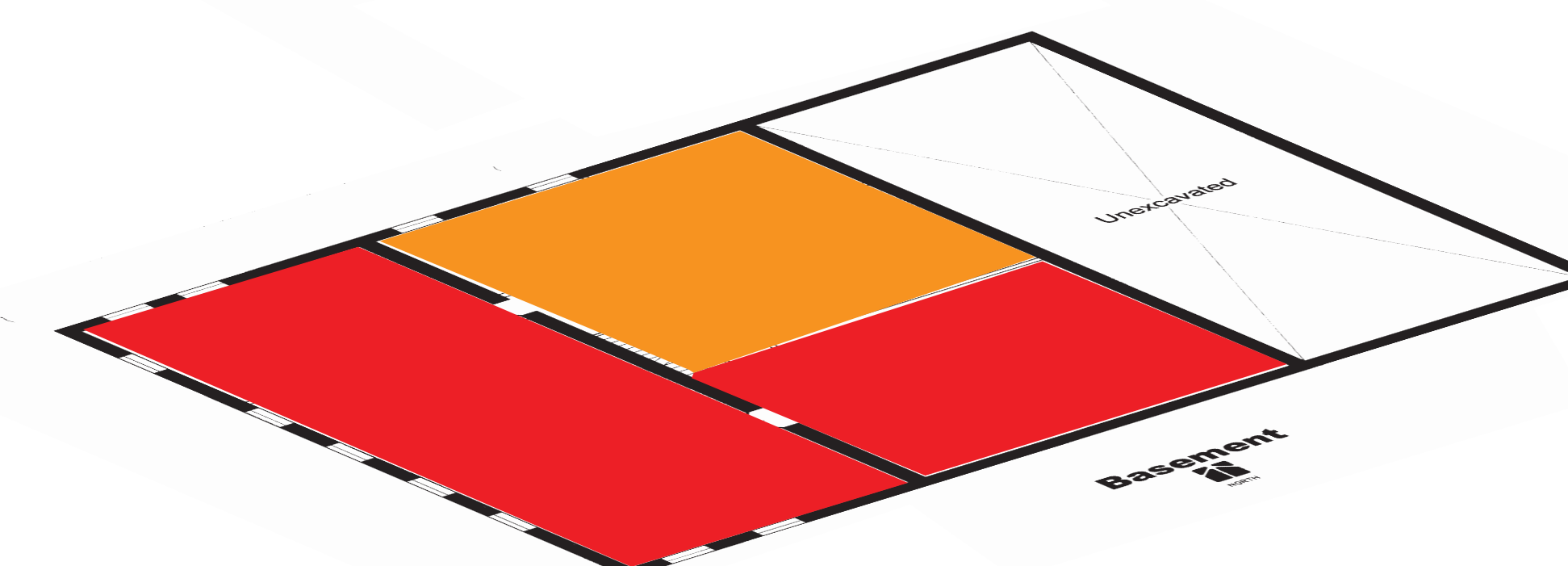
Public and Private Spaces



2nd Floor



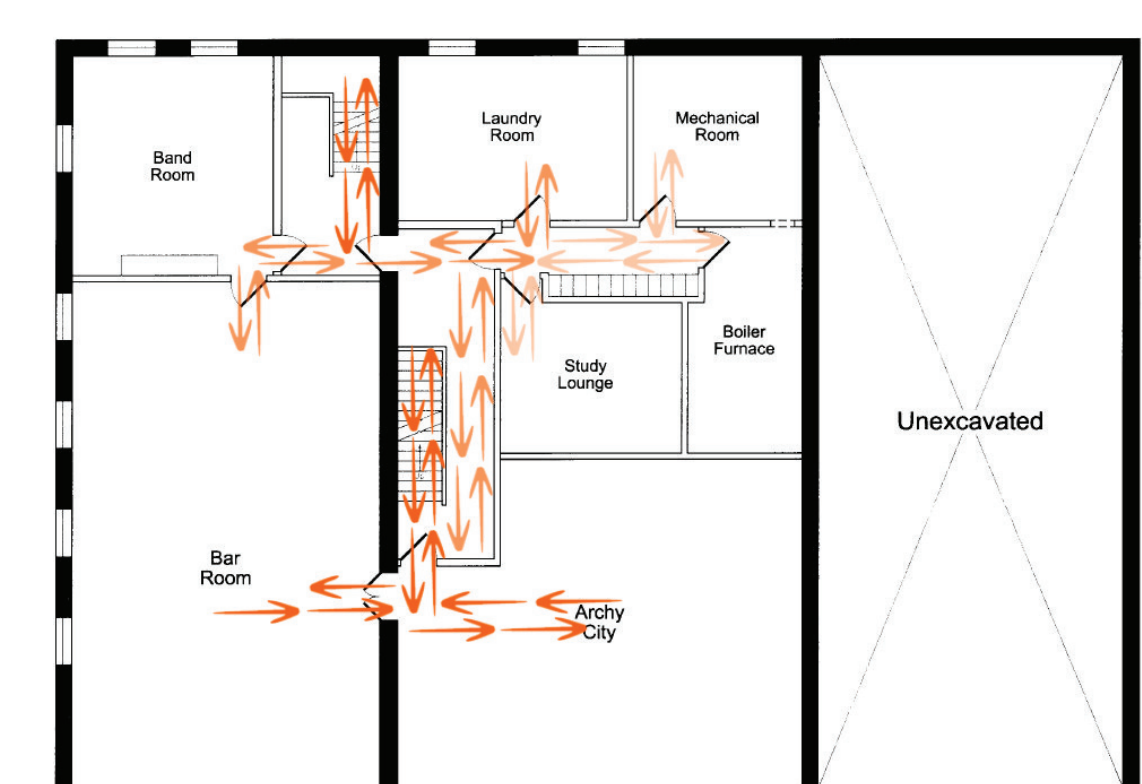
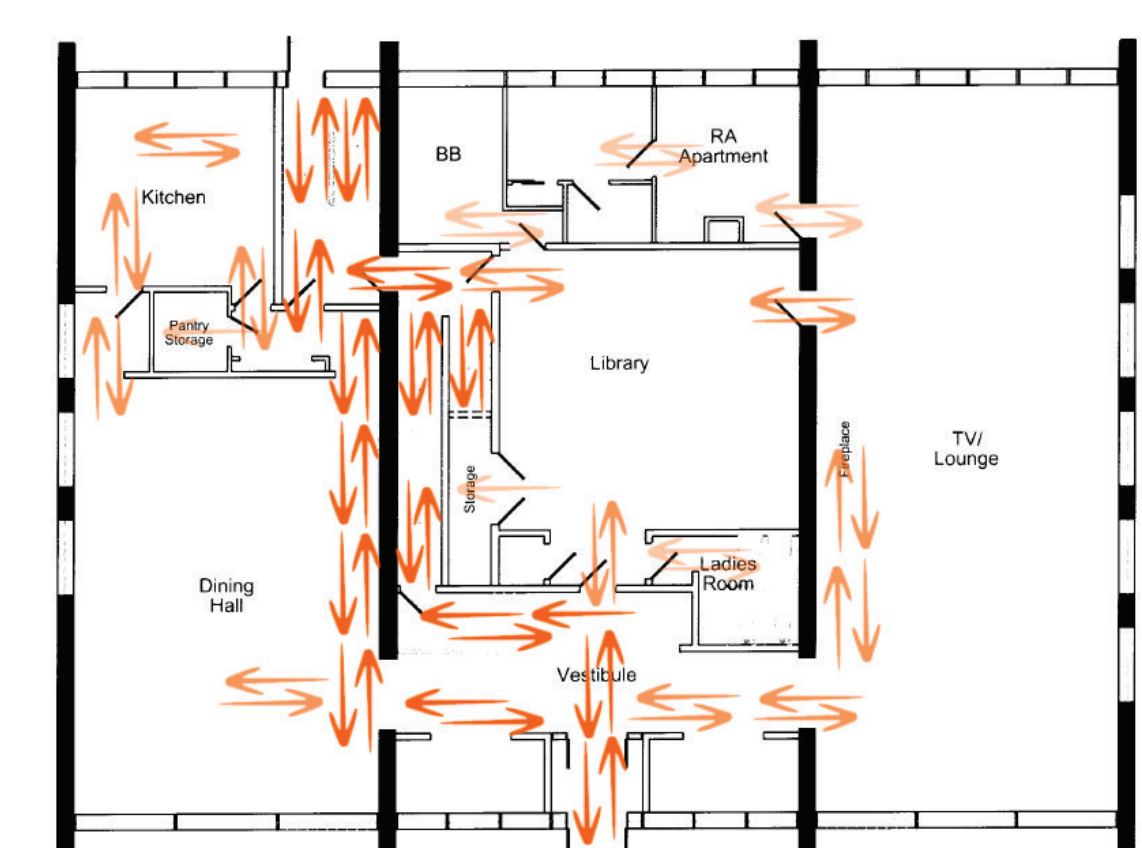
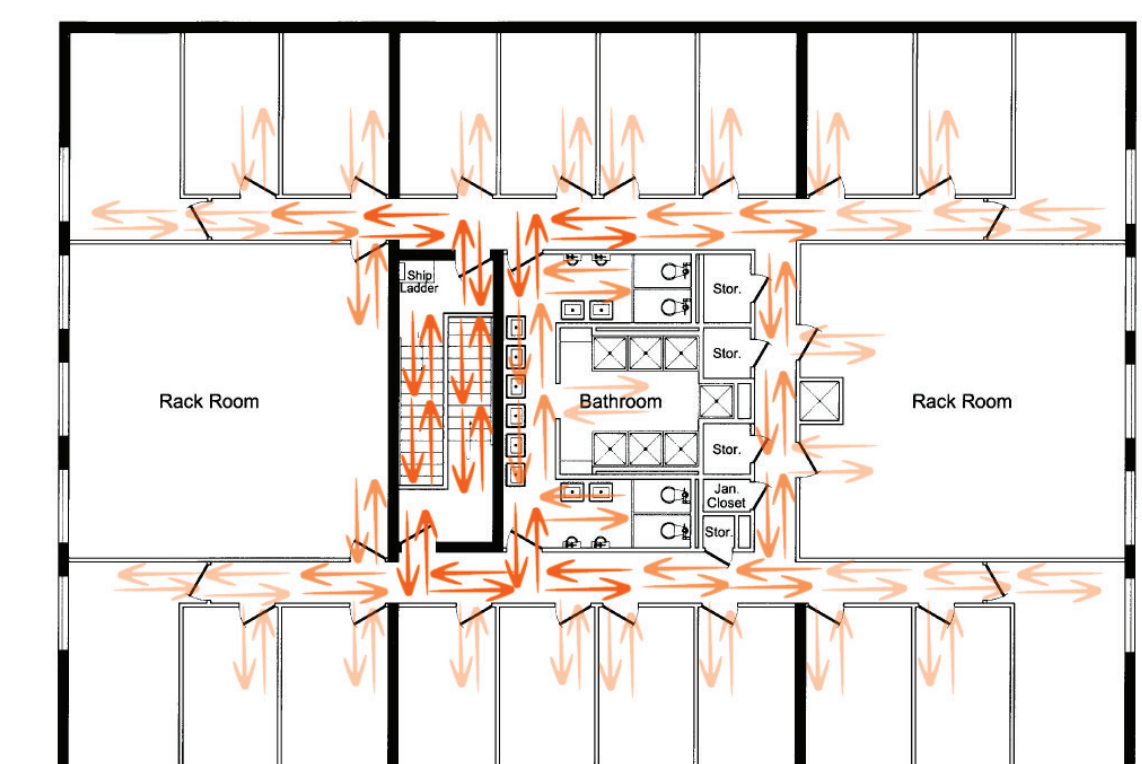
1st Floor



Basement

■ Private ■ Semi-Public ■ Public ■ Mech/Storage

Circulation Patterns



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PROGRAMMING

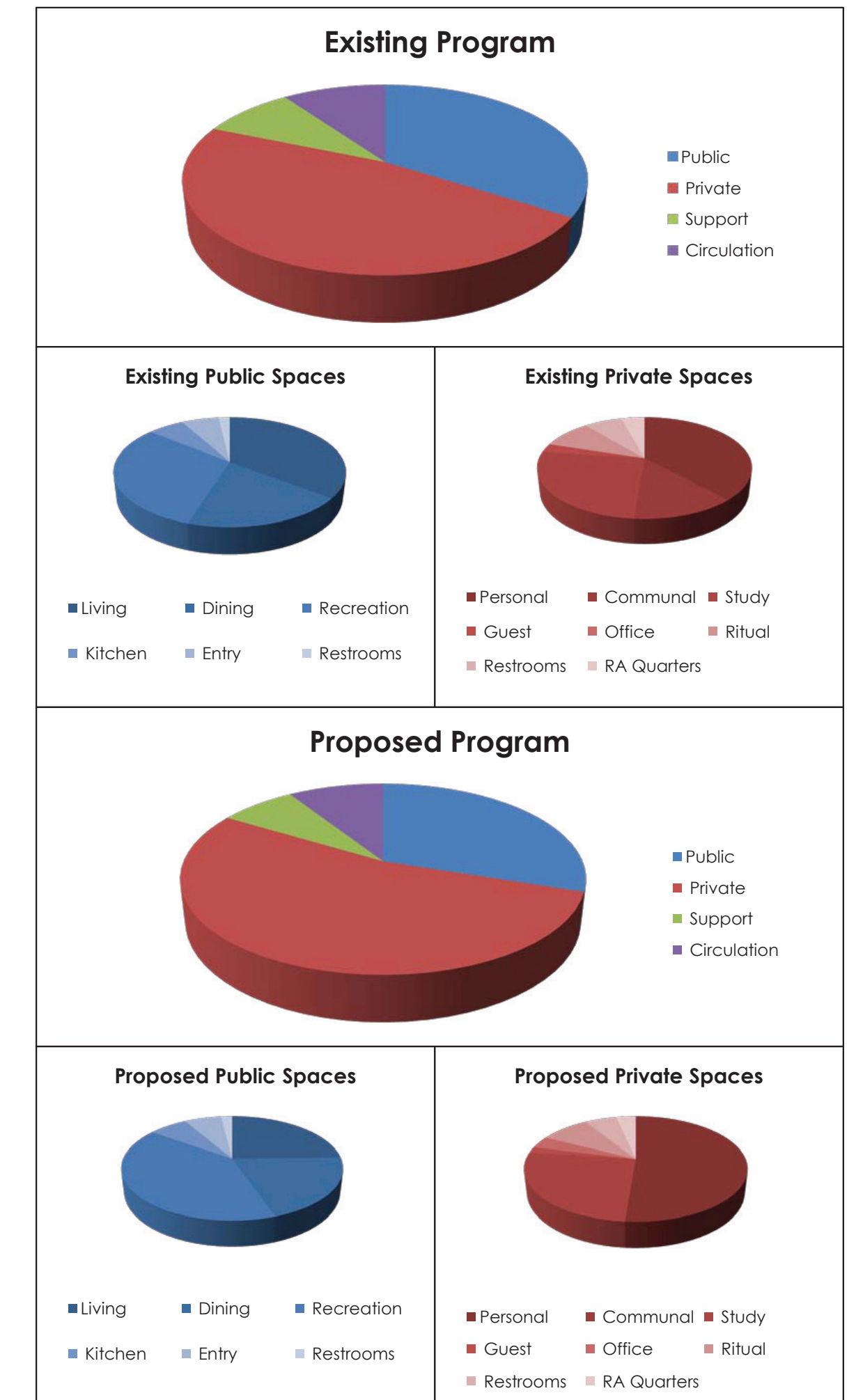
Proposed Redistribution



Exterior view of proposed third floor

Delta Tau Delta Shelter Renovation

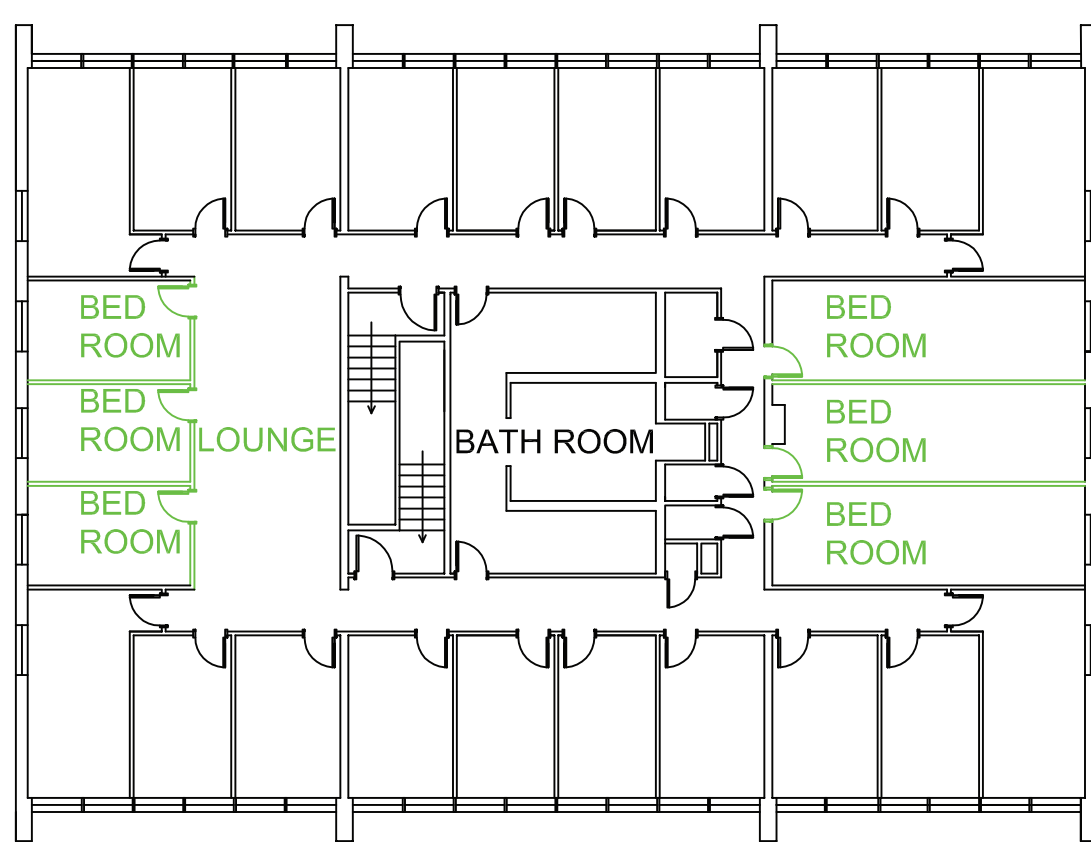
| Architectural Program | Existing Area | Proposed Area |
|--|----------------------|----------------------|
| I. Public Spaces: | | |
| Living room | 1700 sq. ft. | 1130 sq. ft. |
| Dining room | 925 | 925 |
| Recreation | 1484 | 1850 |
| Kitchen | 289 | 310 |
| Entry/Foyer | 296 | 296 |
| Restrooms (Public) | 90 | 90 |
| Total Public | 4784 sq. ft. | 4601 sq. ft. |
| II. Private Spaces | | |
| Personal rooms | 2520 sq. ft. | 4200 sq. ft. |
| Communal sleeping rooms | 884 | 0 |
| Study rooms | 1721 | 2121 |
| Guest sleeping rooms | 182 | 140 |
| Offices/archives | 0 | 300 |
| Ritual room | 600 | 700 |
| Restrooms (Private) | 450 | 450 |
| RA's quarters and restroom | 280 | 280 |
| Total Private | 6637 sq. ft. | 8191 sq. ft. |
| III. Support | | |
| Mechanical room | 390 sq. ft. | 390 sq. ft. |
| Laundry | 238 | 100 |
| Storage lockers (personal) | 210 | 210 |
| Storage closets | 156.5 | 156.5 |
| Entry closets | 132 | 132 |
| Mail boxes | 24 | 24 |
| Pantry | 49 | 49 |
| Cleaning closets | 40.5 | 40.5 |
| Total Support | 1240 sq. ft. | 1113 sq. ft. |
| IV. Circulation | | |
| | 1383 sq. ft. | 1390 sq. ft. |
| Inhabitable Space (less Support and Circ.): | 11421 sq. ft. | 12792 sq. ft. |
| Total Space: | 14044 sq. ft. | 15295 sq. ft. |



Proposed Architectural Solutions

Basement Excavation Proposal

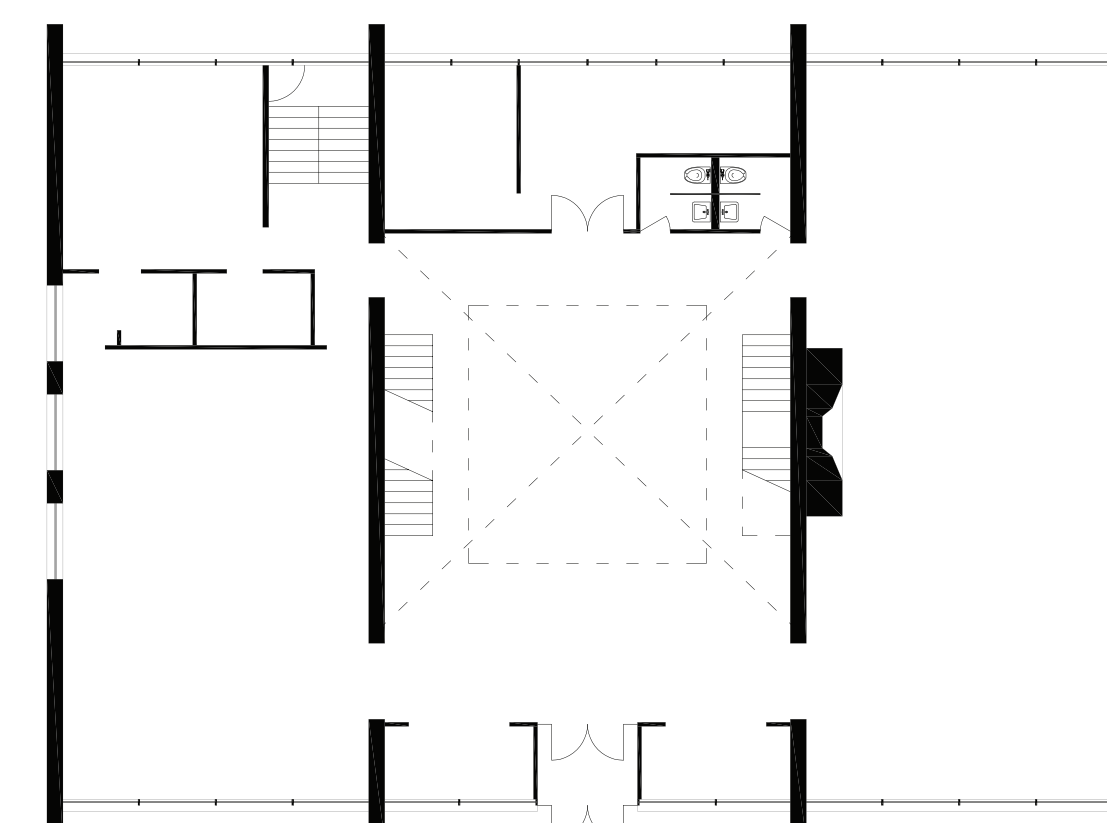
Third Floor Proposal



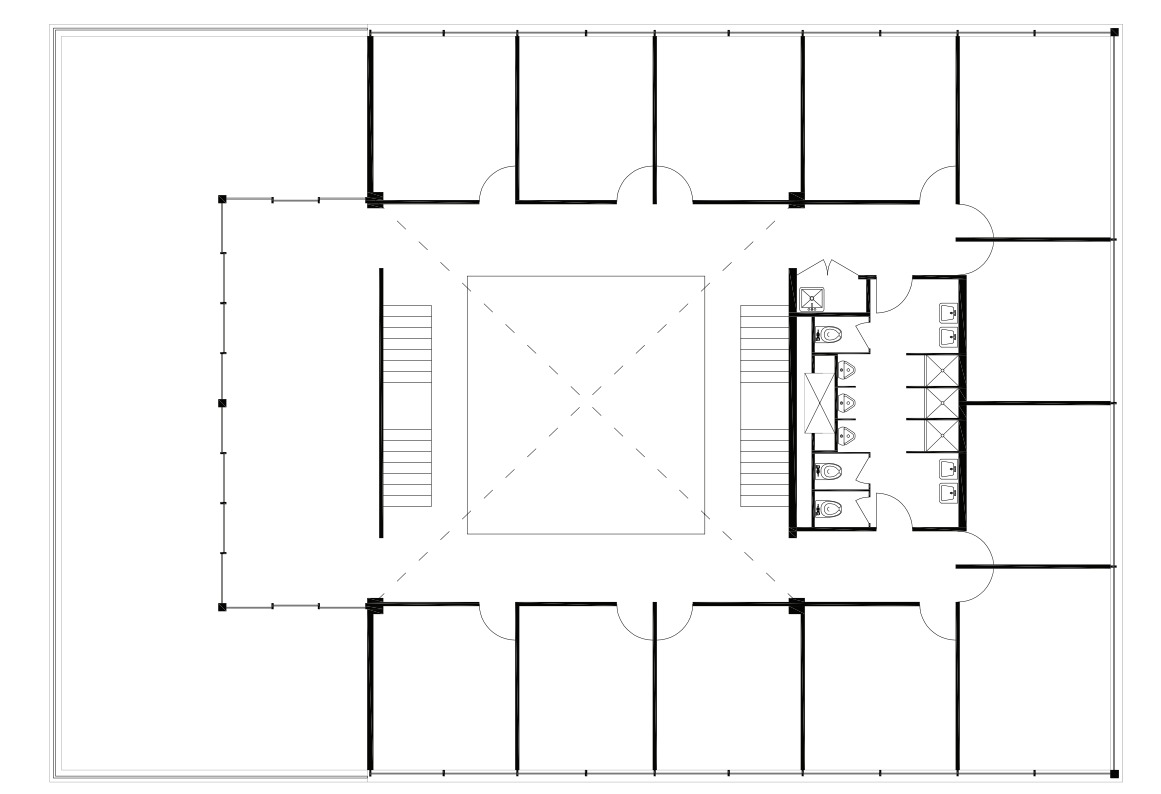
Second Floor
Scale: 1/16"=1'-0"



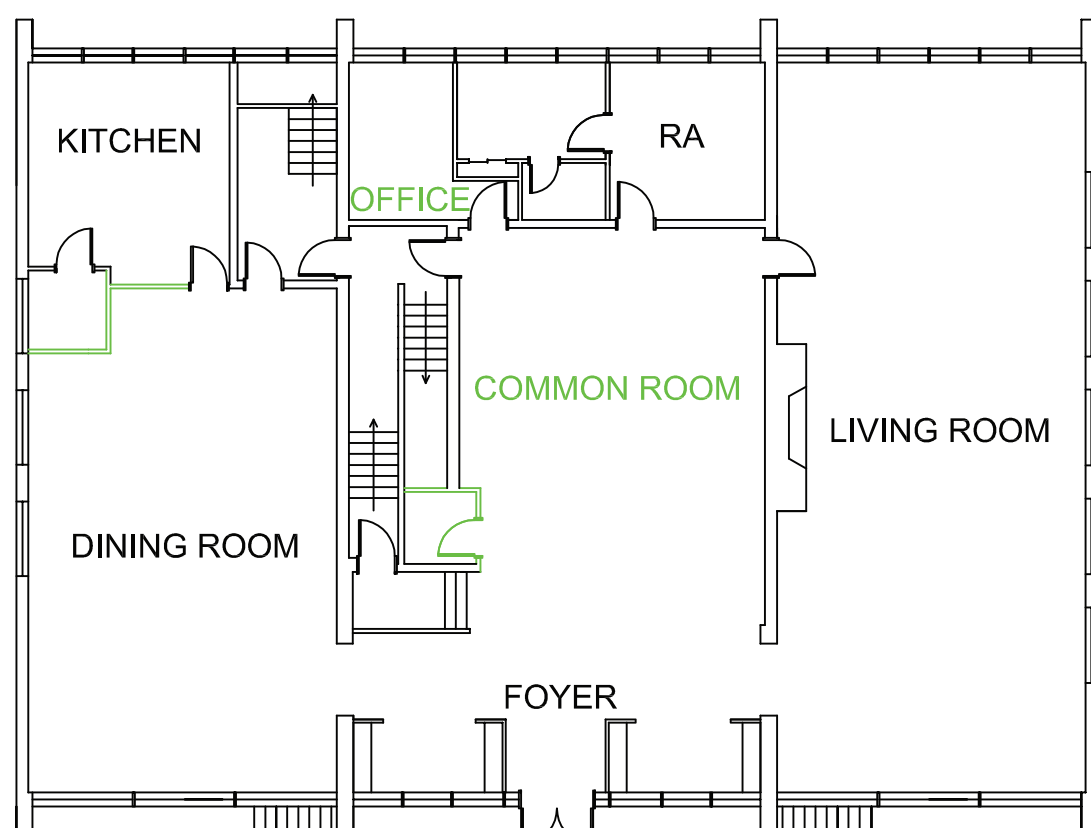
Interior view of proposed atrium



Ground Floor
Scale: 1/16"=1'-0"



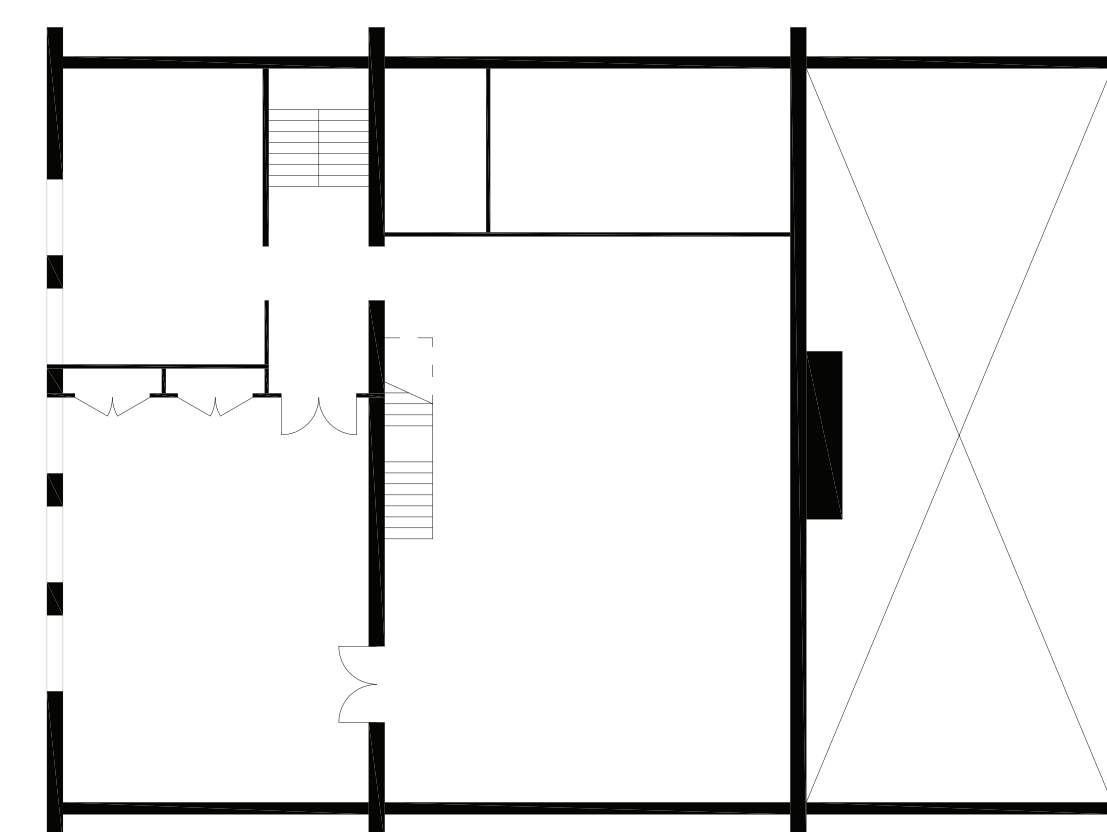
Third Floor



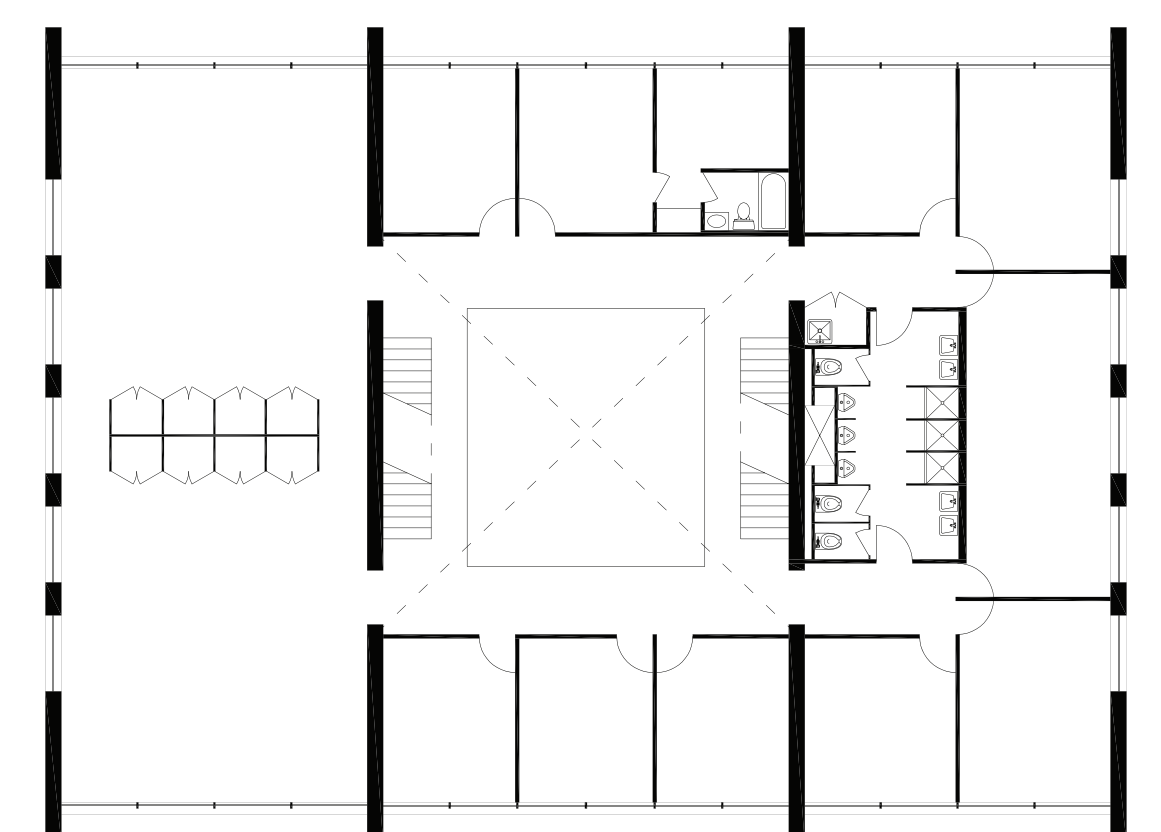
Ground Floor



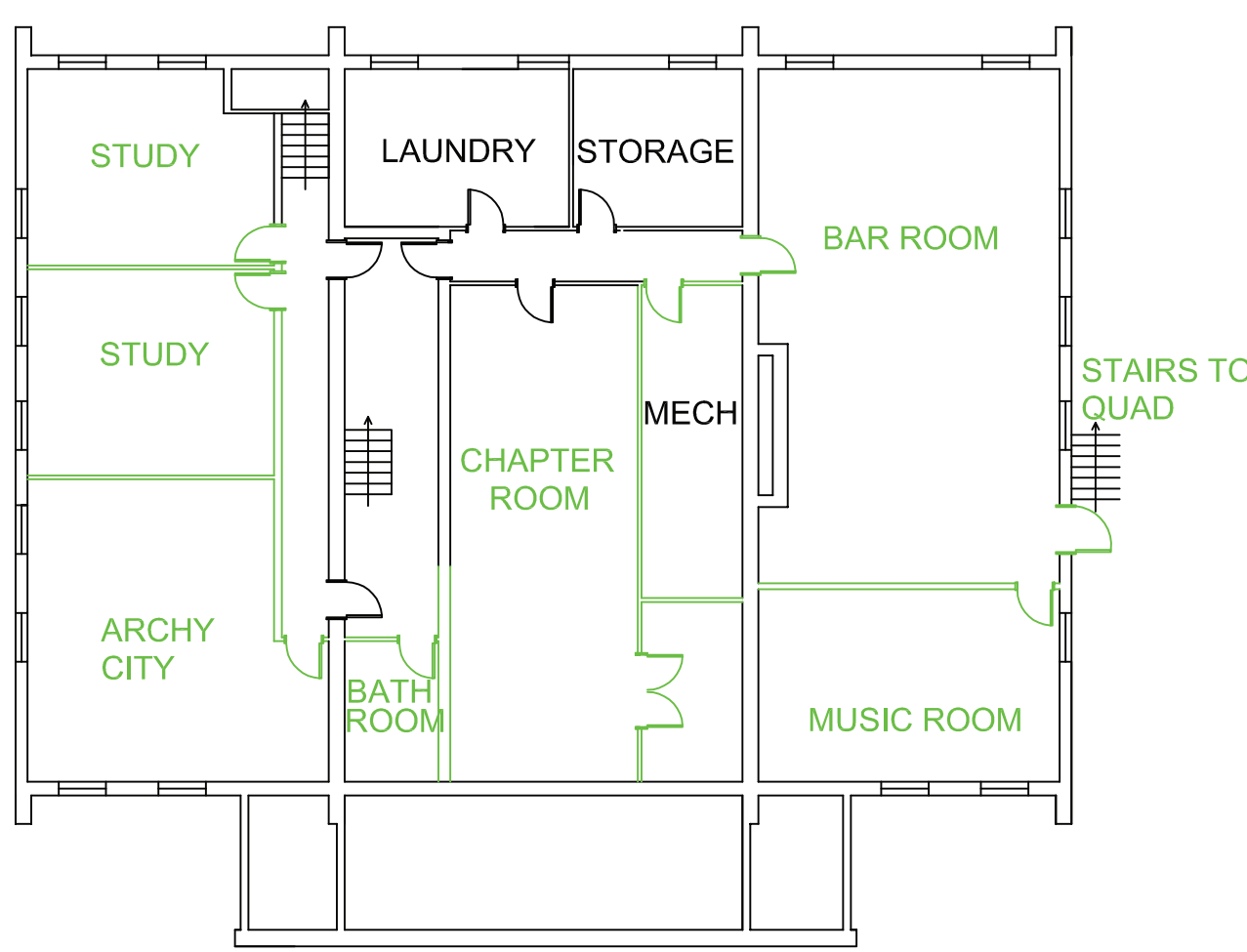
View of proposed second floor renovation with lounge



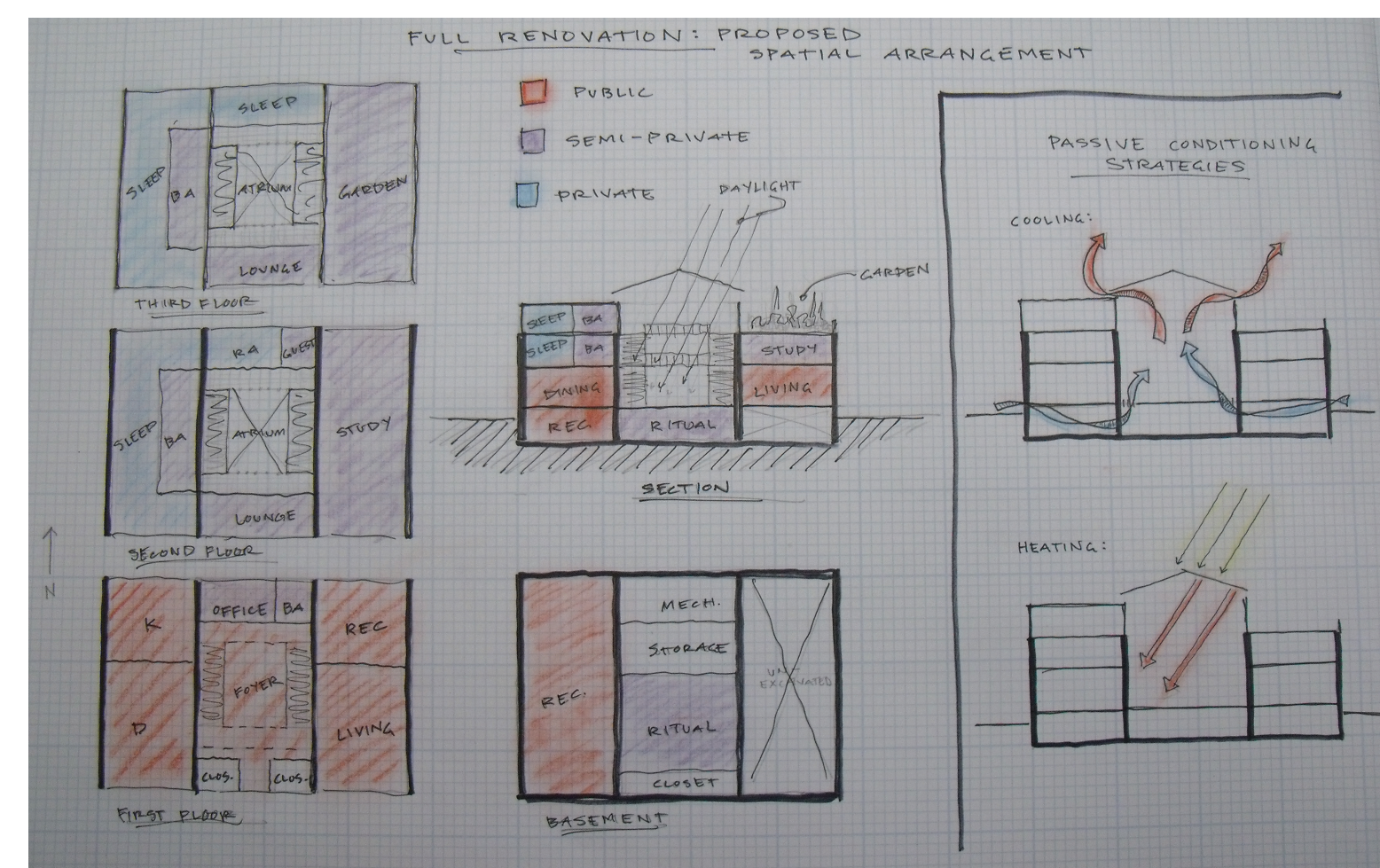
Basement



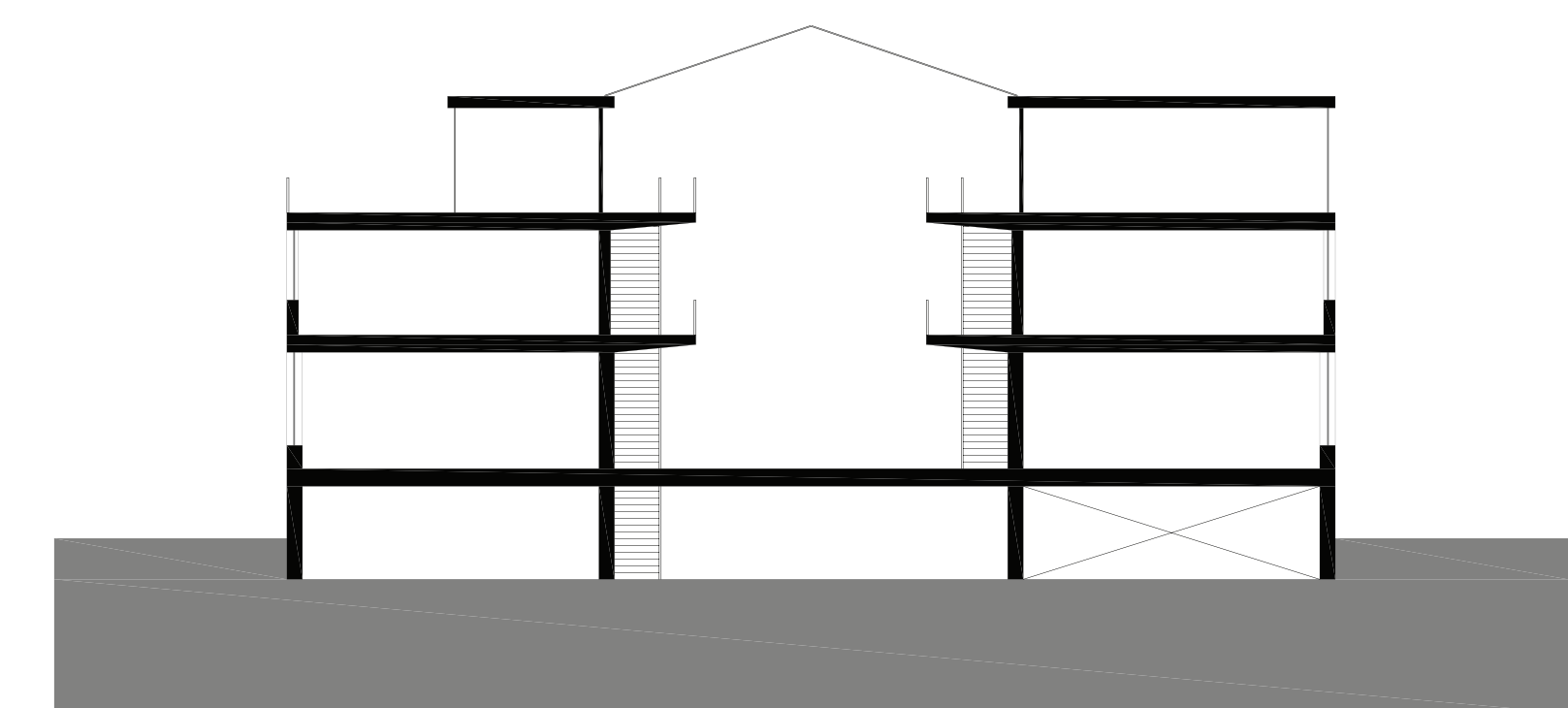
Second Floor



Basement



Original sketch proposal



Longitudinal Section
Scale: 1/16"=1'-0"

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