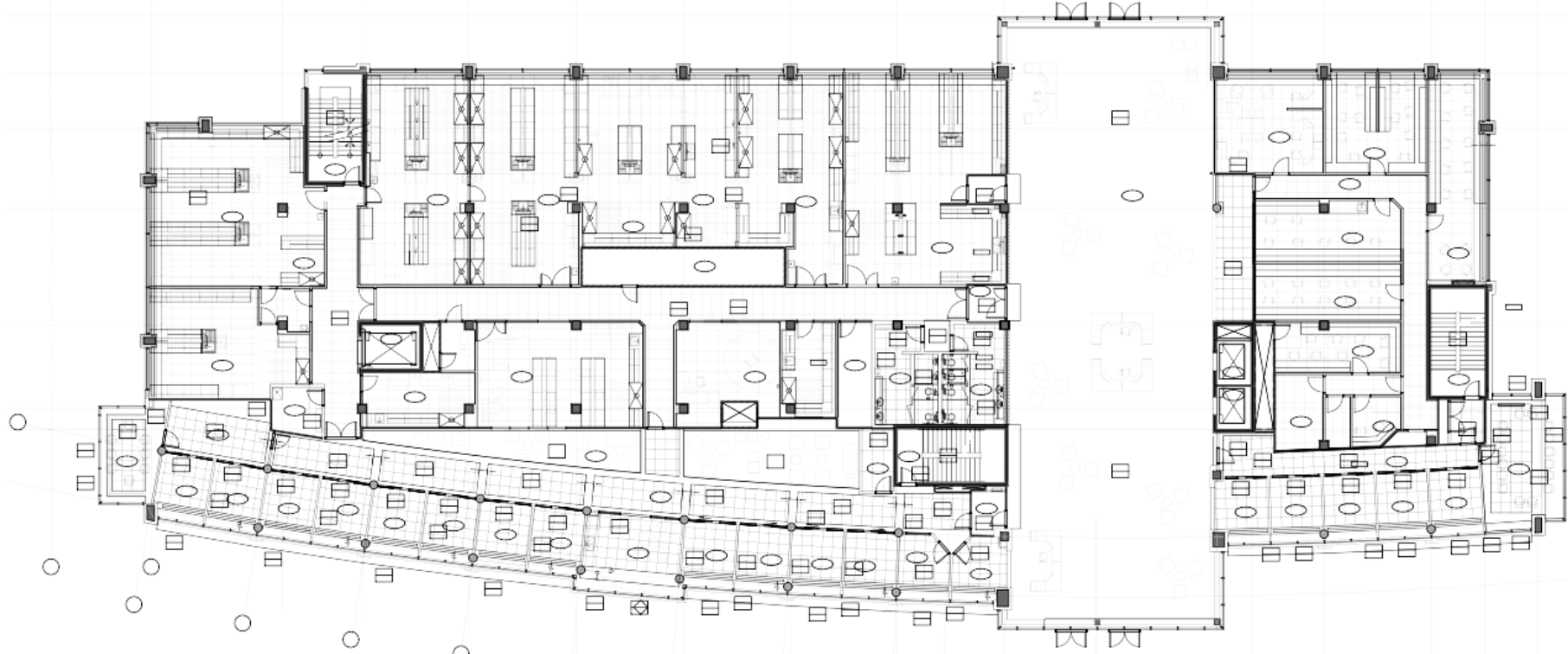


2023 ASHRAE Integrated Sustainable Building Design Competition



Project Description:

As we are entering the design calculation portion of the competition, our overall goal is to provide correctly sized heating, ventilation and air conditioning (**HVAC**) systems for the building. The building is a brand new laboratory in **Cairo Egypt**, and the **total building area is 2,515 m²**. The building consists of a wet bench lab, dry bench lab, research support offices, common area for circulation, secured high density data center room, penthouse, common reception area, researcher offices, storage, resting pods room and social room. While completing this project, we have to ensure that we are complying with multiple **ASHRAE standards**. The owner of the building prefers that we use a **variable air volume (VAV) air handling unit (AHU)**. When it comes to the source of heating and cooling, we may choose that on our own, however it must follow the standards highlighted by ASHRAE and the local codes.



Building Assumptions:

It is assumed that the new building envelope construction and other building systems (e.g. lighting and plumbing) meet ASHRAE 90.1-2019 requirements, while incorporating the owner's project goals below:

- Synergy with surrounding architecture.
- Superior acoustic criteria in all spaces with minimal sound transmission from the adjacent spaces and low noise produced from HVAC systems.
- Assume the building is standalone, and therefore the HVAC systems are not tied to any central plant or district systems.
- Assume all the utilities are provided on site (e.g. natural gas, electricity, city water and sewer).

Deliverables:

- Reports per Syllabus
- Ventilation Calculations – Summary Table
- Load Calculations – Load Calculation Report
- System Selection – Compared Options, Selection Criteria
- Equipment Selection – Calculations, Cut Sheets, Equipment Schedule
- Ductwork – CAD Drawing
- Piping – CAD Drawing
- Controls – Schematic and Sequence of Controls
- Commissioning – Cx Plan
- Present progress at monthly Chapter meetings (Connor)

Codes and Standards:

Codes as determined by the local Authority Having Jurisdiction (AHJ)

- ASHRAE Standard 15 and 34
- ASHRAE Standard 55
- ASHRAE Standard 62.1
- ASHRAE Standard 90.1
- ASHRAE Standard 189.1
- ASHRAE Handbooks

ASHRAE Classification of Laboratory Ventilation Design Levels

Progress:

- Ventilation Calculations: determine how much outside air, according to ASHRAE standards, needs to be brought into the different rooms
- The equation used to make this calculation is ASHRAE 6.2.2.1.

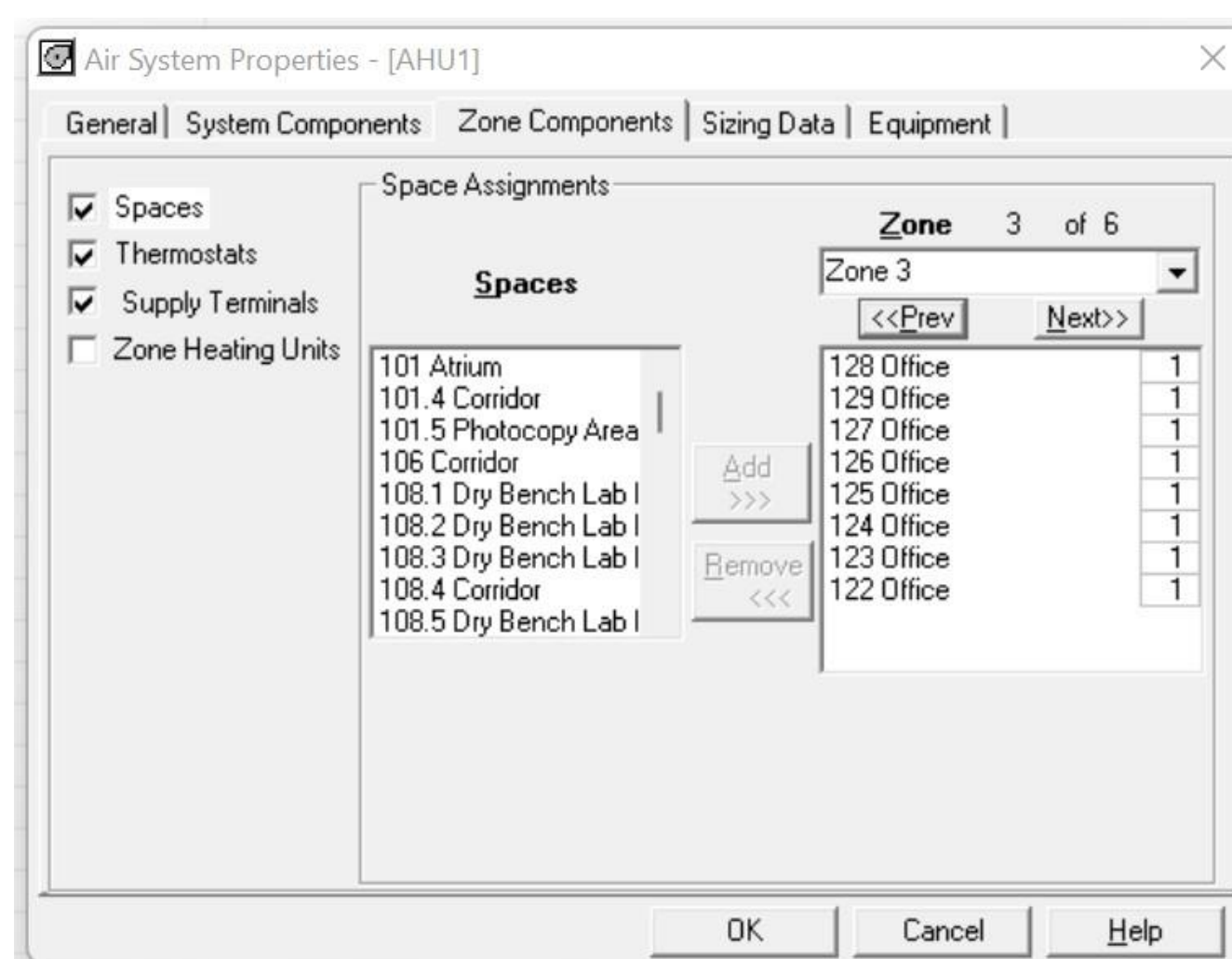
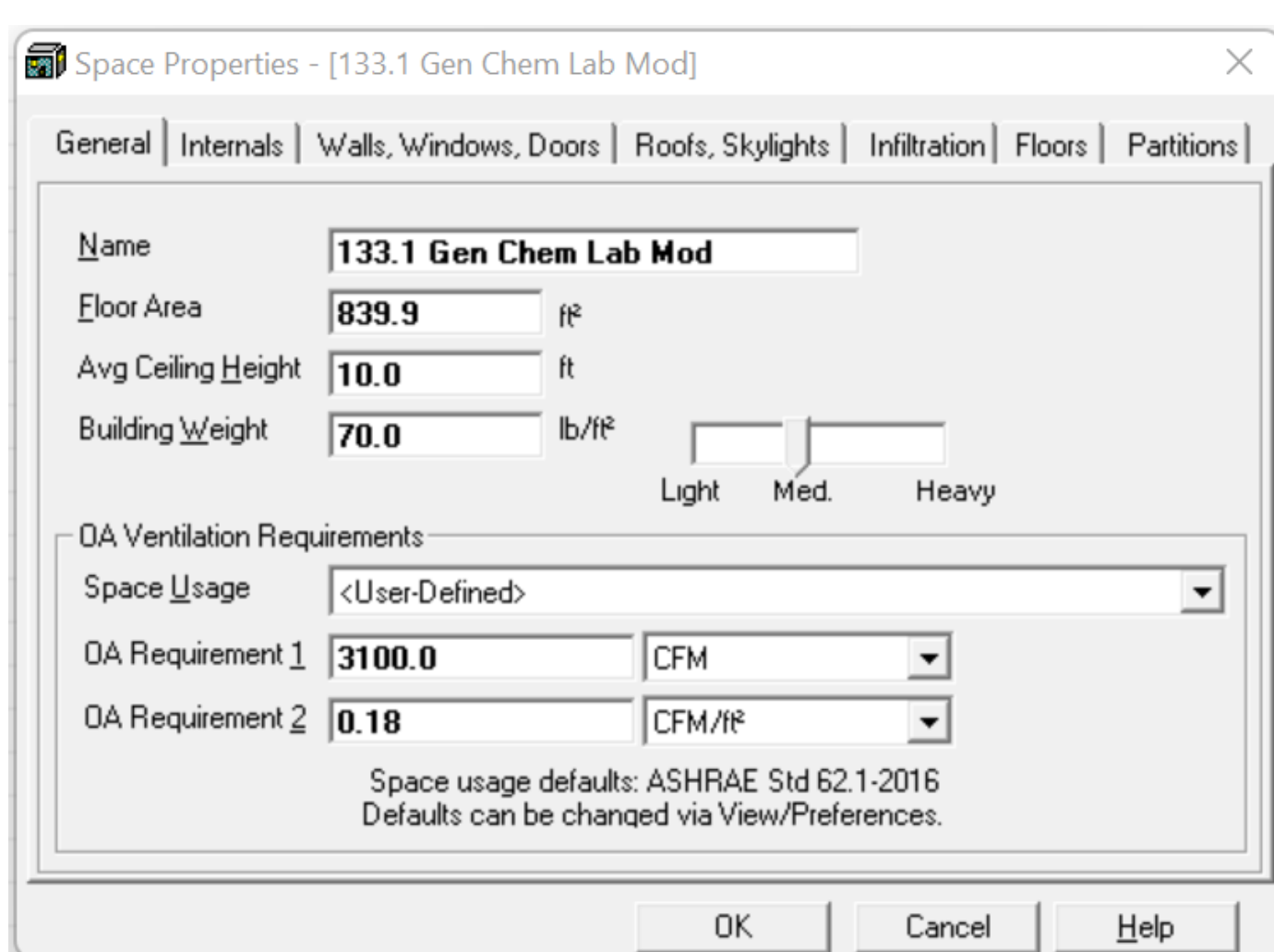
$$V_{bz} = R_p * P_z + R_a + A_z \quad (1)$$

- After finding air required, we calculated the number of air changes for each room
- Additional calculations were necessary to account for fume hoods in laboratory spaces.
- Zones with fluctuating occupancy used the equation from ASHRAE 6.2.6.2, Short Term Conditions

$$T = \frac{3v}{V_{bz}}, T = \frac{50v}{V_{bz}} \quad (2)$$

- Used *Carrier's* Hourly Analysis Program (HAP) software to upload all spaces, ventilation requirements, schedules, plug loads, windows, the location's weather, etc.
 - Ran load reports and beginning to break down the spaces into zones for equipment selection

Space	Floor Area
(New default Space)	4648.9
101 Atrium	2332.6
101.4 Corridor	234.4
101.5 Photocopy Area	371.8
106 Corridor	385.0
108.1 Dry Bench Lab Mod	387.6
108.2 Dry Bench Lab Mod	449.3
108.3 Dry Bench Lab Mod	250.3
108.4 Corridor	334.9
108.5 Dry Bench Lab Mod	316.1
108.6 Dry Bench Lab Mod	239.4
108.7 Dry Bench Lab Mod	85.2
108.9 Dry Bench Lab Mod	127.4
109 Office	1014.0
110 Bio Lab Clean	126.6
110 Office	566.2
110.1 Bio Lab Infectious	123.7
111 Office	126.2
112 Office	125.9
113 Office	1248.1
114 Inorganic Disg. Lab	3907.0
114 Meeting Room	118.8
115 Office	120.6
116 Office	128.2
117 Office	127.8
118 Data/Tel Room	288.9
119 Office	127.9
120 Office	128.2
121 Office	127.8
122 Common Room	128.2
122 Office	715.6
123 Office	128.2
123 Unassigned (storage)	128.2
124 Office	128.2
125 Office	128.2
126 Office	128.2
127 Office	89.2
128 Office	125.5
129 Office	2171.5
130 Meeting Room	839.9
131 Gen Chem Lab Mod	859.2
132 Gen Chem Lab Mo	1042.9
133.3 Gen Chem Lab Mod	772.5
133.4 Gen Chem Lab Mod	135.8
137 Power Room	563.2
138 Core Lab Support	663.2
139 Core Lab Support	221.0
139 Pechlonic Lab Mod	219.7
143 Male W/C	220.1
144 Female W/C	32.8
ELEV 1	32.8
ELEV 2	32.8
ELEV 3	136.4
High Density Server Room	220.4



Mr. Justin Kohan



Mr. Connor Norton



Ms. Melissa Hiller



Ms. Kaelyn Rooney



Ms. Renée Brogley



Faculty Mentor:
Prof. Jianshun Zhang