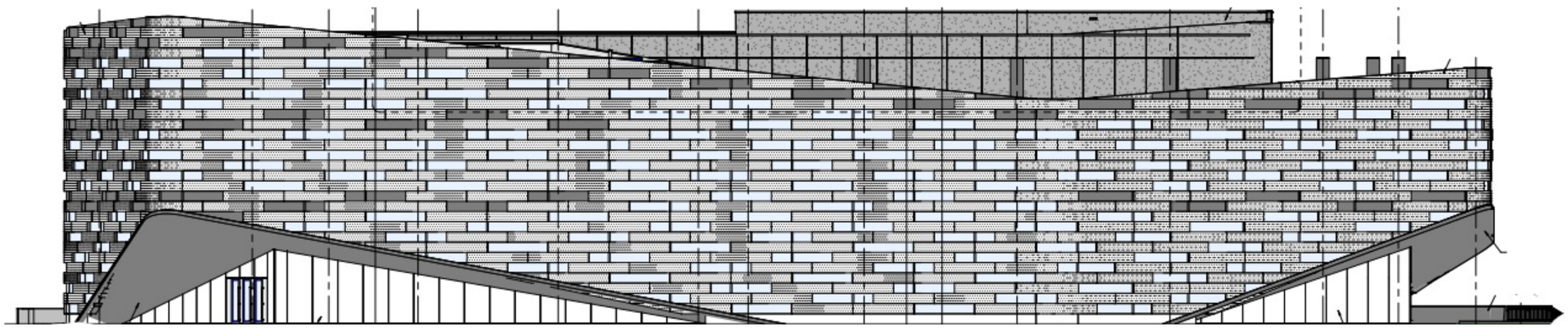
HVAC Design for San Paolo Brazil Library

Project Description:
We are participating in the 2024 ASHRAE Student Design Competition. The focus of our project is to design an HVAC System for a brand-new **library** in the heart of **São Paulo, Brazil.** This new library will be a center of education and community involvement. The building has open library space, retail space, cafes, conference and office rooms and an automated storage and retrieval system. The building also has other basic support spaces such as restrooms, mechanical rooms, electrical closets, telecom closets etc. The design of the HVAC system should be considering comfort, health and safety, sustainability, functionality, future flexibility, maintainability and a 50-year service life.



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 Sequences of Controls
- Commissioning – Cx Plan

Codes and Standards

Codes are determined by the local Authority Having Jurisdiction (AHJ). The following AHSRAE standards are being utilized for this project:

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

Building Assumptions

It is assumed that the library construction will meet ASHRAE 90.1 requirements while incorporating the owner's project requirements:

- Compliment surrounding architecture.
- Superior acoustic criteria in all spaces with minimal sound transmission from the adjacent spaces and low noise production from the HVAC systems.
- Assume the building is standalone, and that the HVAV systems are not tied to any central or district energy systems.
- Assume all utilities are provided on site.
- Assume the sensible heat load from the Automated Storage and Retrieval System is equivalent to two 50 horsepower electric driven motors.

Current Progress

Ventilation Calculations

- One of our first project deliverables is to determine how much outside air needs to be supplied to each room to meet ASHRAE standards.
- We first used AutoCAD to determine the square footage of each room by analyzing the drawings of the library. Then calculated the outdoor airflow required in the breathing zone using AHSRAE 6.2.2.1:

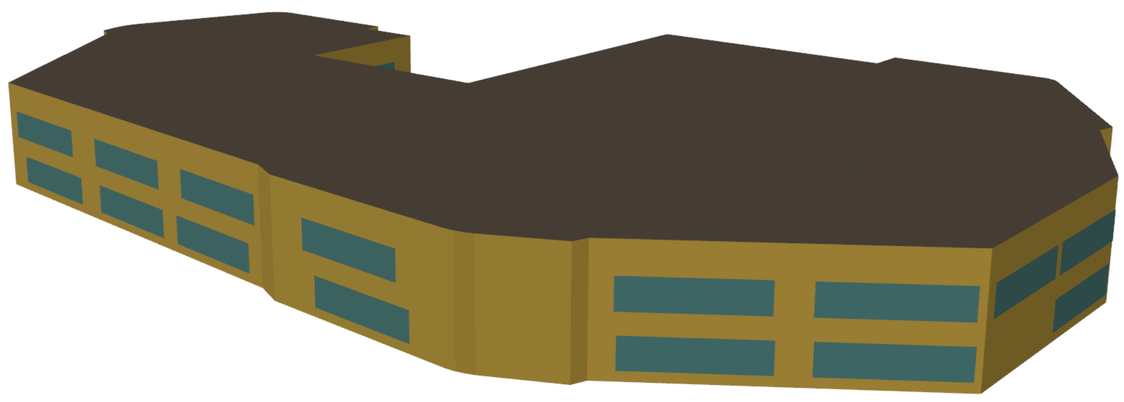
$$V_{bz} = R_p * P_z + R_a * A_z$$

- Where:
  - A_z= Zone floor area, the net occupiable floor area of the ventilation zone.
  - P_z= Zone population, the number of people in the ventilation zone during use.
  - R_p = Outdoor airflow rate required per person as determined from ASHRAE Table 6.2.2.1.
  - R_a = Outdoor airflow rate required per unit area as determined from ASHRAE Table 6.2.2.1.
- Since it is known that the peak occupancy will be of short duration and not all 24 hours of the day, we can adjust the design to be based on the average conditions over time period, T. This was done using ASHRAE 6.2.6.2-1 and 6.2.6.2-2:

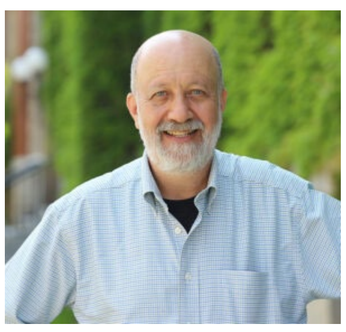
$$T = \frac{3v}{V_{bz}} \qquad T = \frac{50v}{V_{bz}}$$

HAP Test Simulations:

- We are using Carrier's Hourly Analysis Program (HAP) to simulate conditions and help us design the HVAC system.
- The first step in using HAP is to create a 3D-model of the building itself:



- This model contains all exterior and interior walls, windows and any specification necessary to create an accurate model of an HVAC system.
- The next step is to start selecting systems that will work well with the library and fulfill all the owner's requirements.



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