

Executive Summary

The analyses presented and evaluated in this report are a result of information that have been collected over the fall and spring semesters. After a careful investigation of 123 Alpha Drive's building characteristics and components, modifications in the mechanical, acoustical, and electrical systems were proposed. The analyses were conducted in order to educate the author of this report about architectural engineering design principles and strategies.

The mechanical depth portion of the report consists of the installation of a variable refrigerant flow (VRF) system along with a dedicated outdoor air system (DOAS) in place of the existing roof-top units in the office and lab spaces of the building.

The variable refrigerant flow system analysis indicated a large savings in annual HVAC costs of up to \$9000, and reduces the amount of energy consumed in comparison to the original HVAC design by over 15%. Carbon emissions from a variable refrigerant flow system were also found to be significantly reduced. When comparing first costs and annual HVAC costs, it was found that the proposed VRF system, accompanied by a dedicated outside air system, was economically unfeasible, as the payback period for the system was nearly 16 years.

The proposed HVAC system does possess much more precise control than the original system, however. A building management system control was added to the variable refrigerant flow system, which allows for control of up to 256 indoor units and 16 outdoor condensing units. The building management system can also dictate the controls of the energy recovery ventilators, and can also set restrictions on occupant control of their individual indoor terminal unit. Wired remote controllers were also added in an effort to provide occupants with the opportunity to maximize their comfort. Simultaneous heating and cooling of each individual indoor unit was also made available.

The acoustical evaluation of the Noise Criterion ratings of the original HVAC system and the proposed VRF system indicated that the existing HVAC system did not meet the recommended rating for almost all categories of office and conference room noise criteria. Upon further software-based analysis, it was found the cassette style indoor terminal units produced a Noise Criteria rating far below the recommended values, further improving its aim to provide maximal comfort.

The electrical analysis focused on the replacement of mechanical panels based on the proposed variable refrigerant flow and dedicated outdoor air systems. A new 225A 460V 3 phase panel was installed in place of a motor control center of equal rating, limiting the amount of change in feeder size and wiring. Two 100A 208V 1 phase panels were added to accommodate for the VRF system indoor terminal units and the energy recovery ventilators. Attempts to place all indoor units on the same 225A were unsuccessful, as there were too many mechanical units compared to single pole switches.