National Law Enforcement Museum Washington, D.C.

Architectural Engineering Senior Thesis: Executive Summary

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EXECUTIVE SUMMARY

The National Law Enforcement Museum, a new museum to be completed by summer 2016, is an effort funded by the National Law Enforcement Officers' Memorial Fund. This structure will be situated in the Judiciary Square complex a few blocks from the United States Capitol. Highlighted by two glass pavilions in between the wings of the District of Columbia Court of Appeals, the museum will be an underground space with a research area, exhibit space, café, gift shop, hall of remembrance and theater.

The objective of this document is to demonstrate a depth of knowledge in building heating, ventilation and air conditioning design. Throughout the report, two types of modeling software will be used to analyze the existing design as well as proposed changes to the design. The goal of these changes is to reduce energy load, cost, and noise to the museum spaces.

Beginning the document, the mechanical system of the National Law Enforcement Museum is analyzed in depth. In this portion, a full discussion of the variable air volume system's design objectives, site conditions, system operation, code compliance and modeling approach occurs. Heating load, cooling load, ventilation requirements, airflow and annual energy use are all demonstrated in relation to the mechanical system.

The first analysis proposes a change to the museum's glass pavilions. With the current design, the 42% of the building's cooling load is in response to the immediate solar gain from the pavilions. It is proposed that the glass be improved to a higher U-value, shading coefficient and less transmissivity. Another part of this proposal is to take away the sky lighting roof and replace it with opaque materials similar to those used on the exterior walls of the pavilions. The results of these changes are examined using Trane Trace 700. A comparison of the cooling load, heating load and energy use shows that these adjustments would reduce cost over the life of the structure.

Secondly, a variable refrigerant flow system is proposed as a redesign of the NLEM mechanical system. This type of system is predicted to reduce building energy loads and costs. In the same way as the original system, the VRF structure is analyzed using Trane Trace 700 to determine its energy loads, costs, and building heating and cooling loads. These criteria are then compared to the results from the original system's analysis. Through these evaluations, it is determined that using a VRF system would be beneficial to the building because of its reduced energy cost even though the investment is $40,000 more than the conventional variable air volume system.

The final components of this document displays a range of knowledge in building engineering. Room acoustics is the first topic. The origin and importance of reverberation time are discussed, particularly in its applicability to the Hall of Remembrance. The RT of the room is analyzed and determined to be adequate for the task at hand.

Extensive use of glass on the grand entrances to the museum lead directly to a daylighting analysis. The program IES Virtual Environment is used to determine how much daylight infiltrates into the building spaces and whether this will be beneficial to reducing energy costs with daylighting sensors. The results from the modeling show that there is such a large amount of light illuminating the space that utilization of light sensors will be highly beneficial.