

## Executive Summary

This report is an evaluation of Underfloor Air Distribution (UFAD) and Displacement Ventilation (DV) systems compared to traditional overhead mixing HVAC systems. The areas of application for these systems are the gate holdrooms and airside concourse of Terminal 3 at McCarran International Airport in Las Vegas, NV. The design process is discussed throughout the report and includes load calculations, ventilation requirements, equipment selections, cost comparisons, and other considerations.

Load calculations for Terminal 3 are performed using Trane TRACE software. This software is used to model the spaces of interest based on the existing mechanical system configuration. From here, various load factors are applied to the spaces to determine the load present in the occupied zones. These occupied zone loads are then used to determine the necessary capacity of the redesigned airside systems. An additional 92,532 CFM is required in the spaces served by the UFAD systems; and an additional 36,162 CFM is required in those spaces served by the DV systems.

Outdoor air ventilation rates are calculated in accordance with ASHRAE Standard 62.1-2007. Based on the work performed with regards to this standard, the ventilation effectiveness of both UFAD and DV systems is higher than it is for the existing overhead mixing system. As such, supply outdoor air flow rates required at the outdoor air louvers can be reduced by 52,677 CFM.

Unfortunately, the redesigned system has an associated increase in first cost. This is partly due to the requirement of nine additional air handlers, and partly due to the need for additional terminal units and diffusers within the various spaces. The total increase in first cost is approximately \$1,051,280. Potential changes in annual operating costs are also analyzed based on simulations performed in TRACE. Even with reduced outdoor air flow rates and increased economizer operation, annual operating costs still increase due to the larger amount of supply air required. This increase in operating cost is approximated as \$158,650 per year. Given the large size of Terminal 3, these costs are relatively minimal compared to the total building costs. Regardless, these increases are not ideal and detract from the potential benefits of the system.

Since the UFAD system will require an underfloor air plenum, an access floor will be installed in the gate holdroom areas. This will require some structural modifications to ensure that a smooth transition can be made from the raised floor to the adjacent existing floor. While the structural impacts of the raised floor are within reason, there are some architectural impacts that are not ideal. Furthermore, the raised floor has a substantial cost of about \$985,000 associated with it.

An acoustical analysis is also performed with regards to noise from mechanical system fans. This analysis indicates that the redesigned system will allow for the removal of existing sound attenuators and duct lagging in the area of redesign. The removal of this equipment results in an estimated savings of \$45,000 in initial costs.

In general, the replacement of the existing overhead distribution system is not recommended. While there are potential benefits to UFAD and DV systems, they are not appropriate for a facility of this nature. They may, however, be appropriate for other building types.