



DALLAS CENTER GRIMES SCHOOL DISTRICT ADMINISTRATION BUILDING

ENGINEERING STUDY
2405 W 1ST STREET
GRIMES, IA 50111

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I. Executive Summary Letter

On Monday, February 24, 2025, Baker Group conducted a review of the HVAC systems at the Dallas Center Grimes – Administration Facility, located at 2405 W 1st Street. The assessment focused on the building's heating and cooling infrastructure, which includes a fully redundant VRV heating and cooling system, supplementary heating units, and a stand-alone dedicated outdoor air system (DOAS).

Baker Group gathered essential building design data, including plans, installation drawings, and the IOM manual, to assess whether the HVAC system was properly sized for its intended use. Using Trane Trace 3D software, heating and cooling loads were calculated, while room occupancy loads were determined based on the architectural floor plans.

Our findings indicate that the original HVAC system is adequately sized to meet the building's heating and cooling needs. However, there are concerns related to improper design and ductwork installation, which may hinder the system's performance. Specifically, the outdoor air system could struggle to provide sufficient dehumidification due to an improper airflow balance throughout the building.

Additionally, issues with ductwork installation could exacerbate these airflow imbalances, further impacting the system's ability to maintain consistent conditions. In such cases, we recommend limiting the Dedicated Outdoor Air System (DOAS) to supply only the minimum ventilation required for proper building pressurization.

The HVAC systems at the Dallas Center Grimes – Administration Facility are generally well-sized for their intended functions. While the system performs effectively in most scenarios, attention should be given to the design flaws and ductwork issues that may compromise the dehumidification capacity of the outdoor air unit, especially during high humidity conditions.

Implementing the recommended adjustments will help ensure continued comfort and efficiency within the building. Future monitoring along with these adjustments, including ductwork revisions, may be needed to optimize the system's performance under varying environmental conditions. Further details on our methodology and assessment are provided in the following pages.

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cc

Dale Drent
Mustafa Jahic

II. Existing Facilities Overview & Issues

Original Building Space Considerations

- **Building Area & Usage:** The DCG Admin Building is approximately 9,200 square feet of usable area.
 - 2,100 square feet of dedicated conference room space, including expandable school board meeting space
 - 1,420 square feet of private office space
 - 5,600 square feet of interior offices, corridors, lobbies, and work areas

Original Building HVAC Design Intent

- Primary Heating and Cooling Operations are controlled exclusively through the Daikin VRV (Variable Refrigerant Volume) System with Rooftop Mounted Condensing Units
 - 22 Tons Nominal Cooling
 - 295MBh Heating
- Zone-level heating and cooling are controlled by ceiling mounted fan coil units
 - Refrigerant coil for primary cooling and heating
 - Duct heaters installed downstream of FCU for secondary heating
- Ventilation Air
 - All ventilation air is controlled through a roof mounted dedicated outdoor air system (DOAS)
 - DX Cooling with gas-fired heating
 - Delivers room-neutral air to each fan coil unit

Problems have plagued HVAC operation since building turnover in 2020. These include, but are not limited to:

- Improper System Installation
 - Multiple compressor failures and replacements with our rooftop mounted equipment
 - Refrigerant line installation to indoor fan coil units; Improper line sizes lead to oil return problems and compressor failure
- System Management Misconceptions
 - System designed to run as fully redundant LEAD/LAG. With two compressors in the system, one compressor can be set as the lead machine, and the other as the lag machine. When the pressure drops to a certain point on the lead compressor, the lag compressor will then take over.
 - Improper owner training at turnover may have led to misunderstandings of how the system functions.

III. Engineering Assessment

Baker Group collected key building design information, such as plans, installation drawings, and the IOM manual, to evaluate whether the HVAC system was appropriately sized for its intended purpose. Heating and cooling loads were calculated using Trane Trace 3D software, and room occupancy loads were estimated based on the architectural floor plans.

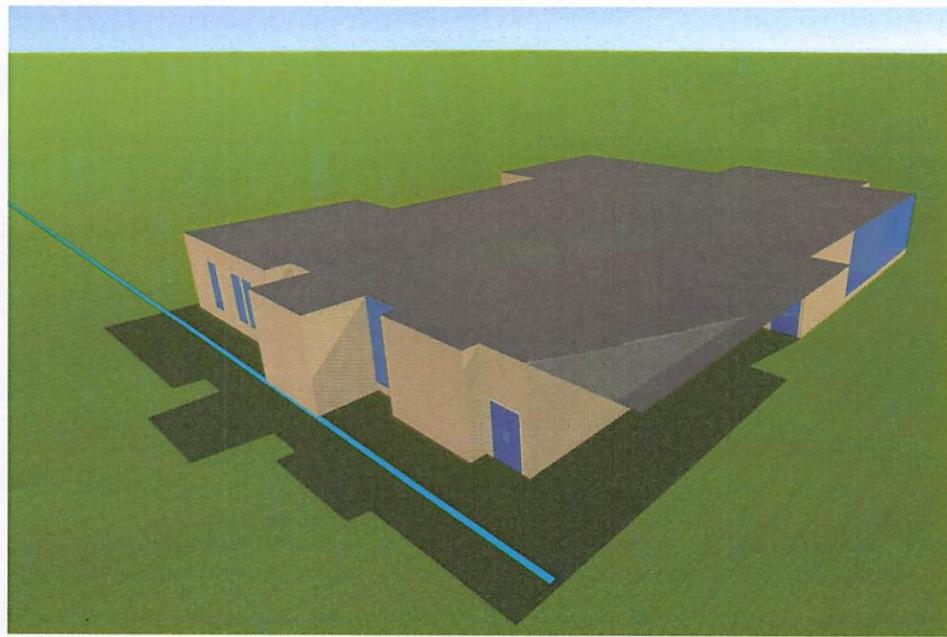


Figure 1: Trace 3D Building Model – Exterior, View Looking NE

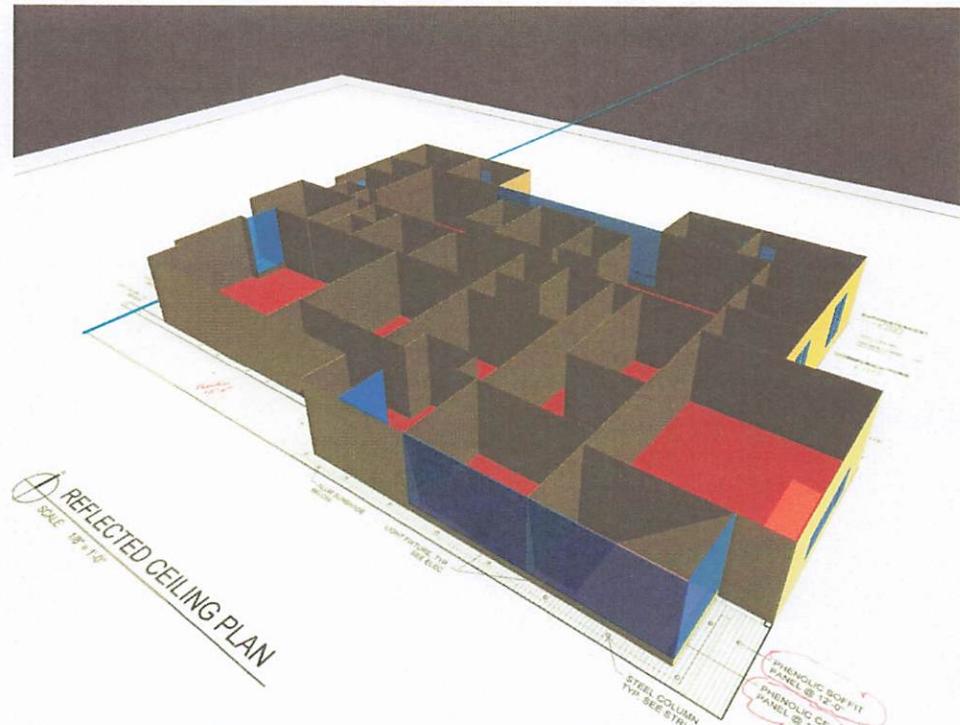


Figure 2: Trace 3D Building Model – Interior, View Looking NW

After performing multiple building load simulations using the Trane Trace 3D software, we determined that the total cooling load for the building is approximately 10,500 CFM at 26.5TONS. This equates to the following:

CFM/SF	1.15
CFM/Ton	395
ft²/ton	345
Cooling BTU/ft²	35
Heating BTU/ft²	33

Table 1: Engineering Checks

It should be noted that the figures above fall within industry standards for commercial office buildings and therefore can be used to verify that our existing system is sized accurately.

It should also be noted that the figures above include both sensible and latent cooling. For a VRV system with a Dedicated Outdoor Air System like the type installed at the DCG Administration Building, we need to account for these figures individually.

Sensible Clg BTU/h	245,000
Vent. Clg BTU/h	75,000
Sensible Clg (Tons)	20.5
Vent. Clg (Tons)	6.25

Table 2: Sensible vs Ventilation Cooling

In a Variable Refrigerant System like the one installed at the Dallas Center Grimes administration building, the sensible cooling load is handled by the rooftop mounted condensing units. The latent cooling load is handled independently by the Dedicated Outdoor Air System. When we compare the calculated loads to the installed tonnage, we can see that the figures align within 10-20% of the calculated values

	Calculated	Installed
Sensible Clg (Tons)	20.5	22
Ventilation Clg (Tons)	6.25	8
Sensible CFM	9,225	9,103
Ventilation CFM	1,260	1,800

Table 3: Calculated vs. Installed Capacities

Once capacities were verified, we then investigated the installation drawings to determine if there were any notable discrepancies in the design. We determined that conditions may exist where the outdoor air system could struggle to provide sufficient dehumidification due to an improper airflow balance throughout the building. Additionally, issues with ductwork installation could exacerbate these airflow imbalances, further impacting the system's ability to maintain consistent conditions.

The Valant Dedicated Outdoor Air System was designed to deliver 1,800 CFM of outdoor air into the conditioning it to ensure proper ventilation and indoor air quality. It handles dehumidification, temperature control, and supplies fresh air to maintain building pressurization. By managing these tasks separately, it allows the main VRV system to focus on heating and cooling indoor spaces more efficiently.

However, the installed system at the DCG Administration Building has a design flaw that may potentially be impacting the indoor air, especially during high humidity conditions.

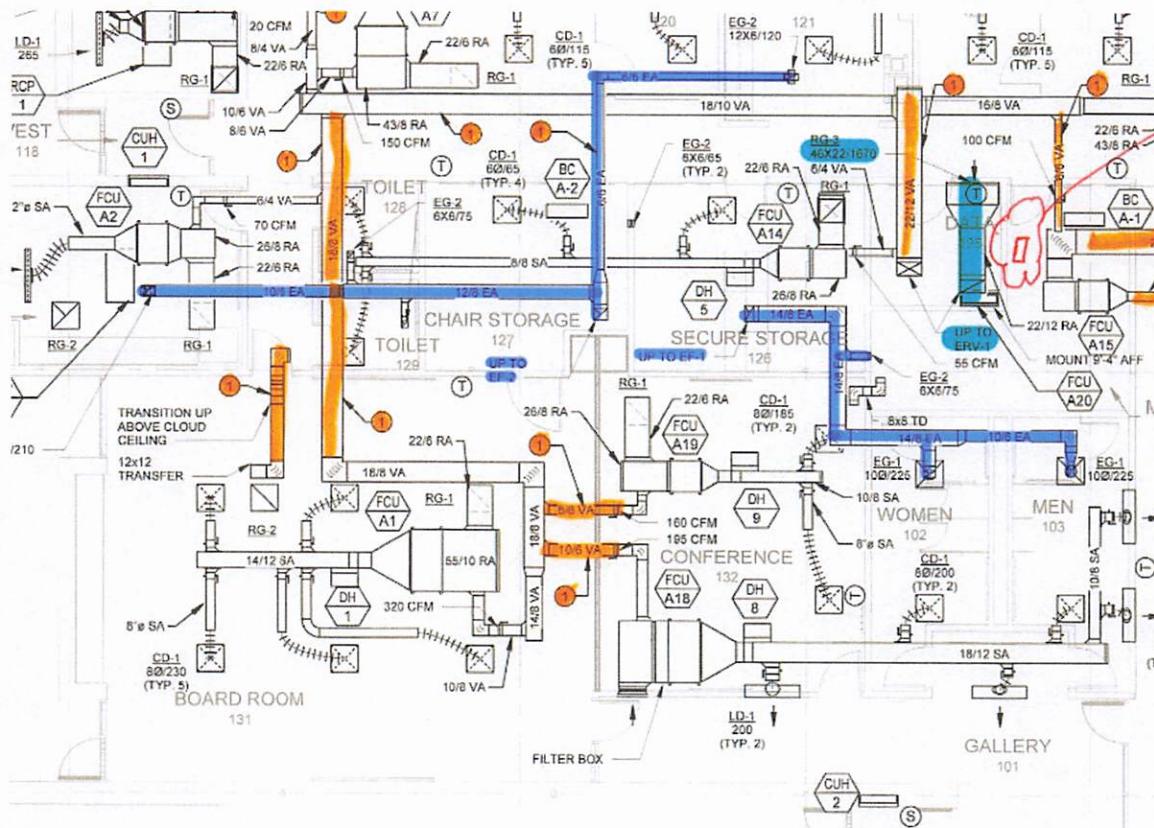


Figure 3: DCG Admin Building Partial Ductwork Plan

The DOAS unit at the DCG Administration Building is designed to deliver 1,800 CFM of supply air while returning 1,800 CFM from the building. The building's dehumidification is based on the unit running at full capacity. However, two separate exhaust fans are installed and ducted independently, which likely restricts the airflow returning to the DOAS unit.

In the diagram above, the exhaust air is shown in purple, and the DOAS return air is shown in blue. Typically, all exhaust air, including general restroom exhaust, should be routed back to the DOAS unit, especially when it includes an enthalpy wheel. This setup allows the unit to maintain proper building pressure while operating at its design capacity. However, when the exhaust duct is routed separately, the air is removed without passing through the enthalpy wheel, limiting its effectiveness. As a result, the DOAS unit's capacity is reduced, which could also lead to building pressure issues.

VI. Recommendations

Baker Group recommends that the first step be to route all general exhaust air to the DOAS unit. This will ensure that the enthalpy wheel operates as designed, delivering the necessary supply air and providing the correct DOAS discharge air temperatures for full dehumidification throughout the building.

The following modifications will be required:

1. Disconnect and remove the existing roof-mounted exhaust fans
2. Revise the current exhaust air ductwork to route all exhaust to the DOAS unit
3. Install one (1) in-line booster fan for exhaust air
4. Rebalance building airflow to be controlled through the DOAS unit

The budget cost for the above scope of work is \$23,580.00.

The new exhaust ductwork installation is shown below (in green):

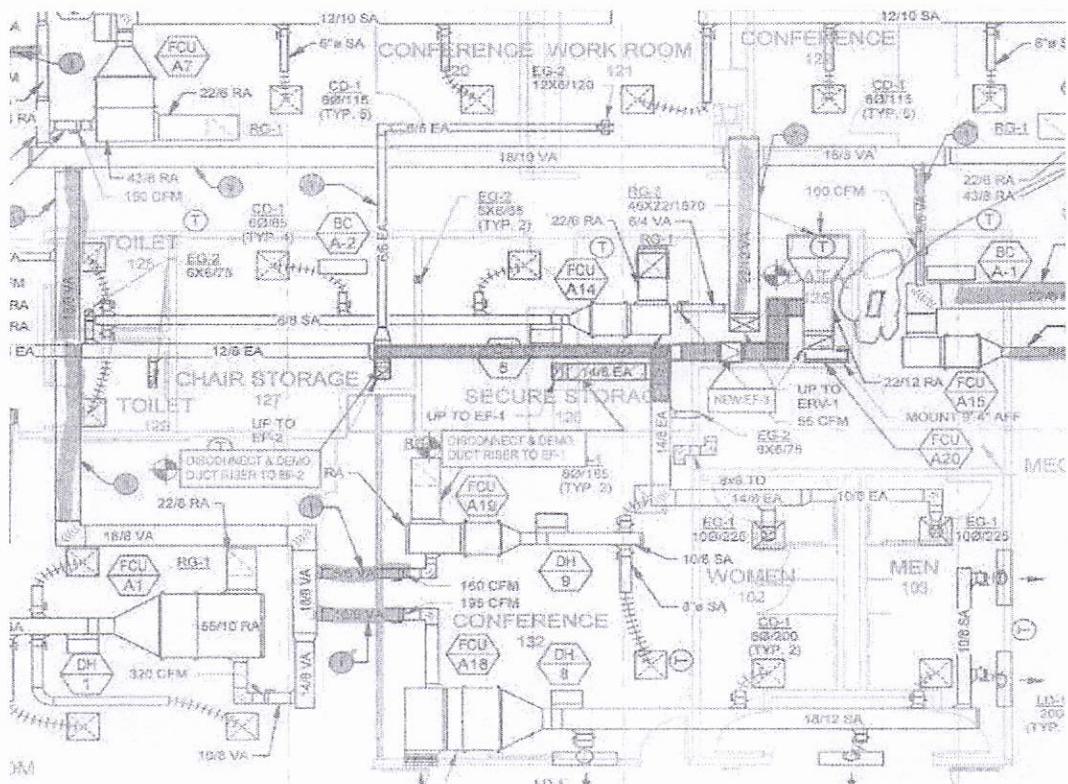


Figure 4: Proposed Exhaust Ductwork Modifications

Additionally, we believe that there may be annual energy savings of \$1,600 when compared to how the system is currently being operated.

This repair / system modification is needed to make the system operate properly. Currently the way the system runs, it is causing comfort issues as well as creating an environment in the summer where mold spores can grow. Because this modification is directing the exhaust air through the DOAS unit it will reduce energy consumption as well. The reduced energy alone will not pay for the modification, but the modification will allow the building to operate at the proper airflow conditions.

Once these revisions are implemented, it will be important to monitor outdoor air conditions and the performance of the enthalpy wheel. On especially humid days, we may consider reducing the amount of outdoor air to improve the system's overall performance.

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