

The Invisible Engine: Digitally Engineering the Art Institute of Chicago's Grainger Center

How Roots BIM LLC utilized fabrication-level coordination to protect humanity's cultural heritage.

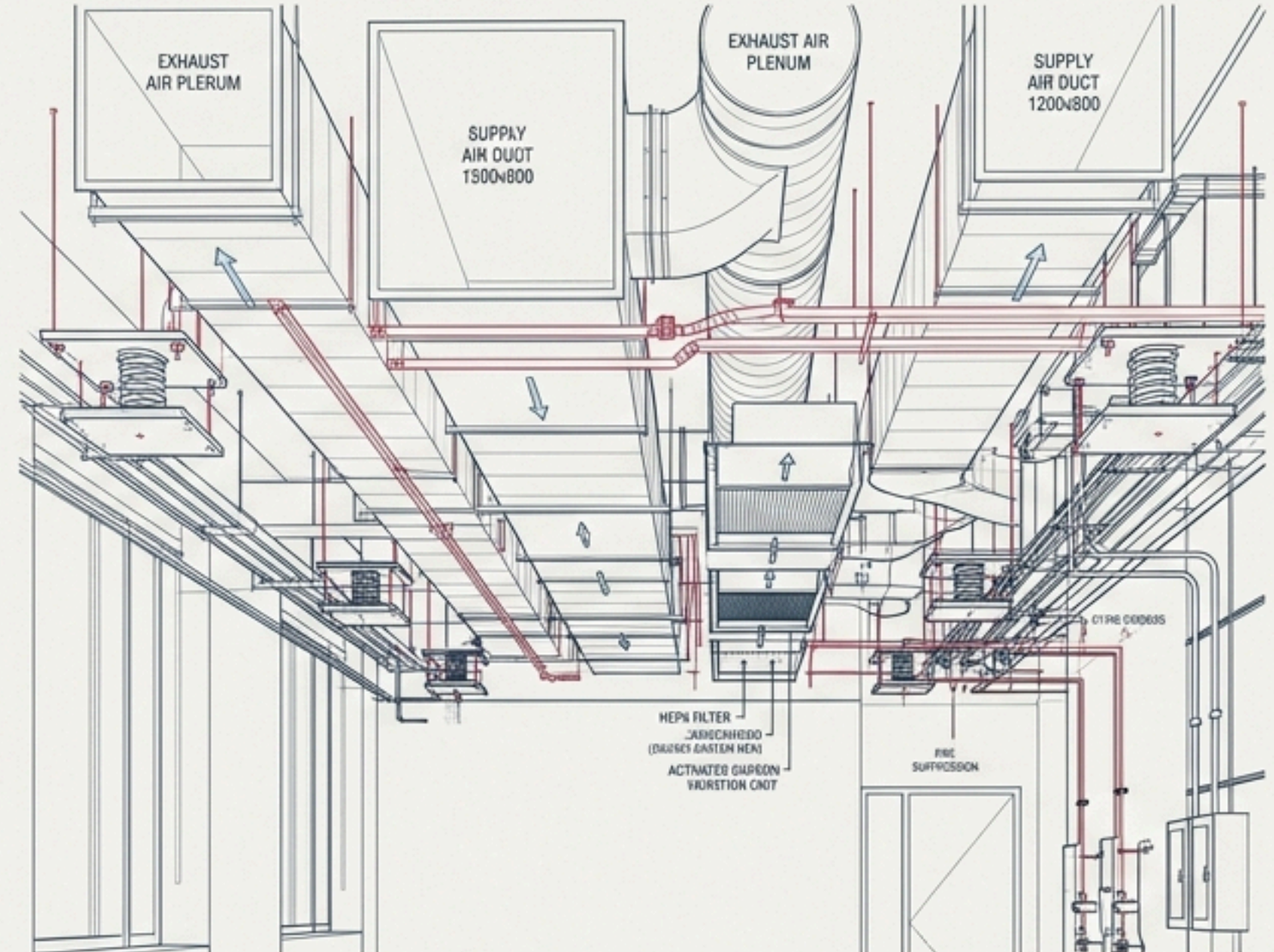


Some buildings protect people. Others protect history itself.

FRONT-STAGE



BACK-STAGE

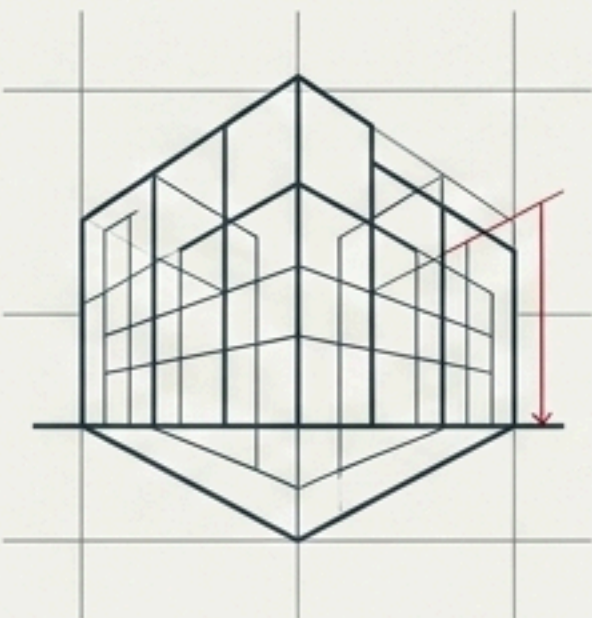


When engineers coordinate a hospital, precision saves lives.
When they coordinate a conservation laboratory, precision
preserves centuries of human civilization.

The Grainger Center for Conservation and Science is the Art Institute of Chicago's first purpose-built facility dedicated to the long-term preservation of its extraordinary collection of 300,000+ artworks. Constructing its invisible infrastructure was one of the most technically demanding coordination projects undertaken by Roots BIM LLC.

Defining the Parameters of a World-Class Conservation Hub

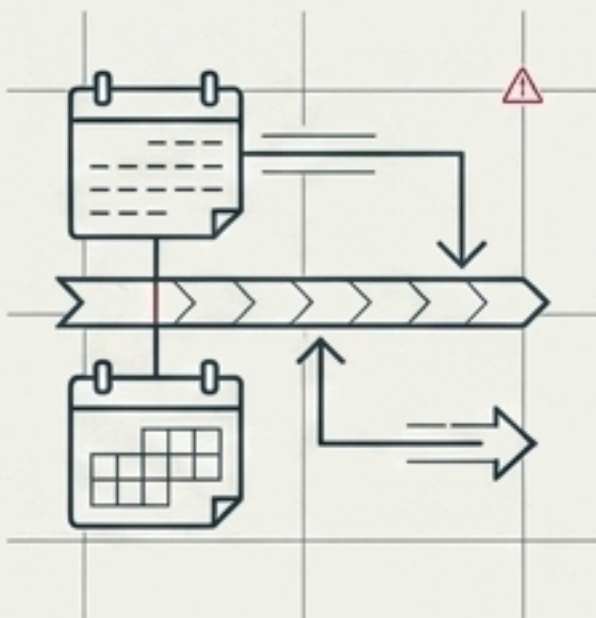
PROJECT BLUEPRINT



Project: Grainger Center for Conservation and Science

Client: The Art Institute of Chicago
(111 South Michigan Avenue, Chicago, IL)

Area: ~25,000 Square Feet

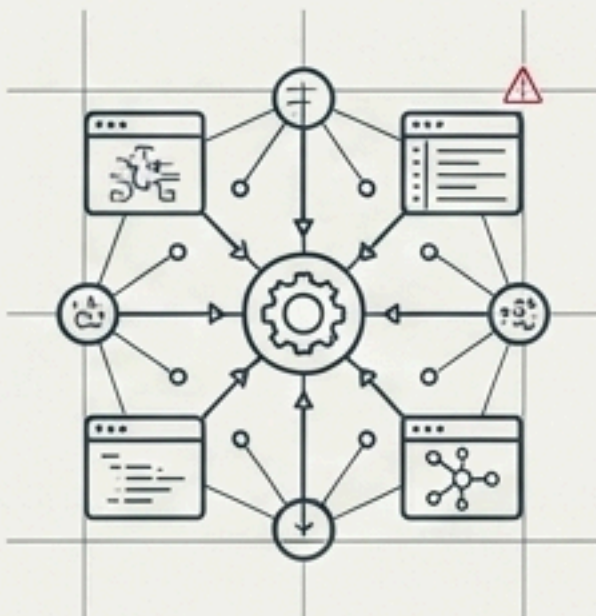


BIM Duration:
May 2026 – August 2026

Construction Execution:
Spring 2026 – Fall 2027



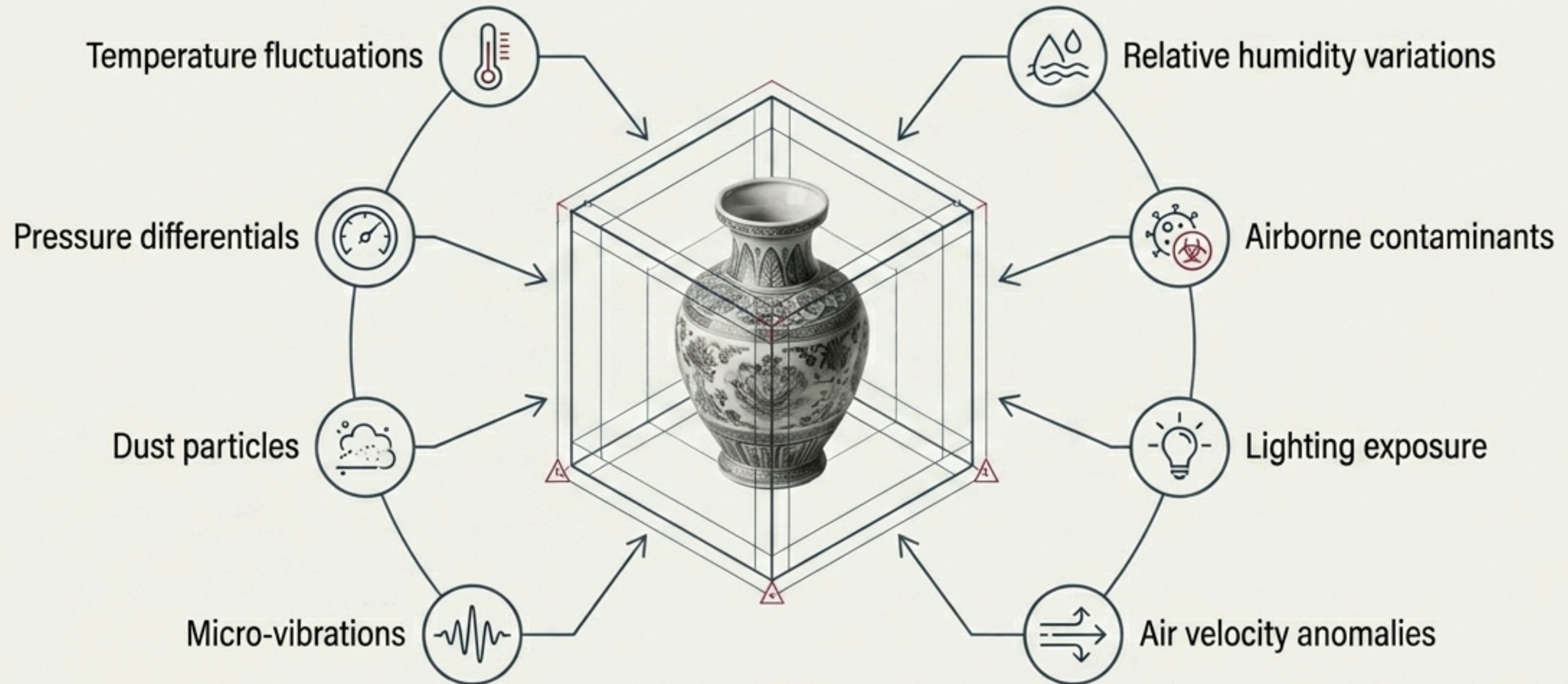
Engineering Team:
4 Dedicated Roots BIM
Engineers leading dense
multidisciplinary
coordination.



Core Software:
Autodesk Revit 2025
(Parametric Modeling) &
Autodesk Navisworks 2025
(Model Federation &
Clash Detection)

The Threat Matrix: Why Conservation Facilities Defy Standard Engineering

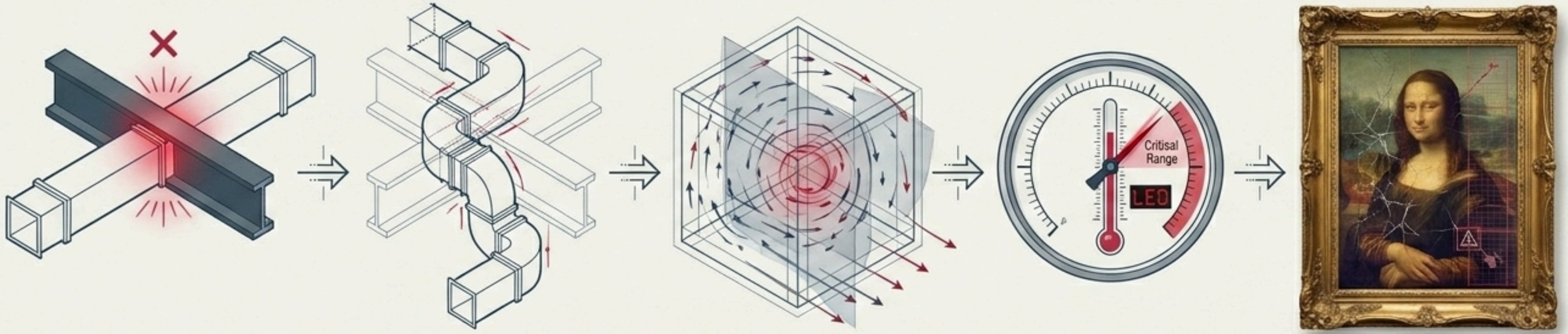
Unlike conventional buildings, conservation laboratories demand absolute museum-grade environmental stability. A single uncontrolled HVAC airflow can permanently damage centuries-old artwork.



Engineering Tailored Micro-Climates for 12 Distinct Disciplines

Conservation Discipline	Primary Vulnerability	Rigid MEP Engineering Mandate
Paintings	Canvas deformation and cracking	Highly stable humidity control
Textiles	Fabric degradation	Contamination-controlled airflow
Paper & Photographs	Airborne pollutants and moisture damage	Tightly regulated moisture & specialized pollutant filtration
Time-Based Media	Degradation of legacy technology	Specialized environmental controls for digital preservation
Sculptures & Archeology	Particulate spread during restoration	Precision localized extraction systems

The Cascade of Failure: When Physical Space Compromises Climate Control



Step 1: Uncoordinated duct-to-beam clash discovered during physical installation.

Step 2: Contractor executes an unplanned spatial workaround to fit the duct.

Step 3: The workaround fundamentally alters planned HVAC air velocity and pressure differentials.

Step 4: The altered airflow creates a localized micro-climate variation.

Step 5: Centuries-old artifact suffers accelerated deterioration, or delicate million-dollar laboratory equipment installation is delayed. Virtual coordination is the only way to break this chain.

Virtual Assembly vs. Field Discovery

Complex engineering problems cannot be solved during construction. They must be solved virtually—before a single component reaches the site.

Field Discovery (Traditional)

Reactive, relying on RFIs and field adjustments.

Exponential cost multipliers for rework.

Unpredictable, prone to trade stacking.

Risk of dismantling delicate lab infrastructure years later.

Virtual Assembly (BIM)

Proactive, systems digitally assembled and validated beforehand.

Clashes resolved in software at zero material cost.

Optimized, predictable, and fully planned.

Exact service clearances and maintenance access zones verified pre-construction.

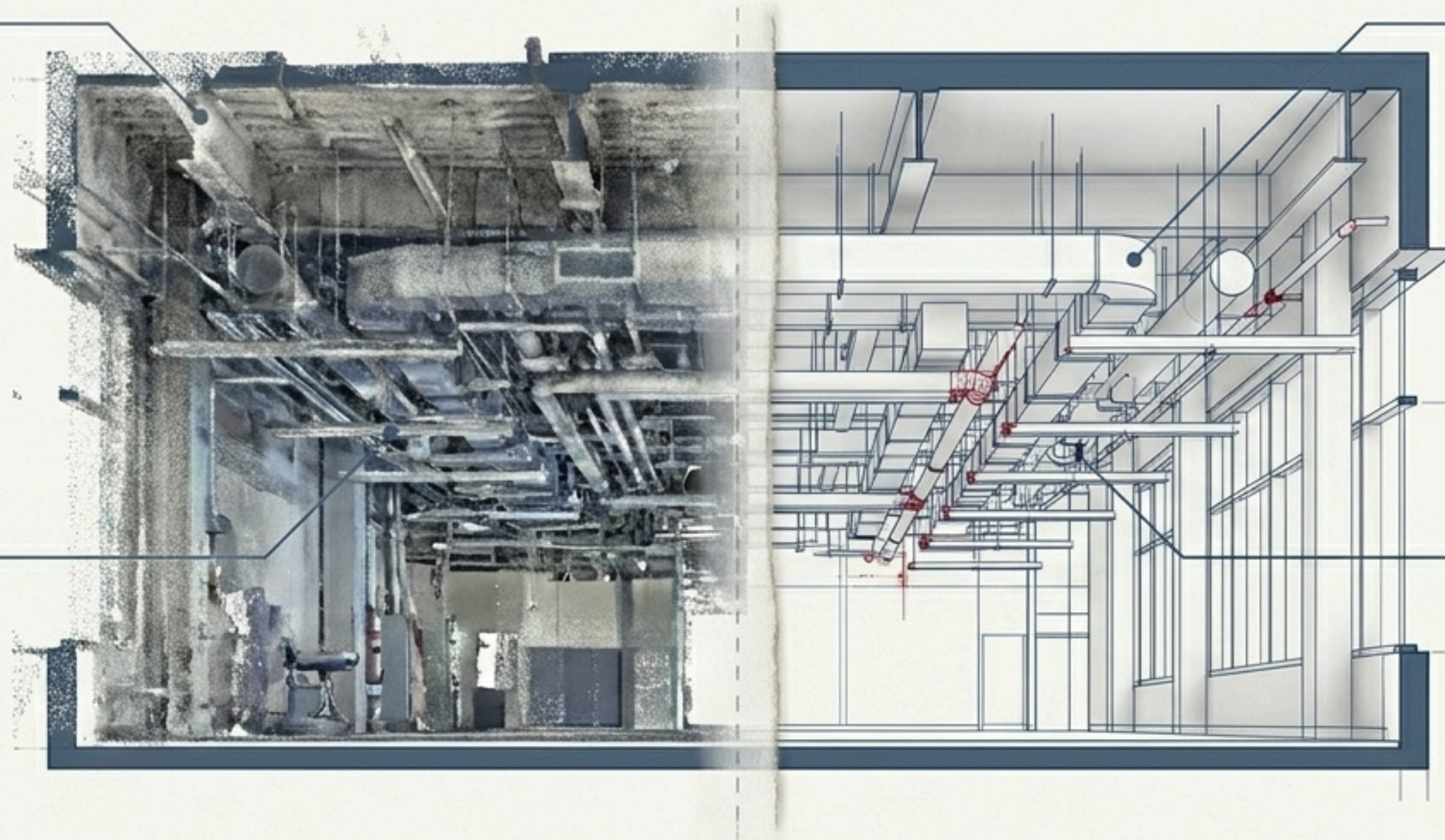
Anchoring Design in Reality: The Scan-to-BIM Foundation

Existing building conditions rarely match legacy drawings. Eliminating assumptions was step one for the Grainger Center.

Scan-to-BIM Overlay

Captured actual structural geometry and ceiling elevations.

Identified critical field deviations immediately.

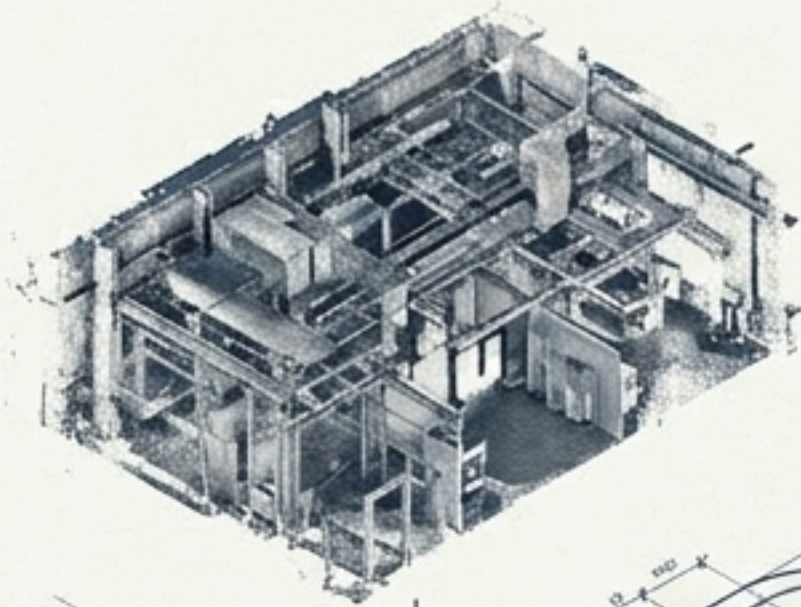


Modeled existing utilities and hidden building constraints.

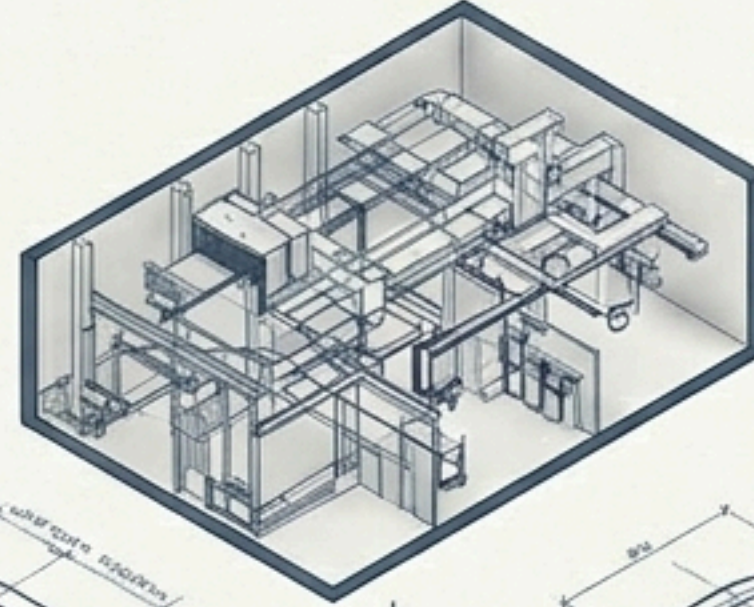
Ensured every subsequent engineering decision was based on the actual physical environment.

A Multidisciplinary Digital Ecosystem

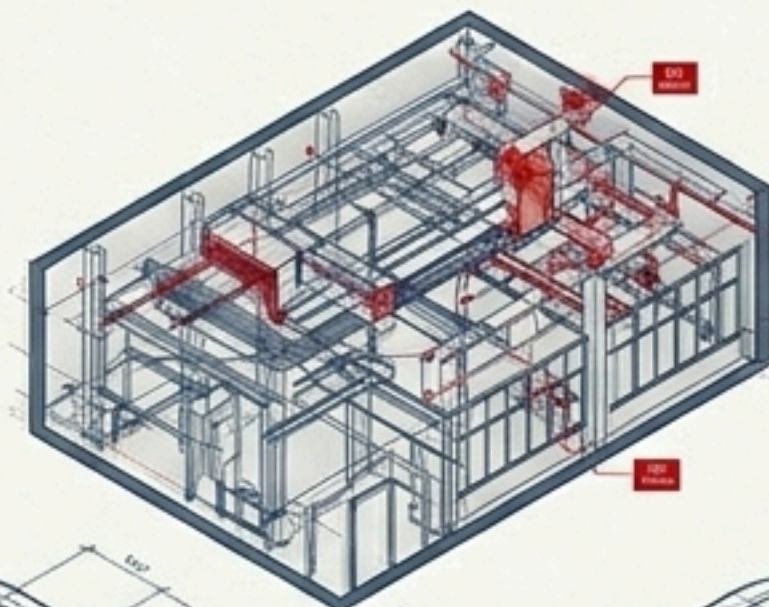
Station 1:
Scan-to-BIM



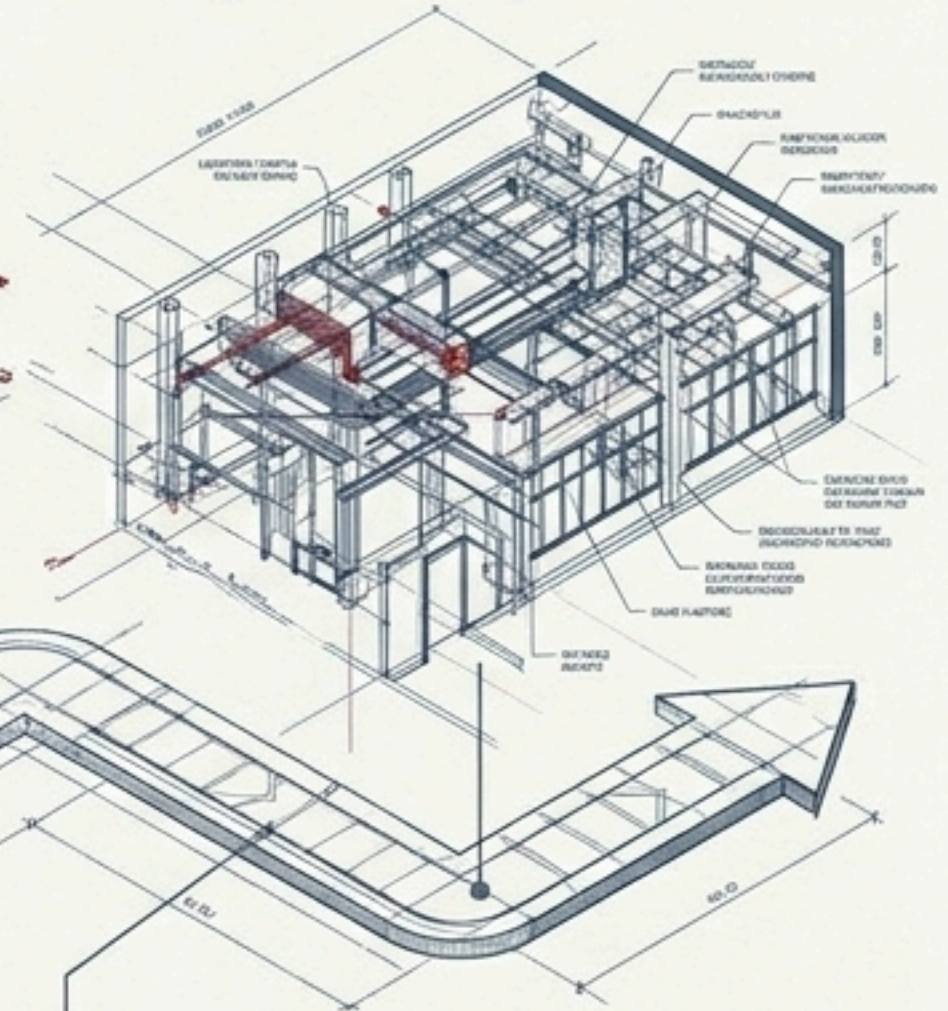
Station 2:
Mechanical BIM Modeling



Station 3:
Clash Detection &
Lead Coordination



Station 4:
Shop Drawing Development



Structural

Capturing the baseline reality to reduce uncertainty.

Developing air handling, supply/return, laboratory ventilation, and equipment supports with fabrication-level accuracy. Constructability is the primary objective.

Densifying mechanical, structural, architectural, and laboratory infrastructure into a single federated model to eliminate interference.

Transitioning from coordinated models to fabrication-ready deliverables for field execution.

The Software Ecosystem Driving the Coordination

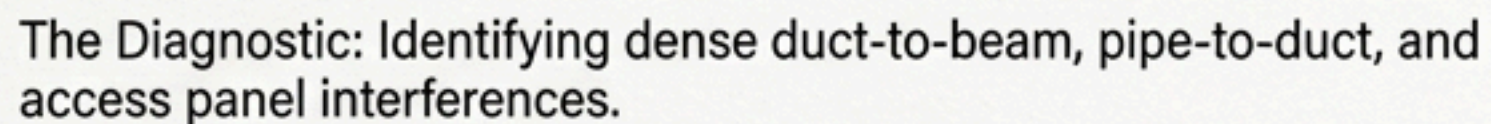
Tech Stack Gear Diagram

Autodesk Revit 2025:
Drives Mechanical BIM modeling, parametric component development, coordination modeling, and shop drawing generation.

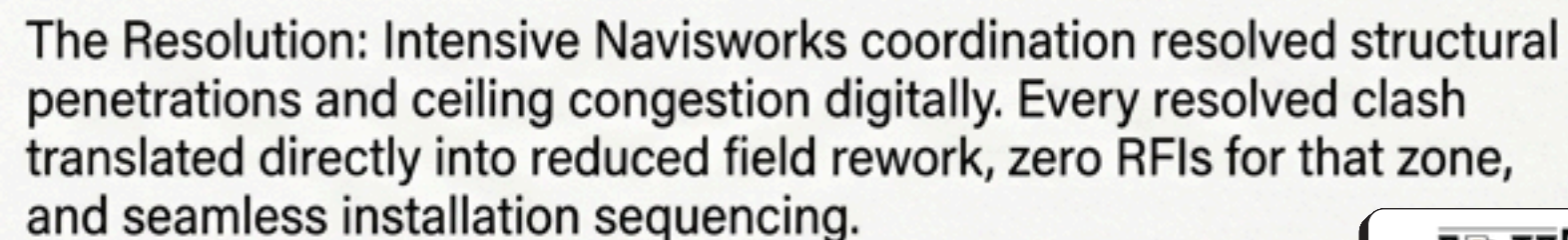
Autodesk Navisworks 2025:
Drives model federation, exhaustive clash detection, issue tracking, and interdisciplinary coordination reviews.

Pre-Construction Validation:
Together, these platforms created a collaborative digital environment where every engineering decision was validated before physical construction began.

Before

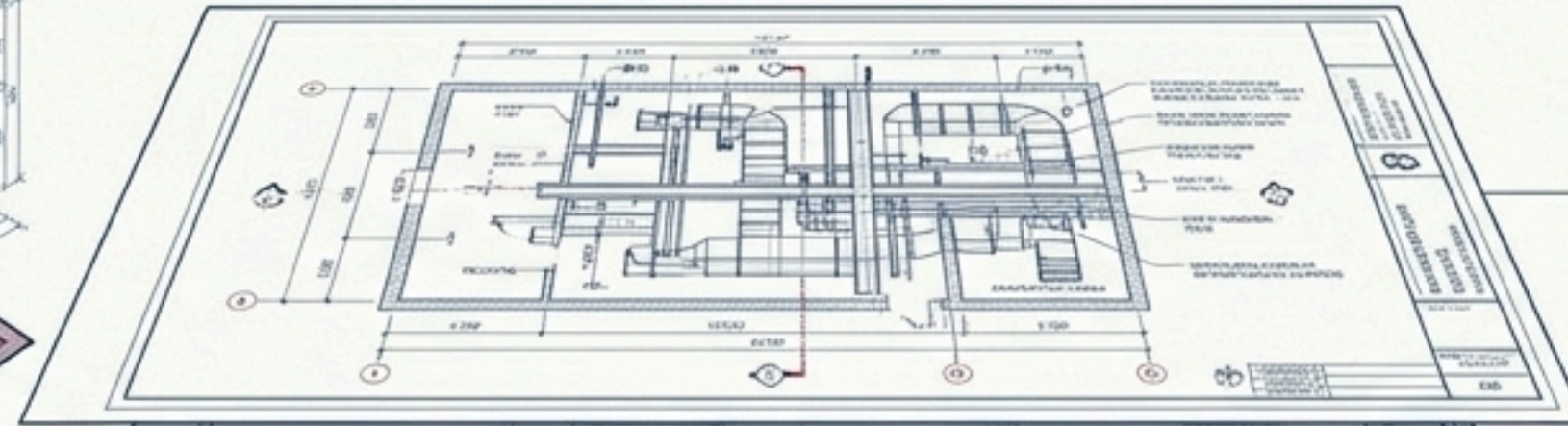
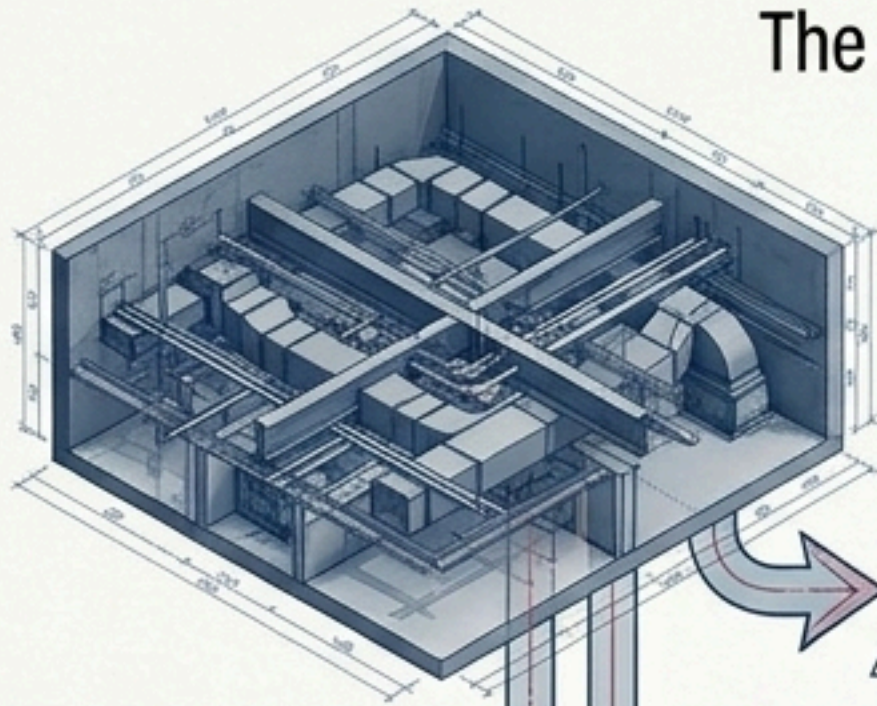


After

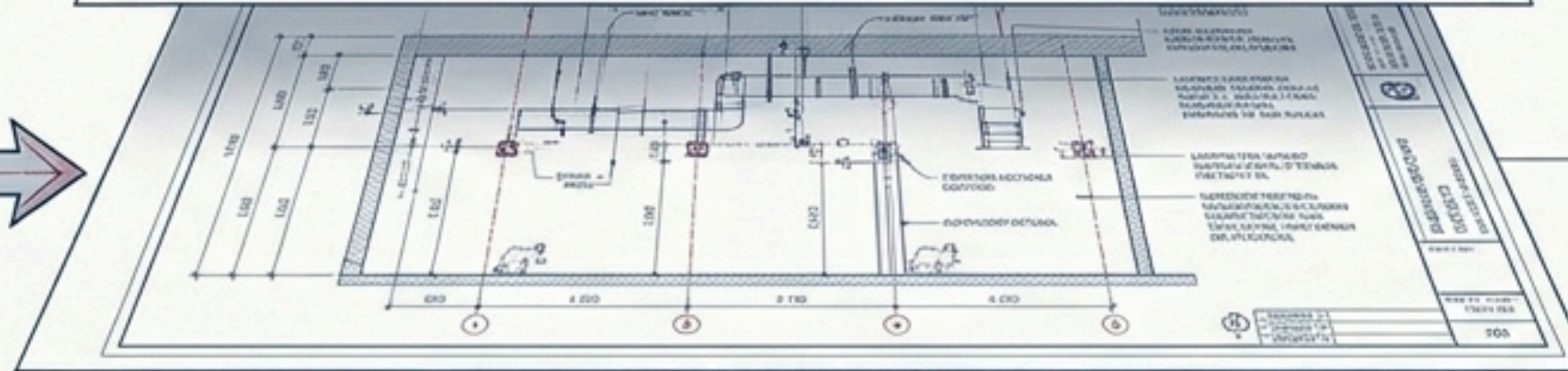


From Virtual Perfection to Fabrication-Ready Execution

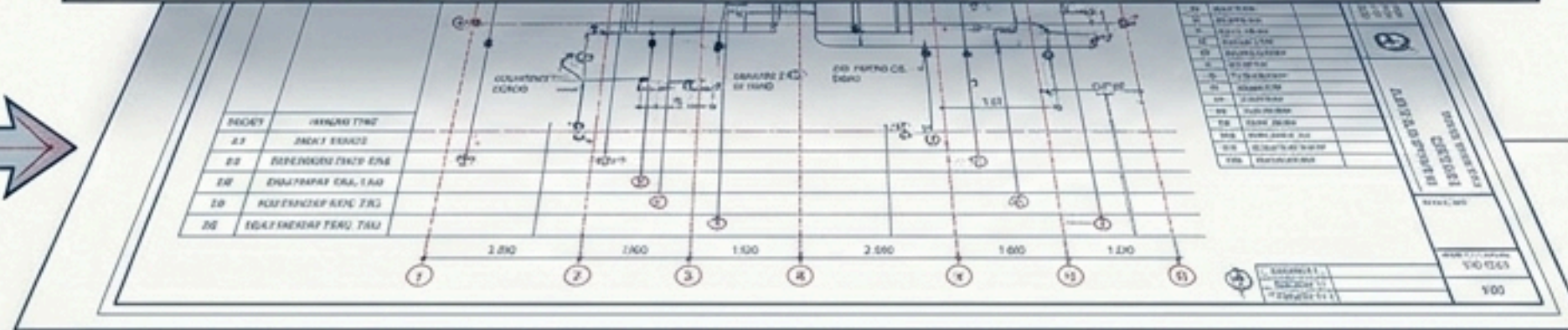
The most coordinated model is useless if the field cannot build it.
Models transition directly into executable documents.



Dimensioned installation drawings and section views.



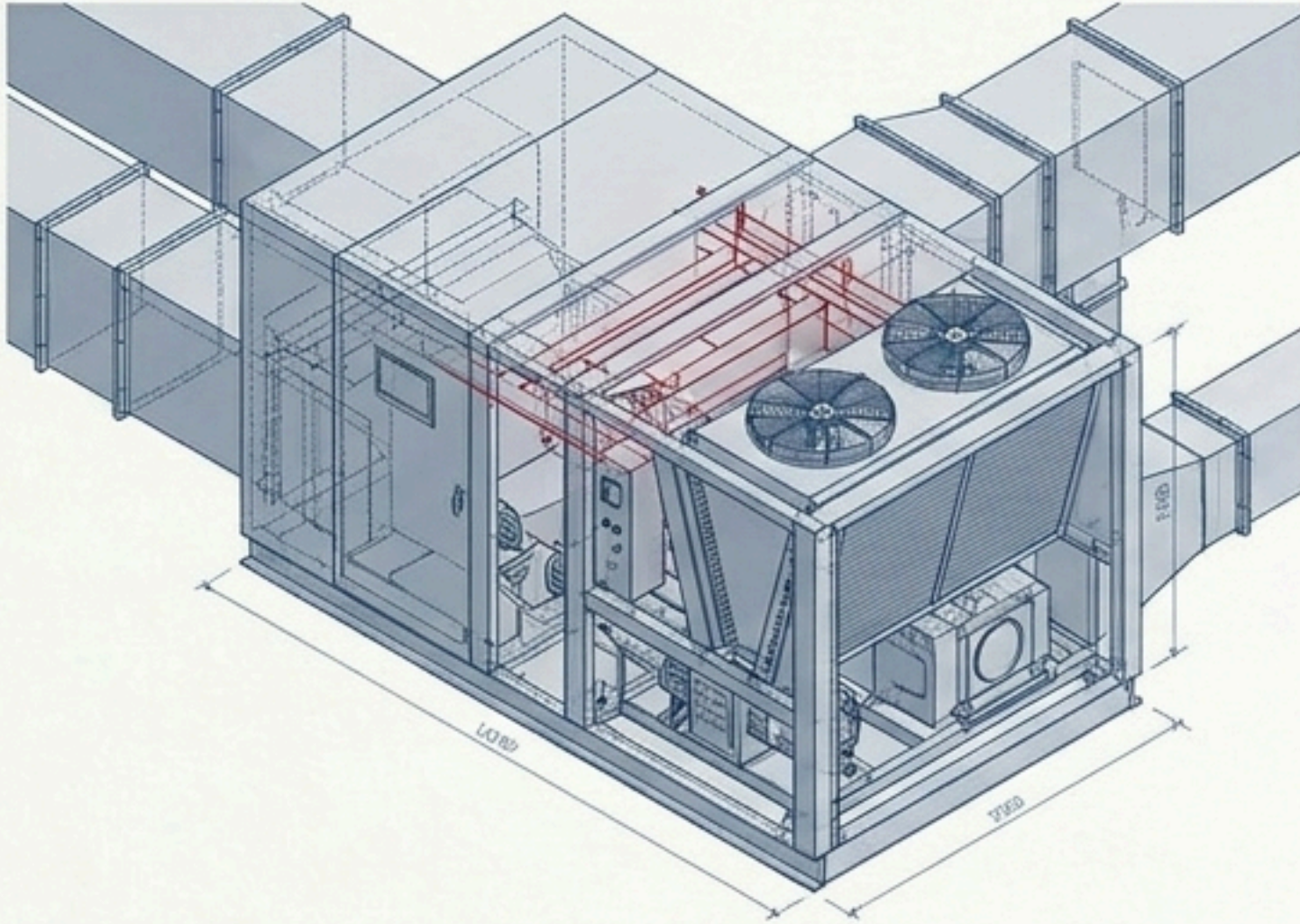
Precise mechanical layouts and fabrication details.



Equipment schedules and exact hanger locations.

The Result: Contractors install systems with absolute confidence, minimizing field interpretation and eliminating guesswork.

Constructability is Preservation



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The Grainger Center is more than a building; it is a scientific instrument dedicated to safeguarding cultural heritage.

In a conventional building, a mechanical clash is a financial nuisance. In a conservation laboratory, a clash compromises the very climate control required to protect a 19th-century masterpiece.

Perfect physical preservation requires perfect virtual construction. BIM extends beyond modeling—it is the engineering intelligence platform that transforms complexity into constructability.

Building Digital Confidence Before Construction Begins

