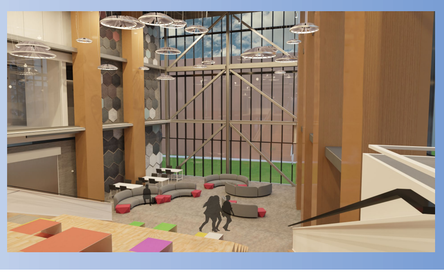
Tarrant County College Student Success Center
Fort Worth, Texas

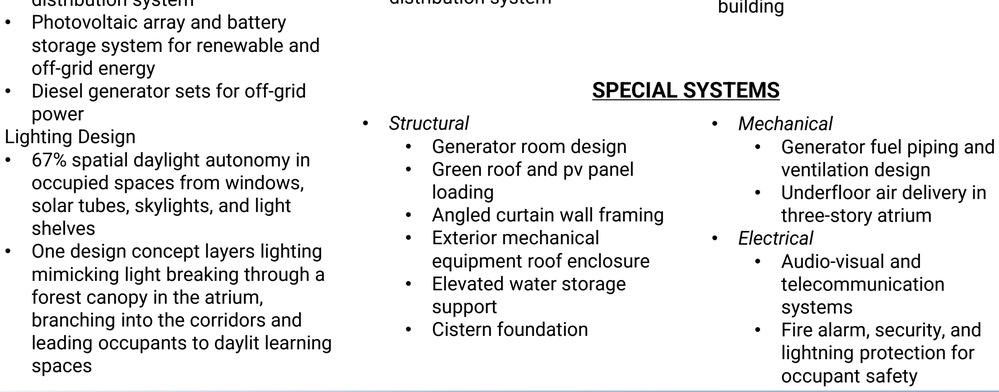
Interdisciplinary Capstone Project




Project Overview

Interdisciplinary teams engineered fully integrated designs for the Student Success Center on the Tarrant County College campus in Fort Worth, Texas, a 3-story, 153,490sf building with classrooms, administration spaces, and a large atrium. The budget of $42M includes the base engineering of the building with additional project challenges:
1) resiliency to handle natural disasters; 2) emergency planning for utilities; and 3) overall building performance enhancements.
The intent is to create an inviting space focused and designed around the college's desire to be <u>one college</u>, <u>student ready</u>, and to <u>serve the community.</u>



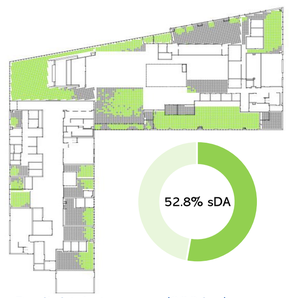
Design Challenges

Resilient Building – Natural Disasters
- Community Shelter
- Safe Room
- Protected Utilities
- EF-3 rated facility
- EF-5 rated storm shelter
- Protection of mechanical and electrical systems that were designed with resiliency and redundancy in mind
- EF-5 rated windows to maintain structural integrity and thermal performance while allowing daylight in the space

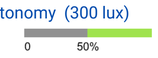
Emergency Planning - Utilities
- Full Power for 2 Days
- 40% Square Footage Powered for 5 Additional Days
- 2 Dedicated Emergency Panels

Building Performance Enhancement
- 54.6% Reduction over ASHRAE 90.1 Baseline
- Improved Daylight Access of Regularly Occupied Spaces with 53-67% sDA
- Integrated Acoustic Solutions
- Green Roof with Photovoltaics

Floor One sDA

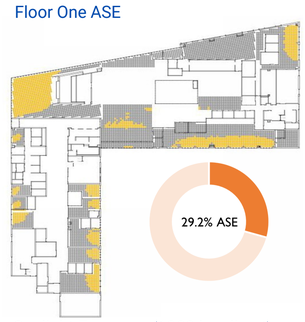


Daylight Autonomy (300 lux)



Floor One UDIa

Floor One ASE



Sunlight Exposure (1000 lux direct)

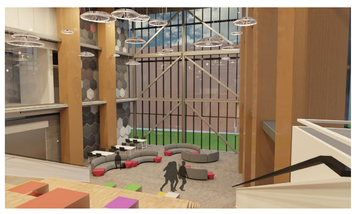
Engineering Design

INTEGRATION

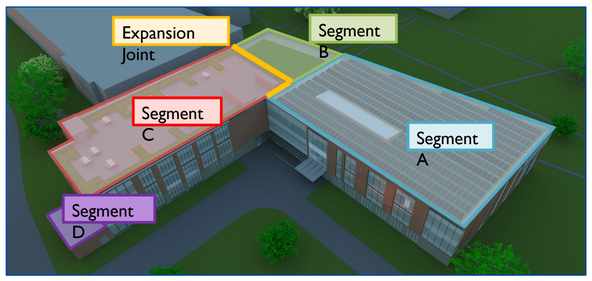
Roof Coordination
- Green roof and photovoltaic array integrated mounting system for improved array efficiency and enhanced thermal performance
- Skylights and solar tubes increase daylight in the building core

Atrium Design
- Curtain wall reduces glare and lowers the solar heat gain while adding an architectural focal point
- Raised floor system for supply air and powered floor boxes
- Custom shading system for control of daylighting
- Suspended, integrated lighting and acoustic fixtures

Shelter and Safe Room Design
- EF-3 rated community shelter
- EF-5 rated safe room
- Mechanical and Electrical systems maintain full operation in emergency conditions



Atrium



Segments A&B EF3 resilient community shelter
Segments C&D EF5 resilient safe room

ELECTRICAL SYSTEMS

Power Systems Design
- 2500 A, 480Y/277V microgrid distribution system
- Photovoltaic array and battery storage system for renewable and off-grid energy
- Diesel generator sets for off-grid power

Lighting Design
- 67% spatial daylight autonomy in occupied spaces from windows, solar tubes, skylights, and light shelves
- One design concept layers lighting mimicking light breaking through a forest canopy in the atrium, branching into the corridors and leading occupants to daylit learning spaces

STRUCTURAL SYSTEMS

Gravity system
- Concrete on metal deck roof and floor slabs
- Steel columns and beams selected for flexibility in design

Lateral systems
- CMU shear walls
- Steel moment frames
- Diaphragm design
- Separate lateral system design for safe room and rest of the building

Foundation systems
- Grade beams
- Gravity drilled shaft piles
- Moment frame drilled shaft piles
- Slab on grade with soil improvement
- Depressed slab in atrium to accommodate underfloor air distribution system

MECHANICAL SYSTEMS

Primary HVAC System
- Geothermal loop field with auxiliary fluid cooler for high energy efficiency and renewable heat source

Secondary HVAC System
- Chilled Beams increase indoor air quality due to extra outdoor air demands
- Air Supplied through DOAS units with integral ERV wheel

Building Energy
- Energy model shows the facility exceeds ASHRAE 90.1 baseline by 55%

Rainwater Recycling
- Rainwater is collected from roof area A and B
- Average annual rainfall exceeds flushing requirements for the building

SPECIAL SYSTEMS

- *Structural*
  - Generator room design
  - Green roof and pv panel loading
  - Angled curtain wall framing
  - Exterior mechanical equipment roof enclosure
  - Elevated water storage support
  - Cistern foundation
- *Mechanical*
  - Generator fuel piping and ventilation design
  - Underfloor air delivery in three-story atrium
- *Electrical*
  - Audio-visual and telecommunication systems
  - Fire alarm, security, and lightning protection for occupant safety

Heath, Safety, & Welfare

- Fire alarm and sprinkler system meet life safety requirements
- Security system for safety and peace of mind.
- The entire building can survive an EF-3 tornado and continue normal operations and provide community shelter
- A portion of the building can withstand an EF-5 tornado and is designed as a safe room
- Chilled beams provide 2-3 times ventilation as required by code to prevent spread of disease
- Automatic window shades and light shelves prevent glare in classrooms while carrying daylighting further into the building
- Acoustic paneling and STC rated walls optimize acoustics in learning spaces
- Structural members designed to protect occupants during natural disasters using ASCE 7-10.

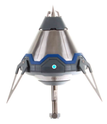
LEED

The Leadership in Energy and Environmental Design standard promotes sustainability. In accordance with the college's sustainability initiatives, the team aims to develop a LEED Certification, with the desire to earn LEED Gold by means of light, sound, and thermal comfort.

WELL

WELL V2 Certification considers six design principles based on the project being equitable, global, evidence-based, technically robust, customer focused, and resilient. The Student Success Center has been designed with anticipation of achieving a WELL Gold certificate.

Security
- Pan-Tilt-Zoom Cameras
- Card Access
- Gunshot Detection
- Panic Buttons



Prevectron 3

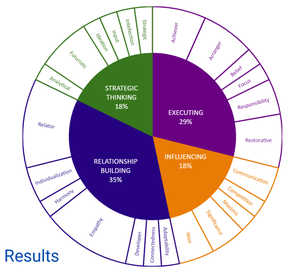
Lightning Protection

A Prevectron 3 active air terminal was utilized for this project. Energy stored in a capacitor during a storm is released as lightning is about to strike, which brings the strike down safely through the grounding system. This system is efficient as it uses much less material because one active air terminal provides coverage to the entire building.

Knowledge and Skills Gained

Soft Skills

Essential skills, often referred to as "soft skills" were developed and honed through this rigorous academic-year activity. These are requirements for professional engineers to make impactful contributions to the built environment.
- Communication
- Organization
- Critical thinking
- Teamwork
- Professionalism



Clifton Strengths Finder Results

Technical Skills

Structural
- Software: Revit, AutoCAD, L-Pile, RAM Structural System, Bluebeam Revu, Enercalc, MasonryIQ, RISA Systems, Excel
- Gravity, lateral, and foundation system selection and design
- Foundation load transfer, structural redundancy, and system evaluation
- Steel, concrete, timber, and masonry design
- Impact-resistance per ICC-500 and FEMA P-361
- Safe room design

Mechanical
- Software: Trane Trace 700, Revit/BIM 360, Bluebeam Revu, GSHP Geothermal, Climate Consultant, VA Design
- Geothermal design, underfloor air distribution, and chilled beam systems
- ventilation practices
- Multi-entrance plumbing design
- ASHRAE 15 Refrigerant Design
- Primary and secondary system design and selection
- Plumbing and fire protection systems design
- Acoustical analysis

Electrical
- Software: Revit, SKM Powertools, 3ds Max, Rhino 3D, Bluebeam Revu, Climate Consultant, SAM, Enscape
- Power systems and distribution design
- Emergency power back-up
- Renewable, sustainable, and on-site generation
- Lighting design
- Daylighting analysis and design
- Telecommunications, fire alarm, security, and audio/visual infrastructure
- Lightning protection system

Industry Collaboration

Industry professionals provided support throughout by sharing expertise and insight to engineering judgement. Collaboration with professionals allowed students to depth and quality to the engineering designs.

Calculated value of donated professional time : **$339,450**

(19) Mentors: Teams of structural, mechanical, and electrical/lighting engineers from industry supported students through the design process on a weekly basis.

(8) Specialty Mentors: Industry members with specific expertise in acoustics, healthy buildings, codes, shading, and tornado design.

(30) Evaluators: Industry professionals provided feedback on documents and presentations for each submittal.

Project Issued	Coordination Plan	Code Analysis	Schematic Design	Design Development 1	Design Development 2	Construction Documents
July 2021	August 2021	September 2021	October 2021	December 2021	February 2022	April 2022