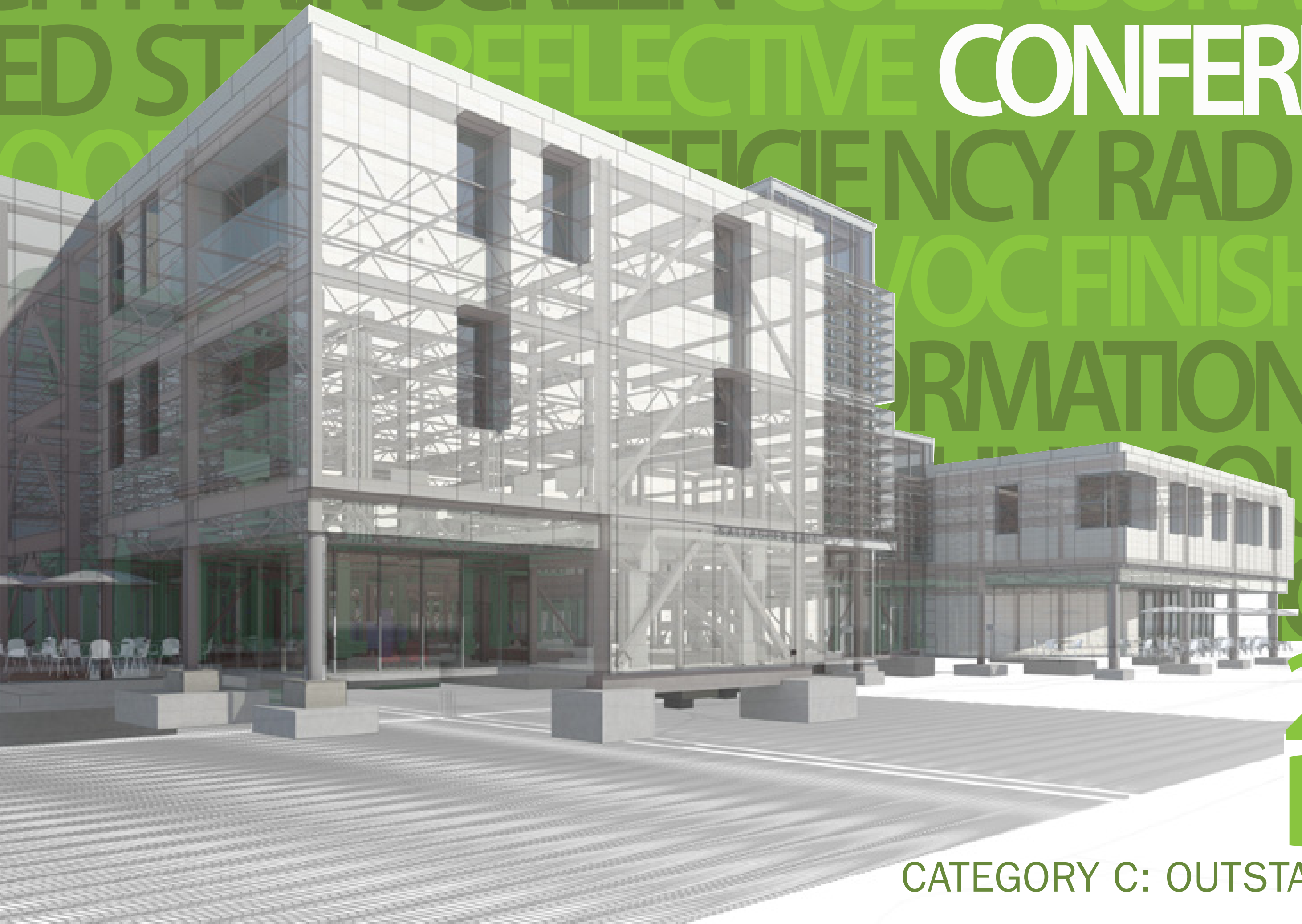
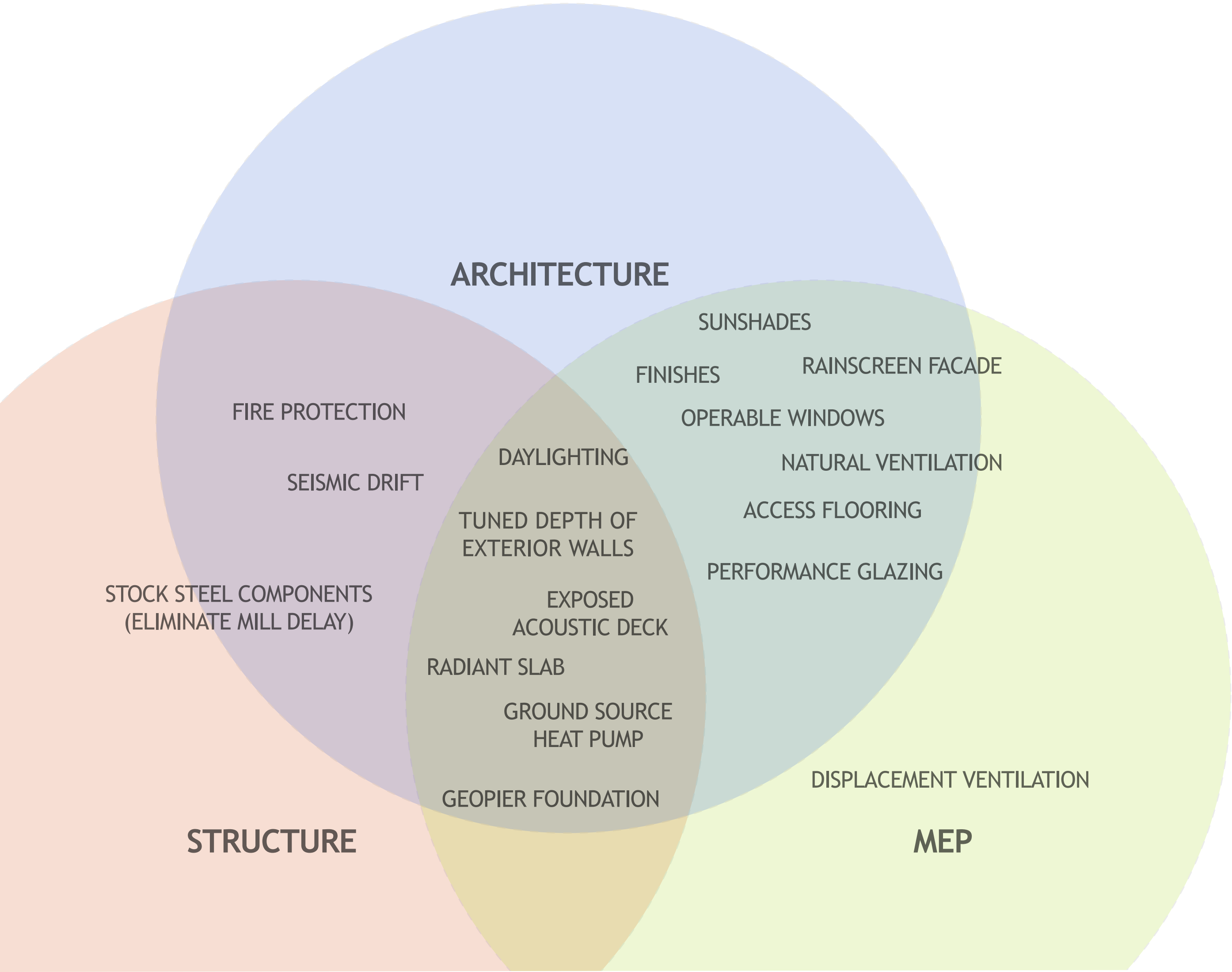
UC DAVIS GRADUATE SCHOOL OF MANAGEMENT & CONFERENCE CENTER



2010 AIA TAP BIM AWARDS

CATEGORY C: OUTSTANDING SUSTAINABLE DESIGN

No premium. Sustainable design through system integration, enabled by Building Information Modelling.



In order to achieve its specific energy performance goals, the design/build team on the Graduate School of Management (GSM) used Integrated Design to balance the architectural, structural, mechanical building needs with the project's budgetary and construction scheduling constraints. Early on, the team realized an integrated design would provide a demonstrable advantage in exceeding the client's energy performance and overall sustainability goals while delivering superior aesthetics, quality, and cost benefits. The University's contract documents required a 20% improvement over the California Title-24 energy standard, but the team knew that through early collaboration these goals could be elevated; the design team aimed to exceed the 2030 challenge targets.

During the competition (schematic) design phase, synergies and trade-offs were considered in an effort to add value and maximize the efficiency of building systems. Conventional finishes and materials, such as suspended acoustical ceilings, were eschewed in favor of systems, such as radiant floor slabs, that satisfy the multiple needs of structure, thermal comfort, acoustics, light fixture attachment, and ceiling finish. This design process led to the development of many sustainable design strategies that were economically viable and embody integrated design, three of which are: **radiant core cooling and heating, a ground-source heat exchange system, and a custom-engineered ventilated "rain screen" façade.** The design/build team then managed the project budget to allow extensive use of sustainable materials and low-flow plumbing fixtures to. The project is pending LEED® certification and is scoring at the cusp between Gold and Platnium certification. This high level of sustainability was delievered at no premium.

Located at a prominent gateway on the south edge of our campus, the GSM was delivered under **tight budget and schedule** constraints. Commitment to the use of BIM and design talent provided the University with an early and accurate understanding of design strategies, materials and systems selection, aesthetic considerations, and cost.

-Owner

A cornerstone of the vision for the campus's new **front door**, a dynamic hub that will better connect UC Davis' world-class academic programs with the region.

-Owner

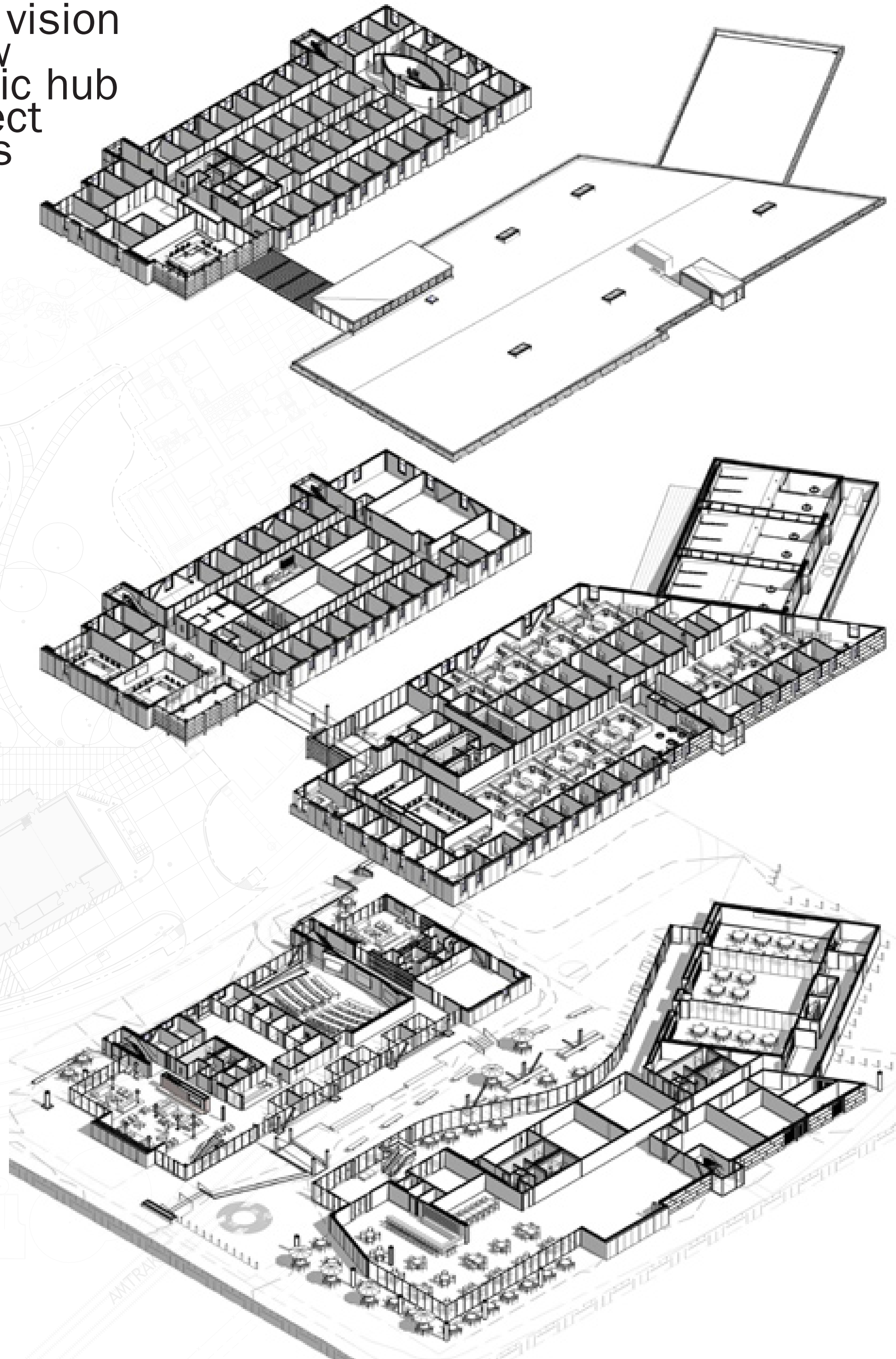
The Graduate School of Management and Conference Center project offers a tremendous opportunity to infuse even more life and activity in the South Entry Quad neighborhood of the campus. The four distinct but related uses – the Graduate School of Management (GSM), the Conference Center with restaurant, and the University Relations offices – combined with the vibrant Mondavi Center for the Arts, the Alumni Center, and a future hotel, create a welcoming threshold to the campus for the greater regional community.

The prominence of the project site rendered the University's commitment to sustainable design all the more noteworthy, a commitment that influenced the design of every system in the design/build competition submittal.

The program is divided into two buildings:

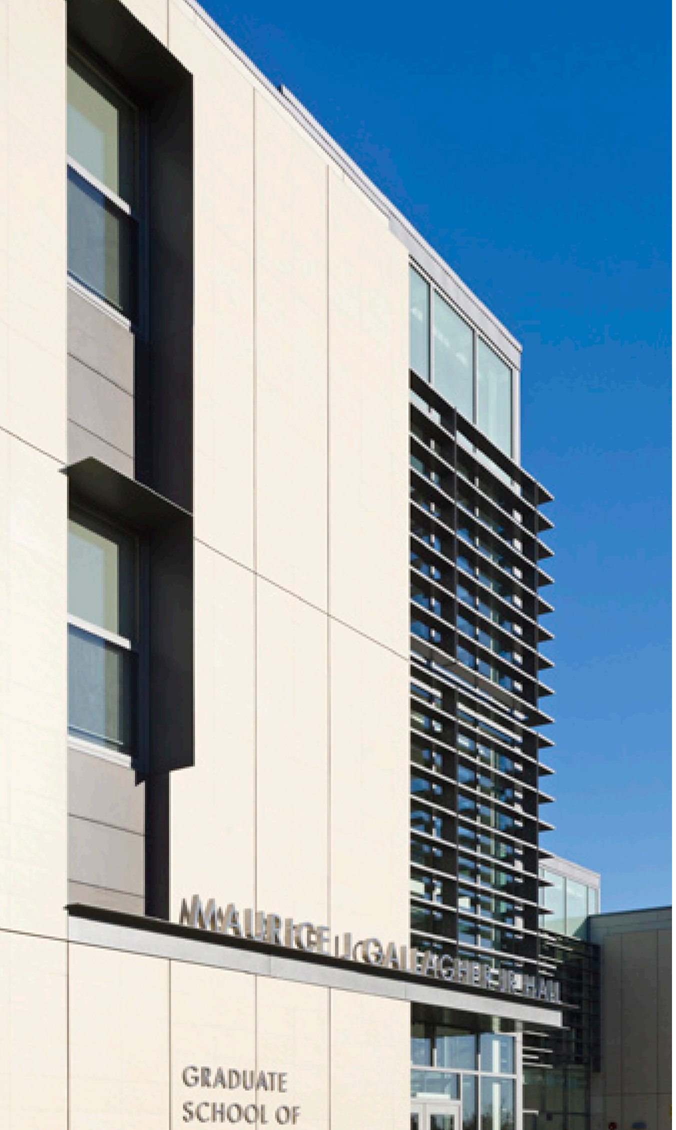
- A three-story, 40,000 gsf GSM includes faculty, staff and student offices, meeting rooms, classrooms, and the Dean's office.
- The two-story, 42,000 gsf Conference Center includes a restaurant, meeting spaces, ballroom, bookstore, and Class A office space.

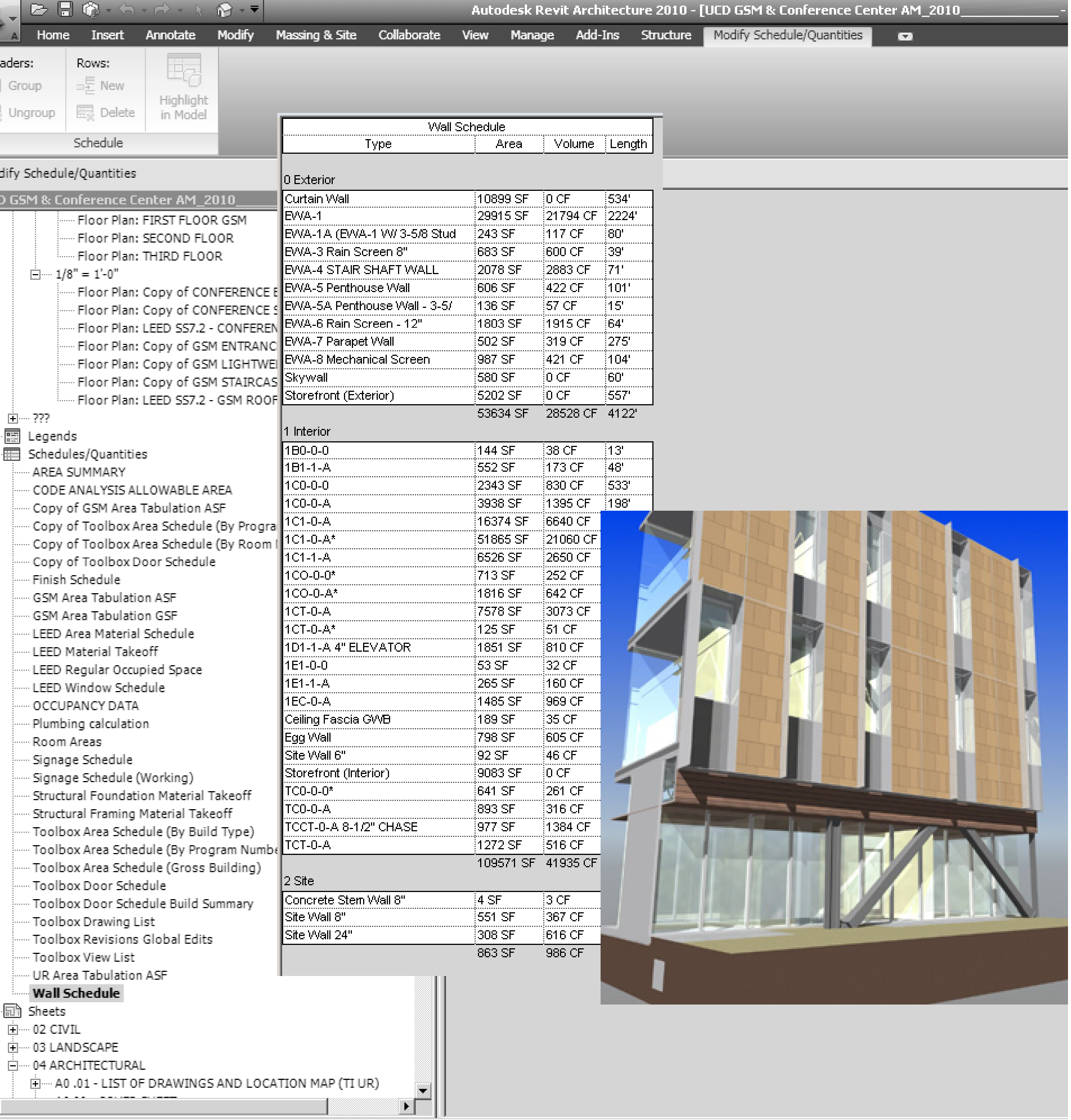
An entrance and arrival gateway area is defined by the two building lobbies and a pedestrian bridge link between the buildings. The constricted space at the bridge marks the transition between the public quad to the semi-private communal courtyard between the buildings. A slight grade change forms an upper and lower courtyard. The campus's botanical garden wraps the GSM and extends as a finger of vegetation along the spine of the courtyard. The courtyard links the future hotel to the quad and to the ballroom.



BIM gives an accurate view of how design choices impact costs. For example, windows weren't eliminated just to be on the safe side. Instead, they were optimized to **add value**.

-Contractor





Wall Schedule

Type	Area	Volume	Length
0 Exterior			
Curtain Wall	10899 SF	0 CF	534'
EWA-1	29915 SF	21794 CF	2224'
EWA-1A (EWA-1 W/ 3-5/8 Stud	243 SF	117 CF	80'
EWA-3 Rain Screen 8"	683 SF	600 CF	39'
EWA-4 STAIR SHAFT WALL	2078 SF	2883 CF	71'
EWA-5 Penthouse Wall	606 SF	422 CF	101'
EWA-5A Penthouse Wall - 3-5/	136 SF	57 CF	15'
EWA-6 Rain Screen - 12"	1803 SF	1915 CF	64'
EWA-7 Parapet Wall	502 SF	319 CF	275'
EWA-8 Mechanical Screen	987 SF	421 CF	104'
Skywall	580 SF	0 CF	60'
Storefront (Exterior)	5202 SF	0 CF	557'
	53634 SF	28528 CF	4122'
1 Interior			
1B0-0-0	144 SF	38 CF	13'
1B1-1-A	552 SF	173 CF	48'
1C0-0-0	2343 SF	830 CF	533'
1C0-0-A	3938 SF	1395 CF	198'
1C1-0-A	16374 SF	6640 CF	
1C1-0-A*	51865 SF	21060 CF	
1C1-1-A	6526 SF	2650 CF	
1CO-0-0*	713 SF	252 CF	
1CO-0-A*	1816 SF	642 CF	
1CT-0-A	7578 SF	3073 CF	
1CT-0-A*	125 SF	51 CF	
1D1-1-A 4" ELEVATOR	1851 SF	810 CF	
1E1-0-0	53 SF	32 CF	
1E1-1-A	265 SF	160 CF	
1EC-0-A	1485 SF	969 CF	
Ceiling Fascia GWB	189 SF	35 CF	
Egg Wall	798 SF	605 CF	
Site Wall 6"	92 SF	46 CF	
Storefront (Interior)	9083 SF	0 CF	
TC0-0-0*	641 SF	261 CF	
TC0-0-A	893 SF	316 CF	
TCCT-0-A 8-1/2" CHASE	977 SF	1384 CF	
TCT-0-A	1272 SF	516 CF	
	109571 SF	41935 CF	
2 Site			
Concrete Stem Wall 8"	4 SF	3 CF	
Site Wall 8"	551 SF	367 CF	
Site Wall 24"	308 SF	616 CF	
	863 SF	986 CF	

Project characteristics are identified from the very beginning using BIM, completely transforming traditional expectations about the cost of integrating **sustainability.**

-Contractor

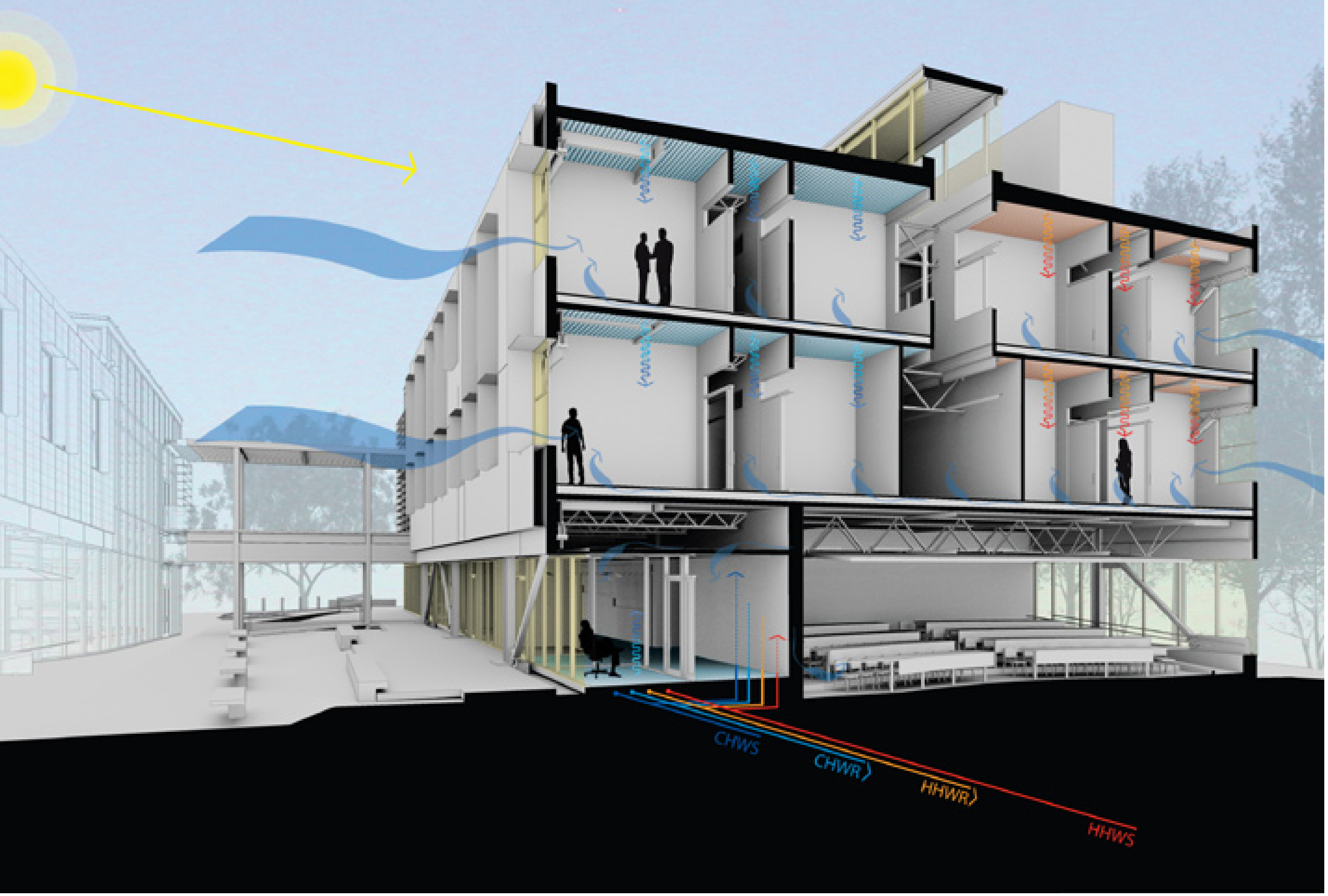
A custom-engineered ventilated barrier wall system was developed to provide the benefits of a rain screen system while affording the client a richer palette of materials within a fixed exterior envelope budget.

Open joints in the façade of the barrier wall system eliminate caulking and sealants and allows air to move freely between the exterior environment and the interior cavity, resulting in pressure equalization that reduces inward moisture migration. Continuous air flow through the open joints and cavity also provide enhanced envelope performance by preventing heat build-up on warmer days and vaporizing any penetrating humidity on colder days. The primary cladding materials of the barrier wall system – either stone tile or fiber cement board panels – are attached to an engineered metal channel system , a UV-resistant underlayment, and exterior glass mat faced gypsum sheathing panels attached to 6" cold formed metal studs with R-19 insulation.

While the barrier wall system offered superior technical performance, the system also contributed to building shading and aesthetics. Manipulating the depth of the ventilated cavity allowed the team to respond to solar exposures: increasing the depth of the barrier wall on the south & west facade provides passive shading. Rather than relying solely on an armature of applied screening elements, the cladding system boldly expresses the demands of the different building orientations. Since the weatherproofing is separate from the exterior cladding, greater flexibility is allowed for construction schedules and ultimately, installation times.

Built to **demanding environmental standards,** the GSM is expected to raise the profile of the nationally ranked school while serving as an important new venue for business and academic conferences.

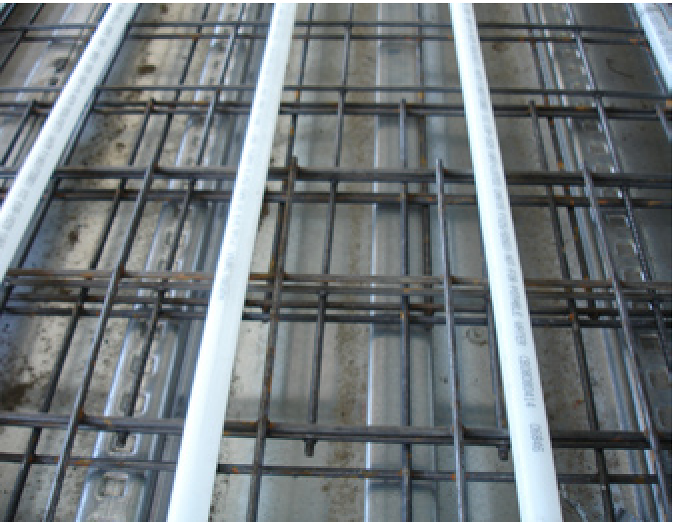
-Owner



Two coincident challenges provided yet another opportunity for integrated design: the project's distance from the campus central plant and the buildings' engineered pad and required excavation allowed the project to incorporate a horizontal, ground source heat pump array. The radiant slab system couples with the ground source heat pump to provide very efficient low temperature heating and high temperature cooling.

In off-peak conditions and during nighttime cooling mode, the cooled water from the ground source array will be circulated directly to charge the radiant slab and floor systems to provide sensible cooling to the offices during the day. This method of cooling is operationally cost effective as the only component operating is the water circulation pump. In heating mode, a supplemental heat pump efficiently operates to generate low temperature hot water for distribution to the radiant floors and slabs.

The heat pump array will reduce substantially the water consumption of the mechanical system over a conventional chiller/cooling tower arrangement. The heat pump array will meet the bulk of the operating hours; the small cooling tower will be called upon infrequently, using only minimal water.



As we brainstormed, the engineers' and contractor's ideas were captured in the BIM. This allowed us to be simultaneously **innovative & practical.**

-Architect

Commitment to **environmental responsibility** is expected to establish GSM as the first business school in California to qualify for the USGBC's LEED® Gold standard certification.

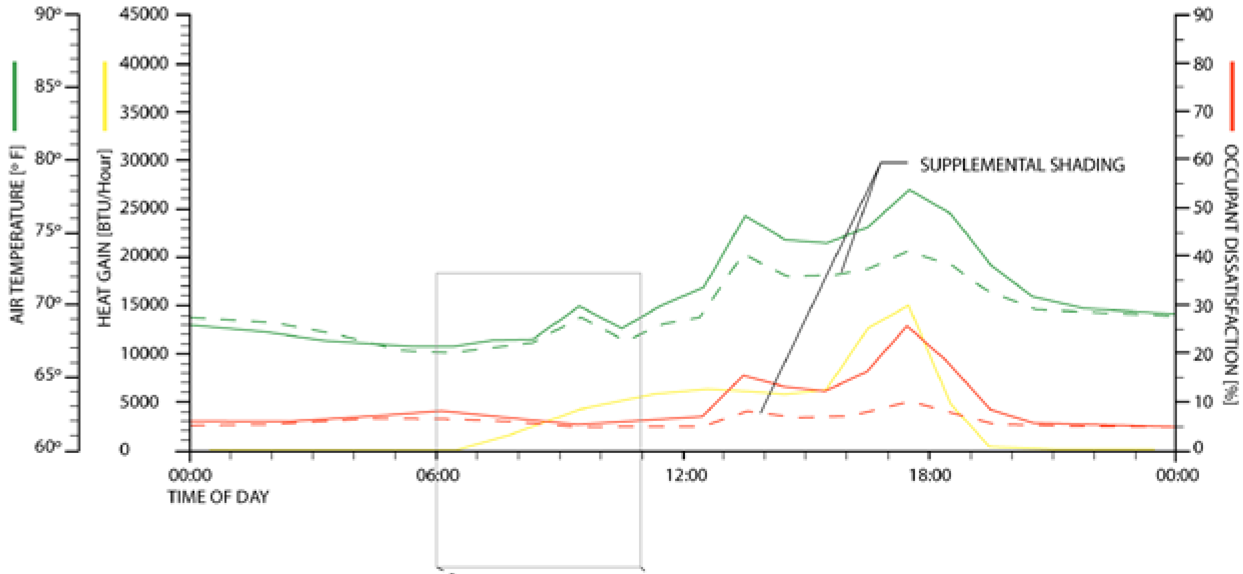
-Owner

The project's radiant core cooling and heating system integrates the project's structural, mechanical, and architectural systems into one holistic approach to thermal comfort delivery. The exposed slab system (acoustical metal deck, concrete fill and radiant tubing) captures the following **multiple functions and benefits** from a single component expenditure:

- Structural system
- Active HVAC system
- Architectural finish
- Silent operation
- Extended component life cycle
- Thermal mass
- Acoustical absorption
- Thermal comfort
- Support for lighting

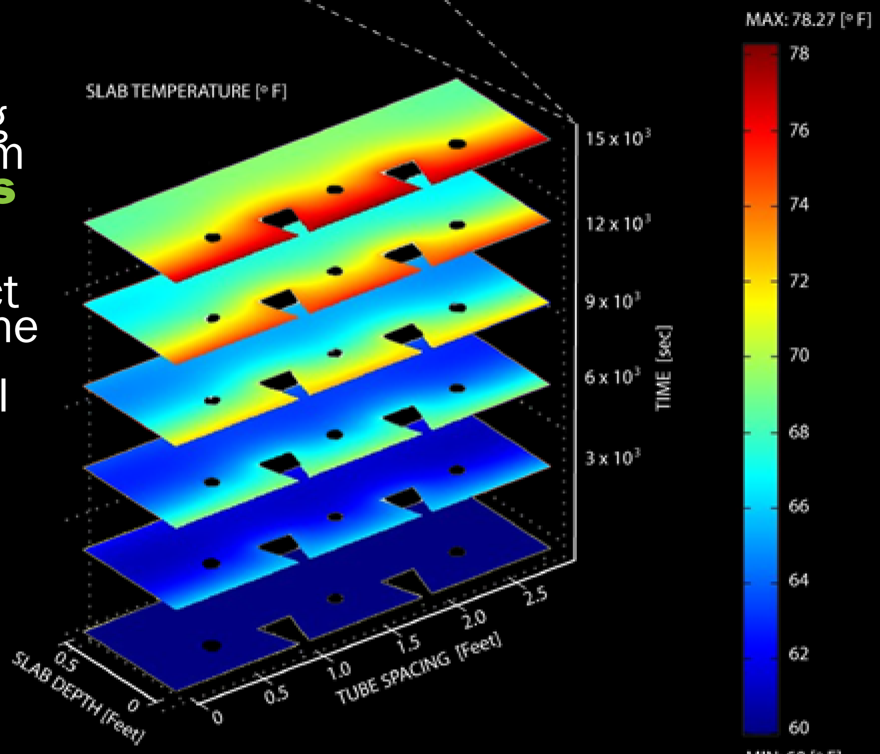
The radiant slab system provides thermal comfort by lowering the radiant temperature of the surfaces in the spaces. This allows the ambient air temperature to rise for an optimum operative air temperature, allowing more free cooling hours and permitting evaporative cooling to be used for the majority of the year, further saving on the run time of compressors. Analysis indicates that the perimeter office zones will maintain comfort on the hottest days while the system is inactive (but still radiating "coolth") and the windows are partially open, improving occupant satisfaction. Ventilation air is provided via operable windows and an underfloor plenum.

For four to six hours of the day, the radiant ceiling system does not need to be active since it has been charged the night before. This allows the peak energy consumption to be displaced to nighttime and reduces the magnitude of that peak energy consumption by transferring daytime compressor energy to night time pump energy. The radiant system also conserves energy through mixed-zone operation, allowing heating and cooling hot water to be exchanged between zones and permitting one portion of the building (i.e. the south face) to be in cooling mode while another (i.e. north face) to be in heating mode.



The geothermal array reduced the size of the heating and cooling system by about 100 tons and also allowed us to scale back the amount of duct work throughout the building by using exposed structural slabs as the radiating surface.

-MEP Engineer



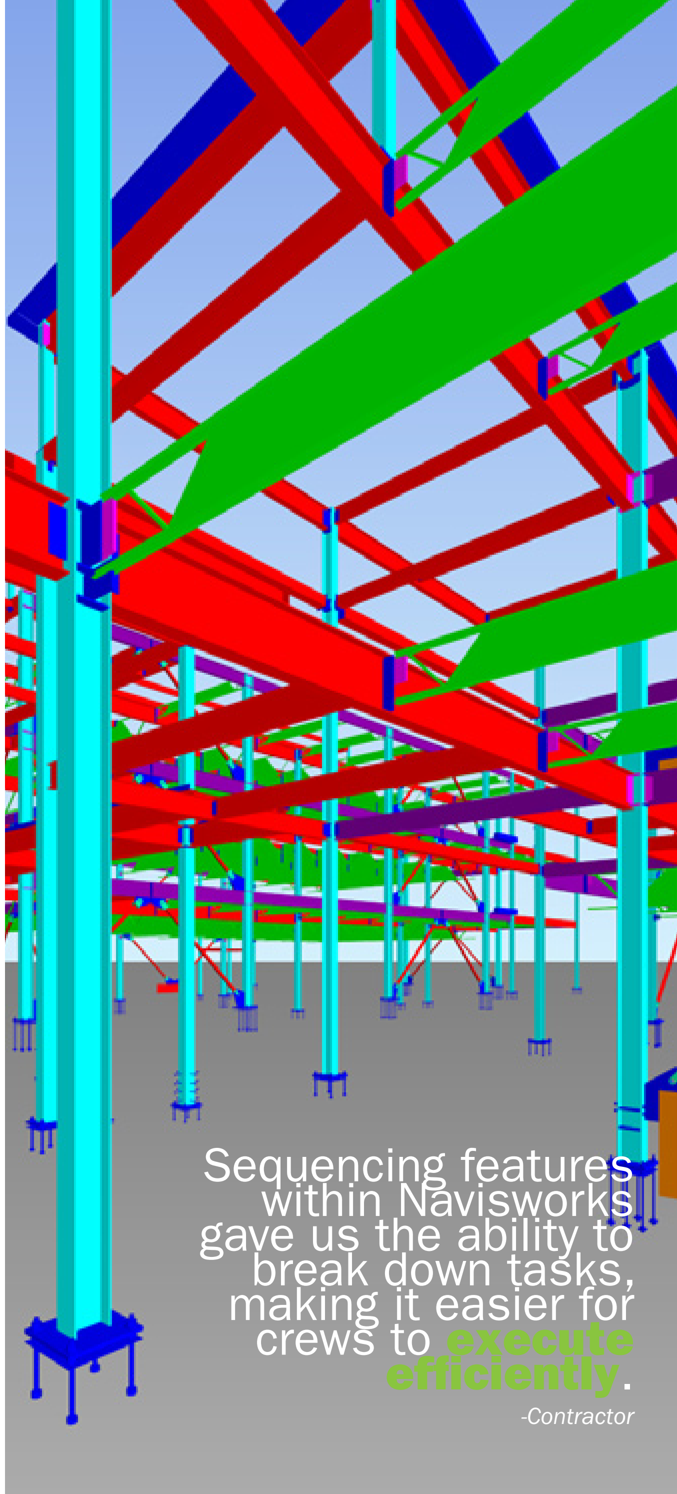
This application of concrete-filled metal deck and hydronic piping is not common in the United States, and the success of this system is dependent on another tenet of sustainable design: load management. For a building to be sustainable, the electrical and cooling loads need to be reduced and then managed. The GSM's electrical and lighting systems were designed to maintain the interior cooling loads at an acceptable level. Combined with a daylighting strategy that provides 25 footcandles to over 75% of occupied spaces, lighting energy usage is 24% less than the baseline Title 24 design allowance.

BIM allowed us to **avoid** many potential issues and **clashes in advance**— if a beam was off by even an inch, it was easy to spot.

-Structural Engineer

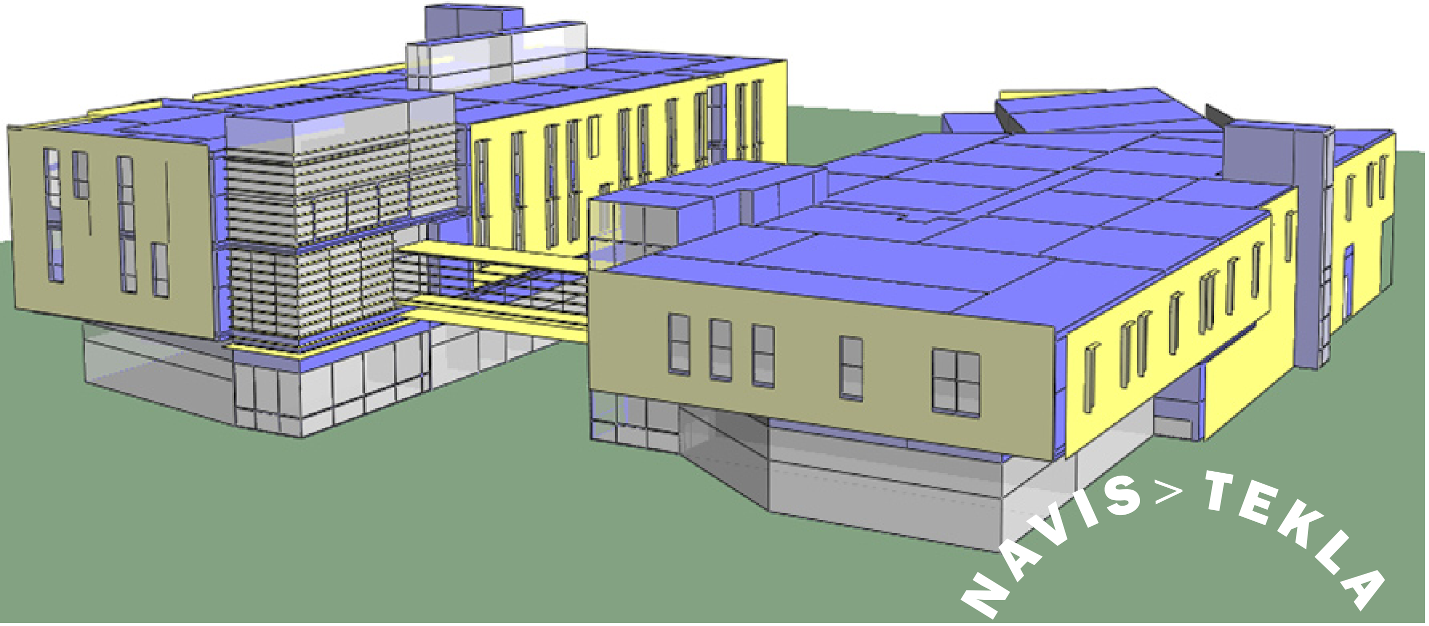
Prior to using Building information Modelling, we had to stop designing to develop presentation material for the client. Now, we can **keep enhancing** the design almost up to a deadline, and in many regards, the documentation takes care of itself.

-Architect



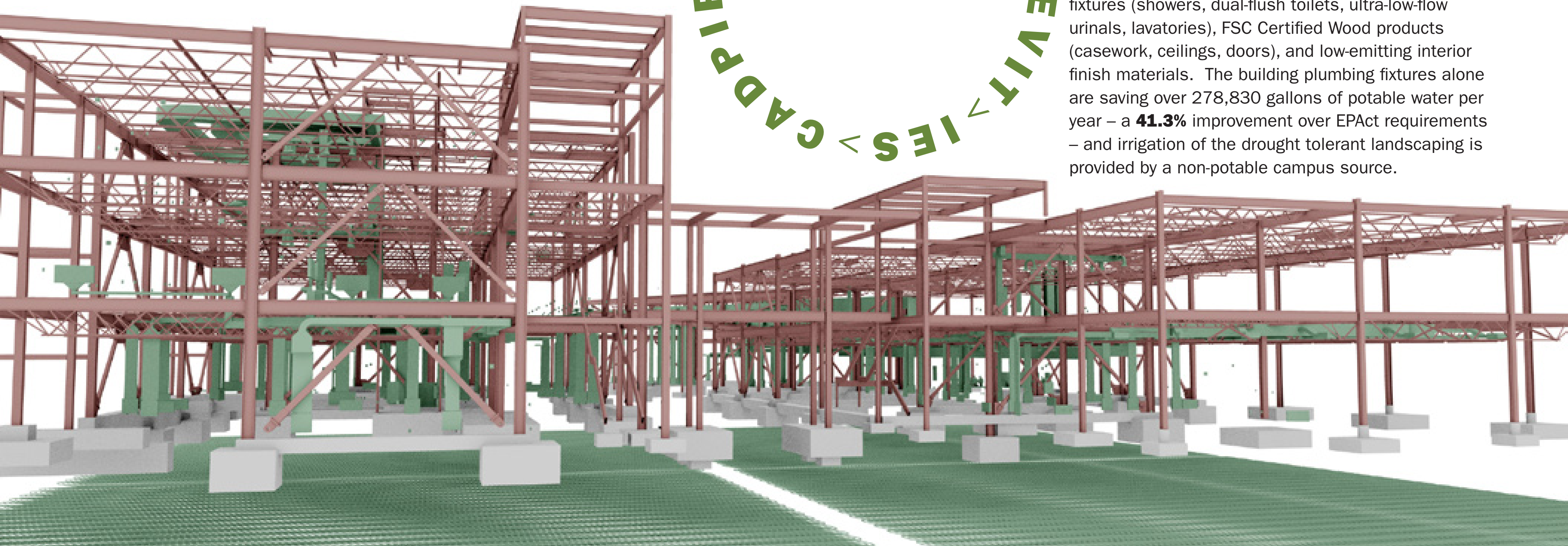
Sequencing features within Navisworks gave us the ability to break down tasks, making it easier for crews to **execute efficiently**.

-Contractor



Integration allowed the team to deliver these innovative systems for the lowest first cost, and directly contributed to the project's final calculated energy savings of **27.1%** over Title 24 requirements (Using Required EnergySoft program), or **32.8%** excluding process energy. However, the design team is aware of the limitations of software in modeling radiant slabs and has undertaken additional analysis using software (IES) that indicates energy savings in excess of 40%. Furthermore, according to the Energy Star website, the project's energy usage reflects a **74%** improvement over the typical office building, well ahead of the current goals for the 2030 challenge. These energy savings are a major contributor to the building's projected LEED Gold certification.

As previously noted, the integrated design approach focused on providing value. The cost savings provided by the use of high-value integrated systems allowed the design team to incorporate other independent sustainable design features such as low-flow water fixtures (showers, dual-flush toilets, ultra-low-flow urinals, lavatories), FSC Certified Wood products (casework, ceilings, doors), and low-emitting interior finish materials. The building plumbing fixtures alone are saving over 278,830 gallons of potable water per year – a **41.3%** improvement over EPAct requirements – and irrigation of the drought tolerant landscaping is provided by a non-potable campus source.



No two construction projects are ever alike, but with BIM, we visualized each task necessary to complete Gallagher Hall so that when it came time to build, it was like we had done it before. It's not just about using 3D instead of 2D. We wanted **partners** that could take full advantage of BIM to design and engineer for constructability.

-Contractor