



BIG TRAM ON CAMPUS

San Diego State University lobbied hard for a light-rail station that connects the campus to downtown and reduces students' dependence on automobiles.

By Jay W. Schneider, *Senior Editor*

When students, faculty, and staff moved into seven brand new buildings clustered around a quad in February 1931, the San Diego State Teachers College stood alone on this mesa east of downtown San Diego.

Flash forward 75 years and several name changes—the school officially became San Diego State University in the early 1970s—and the 33,000-student institution is landlocked, surrounded by private development on three sides and a hill on the other. With 90% of SDSU students commuting to campus by car, the need for parking complicated the school's space crunch—as would the additional 12,000 students expected to commute to campus over the next two decades. University officials were loathe to use what little land they had available for parking, so finding a cure for the common car became a high priority.

Opportunity knocked in 1989 when the San



The sloping green in front of the entrance to SDSU's trolley station exposes one exterior wall, which is punctuated by openings filling the subterranean space with natural light (top). Artist Ann Mudge designed "galaxy spirals" to decorate the openings; her design for the platform's brick floor mimics a riverbed (above). *All photos: Larry Falke*

TRANSIT FACILITY

The trolley station sits smack dab in the middle of campus.

A. Aztec Center, the university's student union.

B. Plans to make Aztec Green more active include food and retail kiosks. The landscaped and brick-paved plaza will also get more shade trees.

C. The station is topped by the Aztec Walk pedestrian plaza.

D. The new 225-foot-long pedestrian bridge connects Aztec Walk (C) to SDSU dormitories and parking facilities.

E. SDSU is planning a mixed-use retail and dormitory complex for this parking lot.

F. The bus lane handles about 16 buses per hour. Elevators connect the bus transit center to the station platform 55 feet below.



Diego Metropolitan Transit Development Board (now operating as the Metropolitan Transit System) began planning a \$506 million, 5.6-mile-long expansion to its Mission Valley East trolley line, which would close the gap between the Blue Line and the Orange Line. The new line would run very close to the SDSU campus.

University officials saw the new trolley line as a godsend to connect the university to downtown San Diego (about 12 miles from campus), to the city's various sports arenas (Qualcomm Stadium is about three miles from campus), to the region's various neighborhoods so students

could get to campus without a car, and to an existing campus bus terminal, therefore consolidating transportation hubs. The university had no idea that bringing the trolley to campus would be so difficult.

"When the MTDB started initial planning for the trolley line in 1989, they started looking at 11 or 12 different routes to connect the lines," says Tony Fulton, SDSU's university architect. These included routes that paralleled the freeway, more or less bypassing the university. SDSU officials lobbied long and hard for a campus station, one that sat smack dab in the middle of campus. At one time they even fought against a compromise that would have brought the trolley station to the campus's north side.

"When the MTDB got to the university, they went through a series of concepts that put a park & ride on the north side at the bottom of the valley by the freeway exit," says Mark Foster, AIA, design partner at Zimmer Gunsul Frasca Partnership (ZGF), the Portland, Ore., architecture firm that designed the university's station. "They would build stairs or an elevator up the hill to the university. Basically, every one of their concepts was a light-rail stop that only served the freeway."

The reason MTDB spent so many years resisting the idea of tunneling underneath the school and having a trolley penetrate the campus was cost—about \$40-\$50 million more than a light-rail line that touched the north side of campus. After about eight years of planning and wrangling,

BUILDING TEAM

- Architect: Zimmer Gunsul Frasca Partnership
- Contractor: Clark Construction Group
- Civil engineer and rail engineer: URS Corporation
- Structural engineer: INCA Engineers
- Tunnel engineer: Hatch Mott MacDonald
- Utilities engineers: Lintvedt, McColl & Associates; Randall Lamb Associates
- Electrical engineer: W.J. Yang & Associates
- Acoustics: Wilson Ihrig & Associates
- Landscape architect: Estrada Land Planning
- Urban design consultant: Lloyd Lindley
- Geotechnical engineer: Golder Associates
- Vertical transportation: Lerch Bates & Associates



Gold travertine covers the meter-thick pillars, which are topped off with planters and decorative light fixtures. A trellis hangs above the window openings, which are filled with curving decorative metal forms and a barely perceptible bird netting.

the MTDB agreed to fund a station on campus, a project that eventually cost \$103 million.

How were they convinced? “I lied, cheated, and stole,” jokes Fulton. “I kept making appearances before the board to tell them that putting the route on the north side wouldn’t encourage ridership. They would have to move their existing bus terminal to the north side where it and the trolley station would sit 400 feet below campus. Students would have to traverse a hill to the trolley and bus station,” he says. “I told them it’s very unlikely the ridership would be there.”

While Fulton talked up the possibility of anemic ticket sales, the MTDB was further persuaded by information showing it would be cost-effective to tunnel under university-owned property rather than having to make costly land acquisitions, which would have been necessary had they run the line elsewhere.

MTDB was also swayed by an engineering workup by URS Corporation, Grand Rapids, Mich., which showed that 2,915 feet of the 4,000-foot-long tunnel could be excavated using fairly simple cut & cover: The light-rail line would be run underneath an existing road where the pavement would, essentially, be peeled off, the ground trenched, and the pavement laid back over the tunnel structure.

The remaining 1,085 feet, the area where the tunnel would run underneath existing campus buildings, would be excavated using the New Austrian Tunneling Method—or NATM—which

uses the stress of the surrounding ground and rock mass to stabilize the tunnel. (See page 41.)

Construction on the Mission Valley East trolley line extension began in 1999, 10 years after the project was initiated. When construction made its way to the heart of SDSU, university officials made sure school activities faced minimal disruption even as the ground opened and separated the main campus from much of the parking and most of the dormitories. For two years, pedestrian and auto traffic was carefully diverted around closed roads and over a tempo-

The elevator shafts have glass sidewalls that bring natural light from the street level to the mezzanine level (shown here) and to the pedestrian platforms below.



TRANSIT FACILITY



A blue cold cathode light tube streaks across the mezzanine ceiling. Acoustic insulation fills the caps between the concrete ceiling beams, and is also hidden behind the orange-red perforated metal ceiling panels.

rary bridge spanning the excavation site. To minimize campus disruption, the university had construction suspended during the first three weeks of each semester and during finals. SDSU officials had shrewdly negotiated an agreement with the MTDB allowing them to shut down construction during the school's most active weeks. "It was a challenge managing an elaborate series of activities, but we know more about the impact of a project on school operations than an outside firm does," says Fulton. "It made the process a lot smoother than if we had closed our eyes and let the project barrel through campus."

While students, faculty, and staff carefully negotiated temporary routes above ground, 55 feet below ground the Building Team was hard at work on the university's 50,000-sf trolley station.

"We didn't have a building in the normal sense," says ZGF's Mark Foster. "The program was almost entirely circulation. It's mostly platforms, stairs, elevators, escalators, a mezzanine, and pathways to get to stuff. This was an engi-

neering project for which they hired an architect.”

SDSU architect Fulton, who has a reputation for being hands-on, did not stipulate any specific aesthetic requirements for the building itself, but he did make sure final engineering and design plans addressed noise and vibration, which the university community was concerned about both during construction and when actual trolley operations were to begin. The tunnel is at least 10 feet from any campus building, and there's acoustic material aplenty in both the station's walls and ceiling.

There's also plenty of natural light, and that's what makes the station's design so unusual. The land on the project's north side was gently sloped down to the station's mezzanine level (and turned into a plaza named the Aztec Green), leaving the station's north wall exposed. That outside wall is punctuated with 20 openings—separated by meter-thick pillars—that fill the interior with daylight. “It makes for a much better space,” says ZGF's Foster, “but the engineers, especially the ventilation engineers, were reluctant to let us do it because it makes their job a lot harder. You don't have a controlled aperture of the tunnel diameter at each end, so there's more than one direction the air is being pulled from.” MTDB and the university thought the openings were great, so they stayed.

Foster also designed the elevator shafts with glass sidewalls; these act as light shafts, bringing light from the street level directly to the pedestrian platform two levels below. The street level is part bus transit center and part pedestrian walkway (“Aztec Walk”) that leads to a new 225-foot-long, post-tension pedestrian bridge connecting the campus to dormitories and parking. Two 360-foot-long passenger platforms, long enough to accommodate four-car trolleys, are located on the lower level.

When it came to designing the station's one exposed exterior wall, Foster avoided borrowing the university's Mission-style aesthetic, instead choosing to finish the façade in gold travertine.

Tunneling through SDSU

The New Austrian Tunneling Method isn't new,” says Siegfried Fassmann, who was the project manager for URS during the light-rail expansion project. “It's probably about 50 years old, but it's new to the U.S.”

Fassmann felt strongly that NATM was the only way to go through the university grounds without disturbing the surface. Soil conditions—hard, round cobbles and some boulders suspended in a sandy clay matrix—also proved favorable.

NATM relies on the strength of the surrounding rock and soil being conserved as the main component of tunnel support. For the 1,085 feet of the tunnel where the cut & cover method wasn't applicable, a 37-foot-wide by

29-foot-high single-tube tunnel was sequentially excavated and a thin layer of shotcrete (augmented by lattice girders and welded wire fabric) was applied immediately behind the excavator to create a load-bearing ring. A boring machine wasn't required because the excavation distance was short; longer distances require a boring machine and make NATM an expensive alternative. The final step involved cast-in-place concrete lining for permanent support.

The tunnel was excavated in four- to eight-foot segments before the shotcrete was applied and the concrete cast. “You excavate in phases so you don't overstress the soil,” says Fassmann. “We had hardly any settlement, and no surprises.”

TRANSIT FACILITY

“What we wanted was something that would read at a distance, something large-scale with quality materials, but also something that within a few years will become part of the landscape,” says

Foster. Plants line the base of the wall and a trellis projects from between each of the meter-thick pillars, which are themselves topped with planters.

Inside finishes presented more of a

challenge because the station’s walls are 40-foot-high concrete slabs. “Nobody has a budget to put architectural surface material on all that,” says Foster, who imagined a high-water mark 10 feet high and finished the walls up to that point. Stone covers the first three feet before giving way to seven feet of woven stainless steel panels, which hide acoustic panels.

Finish details are also incorporated into the floors and ceiling. The station’s



Only the first 10 feet of the station’s concrete walls are finished. Hanging metal sculptures are by Ann Mudge.

platforms have a wavy brick pattern, conceived by San Diego artist Ann Mudge to resemble a riverbed. Mudge’s artistic forms are also represented by the curving sculptural screens, called “galaxy spirals,” that decorate the station’s 20 window openings, and by the blue serpentine cold cathode lighting that snakes through the station’s ceiling, which is finished with perforated metal panels covering acoustic insulation.

The station opened in September 2005 and initial student tickets sold out. “Ridership turned out to be dramatic,” says SDSU’s Fulton. It’s been reported that parking pass sales are down 20%. “I think what we did, putting the station in the middle of campus, was difficult because academic operations and construction are often at odds,” says Fulton. “But, when all is said and done, the project is in exactly the right place.” BDC