

# SAN MARCOS HIGH SCHOOL

San Marcos, California

By Hossain Ghaffari, Ph.D., P.E.



Classroom building and central quad area.

The \$136 million 420,000-square-foot San Marcos High School opened in January 2014 in a phased reconstruction of the entire project site. This project transformed the existing 1,800 student capacity single-story complex to a 3,000 student capacity state-of-the-art multi-story high school complex, more than doubling the size of the old school. This new facility provides equity with the other District high schools and includes College Prep and Career Technical Education spaces for the humanities, math/science, technology, performing arts, practical arts, agricultural sciences, and special education programs. The new San Marcos High School Campus features several separate structures that utilized tilt-up and cast-in-place concrete and structural steel construction, including: a 2-story Performing Art Center with a 400-seat theatre, a 2-story Athletic Center with a 3-court gym, a 3-story Academic Building, and a 1-story Academy Building. There are also additional one-story structures housing the mechanical equipment, athletic fields shower and lockers and press boxes.

Concrete played an important role in the project, serving as a durable and regional material that has recycled content when teamed with rebar and fly ash. Its thermal properties allow spaces to stay cooler during the day, further reducing loads on the campus' mechanical systems. Therefore, for the buildings where concrete façade was used, it was an easy decision to use concrete shear walls as the lateral force resisting system for the structure and tilt-up construction was preferred based on two critical concepts. It was imperative that the finish of the exposed concrete surfaces was as flawless as possible, making tilt-up

construction feasible as they are formed on one side; by using a smooth slab-on-grade casting bed, that goal was reached. The construction schedule also played an important role in the decision to utilize tilt-up construction since additional time for erecting the formwork was eliminated by casting the panels flat on the ground. There were 312 panels, some of them as tall as 65 feet. The casting and lifting sequence of the panels, along with erection of the structural steel around temporary braces for the panels, was very challenging. Considering the extremely demanding construction schedule, timely delivery and assembly of the panel reinforcing and embeds and concrete pour was crucial for the on-time completion of the project.

John A. Martin Associates (JAMA) designed the panels with the constraint to optimize the panels' thickness to meet the lifting requirements, while minimizing steel congestion to avoid the risk of honeycombing during concrete placement and consolidation on the cast side of the panels. Some of the walls had large openings, making their design challenging. JAMA had to decide how to break up the panels in these walls to accommodate the openings so that the lifting of the panels and their connections together, to meet the chord and shear demand, was achievable while making sure that the location of the panel joints were architecturally acceptable. At the locations where structural steel drag members were to be connected to the shear walls and the force to be dragged into the shear wall, designing the proper embed to fit into thin tilt-up panel ends and providing the proper mechanism to complete the load path became challenging. These embeds would be inside the boundary element of



Classroom and art buildings.



Art, gymnasium and shop buildings and central quad area.

the walls. The situation became more complex at the locations where the embed was to be used for the connection of two drag members that were perpendicular to each other, and each drag member force was to be dragged into different panels at the panel joints. Again, the issue of steel congestion for such embeds being placed into the boundary element of the shear walls had to be proactively addressed at the schematic design phase to ensure there were enough shear walls with a proper system to reduce the drag force to be accommodated in thin tilt-up panel walls.

### Three Story Academic Building

The Academic Building, at 250,000 square feet, is a three story structure with a cast-in-place special reinforced concrete shear wall lateral system and structural steel gravity framing constructed at grade-over-spread and wall footings. Floors consisted of composite light weight concrete over metal deck. Tilt-up panels could not be used for this building since it housed all of the classrooms. Ribbon windows were used in a curtain wall system; thus, there were not enough solid wall sections at the building exterior to be utilized as shear walls. Therefore, mostly thick cast-in-place core shear walls were used for the lateral force resisting system.

### Two Story Athletic Center Building

The Athletic Center Building is a two story structure (82,000 square feet) with a precast tilt-up special reinforced concrete shear wall lateral system and structural steel gravity framing. The building is located on the sloped portion of the site. Therefore, the north portion of the building is constructed over a partial basement with cast-in-place concrete walls, while the south side of the building is constructed at grade-over-wall and spread footings. Floors consisted of composite light weight concrete-over-metal deck.

### Two Story Performing Art Center Building

The Performing Art Center Building (63,000 square feet) is a two story structure with a precast tilt-up special reinforced concrete shear wall lateral system and structural steel gravity framing constructed at grade over spread and wall footings. Floors consisted of composite light weight concrete-over-metal deck.

### One Story Academy Building and Support Buildings

The Academy Building and other support buildings are one story structures with precast tilt-up special reinforced concrete shear wall lateral system and structural steel gravity framing constructed at grade-over-spread and wall footings. ■



#### Project Team

**Owner:** San Marcos Unified School District  
**Structural Engineer:** John A. Martin & Associates  
**Architect, Civil and Landscape:** LPA, Inc., Irvine, CA  
**General Contractor:** Lusardi Construction Company, San Marcos, CA



*Gymnasium building.*



*Erected tilt-up panels.*



*Steel framing and concrete shear walls.*

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