The Bridges of San Diego County: The Art of Civil Engineering

Christine Robbins

Every bridge represents a problem solved, a challenge overcome, a connection made. San Diego, with its abundance of hills, mesas, and canyons, showcases the art of bridge building. Civil engineers took on the task and were lauded for their work in this poem:

> They have built magnificent bridges where the nation's highways go;
> O'er perilous mountain ridges and where great rivers flow.
> Wherever a link was needed between the new and the known
> They have left their marks of Progress, in iron and steel and stone.
> There was never a land too distant nor ever a way too wide,
> But some man's mind, insistent, reached out to the other side.
> They cleared the way, these heroes, for the march of future years.
> The march of Civilization—and they were its Pioneers.
>
> —Portion of "The Bridge Builders," a poem by Evelyn Simms

The American Society of Civil Engineers (ASCE) considers bridges an important aspect of civil engineering. According to the organization's policy statement; "Bridges are a visible icon of the Civil Engineer's art. Historic bridges are important links to our past, serve as safe and vital transportation routes in the

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present, and can continue to serve as important elements of our transportation systems in the future."[1] Former president of the San Diego Section of ASCE, Art McDaniel, P.E., F.ASCE, noted, "Since wheeled transportation began, Civil Engineers have been upfront in the creation of its elements, especially bridges."[2]

San Diego engineers have been building bridges for more than one hundred years. In fact, the San Diego ASCE celebrated its centennial anniversary at the same time as Cabrillo Bridge in Balboa Park, one of the most iconic structures in the city. McDaniel Engineering served as a training ground for many San Diego civil and structural engineers. One of those engineers, Mark Ashley, P.E. M.ASCE, was ASCE San Diego President in 1994. He became Senior Vice President/West Region Director at T.Y. Lin International, a world-class structural engineering firm that acquired McDaniel Engineering and has had a major role in designing and constructing many San Diego bridges. He commented on the local bridges that he has worked on:

> As readers can see, and many Civil Engineers and others already know, there are a wealth of remarkable bridges in the San Diego area that were carefully designed and constructed to overcome unique engineering challenges in an environmentally responsible way while managing to be iconic in their own right. It has been extremely gratifying to have a hand in several of them, and I've been very fortunate to have worked with clients that demonstrated the vision for excellent projects.[3]

Another San Diego company well known for their bridge work was Simon Wong Engineering. In 1993, Mark Creveling, P.E., M.ASCE, a product of McDaniel Engineering and a former President and Governor for ASCE, opened a bridge engineering group with Simon Wong. The Simon Wong firm joined Kleinfelder in 2012 and has continued to provide engineering, construction management, and inspection of bridges, with several hundred bridges to their credit.[4] One of the firm's senior bridge engineers, Jim Frost, P.E., M.ASCE, Vice President/ Western Region Structures Manager at Kleinfelder and the 2012 ASCE San Diego President, suggests that bridges represent something special to his profession: "Civil Engineers are often overlooked in our society because their work is hidden or taken for granted. Bridges provide a visual reminder of the importance of the Civil Engineer, and San Diego is a beautiful canvas for our work."[5]

This brief history and description of some of the bridges built in San Diego County honors civil and structural engineers, past and present, whose art has improved our way of life and contributed beauty to the man-made environment.

Graceful Concrete Arches

Georgia Street Bridge, c. 2014. Photograph by Patrici Foust-Rezig, c. 2014.

Georgia Street Bridge – 1914

In the second decade of the twentieth century, San Diego began to expand. Roads, railways, and electric streetcars reached out from the city's core and helped to suburbanize once-rural areas like North Park. The Georgia Street Bridge made many of these developments possible. Historian Don Covington wrote, "More than any other man-made feature, the Georgia Street Bridge stands as a landmark and symbol of the event that opened the northeast mesa to urban development. Mr. [James R.] Comly's masterwork still stands today as the western gateway to the Greater North Park community."[6]

As the population grew along University Avenue between Hillcrest and City Heights, so too did the demand for public transportation along this important regional corridor. In 1913, there existed only a narrow roadway and a single streetcar track. Accommodating an additional track, as well as a road for the increasingly popular automobile, presented a challenge to city engineer James Comly.[7] The existing passage between Park Boulevard and Florida Street consisted of a narrow grade separation cut with bare sides sloping upward to the top of the ridge where Georgia Street was located. Traffic on Georgia Street crossed the

cut via a small redwood bridge. But widening the University Avenue cut meant that a new, longer bridge would be needed, and that its now steep perpendicular walls would need support.

Comly's solution was a reinforced-concrete bridge that would be both more permanent than steel, and more aesthetically pleasing. As such, it reflected the ideals of the City Beautiful movement, a planning philosophy characterized by the idea that beauty and utility are not mutually exclusive. It held that creating a beautiful, livable space would encourage patriotism and pride in community. This, in turn, would enhance city function and worker productivity. The movement was supported in San Diego by civic and business leaders who saw it as a way of attracting tourists to the city.[8]

The resulting reinforced concrete arch bridge reaches 69 feet across University Avenue and supports interrelated 680-foot-long retaining walls that structurally reinforce the cut, providing safe passage for vehicles and pedestrians.[9] One century later, the City of San Diego and Kleinfelder, its prime consultant for the project, are preparing to structurally retrofit the bridge using funds from the Federal Highway Administration (FHWA). The project will replace the deck and supporting spandrels, rehabilitate the existing arch, stabilize the abutments and retaining walls, and lower University Avenue 2.5 feet to bring vertical clearance up to current code.[10] In addition to ensuring the structural integrity of the bridge, the project will also restore its original appearance by opening up the railing balustrades and replacing the light posts that were removed in the 1940s.

While the Georgia Street Bridge's integrated retaining walls make it relatively

Black Canyon Road Bridge. Photograph by Wade Durant, c. 2015.

unusual among San Diego bridges, its open-spandrel concrete arch design was a popular style of bridge throughout the county.[11]

Black Canyon Road Bridge – 1913

Built in 1913 over the Santa Ysabel Creek between Ramona and Santa Ysabel, the Black Canyon Road Bridge is one of two remaining Thomas System arch bridges in California. Designed by William M. Thomas of the Los Angeles engineering firm Thomas & Post, Thomas System bridges used precast concrete construction, three-hinge arches, and open spandrels.[12]

The Black Canyon Road Bridge was closed to motorized vehicles in 2011 when the road was re-routed around the historic bridge. It remains in place as a pedestrian and bicycle crossing in a relatively unspoiled setting that provides a glimpse into San Diego's rural past.

Bonsall Bridge – 1925

The Bonsall Bridge (also known as the Old Bonsall Bridge and the San Luis Rey Bridge) was built during a boom in bridge construction around the state.[13] An impressive 672 feet long, it includes five open-spandrel arches flanked by two

Bonsall Bridge over the San Luis Rey River, c. 1915. ©SDHC #OP 6804.

smaller arches at either end.[14] It carried US Highway 395 and, later, State Route 76 across the San Luis Rey River just west of Bonsall from 1925 to 1990, when it became a bike path and popular photography location.[15]

Los Peñasquitos Creek Arch Bridge – 1949

Located just south of Poway Road and east of Interstate 15, this 434-foot bridge was built in 1949 and became part of a realigned US Highway 395.[16] Its single arch spans Peñasquitos Creek and the Trans County Trail. In 1965, separate

Los Peñasquitos Creek Bridge, c. 2015. Photograph by Christine Robbins.

southbound lanes were built for the highway. The bridge carried only northbound traffic until 1977 when it was closed to motorized vehicles.[17] It is now a popular bike path. The bridge is also accessible from Scripps Poway Parkway via Cara Way, which provides a somewhat obstructed view of the bridge's 220-foot arch.

Laurel Street Overcrossing/Cabrillo Bridge – 1915

The Laurel Street Overcrossing at State Route 163, also known as the Cabrillo Bridge, is a reinforced concrete cantilevered hollow arch structure that resembles a Roman aqueduct.[18] It has a total length of 769 feet, a width of 41 feet, and a maximum height of 129 feet. At one time spanning a man-made lagoon at the western edge of Balboa Park, it is one of the earliest examples of a Spanish Colonial Style closed-spandrel arch bridge in the United States. A City, State, and National Historic Landmark, the bridge is owned by the City of San Diego. The

Laurel Street Overcrossing/Cabrillo Bridge, c. 1920. ©SDHC #20973.

portion over the state right-of-way is maintained by the California Department of Transportation (Caltrans).

Cabrillo Bridge was named for Spanish explorer Juan Rodríguez Cabrillo who, in 1542, was the first European to land on California's shore. In the early twentieth century, San Diego's city leaders initiated ambitious plans to mark the anticipated completion of the Panama Canal—and San Diego's position as the first U.S. port for ships making the journey west—with the Panama-California Exposition. Once a site was determined, an appropriately grand bridge was needed to provide access from Laurel Street across Cabrillo Canyon to the Exposition grounds.

Bertram Goodhue, the park's supervisory architect, was initially slated to design the bridge. In the end, however, the Exposition's Director of Works, architect/engineer Frank P. Allen, and engineer Thomas B. Hunter were responsible for the final design.[19] The City of San Diego constructed the bridge at a cost of $225,155. It consists of seven 56-foot-wide semicircular arches supported on twelve hollow rectangular piers and a hollow abutment structure at each end. The span from the center of one pier to the next is 68 feet. In 1950, wrought iron fencing was added to one section of the bridge to enhance safety, but care was taken to ensure that its design was complementary to the bridge, its original iron streetlamps, and nearby structures. The bridge has two vehicular lanes and sidewalks and is a vital link for pedestrians, cyclists, and vehicles to access the park over Cabrillo Canyon and SR 163.

In 2004, deterioration of the bridge's concrete surface necessitated emergency

repairs of the bridge spans over the freeway. One evening during construction, a fire started at the base of one of the piers and ignited internal wood formwork that was part of the original construction. Firefighters had to close the freeway and bridge and jackhammer holes in the bridge deck so that water and foam could be sprayed into the piers to extinguish the fire.

In 2013, Caltrans administered the seismic retrofitting and rehabilitation of the entire bridge, with construction costs of $22.4 million.[20] In order to maintain the bridge's historic character, the seismic retrofitting, which included horizontal and vertical post-tensioning, was constructed on the inside of the bridge, hidden from view.[21] Deteriorated concrete was repaired to match the existing color and texture of the bridge. Additional improvements included repair of the drainage; new access doors, internal lighting, and inspection ladders and catwalks; and the addition of exterior up-lighting (designed by CH2M Hill) that illuminates the arches at night. All of these repairs and upgrades were expedited in order to be ready for the centennial celebration of Balboa Park in 2015.

Bankers Hill Commuter Bridges

First Avenue Bridge, c. 2010. Photograph by Peter Smith.

First Avenue Bridge – 1931

The existence of the First Avenue Bridge over Maple Canyon can be attributed

to the growing popularity of private automobiles among residents of San Diego's Uptown district following World War I.[22] The area's canyons limited the possible routes downtown to only a few streets until uptown residents demanded—and helped pay for—a more direct route for commuters.[23]

The First Avenue Bridge and associated improvements provided that route. Also known as "The People's Bridge," it carries First Avenue 463 feet across Maple Canyon in the Bankers Hill area north of downtown. Local civil engineer Tom Johnson Allen of Allen & Rowe Engineering designed the steel truss arch bridge. Standard Iron Works fabricated the structure, and local highway development giant R.E. Hazard Company built it in 1931.[24]

Nearly seventy-five years later, the City of San Diego submitted a plan for a seismic retrofit and painting of the bridge. The award-winning retrofit was designed by T.Y. Lin International and constructed by Reyes Construction. Because the bridge is recognized as a historical resource, the appearance of the bridge needed to maintain its historic character while the structure was brought into compliance with Caltrans seismic safety standards.[25] The project took nearly fifteen months to complete and included improvements to the deck, abutments, columns, and footings. Workers also resurfaced the bridge deck; replaced the missing historic light standards; and returned the bridge to its original color, "Mannered Gold," which was determined only after the careful removal of seven newer layers of environmentally hazardous lead paint.[26]

Two older bridges in the Bankers Hill area were also built for commuters. In the days before private vehicle ownership became widespread, these pedestrian

Quince Street Bridge, c. 2015. Photograph by Christine Robbins. The First Avenue Bridge is barely visible to left of the building.

bridges connected residents of San Diego's suburbs with public transportation on Fourth and Fifth Avenues.

Quince Street Bridge – 1905

A 236-foot long wooden trestle, the Quince Street Bridge, rises 60 feet above Maple Canyon between Third and Fourth Avenues. This City of San Diego landmark was designed by City Engineer George d'Hemecourt and built in 1905 for less than $1,000. Although some repairs were done over the years, termite damage and wood rot threatened the bridge with demolition in 1987. Public outcry resulted in its historic designation based on its design, age, and usefulness to the community.[27] The bridge was retrofitted in 1990 at a cost of $250,000, paid from the city's capital improvements budget.[28]

Bridges Breaking the Concrete Mold

Spruce Street Bridge, c. 1921. ©SDHC #80: 2436.

Spruce Street Suspension Bridge – 1912

This steel, cable-stayed pedestrian bridge spans 375 feet across and 70 feet above Kate Sessions (Arroyo) Canyon along the Spruce Street alignment between Brant and Front Streets. Designed by City engineer Edwin Capps between his two terms as San Diego mayor, this may be the oldest suspension bridge in the county.[29] Burkett & Wong Engineers designed the mid-1980s renovation. San

Steele Canyon Bridge/Sweetwater River Bridge, c. 2005. Photograph by Chris Wray.

Diego County is home to at least two other unusual bridges that made important connections.

Steele Canyon Bridge/Sweetwater River Bridge – 1929

Built in 1929 on Campo Road (now SR 94), once the main route from San Diego to Yuma, this 150-foot steel Parker through truss (the only one in the county) spans the Sweetwater River between Rancho San Diego and Jamul. A "through truss" bridge has a cross-braced truss structure above the road deck, so traffic passes through the truss. Closed to vehicular traffic in 1986, it is now a pedestrian, bicycle, and equestrian bridge at the entrance to the San Diego National Wildlife Refuge.

Goat Canyon Railroad Trestle – 1932

The Goat Canyon Railroad Trestle in Carrizo Gorge is the epitome of "a problem solved" and "a challenge overcome." Carrizo Gorge lies in the path of a 140-mile freight railway that travels across incredibly rough terrain to connect San Diego to Plaster City (20 miles west of El Centro) via Tijuana, Campo, and Jacumba.[30] The trestle was built in the gorge in 1932 to reroute San Diego and Arizona Eastern Railway line trains around a collapsed tunnel. The railway has closed periodically since 1976 when tropical storm Kathleen damaged sections of the line.[31] Metropolitan Transit System (MTS) purchased the line in 1979 and has had agreements with various freight operators, but its future operation is unclear.[32] At 630-feet long and 186-feet tall, the trestle is one of the largest in the world.

Goat Canyon Railroad Trestle, c. 1994. Photograph by Chris Wray.

Picturesque Bridges

Sorrento Overhead/North Torrey Pines Bridge, c. 2015. Photograph by Wade Durant.

Sorrento Overhead/North Torrey Pines Bridge – 1933

The Sorrento Overhead, also known as the North Torrey Pines Bridge, sits on North Torrey Pines Road at the boundary between the cities of Del Mar and San Diego. It overlooks the mouth of Los Peñasquitos Lagoon, adjacent to Torrey Pines State Beach and just north of Torrey Pines State Natural Reserve. The bridge, while not part of the natural landscape, nonetheless appears perfectly suited to this scenic location, so much so, that the City of Del Mar designated it a historic landmark in 1996.[33]

In the early twentieth century, the road between Del Mar and San Diego was winding and dangerous. Flooding regularly damaged the wooden trestles that allowed vehicles to pass under the railroad tracks. As the region developed and traffic increased, it became clear that this coast highway—which was also the main route between Los Angeles and San Diego—needed to be realigned and widened. After years of planning, the highway was rerouted to eliminate steep grades and hairpin turns. M.J. Dwyer, an Assistant Bridge Design Engineer at the Division of Highways in Sacramento, designed a new bridge to replace the railroad underpass just south of the new location.[34] Completed in 1933 by Los Angeles builder Byerts and Dunn, the Sorrento Overhead was a reinforced concrete T-beam girder structure with ornamental balustrade railings and soffit bracketing; peaked arches between the central columns suggest a Gothic influence on the design. Together, its 13 spans were 553-feet long and rose 22 feet above

the railroad right-of-way and over 50 feet above the adjacent wetland. The State of California paid $117,000 for the new bridge, double the anticipated budget.[35]

In the decades that followed, the Sorrento Overhead carried traffic across a state preserve wetland and over busy railroad tracks. Users of the bridge included locals commuting between Del Mar and La Jolla or San Diego; tourists in vehicles or on bicycles travelling along the coastal road; and pedestrians accessing the popular beach and the state park on the bluffs above it.

Due to its age, heavy use, and proximity to the sea, the concrete bridge's structural integrity eventually became severely compromised. In similar circumstances, other bridges in the vicinity were substantially altered (primarily by retrofitting and widening) or even replaced. However, the City of Del Mar, owning one-half of the bridge, resisted the City of San Diego's proposal to replace the structure altogether. After gaining full ownership of the bridge, the city committed to retrofit it in order to retain the structure and appearance of the 1930s original. The retrofit designed by Simon Wong Engineering (now Kleinfelder) was constructed by Flatiron under contract with the City of Del Mar. Work commenced in 2011 and entailed building temporary bridges to re-route traffic in stages while new precast, prestressed, and post-tensioned girders matching the original architecture were installed, the column concrete and rebar replaced, and a cathodic protection system installed.[36] The project also required coordinating with the North County Transit District to meet the railroad's strict requirements for work in its right-of-way; monitoring by biologists to ensure protection for local wildlife, including bats and endangered California gnatcatchers; and working with nearby residents to minimize disruptions made inevitable by night work and temporary road re-alignments. The project was completed in early 2014.

North Torrey Pines Road Bridge over Los Peñasquitos Creek – 2005

Just south of the historic Sorrento Overhead/North Torrey Pines Bridge sits a much more recent—but no less fitting—addition to this picturesque location. Like its much older counterpart to the north, the 2005 North Torrey Pines Road Bridge carries pedestrians, cyclists, and thousands of vehicles across an environmentally sensitive area, in this case, the outlet of Los Peñasquitos Creek and Lagoon. Therefore, its design and construction had to meet the strict requirements of both the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). The haunched, three-span, cast-in-place, prestressed box girder won multiple awards, including the ASCE San Diego Section's Award of Excellence.[37]

Scenic Water Crossings

North Torrey Pines Road Bridge over Los Peñasquitos Creek. Photograph by Vince Streano.

San Diego–Coronado Bridge – 1969

San Diego-Coronado Bridge. Photograph by Thuan Ton.

"It's an iconic piece of public art in one of the world's most beautiful cities," commented Port Commissioner Lee Burdick in 2010. Engineered by a team at

the California Department of Public Works, Division of Bay Toll Crossings, the 2.12-mile long San Diego-Coronado Bridge sweeps dramatically out into the bay, its blue superstructure in harmony with the surrounding water and sky.[38] Lew Dominy, an associate in architect Robert Mosher's office in the years following the latter's work on the bridge, wrote:

> Bob determined the plan with the large radius graceful curve, conceived of the arched columns to recall the mission architecture of our region, and selected the blue color for the steel (which was his favorite color perhaps because he loved to sail). At his office, we always called this royal blue color "Mosher Blue" because it was always a safe choice if we were seeking his approval. He also was the driving force to keep it so simple and pure in form—a large reason for its enduring beauty.[39]

This bridge is the main means for traveling by vehicle across the San Diego Bay between San Diego and Coronado, a popular tourist destination and home to the North Island Naval Air Station and Naval Amphibious Base. Before the bridge was constructed, Coronado was accessible via ferry service or by driving around the southern end of San Diego Bay, then north on the Silver Strand, a trip of approximately 20 miles. The bridge superstructure consists of steel I-girders and steel box girders that were fabricated in the San Francisco Bay Area and brought to San Diego by barge.[40] The substructure's 30 towers rest on 487 prestressed reinforced concrete piles that were driven up to 100 feet into the floor of the bay, then filled with concrete.[41] Clearance over the bay is 200 feet to allow for the passage of large ships, as requested by the U.S. Navy.[42]

The Coronado Bridge officially opened in 1969 during the celebration of San Diego's bicentennial. Daily traffic grew from nearly 25,000 vehicles per day in 1971 to nearly 75,000 per day in 2009.[43] It has been retrofitted twice, each time after an earthquake elsewhere resulted in updated seismic standards.[44] The latest retrofit was designed by a McDaniel Engineering/J. Mueller International joint venture and implemented in 1999.[45] Under prime contractor Traylor Pacific, the work included adding lead-rubber seismic isolation bearings at the tops of some piers and large viscous dampers (like shocks on a vehicle) at the ends of the steel box girder that spans the main channel openings.[46] The retrofit team also worked with the community to preserve the historically and culturally significant Chicano Park murals.

David Kreitzer Lake Hodges Bicycle Pedestrian Bridge – 2009

David Kreitzer Lake Hodges Bicycle Pedestrian Bridge. Photograph by Vito Palmisano.

When San Diego is not experiencing a record drought, the world's longest stress ribbon bridge is reflected in the waters of Lake Hodges, just south of Escondido.[47] The David Kreitzer Lake Hodges Bicycle Pedestrian Bridge allows active San Diegans to enjoy the mild climate. Designed to minimize impacts on sensitive habitats, the 990-foot bridge has only two supports within the lake.[48] Part of the San Dieguito River Park's trail system, it not only connects trails on the north and south shores of the lake, but also provides access to the Coast to Crest Trail, which reaches from Del Mar to Volcan Mountain near Julian.[49]

Mike Gotch Memorial Bridge. Photograph by Tom Pavia.

Mike Gotch Memorial Bridge over Rose Creek (Mission Bay) – 2012

With an overall length of 260 feet, this elegant bridge is one of the longest single-span pedestrian bridges of its type in the United States.[50] It also completes the northeast section of the path circling Mission Bay, giving pedestrians and other non-motorized traffic a safer alternative to busy surface streets. It is fitting that this bridge honors Mike Gotch, a former member of the City Council and the State Assembly, and a committed environmentalist who worked to ensure public access to Mission Bay.[51]

Cantilever Bridges

Pine Valley Creek Bridge, c. 1974. Photograph by Man-Chung Tang.

Pine Valley Creek Bridge – 1974

In the early 1970s, the old US 80 highway connecting San Diego to points east was gradually giving way to the new Interstate 8. Sixty miles east of the city, Caltrans bridge designers were faced with the formidable task of crossing a 450-foot wide, 440-foot deep canyon. The result was one of the tallest bridges in California and the first long-span segmental bridge in the United States: the Pine Valley Creek Bridge.[52]

The Caltrans design (under project engineer Bert Bezzoni) consisted of approximately 15 drawings, but once the project was awarded to a joint venture

of SJ Groves and Dyckerhoff & Widman, it was subjected to a Value Engineering Redesign under chief engineer Man-Chung Tang. Involving more than 500 drawings, it was a complex and exciting project. According to Tang, "At that time, no one had experience in cantilever construction in the U.S."[54] Because it was such a new method of construction, Tang "also designed all formwork, form travelers, and the moveable truss used for trucks to transport people and material from pier to pier." The hard work was well worth it, though. "Most long span concrete bridges, worldwide, have deflection problem. The PVCB is an exception. It is perfectly straight after over 40 years of service."[53]

Otay River Bridge – 2007

More than 30 years later, another world-class segmental cantilever bridge was built in the county. The 2007 completion of the Otay River Bridge on the South Bay Expressway, a toll road between SR 905 near the US/Mexico border and SR 54, provided inland south county residents and cross-border traffic with a convenient connection to the regional highway system, allowing them to avoid the busier I-805.

Like the Pine Valley Creek Bridge, this 3,320-foot long, 180-foot high bridge uses segmental cantilever design. The older bridge was entirely cast in place, however. The Otay River Bridge uses cast-in-place piers, but they support a superstructure of precast segmental box girders that were made by Pomeroy Corporation in Perris, California; shipped to the bridge site; and installed using

Otay River Bridge, c. 2007. Photograph courtesy of Caltrans.

an overhead gantry. Recipient of numerous awards, the bridge was designed and built by Otay River Constructors (a Washington Group/Fluor joint venture), with design consulting by International Bridge Technologies and Washington Infrastructure Services. Parsons Transportation Group provided construction supervision.[55]

Freeway Crossings

West Lilac Road Overcrossing, c. 1980. Photograph courtesy of Caltrans.

West Lilac Road Overcrossing – 1978

Nearly 700-feet long and rising 122 feet above the Interstate-15 north of Escondido, the West Lilac Road Overcrossing provides a dramatic connection between the communities surrounding Valley Center and Bonsall. It may be one the best known bridges in the county, but it often provokes the question: Why was a structure of this magnitude built in such a sparsely populated, semi-rural location?

The answer is "Mr. Caltrans." Engineer Jon Mehtlan explains, "A more typical slab bridge built a half mile north or south could have accomplished the same task for much less money. But then-Director of Caltrans District 11, Jacob Dekema, liked to do something iconic every once in a while."[56] Dekema, often referred to as the father of San Diego's highway system, brought great vision and direction to the region. And in the 1970s highway funding was available to support the resulting projects.[57]

During the construction of West Lilac Road Bridge, Mehtlan was an Assistant

Bridge Engineer at Caltrans doing fieldwork under Structure Representative John Day.[58] He recalls that the West Lilac Road overcrossing was a complicated undertaking. A product of the Caltrans Bridge Department, it was designed by engineers Fred G. Michaels and John Suwada (with architecture consulting by William Wells) in 1973.[59] Mehtlan recalls that the project sat on the shelf for a few years, during which time Michaels and Suwada left Caltrans, taking their notes with them. This left the field engineers to their own devices and many engineering calculations were worked out onsite. Nothing on the bridge was symmetrical; the arch, the sloping girders all varied lineally from one end to the other, so calculations had to be made inch-by-inch the entire length of the bridge, all before the computer age.

While the location of the bridge enhances its visual impact, the terrain presented its own challenges, requiring three times the effort to manage lines and grade. One contractor employee found the project so frustrating that he left the business entirely. Prior to construction of the bridge, the hill existed with a cut for the new Interstate-15 travel lanes.[60] Then 11 million cubic yards of rock had to be excavated to prepare the slopes for the installation of the bridge.[61] Because the bridge was cast in place, the falsework had to be installed according to very precise field calculations that took weeks to do.[62]

The bridge has three spans. One, the arch, is conventionally reinforced with interior rebar. The two approach spans, however, were post-tensioned.[63] When the cables in the superstructure were pulled tight on the day before Thanksgiving, the bridge's weight was transferred onto the arch, which was still being supported by falsework. Field calculations indicated that transferring this load would cause the falsework at the center of the arch to move an acceptable 1-3/8 inches. When the crew returned from the four-day holiday, however, they found that the falsework had become so tightly compacted and mangled that it had to be removed with cutting torches. In all, the project took nearly two years and $1.5 million to complete. It opened in 1978 and has been fascinating people ever since.[64]

Adams Avenue Overcrossing/Roscoe E. Hazard Memorial Bridge – 1970

A number of well-known bridges were built while Dekema was at the helm of Caltrans District 11, including the Adams Avenue Overcrossing. This graceful 439-foot bridge spanning Interstate 805 is a haunched, three-span box girder supported by tapered piers. Connecting the communities of University Heights and Normal Heights, it was named for Roscoe E. "Pappy" Hazard (1881-1975), also known as "Mr. San Diego." Hazard was a prominent builder of highways and ardent supporter of San Diego history.[65]

Adams Avenue Overcrossing/Roscoe E. Hazard Memorial Bridge, c. 1973. Photograph courtesy of Caltrans.

Eastgate Mall Road Overcrossing/Henry G. Fenton Bridge – 1971

It is often suggested that this bridge over I-805 between the Golden Triangle and Miramar is a twin of the West Lilac Road Overcrossing. Caltrans engineer Fred Michaels was involved in the design of both bridges and they are visually similar, but they are not quite identical. The Eastgate Mall Road Overcrossing is

Eastgate Mall Road Overcrossing/Henry G. Fenton Bridge, c. 1993. Photograph courtesy of Caltrans. Photographer: Lynn G. Harrison.

smaller and its arch is flanked on each side by an inclined column. Also known as the Old Miramar Road Overcrossing, in 1982 the bridge received its third designation when it was named the Henry G. Fenton Bridge in honor of the local contractor and rancher.[66]

I-805 Viaduct over Mission Valley – 1973

I-805 Viaduct over Mission Valley (looking north), c. 1972. Photograph courtesy of Caltrans.

Once an agricultural area with a highly unpredictable river and a history of flooding, Mission Valley entered the modern era in the 1950s with development in the form of hotels, shopping centers, and recreational amenities, indoors and out.[67] Office buildings, the San Diego Stadium, and Interstate 8 soon followed.[68] Planning for an inland north-south freeway mirrored the valley's development, and construction of Interstate 805 began in 1967. It would need to cross both the I-8 and the San Diego River.

The solution was the 3,900-foot Mission Valley Viaduct, at one time the longest concrete box girder bridge in the world. The Viaduct is the top stack of the Jack

Schrade Interchange, a four-level symmetrical stack interchange that allows a smooth flow of traffic between the I-805 and I-8 freeways.[69] In addition to being visually appealing, the viaduct also serves an important purpose in carrying traffic across Mission Valley. In fact, this portion of the I-805 is part of the Intermodal Corridors of Economic Significance (ICES) system—corridors essential to the state's economy.[70] Anticipated development along the I-805 presents a challenge for future planners to accommodate increasing traffic across this vital structure.[71]

Trolley Bridges

Whereas the Viaduct carries large numbers of travelers *across* the busy Mission Valley corridor, people also need to travel *along* it and now have an option to do so via public transportation. While the last of San Diego's early trolley lines ceased operation in 1949, public light rail projects resurfaced a quarter century later.[72] In 1976, State Senator James R. Mills from San Diego sponsored legislation to create the Metropolitan Transit Development Board (MTDB).[73] By the mid-1990s, the MTDB's trolley system included lines running from San Ysidro and Santee to downtown. Work was underway on a north-south line from downtown to Old Town, and plans were in motion to extend service through Mission Valley, which had become a multi-use urban transportation corridor, albeit, one in a flood plain.

Qualcomm Station, c. 2015. Photograph by Gene Spineto.

Over the ensuing decade, that plan would bear fruit. The line developed eastward from Old Town, with many segments elevated to reduce flooding hazard and clear existing structures.

Qualcomm Station – 1997

Opened just in time for Super Bowl XXXII in January 1998, this imposing concrete station complements the Brutalist architectural design of Qualcomm stadium, formerly named for Jack Murphy in 1969.[74] On average, it is not the most-used station on the line. Trolley ridership during games, however, is very high, taking thousands of vehicles off the surrounding roads on game days.[75] The platforms and rail line are raised, allowing parking beneath. This station provides the most parking of any in the system: 5,000 free spaces are available when the stadium isn't hosting a major event. This is particularly useful since the green line began offering direct service to another special-event draw, the convention center.[76]

Grantville Station – 2005

Grantville Station. Photograph by Vince Streano.

Grantville Station is a substantial concrete structure located two stops east of Qualcomm Station. It appears somewhat more ethereal than the latter due to its green mesh screens and steel canopies.[77] While both stations serve riders travelling to entertainment venues, Grantville also serves the busy Mission Gorge Road commercial district, as well as nearby residential areas.

Mission Valley East Light Rail Transit Extension – 1999-2005

Mission Valley East Light Rail Extension at Mission Gorge Road. Photograph by Vince Streano.

This $506 million project completed the Green Line through Mission Valley.[78] It closed the nearly six-mile gap that had existed between Mission San Diego and La Mesa and added stops at Grantville, San Diego State University, Alvarado Hospital, and 70th Street on its way to Grossmont Center.[79] Many local design and construction firms were involved in this project, which received an ASCE Award of Merit in 2008.[80]

Harbor Drive Pedestrian Bridge – 2012

Harbor Drive Pedestrian Bridge, c. 2012. Photograph by Brooke Duthie.

A century ago, San Diego's oldest suspension bridge helped neighborhood residents to easily reach trolley lines. The city's newest such bridge, however, was a matter of public safety as it provided access for pedestrians and cyclists over busy Harbor Drive and the six train and trolley tracks crossing the southern end of Park Boulevard. But the Harbor Drive Pedestrian Bridge is also the realization of a goal first expressed in 1908—connecting two of the city's renowned and important regional assets.[81] With the opening of this bridge in 2011, it became possible to travel along Park Boulevard from Balboa Park all the way to the San Diego Bay.

Designed by T.Y. Lin International and Safdie Rabines Architects, and built by Reyes Construction, this multiple-award winning structure is one of the longest self-anchored suspension bridges in the world. And while many bridges require distance viewing to achieve their full aesthetic impact, this bridge is visually

striking from all angles, including from atop the curved deck suspended along its inside edge from a single 131-foot pylon.[82] Only a few years old, the Harbor Drive Pedestrian Bridge is recognized as the latest in a long list of extraordinary bridges in the San Diego region.

From the early 20th century, when San Diego was a small coastal town, its residents—and engineers—have built bridges to solve problems, overcome challenges, make connections, and provide artistic vision to inspire the imagination. These vital structures have helped the region to grow, flourish, and become the vibrant and diverse metropolitan area that it is today.

NOTES

1. American Society of Civil Engineers, "Policy Statement 504, Rehabilitation of Historic Bridges," http://www.asce.org/issues-and-advocacy/public-policy/policy-statement-504---rehabilitation-of-historic-bridges/ (accessed October 19, 2015).
2. Art McDaniel, conversation with Roya Golchoobian, December 24, 2015.
3. Mark Ashley, email exchange with Clark Fernon, December 2, 2015.
4. Mark Creveling, email exchange with Clark Fernon, December 13, 2015.
5. Jim Frost, email exchange with Clark Fernon, December 03, 2015.
6. Donald Covington, *North Park: A San Diego Urban Village, 1896-1946* (San Diego: North Park Community Association, 2007), 28.
7. Comly also designed the concrete girder bridge that carries Market Street over 24th Street in the Grant Hill neighborhood. Alexander D. Bevil, *National Register of Historic Places Continuation Sheet* (University Heights Historical Society, June 5, 1998), Section 8, page 3.
8. Covington, *North Park*, 28; Gregory Montes, "San Diego's City Park 1902–1910 From Parsons to Balboa," *The Journal of San Diego History* (hereafter *JSDH*) 25, no. 1 (Winter 1979), http://www.sandiegohistory.org/journal/79winter/citypark.htm (accessed April 30, 2015).
9. The Georgia Street Bridge's builder was Edward T. Hale. Bevil, *National Register of Historic Places Registration Form*, 3.
10. City of San Diego Development Services, Advanced Planning & Engineering Division, *Draft Mitigated Negative Declaration, Project No. 263173* (January 4, 2013), 1.
11. An arch bridge's "spandrels" are the roughly triangular areas formed on each end of the bridge between the arch, the abutments, and the roadway (deck). An "open-spandrel" bridge has visible supporting vertical members within that triangular area.
12. Precast concrete construction means that portions of the structure are made separately, either on site or elsewhere, and then attached to the structure. California Department of Transportation. *Historic Highway Bridges of California* ([Sacramento]: California Department of Transportation, 1990), 104.
13. "Plans for $2,000,000 in New Bridges are Approved," *California Highways* 1, no. 7 (July 1924), 10, https://archive.org/stream/california192427highwacalirich#page/n45/mode/2up (accessed June 29, 2015).
14. "Bonsall Bridge," *Bridgehunter*, http://bridgehunter.com/ca/san-diego/san-luis-rey-river/, last modified May 30, 2010 (accessed April 25, 2015).
15. "California 76," *AA Roads*, http://www.aaroads.com/california/ca-076.html, page updated

December 8, 2012 (accessed June 11, 2015); Shawn Maree Smith, "New Bridge to Span San Luis Rey River After Years of Delay," *Los Angeles Times,* June 11, 1989, http://articles.latimes.com/1989-06-11/local/me-3106_1_golden-gate-bridge-san-luis-rey-bridge-caltrans (accessed June 11, 2015).

16. "Old Highway 395, Part 5: US 395 Bypass/Escondido Freeway (1950-1969), South Centre City Parkway in Escondido," *Floodgap Roadgap,* http://www.floodgap.com/roadgap/395/old/u5/ (accessed June 10, 2015); and "U.S. 395, Illustrated" *California Highways and Public Works* 29, nos. 11,12 (November–December 1950): 17–19, https://archive.org/stream/californiahighwa195051calirich#page/n455/mode/2up (accessed June 30, 2015). The name of this bridge is the source of some confusion. It is also known as Peñasquitos Bridge and Old Highway 395 Bridge, as are other bridges in the county.

17. "Old Highway 395, Part 5," *Floodgap Roadgap*; "U.S. 395- Final Alignment," *Old U.S. 395 Highway, San Diego, California,* http://www.garbell.com/US395-old/395Penasquitos-bridge/395PsqBridge.htm, page modified June 23, 2008 (accessed June 10, 2015).

18. A "cantilever" is a horizontal "structural member that projects beyond a supporting column or wall and is counterbalanced and/or supported at only one end." *Communities of Practice: Center for Environmental Excellence by AASHTO (American Association of State Highway and Transportation Officials),* "Glossary," http://environment.transportation.org/cop/groups/historic_bridges/pages/glossary.aspx (accessed April 15, 2015).

19. "Laurel Street OC," *California Department of Transportation Digital Collections*, http://cdm16436.contentdm.oclc.org/cdm/compoundobject/collection/p16436coll2/id/1476/rec/5 (accessed March 30, 2015); *Historic Highway Bridges of California*, 88; Richard W. Amero, "The Cabrillo Bridge, Caltrans and Balboa Park," 2, *Save Our Heritage Organization*, http://www.sohosandiego.org/main/plazabpplanning.htm (accessed April 3, 2015); and Carlton Monroe Winslow, *The Architecture and the Gardens of the San Diego Exposition* (San Francisco: Paul Elder & Co., 1916), 24.

20. Catherine A. Cardno, "Retrofitting Under Way on San Diego's Cabrillo Bridge," *Civil Engineering* 84, no. 3 (March 2014): 28-30; Lou Melendez (Caltrans' Project Manager on the retrofit), email exchange with Peter Smith, July 05, 2015.

21. "Post tensioning" is a type of what is typically called "prestressing," wherein steel cables are placed inside of ducts that run through a concrete structure. The cables are tensioned after the concrete has hardened, putting the concrete into compression and strengthening the overall structure.

22. The historic Uptown District was bounded by A Street to the south, Balboa Park to the east, and Hillcrest to the north. City of San Diego Planning Department, IS Architecture, and Walter Enterprises, *Uptown Historic Context and Oral History Report*, City of San Diego (November 24, 2003), 2.

23. The cost to build the bridge was $113,708.33, and it was paid for by assessments on property owners along First Avenue. *Historical Resources Evaluation Report for the First Avenue Bridge*, 6.

24. Ibid., 7.

25. David Ogul, "First Avenue Bridge Reopens," *San Diego Union-Tribune,* February 22, 2010, http://www.utsandiego.com/news/2010/feb/22/first-avenue-bridge-to-reopen-today/ (accessed March 15, 2015).

26. *Historical Resources Evaluation Report for the First Avenue Bridge*, 1.

27. Rita Calvano, "Quince Street Footbridge Declared 'Historical'; Backers Given a Boost," *San Diego Tribune,* October 29, 1987, http://www.hillquest.com/quince-street-bridge/ (accessed April 24, 2015).

28. John D. Cramer, "Quince Street Bridge, 1905 Landmark, Reopens," *Los Angeles Times,* August 22, 1990, http://articles.latimes.com/1990-08-22/local/me-905_1_quince-street-footbridge (accessed April 24, 2015).

29. The bridge builder was Knight & Hale Construction Company. Photo, San Diego Historical Society #80:2432 (c. 1911-12).

30. John A. Wilson, "Formidable Places: Building a Railroad in Carriso Gorge," *JSDH* 40, no. 4 (Fall 1994), http://www.sandiegohistory.org/journal/94fall/carriso.htm (accessed April 25, 2015).

31. Tropical storm Kathleen damaged sections of the line on September 10, 1976. Gena Holle, "Transit in San Diego: ASCE Anniversary Project," *JSDH* 48, no. 1 (Winter 2002), http://www.sandiegohistory.org/journal/2002-1/holle.htm (accessed May 01, 2015).

32. In addition to the $5.5 million the Carrizo Gorge Railway estimates it spent preparing to reopen the line in 2004, the federal government contributed $10 million in funds administered by the San Diego Association of Governments. Jeff Ristine, "Long-Blocked Rails On Track for Reopening," *San Diego Union-Tribune*, December 7, 2003, http://legacy.utsandiego.com/news/metro/20031207-9999_1m7carrizo.html (accessed April 25, 2015); Metropolitan Transit System, *San Diego & Arizona Eastern (SD&AE) Railway* (April 2013); Dorian Hargrove, "Desert Line Deal Derails," *San Diego Reader*, January 6, 2015, http://www.sandiegoreader.com/news/2015/jan/06/ticker-desert-line-deal-derails/# (accessed June 30, 2015).

33. *Historic Resource Evaluation Report Sorrento Overhead*, 4.

34. Ibid., 9.

35. Ibid., 8.

36. "Precast" is defined in note 12. "Prestressed" means that interior cables providing strength to the bridge are pulled to the appropriate tension before concrete is poured around them. With "post tensioning" tightening takes place after the concrete has hardened. "Cathodic protection systems" run an electrical current through a structure to prevent corrosion of the structure's interior steel.

37. "Haunched" bridges have beams that are enlarged near their supported ends (i.e., at the columns) to increase strength, and so appear as shallow arches. "Cast in place" means that concrete was placed into formwork at the site in its ultimate location.

38. "Superstructure" refers to the part of the bridge that spans whatever obstacle the bridge is designed to cross (in this case, the San Diego Bay).

39. Lewis Dominy, AIA (Principal, Domusstudio Architecture), emails to Richard Chavez (SANDAG), August 24, 2015, and Christine Robbins, September 27, 2015. Dominy and Chavez are working on the Coronado Bridge Bike/Ped Tube study to determine how to incorporate bicycle and pedestrian access to the bridge while preserving its structural and visual integrity.

40. Contrary to a persistent urban rumor, no part of the bridge was designed to float. California Department of Transportation, *San Diego-Coronado Bridge Fact Sheet* (August 2009), 1-2.

41. The prime contractor on the bridge was Murphy Pacific Corporation. Per the bridge's final construction reports, Murphy Pacific Bridge Builders built the superstructure (the structural steel, the roadway deck, and the exterior paint) and Guy F. Atkinson Company the substructure (piers, footings, towers, and dredging). H.D. Reilich was the project's Resident Engineer.

42. State of California Transportation Agency, Department of Public Works, Division of Bay Toll Crossings, *Final Construction Report of the Superstructure, San Diego-Coronado Bridge Contract 10014* (1969), 2.

43. *San Diego-Coronado Bridge Fact Sheet*, 2.

44. The precipitating events were the 1971 San Fernando earthquake and the 1989 Loma Prieta earthquake. California Department of Transportation, *Fact Sheet: San Diego - Coronado Bridge Seismic Retrofit Project* (March 1999), http://www.dot.ca.gov/dist11/operations/bridgeprint.html (accessed April 28, 2015).

45. McDaniel Engineering is now T.Y. Lin International.

46. Mark Ashley (McDaniel Engineering's Senior Project Engineer on the 1999 retrofit), email exchange with Wade Durant, May 05, 2015. Tomás Kompfner was Senior Project Engineer for J. Mueller International on the retrofit.

47. The pedestrian bridge was designed by T.Y. Lin International; the contractor was FCI Constructors, Inc. Tony Sanchez, "A Path to Safety," *Civil Engineering* 80, no. 1 (January 2010): 68, http://www.civilengineering-digital.com/civilengineering/201001?pg=71&search_term=san%20diego%20bridge&doc_id=-1&search_term=san%20diego%20bridge#article_id=361477 (accessed April 10, 2015).

48. Tony Sanchez, "The David Kreitzer Lake Hodges Bicycle Pedestrian Bridge," *Aspire* 4, no. 3 (Summer 2010): 36.

49. "Trails," *San Dieguito River Park*, http://www.sdrp.org/wordpress/trails/ (accessed April 30, 2015).

50. The bridge was designed by T.Y. Lin International.

51. Blanca Gonzalez, "Politician Called an Early Environmentalist," *San Diego Union-Tribune,* May 20, 2008, http://www.utsandiego.com/uniontrib/20080520/news_1m20gotch.html (accessed March 14, 2015). Michael Gotch represented Mission Beach and Pacific Beach on the San Diego City Council (1979–1987) and the 78th District in the State Assembly (1990–1994). He served on the California Coastal Commission from 1980–1988.

52. A much shorter span, precast segmental bridge in Texas pre-dated the cast-in-place Pine Valley Creek Bridge. In 2007, the California State Senate issued a resolution naming the PVC Bridge in honor of the project engineer during its construction, Nello Irwin Greer.

53. Man-Chung Tang (Dyckerhoff & Widmann's chief engineer on the redesign project), email exchanges with Wade Durant, April 16, 2015, and Christine Robbins, May 07, 2015.

54. "Cantilever" is explained in note 18. Cantilevers are a useful construction method for building a long span over a deep canyon when placing supports in the canyon is impractical.

55. Ben Soule, P.E., and Daniel Tassin, P.E., "The Otay River Bridge," *Structure Magazine* (July 2007), 44. Soule was the Engineer of Record for this project, and Tassin its Technical Director. The Resident Engineer during construction was Melanie Estes. Washington Group, one of the joint venture partners, is now part of AECOM.

56. 56 Jon Mehtlan (Area Structures Construction Manager, Caltrans Districts 8 and 11, retired), telephone conversation with Christine Robbins, April 08, 2015.

57. Jacob "Jake" Dekema was District 11's highly respected District Engineer and Director for a quarter-century (surpassing his predecessor's tenure by three years). He held the position from 1955 to 1980, shaping much of the region's modern freeway system and earning him the nickname, "Mr. Caltrans." Ron Main, *District 11 August 1935–August 1988: 53 Years & 5000 Miles* ([Sacramento]: California Department of Transportation, 1988), 3.

58. Mehtlan. The project's prime contractor was Granite Construction. The bridge's official name, The Walter F. Maxwell Memorial Bridge, honors the founder of its structure subcontractor, W.F. Maxwell Construction. The bridge is also known as the Lilac Bridge and the Rainbow Bridge.

59. Caltrans, Office of Structures Design, *Staff Biographies* (July 12, 1989).

60. Mehtlan. Traffic remained on the old U.S. Route 395 until construction was completed.

61. "History of the West Lilac Bridge" *The Boulevard* (February 08, 2008). www.theboulevardonline.com/archives/2008/0208.html (accessed March 14, 2015)

62. "Cast in place" is explained in note 38.

63. "Post-tensioned" is explained in note 21.

64. Carol Lemke, "Crossing Over the Other Side," *Los Angeles Times,* June 27, 1991, http://articles.latimes.com/1991-06-27/news/nc-1696_1_toll-bridge (accessed April 14, 2015).

65. Elvira L. Wittenberg, "Love Affair with History," *JSDH* 12, no. 4 (October 1966), http://www.sandiegohistory.org/journal/66october/loveaffair.htm (accessed April 25, 2015).

66. *California Highways,* "Routes 780 through 980, Interstate 805," http://www.cahighways.org/780-980.html#805 (accessed April 25, 2015).

67. "Mission Valley Over Time," *San Diego Union-Tribune,* June 22, 2008, http://legacy.utsandiego.com/uniontrib/20080622/news_1h22timeline.html (accessed May 4, 2015).

68. Nan Taylor Papageorge, "The Role of the San Diego River in the Development of Mission Valley," *JSDH* 17, no. 2 (Spring 1971), http://www.sandiegohistory.org/journal/71spring/river.htm (accessed May 4, 2015).

69. Jack Schrade was Del Mar's State Senator from 1963–1976. "Routes 780 through 980, Interstate 805," *California Highways*, http://www.cahighways.org/780-980.html#805 (accessed April 25, 2015).

70. California Department of Transportation Planning Division, District 11, *Draft 2020 I-805 Transportation Concept Summary*, (February 2010), 14.

71. Ibid., 8.

72. Gena Holle, "Transit in San Diego: ASCE Anniversary Project." *JSDH* 48, no. 1 (Winter 2002), http://www.sandiegohistory.org/journal/2002-1/holle.htm (accessed May 1, 2015).

73. Jeff Ristine, "After 25 Years, the Trolley Keeps on Moving," *San Diego Union-Tribune,* July 23, 2006, http://www.utsandiego.com/uniontrib/20060723/news_1m23trolley.html (accessed May 1, 2015).

74. The 1967 stadium was designed by Gary Allen of local firm Frank L. Hope & Associates. "Frank Lewis Hope Jr. (1901–1994) Frank Lewis Hope III (1930–)," *Modern San Diego*, http://www.modernsandiego.com/FrankLHope.html (accessed April 25, 2015).

75. Andrew Keatts, "San Diego's Most-Used Trolley Stops," *Voice of San Diego,* June 27, 2014, http://www.voiceofsandiego.org/share/san-diegos-most-used-trolley-stops/ (accessed 05/03/2015).

76. *San Diego Metropolitan Transit System*, "Trolley Station Information," http://www.sdmts.com/Trolley/TrolleyStationInfo.asp (accessed April 25, 2015).

77. Grantville Station's prime contractor was Modern Continental Construction. *The Subway Nut*, "Grantville," http://subwaynut.com/california/san_diego_trolley/grantville/index.php (accessed April 25, 2015).

78. "Mission Valley Over Time."

79. *San Diego Metropolitan Transit System*, "MTS Historical Timeline." http://www.sdmts.com/MTS/timeline.asp (accessed May 1, 2015).

80. American Society of Civil Engineers, "Outstanding Civil Engineering Achievement (OCEA) Award Past Award Winners,." http://www.asce.org/templates/award-detail.aspx?id=6329&all_recipients=1 (accessed May 1, 2015).

81. Planner John Nolan's idea was to create a block-wide landscaped walkway from the southwest entrance of Balboa Park (then named City Park) twelve blocks east between Date and Elm Streets to the Bay. Gregory Montes, "San Diego's City Park 1902–1910 From Parsons to Balboa." *JSDH* 25, no. 1 (Winter 1979), http://www.sandiegohistory.org/journal/79winter/citypark.htm (accessed April 30, 2015).

82. The Harbor Drive Pedestrian Bridge cost $26.8 million to construct and was funded by the San Diego Redevelopment Agency, the California Transportation Commission, the Federal Highway Administration, the State Transportation Improvement Program, and private contributions. "Harbor Drive Pedestrian Bridge," *Civic San Diego*, www.civicsd.com/projects/major-downtown-projects/projects-landing-page/convention-center/harbor-drive-pedestrian-bridge/overview.htm (accessed April 30, 2015).