NRV

Nutt, Redfield & Valentine

Statement of Qualifications

2008

NUTT, REDFIELD AND VALENTINE

Legal Firm Name	Nutt, Redfield and Valentine
Location and Telephone Number	9048 Hazel Oak Ct Orangevale, California 95662 916-989-4234 FAX 916-989-0117
Date of Establishment	May 1, 1992
Type of Organization	Partnership
Number of Personnel	6
Banking Reference	First Northern Bank 11 West Coast Street Woodland, CA 95695

Nutt, Redfield and Valentine is a professional partnership of Richard V. Nutt, Charles Redfield and Robert N. Valentine. This firm was formed in 1992 to offer the combined talents of a highly experienced team of bridge engineers. The focus of the firm is on providing individualized quality bridge engineering services to its clients.

The following paragraphs summarize the personal experience and qualifications of the Principals of Nutt, Redfield and Valentine (NRV). Detailed resumes and project descriptions follow this section.

The background of Richard Nutt is unique in that it encompasses both bridge design and applied research work with Applied Technology Council (ATC) and others over many years. In addition to bridge design related to several new and seismically retrofitted bridge structures, he was a key member of the design teams for the San Francisco Oakland Bay Bridge and the new Benicia-Martinez Bridge in northern California. He also managed and directed a number of applied research projects in various aspects of bridge engineering. Many of the projects required coordination with technical experts, especially in the field of earthquake design. He was the Principal Investigator/Project Manager for the ATC-32 project and responsible for directing and coordinating the efforts of a panel of 13 internationally recognized bridge seismic design experts, six specialty subcontractors and ATC staff in developing improved seismic design criteria for California bridges that will ensure that bridge structures of all types perform well in earthquakes. He also participated in several projects culminating in the development of seismic design recommendations for the AASHTO LRFD Bridge Design Specifications and is coauthor of FHWA Guidelines for the Seismic Retrofitting of Bridges. Mr. Nutt is the recipient of the Applied Technology Council award for excellence in the field of bridge seismic design and retrofitting.

The firm of Charles Redfield Consulting Engineer, which was founded in 1987, specializes in the design of advanced bridge structures. Emphasis of the firm is to design bridges of high technical quality, of correct form and sound aesthetics that compliment the surrounding environment. In recent years he has focused his efforts on unique pedestrian and bicycle bridges including the first pedestrian "stress-ribbon" bridge constructed in the USA (Sacramento River Trails Bridge at Redding, California - 1990), a steel pony truss bascule bridge (Bay Farm Island Bridge) and a uniquely formed continuous, prestressed concrete box girder bridge (Wildcat Trail Bridge) among others. In many of these projects, which

required special expertise, Mr. Redfield was responsible for assembling a team of internationally recognized experts that included Dr. Jiri Strasky of Czechoslavakia, Professor Alex Scordelis of UC Berkeley and Professor Miros Pirner of Praque University. Mr. Redfield also has considerable expertise in the design of segmentally constructed prestressed concrete bridges. He was Project Manager for the design of several monumental bridges including the Jamestown Bridge in Rhode Island and the award winning Lewiston-Clarkson Bridge in Idaho. He has also been a key member of the design team for several other major bridges including the San Francisco Oakland Bay Bridge and the Benicia-Martinez Bridge. Together with Robert Valentine, he designed the first curved segmental prestressed concrete bridge built in the USA by the incremental launching method (Puerto Rico - 1991). Charles Redfield also has a degree in Architecture and is recognized for his practical knowledge of bridge aesthetics.

Robert Valentine commenced his consulting practice in 1986. He has a strong bridge design background and is the designer of the Napa River Bridge (a prestressed lightweight concrete bridge constructed by balanced cantilever methods) and HOV Viaduct No. 2 on I-110 in Los Angeles (constructed using a segmental span-by-span method). He has a long-standing relationship with numerous contractors and has many years of experience in segmental bridge design and construction. He has been particularly innovative in identifying potential cost savings during construction and has successfully performed the engineering for several complicated Cost Reduction Incentive Proposals submitted by different bridge contractors. Having provided construction engineering for many contractors (GFA, Moseman, Kiewit, C. C. Myers, VSL, Bonadiman-McCain, MCM, FCI and others) he has considerable experience with construction practices the solution of construction problems encountered on major bridge projects. Robert Valentine is a also a gifted computer program designer and analyst who originally developed the Bridge Design System (BDS) program used by Caltrans and his own time dependency program (STDS) for the design/analysis of segmentally constructed bridges. This program has a successful history of predicting actual structural behavior and correlates well with original design calculations. Robert Valentine also has a strong background with Caltrans and is completely versed in their procedures.

All NRV Principals have extensive backgrounds in segmental construction. Collectively, they have been involved in over 36 bridge designs in CIP balanced cantilever construction both domestically and abroad. A number of these were redesigns or construction engineering for contractors or prestressing subcontractors. Due to this experience and a thorough knowledge of construction practices (especially in California), consideration of the actual field conditions and procedures are always reflected in the analysis and design.

A list of the segmental bridge experience of NRV is included on the following pages.

Bridge Type	Num.	Bridge Name	Max. Span
Precast Girder	6	Sky Harbor	90 ft
		Taruma Viaducto	45 m
		Porto Colombia	19 m
		Wisconsin Ave.	80 ft
		Great Neck	210 ft
		Sepetiba	20 m
Precast Segmental	3	James River	150 ft
		Zilwaukee	250 ft
		Glenwood Canyon	392 ft
Wing Girder	8	Bogota (6 Bridges)	25 m
		Bear Creek	100 ft
		Connaught	36 m
CIP Span/Span	5	Fornaci	60 m
		Traveraviadukt	55 m
		I-85/I-285	200 ft
		HOV No. 1	132 ft
		HOV No. 2	132 ft
Arch Concrete	3	Scioto	100 ft
		Wisconsin Ave.	159 ft
		Galena Creek Bridge	210 m
CIP Cantilever	36	(See Listing on Following Page)	
Cable Stay (Concrete)	4	Dame Point	1300 ft
		Ruck-a-Chucky	1300 ft
		James River	630 ft
		Portsmouth	860 ft
Cable Stay (Steel)	2	Wierton-Stuebenville	960 ft
		Maysville	1050 ft
Heavy Lift	4	Jamestown	186 ft
		Cochrane	195 ft
		Connaught	84 m
		Illinois River	190 ft
Incremental	2	Caguanas	70 m
		Wabash River	185 ft
Stress-Ribbon	1	Sacramento River Trail	418 ft.

The following is a list of cantilever construction bridge projects in which NVR Principals have participated:

No.	Name	Location	Years	Span (1)	Role (2)
1.	Ponte Colombo Salles	Florianopolis, Brasil	1973-76	165 m	Des Engr
2.	Ponte Costa e Silva	Brasilia, Brasil	1973-75	220 m	Des Engr
3.	Rio do Peixe	Santa Catarina, Brasil	1975	100 m	Des Engr
4.	Ponte Tocantins	Brasil	1975-76	175 m	Prelim
5.	Napa River Bridge	Napa, California	1975-76	250 ft	Design
6.	Puente Rio Dulce	Guatemala	1977-79	190 m	PM
7.	St. Paul River Bridge	Liberia	1978-80	382 ft	PM
8.	Lewiston-Clarkson	Washington-Idaho	1979-82	610 ft	PM
9.	I-205 Columbia River	Oregon-Washington	1980-82	600 ft	Eng
10.	SR-182	Richland, Washington	1980-83	450 ft	Prelim, CS
11.	Cline Avenue Bridge	Indiana	1981-84	316 ft	Des, CS
12.	Connecticut River	New Hampshire	1981	260 ft	Prelim
13.	West Seattle Freeway	Seattle, Washington	1981-82	650 ft	CS
14.	Cumberland River	Tennessee	1983	440 ft	Prelim
15.	Bayamon Bridge	San Juan, Puerto Rico	1983	100 ft	Report
16.	Banger-Brewer I-395	Maine	1984	450 ft	Prelim
17.	Broadway Bridge	Minneapolis, Minn.	1984	280 ft	Prelim
18.	Plymouth Avenue	Minneapolis, Minn.	1984-85	320 ft	CS
19.	Gastineau Channel	Juneau, Alaska	1984-86	620 ft	CS
20.	Jamestown Bridge	Rhode Island	1984-92	636 ft	PM, CS
21.	Umatilla	Oregon-Washington	1985	660 ft	CS
22.	Piney Creek Bridge	Pennsylvania	1985	350 ft	Prelim
23.	Illinois River	Illinois	1985-90	550 ft	CS
24.	3rd Lake Washington - App	Seattle, Washington	1986-88	262 ft	CS
25.	Westmoreland	Dallas, Texas	1987-90	320 ft	CS
26.	Jackson Drive	San Diego, California	1990	600 ft	Consult
27.	Bennett Bay	Idaho	1988		CS
28.	Lehigh River Bridge	West Virginia	1989	550 ft	Prelim
29.	West Seattle Swing Bridge	Seattle, Washington	1989-90	480 ft	CS
30.	Hoover Dam	Arizona	1990-91	480 ft	CS
31.	I-680 Benicia-Martinez	California	1990-95	528 ft	Prel
32.	H-3 Viaduct	Hawaii	1990	360 ft	CK
33.	Misc. Bridges	Taiwan	1991	175 m	CK
34.	SFO Bay Bridge	California	1998-2005	541 ft	Design, CS
35	Oyster Point Blvd Offramp	California	2003	180 ft	CS
36	Devil's Slide Bridge	Pacifica, California	2006-08	129 m	CS

Notes:
1. Length given for main span
2. Legend
   PM : Project Manager
   CS : Construction Services
   CK : Project Review

RICHARD V. NUTT, S.E.

Principal Engineer
Nutt, Redfield and Valentine

Project Assignment Project Engineer/Seismic Design

Years Experience NRV 16 Other 40

Education B.S./1968/ Civil Engineering, San Jose State College (with honors)
M.S./1973/ Structural Engineering, California State Univ., Sacramento

Registrations 1971/Civil - California (c20665); 1980/Structural - California(s2326);
1997/Civil and Structural – Washington(33678)

Summary of Professional Experience

Richard V. Nutt, S.E. - 1988-Present - Owner - Structural Engineer

Designed and or checked the design of numerous highway bridge structures for contractors, developers, and other consultants. Representative projects include:

- San Francisco-Oakland Bay Bridge Seismic Safety Project (Designer – Foundation)
- New Benicia-Martinez Bridge (Designer – Foundation)
- Leidesdorff Lid (Designer – Contractor Redesign)
- Miners Ravine Bridge (Design Checker – Design/Build)
- Palamidessi Bridge (Designer – Contractor Redesign)
- La Cienega – Venice Outer Separation (Designer – Caltrans Design/Build)
- Seismic Retrofit of Southern Viaduct (R1- Line) (Contractor Redesign)
- Seismic Retrofit of Southern Viaduct (North) (Contractor Redesign)
- Arroyo Simi Bridge and OH (Designer of Right Br./Checker of Left Br.)
- HOV Viaduct No. 2 (I-110) (Checker - Contractor Redesign)
- Upper Oso Reservoir Bridge (Designer of Right Br./Checker of Left Br.)

Served as Project Manager and Principal Investigator for Applied Technology Council to Review and Revise Caltrans Seismic Design Standards and Criteria (ATC-32). Project Team member for ATC-18, ATC-18-1 and ATC-49 (NCHRP 12-49) to revise seismic design provisions for the AASHTO LRFD Bridge Design Specifications. Co-Author of the Multi-disciplinary Center for Earthquake Engineering Research's (MCEER) Seismic Retrofitting Manual for Highway Bridges (Vol II) which was written under contract to FHWA.

Louis Berger International - 1989-1990 Senior Structural Engineer

Served as Structural Group Leader for USAID Philippine Rural Infrastructure Fund Project. Was responsible for planning and design of 55 bridges and numerous other structures on 500 km of road and 18 rural feeder ports located throughout the Republic of the Philippines. This required the development of seismic design criteria, standard plans and standard specifications in addition to PS & E for the specific projects, all of which were completed within a very tight time frame.

Dokken Engineering (formerly Engineering Computer Corp.) - 1988-1989 Senior Engineer (Part Time)

Designed and checked the design of several California bridges. Projects included a bridge over the South Fork of the Eel River, the Pajaro River Bridge, the Burns Creek and Pico Creek Bridges, portions of the elevated structures for the Los Angeles light rail system, and bridges within the Interstate 61/70 Interchange in Pomona. Project Manager on the Burns and Pico Bridge projects, both located on California Highway 1 in very environmentally sensitive areas.

Imbsen & Associates, Inc. (formerly Engineering Computer Corp.) - 1977-1988 Vice President/Project Manager

Participated in several applied research and development projects including:

Strength Evaluation of Existing Concrete Bridges
Update of AASHTO Bridge Construction Specifications
Wheel Load Distribution on Highway Bridges
Thermal Effects in Concrete Bridge Superstructures
Earthquake Resistant Bridge Bearings
Numerous Seismic Design Workshops
Seismic Design Guidelines for Highway Bridges (ATC-6).

California Division of Mines and Geology - Office of Strong-Motion Studies - 1984-1985 Structural Response Specialist (Senior Seismologist)

Identified target structures and planned the placement of earthquake sensors within selected buildings and lifeline structures throughout the state. Evaluated records obtained from instrumented structures during earthquakes and assisted in report preparation to disseminate strong-motion data to the professional community.

Applied Technology Council - 1981-1984 Technical Director (Part Time)

Played key role in the following projects which developed criteria and methodology incorporating a broad spectrum of engineering opinion:

Seismic Retrofitting Guidelines for Highway Bridges (ATC-6-2)
Earthquake Damage Evaluation Data for California (ATC-13)
Evaluating the Seismic Resistance of Existing Buildings (ATC-14)

CHARLES REDFIELD, P.E.

Principal Engineer
Nutt, Redfield and Valentine

Project Assignment Principal Bridge Engineer

Years Experience NRV 16 Other 45

Education B.S./1955/ Architectural Engr, Washington University, St. Louis, Mo.
Bachelor of Architecture/1957/ Washington University, St. Louis, Mo.
MS/1963/ Civil Engineering, CCNY, New York

Registrations 1977/Civil - California (c27605); 1968/Civil - Washington (c11094);
Also Oregon, Idaho, Maine, Minnesota, Wyoming, Nevada, and Arizona

Summary of Professional Experience

Charles Redfield, Consulting Engineer. (1987 to Present)

Founded private practice that offers engineering services for unusual structures, principally bridges. Many bridge projects are firsts of their kind and represent innovative solutions to difficult engineering problems.

Designed the Sacramento River Trail Pedestrian Bridge in Redding, California which was the first stressed ribbon bridge constructed in the United States with the assistance of Dr. Jiri Strasky of Czechoslavakia. This bridge consisted of a 418 ft single span that was constructed with minimum disruption to a site with unique natural beauty.

With Robert Valentine designed the Caguanas River Bridge in Puerto Rico, the first curved incrementally launched bridge in the Western Hemisphere.

Participated with Robert Valentine and Richard Nutt in the contractor redesign of the HOV Viaducts No. 1 and 2 on I-110 in Los Angeles, California. These 70 ft wide structures, located in and above the median of one of the most heavily traveled freeways in the US, were designed to be constructed on falsework trusses using a span by span segmentally prestressed technique never before used in the United States.

Designed the Bay Farm Island Bicycle Bridge in Alameda, California, a 9-span steel pony truss structure 750 ft. in length. The central navigation span has a single leaf bascule of 128 ft. that works in tandem with the neighboring highway bascule bridge. The bridge is presently under construction.

Also participated in the preliminary and/or final design and/or construction engineering of several other bridge structures including:

- San Francisco-Oakland Bay Bridge Seismic Safety Project (Prestressed Cantilever Construction)
- Jamestown Bridge Replacement (Prestressed Cantilever Construction)
- Ohio River Bridge near Maysville (Cable Stayed)
- Benicia-Martinez Bridge (Prestressed Cantilever Const. - Lt. Wt. Conc.)
- 3rd Lake Washington Br. Approaches (Prestressed Cantilever Const.)
- Bay Farm Island Bicycle Bridge (Steel Pony Truss w/ Bascule Span)

T. Y. Lin International, Inc. (1976 to 1987)

As Principal and Chief Bridge Engineer, Mr. Redfield directed operations of the Bridge Department. Projects under his direction included bridges of reinforced/prestressed concrete, segmental prestressed bridges of both cast-in-place and precast construction, and cable stayed bridges of both composite steel and concrete design. He was lead designer of major balanced cantilever construction bridges in both the United States and abroad. The following projects are representative of those under his supervision:

Lewiston-Clarkston Bridge (Prestressed Cantilever Construction)
Dame Point Bridge (Cable Stayed Concrete Deck Alternate))
Wierton-Stubenville Bridge (Cable Stayed Composite Deck)
SR-182 Bridge (Prestressed Cantilever Construction)
Jamestown Bridge (Prestressed Cantilever Construction)
Ruck-a-Chucky Bridge (Curved Cable Stayed)
James River Bridge (Cable Stayed Concrete Deck Segmental)

Sistemas VSL Engenharia Sa (1972 to 1976)

In-charge of the Technical Design Section of VSL Prestressing for Brazil. Involved in the design of long span bridges for both the highway and railroad systems in Brazil.

Besides English, Mr. Redfield speaks Spanish, German, Portuguese, and Italian

ROBERT N. VALENTINE, P.E.

Principal Engineer
Nutt, Redfield and Valentine

Project Assignment Value Engineering/Quality Control

Years Experience NRV 16 Other 41

Education B.S./1966/ Civil Engineering, North Dakota State University

Registrations 1972/Civil - California (c22466); 1982/Civil - Minnesota (c15410); 1985/Civil - Rhode Island (c4822)

Summary of Professional Experience

Robert N. Valentine, Inc. (1986 to Present)

Redesigned numerous Caltrans' bridges (new and retrofitted) for California based contractor to facilitate construction and/or reduce construction costs. These projects included HOV Viaducts No. 1 & 2, Arroyo Simi Br. & O.H., Southern Freeway Viaduct (North) seismic retrofit, and Southern Freeway Viaduct (R1 Line) seismic retrofit. Performed the bridge design for design/build contracts with a major California bridge contractor on the Miners Ravine Bridge and the La Cienega Outer Separation Structure.

With Charles Redfield designed the Caguanas River Bridge in Puerto Rico, the first curved incrementally launched bridge in the Western Hemisphere

Redesigned segmental bridges in Atlanta, Georgia for VSL Corporation.

Providing construction engineering for the following prestressed cantilever bridges: Westmoreland Road Bridge, in Texas, Bennett Bay Bridge in Idaho, and Jamestown Bridge Replacement over Narrangassett Bay in Rhode Island.

Engineering Computer Corporation (1976 TO 1986)

Project Manager for the following cast-in-place cantilever bridge designs, or construction engineering projects:

Gastineau Channel Bridge, Juneau, Alaska (620' Main Span)
Plymouth Avenue Bridge, Minneapolis, Minn. (320' Main Span)
Broadway Avenue Bridge, Minneapolis, Minn. (280' Main Span)
Jamestown Bridge, Plymouth, Rhode Island(636' Main Span)
West Seattle Freeway, Seattle, Washington(650' Main Span)
Columbia River Bridge SR-182, Richland, WA(450' Main Span)
Columbia River Bridge, Umatilla, Washington(660' Main Span)
Lake Washington Approaches, Seattle, WA(262' Maximum Clear Span)
Piney Creek Bridge, West Virginia(350' Main Span)
Beaver Creek Bridge, West Virginia(240' Main Span)
Illinois River Bridge, Illinois(550' Main Span)

Project Manager for the following cast-in-place segmental concrete bridge designs, or construction engineering projects:

Denny Creek Bridge, Seattle, Washington
Indiana Route 70, Indianapolis, Indiana

Project Manager for the Long Key Pipeline Failure analysis for the State of Florida.

Design Engineer on the following segmental concrete bridge designs:

Guri Tailrace, Venezuela (620' Main Span)
Colorado River Bridge, CA(290' Main Span)
Feather River Bridge, CA(210' Main Span)
Wabash River Bridge, Indiana(180' Main Span)

Project Designer on the Dames Point steel cable stay alternative done for Mergentine Construction Corporation.

Developed Bridge Design System (BDS), the main bridge design computer program used by the State of California, and consultants. This program is also licensed by several states and the Federal Highway Administration.

Developed Segmental Time Dependent System (STDS) that is used for the time dependent analysis of segmental prestressed bridges.

California Department of Transportation (1966 to 1976)

Project Designer for the Napa River Bridge, the first major cast-in-place cantilever bridge constructed using lightweight concrete.

BENICIA-MARTINEZ BRIDGE
Rte. I-680
Carquinez Straight, California

A new bridge is under construction to carry five northbound lanes of Interstate-680 across the Carquinez Straight near the cities of Benicia and Martinez in northern California. The bridge consists of a haunched prestressed lightweight concrete single cell box girder. The total length of this 16 span bridge is 7432 ft and its typical width is 82.2 ft. The main span is 659 ft long, a record for lightweight concrete. Twelve spans are being constructed segmentally using the balanced cantilever method. Approach structures, which were constructed on falsework, are provided at both ends of the bridge.

Besides normal highway traffic, the bridge is designed to carry light rail vehicles. The bridge is located in a seismically active area and is being designed for the highest level of seismic performance considered by Caltrans. In addition, ship collision is a major design issue in this heavily traveled marine waterway.

Piers for the main structure are made up of four octagon shaped columns that are tied together with full height connecting walls. Careful consideration has been given to the superstructure-pier connections to assure that all forces generated in an earthquake can be transferred without damage to these joints.

Each of the deep-water pier foundations must resist large earthquake and ship collision loads. They are made up of eight or nine 8.2 ft diameter cast-in-drilled hole piles terminating in large prestressed concrete pile caps near the water surface. The pile-to-pile cap connection provides for full moment transfer. Piles pass through approximately 40 feet of water and 100 of mud before encountering relatively weak rock. These piles have composite stay-in-place steel casings that project into the underlying rock a sufficient distance to prevent damage to the pile rock socket during a large earthquake. Large diameter (7.2 feet) rock sockets up to 113 feet long below the steel casing are provided at each pile to resist the large axial tension and compression forces that will be developed

NRV Principal, Charles Redfield, played a key role in developing the preliminary design concept. He also was instrumental in the final design of the superstructure, while NRV Principal, Richard Nutt helped develop seismic design criteria, designed the deep water pile foundations, and assisted with other aspects of the design of the substructure and approach spans. Both Mr. Redfield and Mr. Nutt provided construction support and were instrumental in developing solutions to difficult field problems.

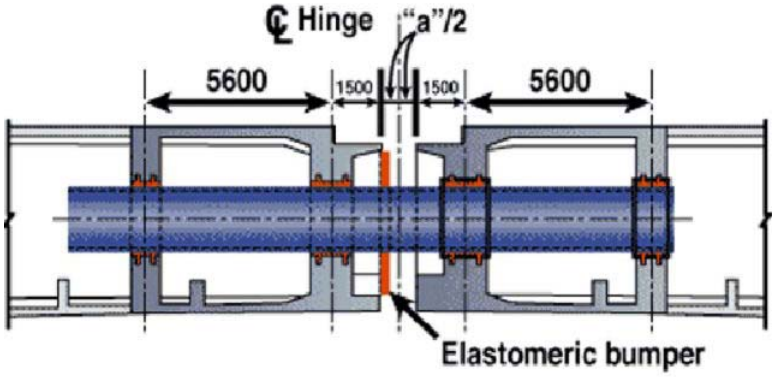
Services Rendered	Planning, Final PS & E and Construction Support
Current Project Status	Under Construction
Contract Status	Ungoing
Client	T.Y. Lin International/CH2M Hill Joint Venture
Client Contact	Mirek Olmer
Owner	California Department of Transportation (Caltrans)
Owner Contact	Ganapathy Murugesh

SAN FRANCISCO – OAKLAND BAY BRIDGE (SKYWAY)
Rte I-80 between Yerba Buena Island and Oakland, California

The eastern half of the San Francisco-Oakland Bay Bridge between Yerba Buena Island and Oakland California is being replaced for seismic reasons. The Skyway portion of this bridge consists of parallel precast, prestressed concrete box girder structures constructed by the balanced cantilever method.

Each of the parallel bridges is approximately 2100 meters long and over 25 meters wide. Each parallel bridge is comprised of fifteen spans that vary between 64 and 160 meters in length. The superstructure is a haunched single cell box girder constructed of precast segments. Besides normal highway traffic, the bridge is designed to carry light rail vehicles.

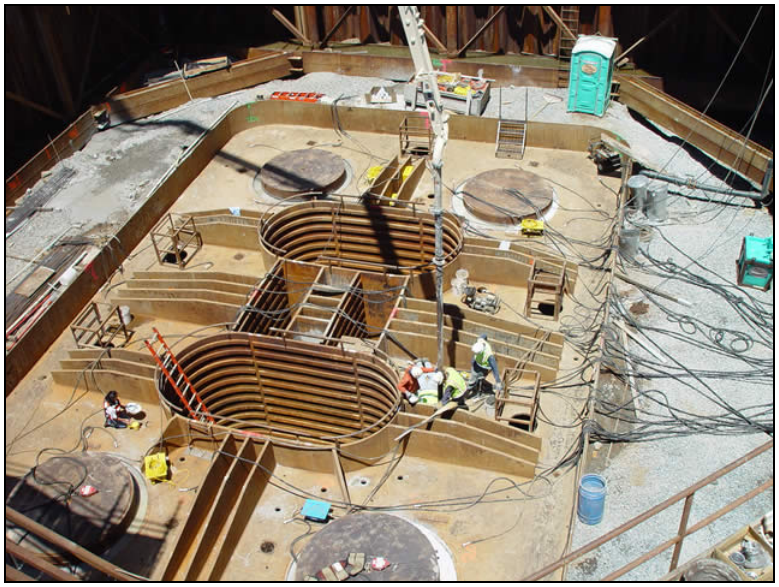
The expansion joints between frames incorporate a unique design consisting of large diameter steel bearing pipes designed to transfer both vertical and horizontal forces. The pipes are machined to a near perfect circle and clad with stainless steel. The pipe slides along the axis of the bridge on Teflon coated elastomeric pads



A steel box girder span with an orthotropic deck is provides as a transition between the skyway and the signature span consisting of a two span self anchored suspension structure.

Piers for the skyway structure are made up of four octagon shaped columns that are tied together with full height connecting walls. Pier lengths are tuned to minimize temperature and prestress shortening forces and maximize seismic resistance. The superstructure-pier connections are designed to assure that no damage occurs to these joints during an earthquake.

The base of each pier is cast into a large socket provided in the unique concrete filled steel pile caps. The caps are supported by 2.5-meter diameter concrete filled steel pipe piles driven on a batter. Piles are driven though sockets in the caps and connected using a combination of field welded steel plates and high strength grout to develop full axial and bending capacity of the piles. Piles extend nearly 100 meters into dense gravels in order to resist the large seismic loadings



NRV Principal, Charles Redfield, played a key role in developing the preliminary design concept for this bridge as well as the main span alternatives. NRV was also a major part of the design team. Mr. Redfield was instrumental in final design of the superstructure and the expansion joints described above, while Mr. Nutt developed design criteria and had a key role in design of the foundations including the unique steel pile caps, the pier-to-pile cap connections, the pile-to-pile cap connections and the pile foundations. Both Mr. Redfield and Mr. Nutt were part of the on-site construction support team that provided a designer liaison with the contractor and owner including the successful resolution of several field problems.

Services Rendered	Planning, Final PS & E and Construction Support
Current Project Status	Under Construction
Contract Status	Ungoing
Client	T.Y. Lin International/Moffitt Nichol Joint Venture
Client Contact	Rafael Manzanarez
Owner	California Department of Transportation
Owner Contact	Dr. Brian Maroney

MAUMEE RIVER BRIDGE
I-280 Across Maumee River in Toledo, Ohio

The Maumee River Bridge is currently under construction in Toledo, Ohio. The project includes a 1525 ft long, six lane, precast concrete, cable stayed main span unit across the Maumee River with nearly 7300 ft of precast, prestressed concrete box girder approach spans plus numerous precast, prestressed concrete box girder on-ramps that are cumulatively over 9300 ft in length.

The approach spans and on-ramps are being constructed using span-by-span segmental techniques. Large gantry cranes are being used for this purpose.

Piers are generally supported on large diameter cast-in-drilled hole piles. Massive “T” bents on a portion of the approach spans, complex gore areas at the location where ramps connect to the approaches and a precast concrete pylon for the main span complicate the construction engineering, along with construction staging requirements and the use of heavy gantries.

NRV, in conjunction with Laurie and Associates and International Bridge Technologies is providing construction engineering. The work includes preparation of shop drawings for the precast elements, evaluation and design for construction loads on the completed structure, correction of construction errors and prestressing requirements for construction including development of superstructure cambers.

Services Rendered:	Construction Engineering
Current Project Status:	Under Construction
Contract Status:	Ungoing
Client:	FruCon Construction
Client Contact:	Mr. Phil Sullivan
Owner:	Ohio Department of Transportation

TWIN CITIES ROAD BRIDGE
Snodgrass Slough in Sacramento County, California

The Twin Cities Road Bridge at Snodgrass Slough is a two-span steel through truss bridge that swings about its center pier to allow for the passage of boat traffic. The truss spans were built in 1931. The bridge also has approach trestles consisting of several concrete slab spans of that have been more recently constructed at either end of the truss spans.

In September of 2004 a hay truck traveling at high speeds struck the bridge, badly damaging several elements of the north truss. Damage was also done to the railing and timber wheel guards. The damage was severe enough to reduce the capacity of the bridge to carry heavy truck traffic.

NRV made the initial evaluation and post-accident load limit rating of the bridge. Because only incomplete as-built drawings were available, it was necessary for NRV to perform a detailed field inspection of the structure in order to develop plans and specifications for its repair. At the request of the owner, NRV selected a group of qualified bidders for the work, oversaw the advertisement and bidding of the project, reviewed and approved contractor submittals, inspected both the shop and fieldwork for the job, and administered the construction contract.

Repair methods included construction of a temporary support system that did not include any new structural elements in the bridge waterway, strict geometric control to assure proper operation of the bridge after repair, removing and replacing members that were damaged beyond repair, in-place flame straightening of less severely damaged members, field welding of torn members, removal of gouges and nicks in the existing steel, straightening of damaged rail, cleaning and painting of the new and repaired steel members, and replacement of the timber wheel guards.

Services Rendered:	PS & E and Contract Administration
Current Project Status:	Completed 2005
Client/Owner:	Sacramento County California
Client/Owner Contact:	Mr. Michael Meshci

BAY FARM ISLAND BICYCLE BRIDGE

Project Location Alameda, California

Client City of Alameda, California

Owner City of Alameda, California

A new bridge of 745' total length has been constructed neighboring an existing Caltrans bascule road bridge between the City of Alameda and Bay Farm Island. The new structure, designed by Charles Redfield, is composed of continuous pony truss approaches and a bascule span that works in tandem with the neighboring existing bridge. They are both operated from the same tender house. The spans are 80'-80'-60'/128'-3"/80'-80'-80'-80'-53'-4". The width is 12' c/c of the trusses. The bridge is supported on 24" octagonal precast, prestressed piles founded in the seismically sensitive "bay mud" of the San Francisco Bay area. The project was designed in accordance to Caltrans procedures for EFPB.

Charles Redfield designed the bridge. Richard Rodgers from Treadwell & Rollo, provided Mechanical Engineering for the moveable span. Ed McNitch supplied consultation relative to construction and cost issues. The engineer's estimate for the two phases of construction was $3,100,000. The successful contractor's bids were $1,683,000 for phase 1 and $1,220,000 for phase 2. Construction and mechanical testing was completed in 1996 and the bridge is now in service.

Services Rendered Preliminary Design and Final PS & E

Current Project Status Construction Completed in 1996

Contract Status Design Completed in 1995

Owner Contact Ms. Cheri Sheets
City of Alameda, California
(510) 748-4515

SACRAMENTO RIVER TRAIL PEDESTRIAN BRIDGE

Project Location	Redding, California
Client	City of Redding, California
Owner	City of Redding, California

NRV Principal, Charles Redfield, is the designer of the Sacramento River Trails Pedestrian Bridge, the first stress ribbon bridge constructed in the United States. Jiri Strasky of Czechoslovakia assisted him in this innovative bridge design. This bridge is part of the City of Redding's park system, connecting portions of the park on either side of the Sacramento River. The bridge site is characterized by extensive rock outcroppings, which dramatically add to the beauty of the river basin. This bridge type was chosen because it was economical, simple to erect, and required no construction activities in the river basin next to the river.

The bridge is made up of a single span, 418 ft. in length, which is fixed to end abutments anchored into the rock. The deck width between railings is 11.2 ft. while the total bridge width is 13.0 ft.

The superstructure is comprised of 40 precast concrete segments that were suspended from bearing cables during erection. These segments were shifted along these cables until they were in their final design position at which point joints were cast between the segments along with cable troughs provided within each precast segment. A second set of cables added to provide the finished structure with the necessary rigidity was initially stressed to 20 percent of its final force on the following day, and then to final stress when the cast-in-place concrete had obtained it's design strength. The finished superstructure, which is only 15 inches in depth, follows the drape of the cables and thus has a grade of approximately 9 percent near the abutments. It was necessary to provide slight haunches at the abutments to resist the moments induced there by prestressing, temperature drop and shrinkage.

Because this bridge utilized an innovative principle for the first time in the United States, great care was taken to assure that the structure would perform as designed. Dynamic analyses were carried out to determine the effect of vibration due to foot traffic at various pace frequencies and the effects of wind. Wind tunnel tests were performed to verify the analyses. Static analyses were performed that considered construction staging and the geometric and physical nonlinearities of the bridge. Static load tests were performed prior to opening the bridge to foot traffic.

Services Rendered	Preliminary Design and Final PS & E
Current Project Status	Construction Completed in 1990
Contract Status	Design Completed in 1988
Owner Contact	Mr. Frederic Mathis City of Redding, California (916) 225-4177

HOV VIADUCT NO. 2

Project Location	Los Angeles, California
Client	C.C. Myers Corporation
Owner	State of California, Department of Transportation

This elevated viaduct has been recently constructed above the center median of the Harbor Freeway (I-110) in Los Angeles. The structure is designed specifically to carry high occupancy vehicles and is intended to alleviate traffic congestion. Because traffic on the freeway could not be restricted during construction it was necessary to build the structure over existing traffic without the use of conventional falsework.

The bridge is approximately 70 ft wide and is supported on single column concrete bents approximately 50 ft. in height. The total structure length is 6472 ft. The span lengths are 132 ft and 124 ft long. The total construction cost was approximately 53 million dollars.

The original design concept developed by Caltrans provided for the construction of individual spans on falsework trusses supported from falsework bents located near the permanent bents. Adjacent spans were to be made continuous through the use of superstructure closure pours at the bents. Negative moment capacity at the bents was to be provided by partial length tendons.

After award of the construction contract, the principals of NRV were retained by the contractor to develop a new design that could shorten the construction time for each span and thus reduce the time that falsework trusses needed to be in place. This design involved a complete revision of both the superstructure and substructure of the bridge. A segmental span by span construction scheme was developed that eliminated closure pours over the bents and allowed for partial stressing of the superstructure prior to placement of the deck slab. This method allowed the construction schedule to be compressed and required less capacity of the falsework trusses. These design changes resulted in a savings of nearly 3 million dollars.

Services Rendered	Contractor Redesign
Current Project Status	Construction Complete
Contract Status	Completed in 1991
Owner Contact	Mr. Richard Land California Department of Transportation Division of Structures (916) 227-8824

ARROYO SIMI BRIDGE & OH (RT & LT)

Project Location: Moorpark, California

Client Name: C.C. Myers, Inc.

Owner: State of California, Department of Transportation

These two structures are part of the State Rte 23/118 interchange. They carry traffic across the Southern Pacific Railroad, Arroyo Simi, and old State Rte. 118. Both structures are 47.5 ft. wide prestressed concrete box girder bridges supported on single column concrete bents of varying height up to 110 ft. The foundations are comprised of a combination of conventional spread footings, pile caps, and large diameter cast-in-drilled hole caissons.

The right bridge is an eight span 1757 ft long structure located on a curved horizontal alignment. The maximum span length is 255 ft. The left bridge is of similar design except that it consists of six spans and is 1368 ft in length. Architectural flares and surface treatment of the columns plus long, sweeping spans make these strikingly beautiful structures.

The structures were originally designed by Caltrans and are unusual in that no intermediate expansion joints are used. This design, which will enhance seismic performance, was accomplished by using partial length prestressing tendons and intermediate closure pours to minimize stresses from creep, shrinkage and prestress shortening.

NRV principals, Robert Valentine and Richard Nutt, developed an alternative design for the contractor that would retain the beneficial features of the Caltrans design but would simplify the construction of the bridges and thus reduce construction costs. This was accomplished by providing a different superstructure cross-section, continuous prestress tendons over large segments of the bridge, and an additional closure pour to reduce the effects of long term creep and shrinkage. These changes also required a redesign of the substructure. Approximately one million dollars in savings were realized as a result of these design changes.

The execution of this redesign required careful structural analysis of the various construction stages using sophisticated computer programs that take into account the time varying properties of concrete at each stage during construction. Among the programs used in this process were Bridge Design System and Structural Time Dependent System, both developed by Mr. Robert Valentine. Results were verified using SFRAME, a program originally developed for Caltrans at UC Berkeley to analyze the time dependent effects of segmental construction.

Services Rendered Contractor Redesign

Current Project Status Construction complete

Contract Status Completed in 1991

Client Contact Mr. C.C. Myers
C.C. Myers, Inc.
(916) 635-9370

IMPROVED SEISMIC DESIGN CRITERIA FOR CALIFORNIA BRIDGES (ATC-32)

Project Location	California
Client	Applied Technology Council, Redwood City, CA
Funding Agency	State of California, Department of Transportation

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NRV principal, Mr. Richard V. Nutt, served as the Principal Investigator and Project Manager for ATC-32. In this capacity he was responsible for directing and coordinating the efforts of a panel of 13 internationally recognized bridge seismic design experts, seven specialty subcontractors and ATC staff in developing improved design standards and criteria for Caltrans that will ensure that California bridge structures of all types perform well in earthquakes and meet the seismic safety goals established by the Governor following the 1989 Loma Prieta Earthquake.

Subcontractors for this project provided expertise in the subject areas of seismic loading, foundation design, concrete design, dynamic analysis, bridge design and special issues such as steel structures and bearings. Issues considered in the development of the proposed criteria and standards include: (a) expected recurrence intervals of damaging earthquakes and the amplitude, frequency content and duration of expected ground shaking; (b) definitions of acceptable damage and acceptable levels of risk; (c) design and detailing of key bridge components including concrete and steel members, foundation components, earth retaining structures and bearings; (d) analysis of seismically induced forces and displacements in bridge structures; (e) relative costs and the desirability of implementing various levels of criteria; and (f) the feasibility/desirability of requiring independent design checks for selected classes of structures, e.g., critical bridge structures such as key crossings of large bodies of water.

This project was conducted in phases. Phase 1 involved a review of Caltrans procedures and an identification of areas of weakness. Proposals for improving these weak areas were also developed. Phase 2 involved development of revised standards and criteria. Many recommendations of this project have been adopted as Caltrans standard seismic design practice

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Services Rendered	Principal Investigator/Project Manager
Current Project Status	Complete – Many Recommendations Adopted
Contract Status	Complete
Client Contact	Mr. Christopher Rojahn Applied Technology Council (415) 595-1542

LRFD SEISMIC DESIGN CRITERIA FOR US BRIDGES (ATC-18, ATC-18-1 and NCHRP 12-49)

Project Location	USA
Client	Applied Technology Council, Redwood City, CA; Multi-Disciplinary Center for EQ Engineering, Buffalo, NY
Funding Agency	Federal Highway Administration and NCHRP

NRV principal, Mr. Richard V. Nutt, has served on a number of projects that have culminated in recommendations for the seismic design of the nations bridges. These have included the ATC 18 and ATC-18-1 projects and the NCHRP 12-49 project.

Mr. Nutt served as one of two structural specialists selected nationwide for the FHWA sponsored ATC-18 project panel to review existing seismic design criteria and philosophies for bridges. Also, serving as a project panel member for ATC-18-1, a follow-up project to assess the impact on the profession of the 5 year FHWA funded Highway Project being conducted by the Multi-Deciplinary Center for Earthquake Engineering Research (MCEER) at the State University of New York in Buffalo. This work also includes developing detailed recommendations for improving bridge seismic design criteria nationwide.

He was a key project team member on the NCHRP 12-49 project to develop a comprehensive seismic design specification for bridges for national use. This specification is compatible with the recently developed AASHTO LRFD design specifications for bridges but can be used as a stand-alone document. He was responsible for an analytical parameter study involving the rapid seismic design of several thousand hypothetical bridges in order to assess the impact and guide the development of the proposed code provisions. He was an active participant in developing the new criteria and assisted the Project Manager in the overall compilation of the project interim and final reports. The recommendations underwent a trial design phase for which Mr. Nutt provided technical support for the trial designers

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Services Rendered	Bridge Structural Engineering
Current Project Status	Complete – In Trial Design Phase
Contract Status	Complete
Client Contact	Mr. Chris Rojahn Applied Technology Council (650) 595-1542