Bridge Talk

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Inside

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NaBRO

Steel Bridge Design: Return to Simplicity

Often times, good ideas are simple in concept and have nothing to do with complexity. Ask a child and most likely, you will receive a straightforward and simple answer to a question which adults consider to be complex. Look around and perhaps you will see solutions that will make steel bridge design and construction simpler than practiced today. For years, prestressed concrete has used simple girders placed over the support and made them continuous for live loads only. Why hasn't steel design used the same concept? There are more good reasons for using such a concept for steel rather than prestress concrete. Lower creep and shrinkage for steel composite plate girders are all you have to mention.

As a result of a research project sponsored by the Nebraska Department of Roads (NDOR), NaBRO is in the final stages of the development of a system that, according to fabricators and contractors, is bound to enhance the economy of steel bridges. In the previous issue of ***Bridge Talk,*** we provided preliminary information on this system. In this article, you will find more technical information on this new steel bridge system.

Overview of the System

In this system, simple span plate girders are placed on the support and concrete diaphragms and the slab deck are cast simultaneously. As a result, the girders carry the dead weight of the deck slab as simple spans. The continuity for live loads is provided by placing reinforcing bars over the pier.

Connection Detail Over the Pier

The joining of the two girders over the support is an area where the designer should pay careful attention. Figures 1 and 2 show a detail that NaBRO has developed and plans to test. This detail may be modified slightly before the project is over.

During placement of the concrete, the ends of the girders must be supported against twisting. This could be achieved by using a combination of angle and plates to form end diaphragms, as shown in Figures 1 and 2. Other details could also be used. These end diaphragms could be used as formwork for placing the concrete in the diaphragms, which will be cast at the same time as the deck placement.

The bottom flange of the steel girders over the pier needs to be connected to the steel sole plate that is placed over the elastomeric pad. This can be achieved by welding the bottom flanges of the girders to the steel sole plate before casting the concrete. Several issues must be considered in selecting the thickness of the steel sole plate. Another issue is the gap between the plate girders placed over the sole plate. Small gap and large sole plate thickness can cause yielding of the sole plate during deck casting. Remember that during deck slab placement, the girders need to behave as a simple beam and should be free to rotate. This can be achieved by providing an adequate gap between girders and the appropriate thickness for the sole plate. The need for connecting the bottom flanges of the steel girders to the sole plate rises from the fact that the live load moment will cause compressive force in the bottom flanges of the girder. These compressive forces need to be transferred over the pier to the adjacent girder. The relatively small area of steel girder flanges, in comparison to flanges of prestressed concrete girders, can cause crushing of the concrete in the vicinity of the bottom flanges. The attachment of the sole plate to the bottom flanges provides a path through which the compressive force can travel. Finite element analysis of the detail over the pier shows that other alternatives such as placing a plate at the ends of the girders are unable to eliminate the stress concentration that develops near the bottom flanges of the girder and will most likely result in crushing of the concrete.

Design and Construction Advantages

The system that was described above has many advantages, some of which are discussed below.

a) For short span continuous bridge systems with maximum spans of approximately 110 ft. the above system can utilize rolled shapes. For instance, W40 x 215, W40 x 249 and W40 x 277 can be used for two span continuous steel bridges with maximum spans of 95, 100 and 105 ft., respectively (with girders spaced at 8 ft. 4 inches).

b) The need for expensive field bolt splices are completely eliminated (for spans of up to approximately 150 ft.).

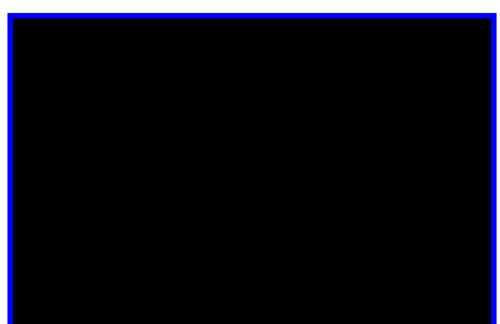

Figure 1

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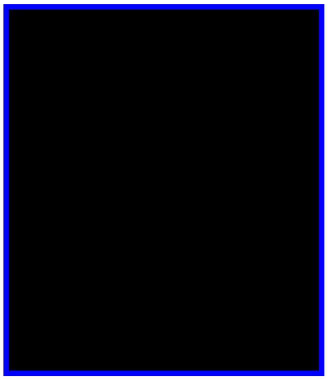
Letter from the Director



NaBRO's activities are taking on new dimensions every day. The expansion of our activities is even beyond our own expectations. The establishment of NaBRO resulted from the need for a new type of organization that would literally bridge the gap between academia, government and industry. We are, in a sense, "Different". Governmental agencies and industry alike are taking note of what we do at NaBRO and the feedback we receive is providing us with the energy to push ahead.

The National Steel Bridge Alliance has entered into an agreement with NaBRO, through which we will provide them with research support. The types of problems we will be tackling are practical and have immediate application in the field. To address such problems we rely on expertise of our research affiliates who are scattered across the nation. Together, NaBRO's research affiliates represent a great resource from which industry and government agencies can benefit. As researchers, we understand the problems facing us and this enhances the outcome of what we do and the way we approach research projects.

The quality of our work is directly related to the quality of the people we have on our staff. We recently hired one of the most qualified research engineers in Dr. Majid Sarraf, who has a Ph.D. from the University of Toronto. His research expertise is in the area of seismic design and behavior of steel bridges and adds a new dimension to our capabilities.

Through our experimental facilities on the Lincoln campus and those of the institutions from which our affiliated researchers hail, NaBRO can address any challenging bridge project in a short time. This is achieved, in part, by having a full time staff devoted to working in the laboratory. Our analytical and numerical capabilities allow us to tackle such sophisticated issues as soil-structure interaction problems in highly active seismic areas or detailed non-linear finite element analysis.

Through several years of research, we have developed state of the art methodologies for rating and evaluation of various bridge types that consider the type of traffic the bridge in question is subjected to. For instance, through special software that we have developed, many concrete slab bridges could be shown to have sufficient safety to remain in service without posting weight limits. These tools are verified by rigorous research studies and full scale testing to collapse of bridge structures.

Our latest activity at NaBRO revolves around the development of a steel bridge design software (LRFD based) that, once completed, will provide designers with a user-friendly tool to develop optimized design solutions.

We hope that the bridge industry will take advantage of the capabilities that we have developed at NaBRO and utilize the expertise that truly represents the best there is.

-Atorod Azizinamini, P.E., Ph.D.

Steel Bridge Design: Return to Simplicity

(Continued from page 1)

c) The contractor will need only one crane on the job site. Girders can be placed over the support without significant interruption to traffic. The elimination of the need for heavy equipment has another advantage. This allows smaller contractors to bid for the job, which usually results in better economy as well as being adaptable for rural areas.

d) Since dead loads do not produce any moment over the negative regions (remember that the girder will carry dead loads as simple spans), the resulting moments in the positive and negative regions are such that one could use the same cross section over the entire span. This eliminates the need for changing plate thickness for the flanges and reduces fabrication costs.

e) The reduction in negative moment over the pier, in most cases, results in reducing the number of cross frames.

Ongoing Work

NaBRO continues the efforts to complete the steel bridge system described above. Once the detail over the pier is finalized, a series of full scale tests will be carried out to investigate the strength and fatigue characteristics of the pier detail. The final document that will be produced will include design provisions, verified by full-scale tests, which will assist in designing the elements of the system. The project is being directed by Dr. Azizinamini. Dr. Rizos is the Co-PI of the project. Nick Lampe is the lead Graduate Student, pursuing his Masters Degree. The advisory panel for the project includes Lyman Freeman, Moe Jamshidi and Sam Fallaha of NDOR and Lincoln Steel and Capital Bridge, both steel fabricators in Nebraska. The National Steel Bridge Alliance is assisting the team in obtaining a realistic cost estimate for the system. A design sub group (high performance innovative design sub group), supported by the American and Iron and Steel Institute (AISI), is also providing the group with input and feedback.

If you wish to obtain more information on the system described above or have used a variation of the concept described above and would like to share your experience, please contact Dr. Atorod Azizinamini at (402) 472-5106.

Figure 2

Bridge Talk is a newsletter of the National Bridge Research Organization (NaBRO) at the University of Nebraska-Lincoln and is published three times per year.

National Bridge Research Organization (NaBRO)
University of Nebraska-Lincoln
W351 Nebraska Hall
Lincoln, NE 68588-0528
Voice: (402) 472-3462
Fax: (402) 472-6658
http://www.NaBRO.unl.edu

The National Bridge Research Organization (NaBRO) at the University of Nebraska-Lincoln (UNL) is dedicated to developing, collecting and disseminating the latest technologies for the advancement of bridge design, construction, retrofit and maintenance. This is accomplished through partnership with industry, government agencies and academia. NaBRO's mission evolves around three initiatives: a) research, b) education and c) technology transfer.

DIRECTOR
Dr. Atorod Azizinamini, P.E.
Associate Professor
(402) 472-5106
aazizi@unl.edu

ASSISTANT DIRECTOR
Dr. Dimitris C. Rizos
Assistant Professor
(402) 472-1928
drizos1@unl.edu

RESEARCH ASSISTANT PROFESSOR
Dr. Majid Sarraf
(402) 472-3462
msarraf1@unl.edu

ASSISTANT TO THE DIRECTOR
Stacy Umbenhower
(402) 472-3462
sumbenhower1@unl.edu

PROGRAM COORDINATORS

Non Destructive Testing Methods
Dr. Dennis Alexander
Kingery Professor, Electrical Engineering

Advanced Rating Methodologies
Dr. Fred Choobineh, P.E.
Professor, Industrial and Mgmt. Systems Engr.

Evolution of Prestressed Concrete Bridges in the United States

by Basile G. Rabbat and Shri B. Bhide, Portland Cement Association, Skokie, IL

Concrete is the most used construction material for bridges in the United States (US) and in the world. Application of prestressed concrete to bridges started in the US in 1950. The Madison County Highway Bridge, located in Tennessee, is a post-tensioned structure. This modest three-span bridge has a 29-ft center span and 20-ft end spans. It was completed in October 1950. Shortly thereafter, the Walnut Lane Memorial Bridge, located in Philadelphia, PA, was completed. The Walnut Lane is the first major prestressed concrete bridge built in the US. It consists of three spans, a 160-ft main span and 74-ft side spans.

Successful completion of the Walnut Lane Bridge marked an important milestone in US highway bridge construction. Prestressed concrete quickly became a material of choice for bridge applications. The percent of bridges built annually since 1950, with prestressed concrete, reinforced concrete, structural steel, and timber is depicted in Fig. 1. Data plotted are extracted from the National Bridge Inventory (NBI) as of December 1998. These data are compiled annually from bridge inspection results. The data are collected by each state, forwarded to the Federal Highway Administration (FHWA), and maintained as the NBI database. The rapid and steady growth in use of prestressed concrete in bridge applications is evident in Fig. 1. About 50 years after the first application, over 50% of bridges built annually in the US are of prestressed concrete.

In 1952 the Bureau of Public Roads, the forerunner to FHWA, published *Criteria for Prestressed Concrete Bridges,* the first formal prestressed concrete design specification. In addition to availability of design criteria, an important factor leading to the growth in use of prestressed concrete was standardization of sections.

In early applications of prestressed concrete to bridges, designers developed their own ideas of the "best" girder sections. The result was that each contractor used slightly different girder shapes. It was too expensive to design "custom" girders for each project. As a result, representatives of the Bureau of Public Roads (now FHWA), AASHO (now AASHTO), and the Prestressed Concrete Institute (PCI) began work to standardize bridge girder sections. This effort resulted in development of the AASHO-PCI standard I-girder sections Types I through IV in the late 1950's. In the early 1960's, Types V and VI were introduced for longer spans. Simultaneously, standard precast, prestressed concrete boxes were developed. There is no doubt that standardization of girders simplified design, led to speed of construction, and resulted in economy.

With advancements in the technology of prestressed concrete design and construction, numerous states started to refine their designs and to develop their own standard sections. As a result, in the late 1970's, FHWA sponsored a study to evaluate existing standard girder sections and to determine the most efficient girders. This study concluded that Bulb-Tees were the most efficient sections. Based on conclusions of the FHWA-sponsored study, PCI developed the PCI Bulb-Tee Standard, which was endorsed by the AASHTO Bridge Engineers at their 1987 annual meeting.

An innovative concept of spliced girders further extended the span capability of prestressed concrete bridges. Spliced girders were used as early as 1959 for a 320-ft span on a bridge crossing Lake Oneido in New York. Although this technique was used in the 1960's and 1970's, it did not gain momentum until the 1980's. By the late 90's, spliced I-girder and Bulb-Tee spans are matching the record of 320 ft, set 40 years earlier.

Another step in the evolution of prestressed concrete applications in the US is segmental bridge construction. A variety of techniques are available to achieve long spans, for straight and

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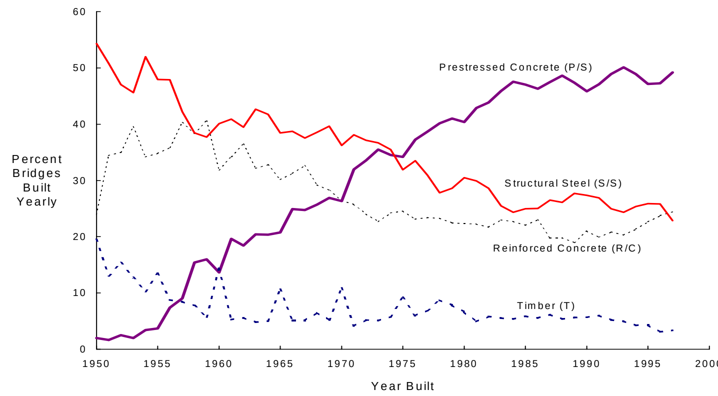

Fig. 1 Bridge Construction Trends based on December 1998 NBI Data

International Conference on High Performance Materials in Bridges

First Call for Abstract

A United Engineering Foundation (UEF) and National Bridge Research Organization (NaBRO) Conference**, "International Conference on High Performance Materials in Bridges"**, will be held in Kona, Hawaii on July 29 – August 3, 2001. This conference is for designers, researchers, contractors, fabricators and government officials involved in the use of High Performance Materials, as applied to bridge structures. The focus of this conference will be on the latest advances and issues related to High Performance Steel, High Performance Concrete, Fiber Reinforced Polymers and Advanced Wood Composites as applied to bridge structures. The conference will include presentations by keynote speakers summarizing major activities around the word. The conference theme will include the following subjects:

1. Advances in material research for using High Performance Steel, High Performance Concrete, Fiber Reinforced Polymers and Advanced Wood Composites as applied to bridges.
2. Design issues and related research studies in the field of High Performance Steel, High Performance Concrete, Fiber Reinforced Polymers and Advanced Wood Composites.
3. Code provisions related to the use of High Performance Steel, High Performance Concrete, Fiber Reinforced Polymers and Advanced Wood Composites in bridges.
4. Case Studies in utilizing High Performance Steel, High Performance Concrete, Fiber Reinforced Polymers and Advanced Wood Composites in bridges.
5. Innovative use of High Performance Materials in bridges.
6. Contractors' and Fabricators' experiences in using High Performance materials in bridge fabrication and construction.
7. Results from monitoring performance of bridges constructed using High Performance Materials in bridges.
8. Theme presentation and providing a summary of active national projects in countries promoting the use of High Performance Materials.
9. Future trends in using High Performance Materials in bridges.

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Letter from the Dean

With change happening so rapidly in our world, it often becomes difficult for universities and colleges to keep pace with research. As our world shrinks, the need for newer and better technologies keeps growing, and it falls largely to universities to fill that need. Because universities are in the front lines in technology research, competition for research funds is fierce. The University of Nebraska-Lincoln consistently has been involved in cutting-edge research and is working to improve its standing nationally in obtaining research funding. A five-year research plan announced by Marcia Torr, vice chancellor for research at the University of Nebraska-Lincoln, aims to double the amount of research funding being brought to the university. I believe it is a goal that can be met.

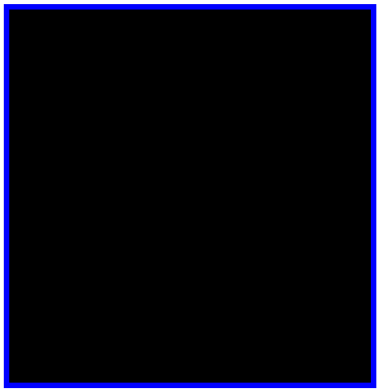
One of the ways in which universities are reaching their research goals is through partnerships with government agencies, other universities and industry. The College of Engineering and Technology is fortunate to have among its faculty talented and innovative scholars who have fostered these partnerships. Many UNL projects funded in part by private industry have resulted in technologies that have profoundly affected people and industries throughout the world. The National Bridge Research Organization, headed by Atorod Azizinamini in Civil Engineering, is one such partnership. NaBRO is a terrific addition to the University of Nebraska-Lincoln and the College of Engineering and Technology. NaBRO's mission – to advance bridge research, to foster an intellectual atmosphere and to disseminate knowledge and information – fits well with the mission of this college.

Transportation is one of the biggest concerns in the U.S. With our nation's economy based on the automobile, financial growth is inherently linked to fast and reliable transfer of people and goods. Our nation's transportation infrastructure is aging, while there is an increased public demand for a new, safe and high quality transportation network at the minimum investment of taxpayer's money. Such demands are the driving force behind technological advancements. Partnerships among government, academia and industry have become the leading entities that transfer innovative technologies from research to practice for the benefit of the public. NaBRO is among the leading organizations in the nation that foster such endeavors. In collaboration with state and government agencies (Nebraska Department of Roads, Federal Highway Administration), academic organizations (Mid-America Transportation Center, Mid-West Roadside Safety) and private industries in the state of Nebraska and nationwide, NaBRO is aggressively pursuing excellence in research, education, and technology transfer in bridge engineering.

This benefits the university, our community and our students in many ways. Our students are actively involved in cutting-edge research and are given the opportunity to work and interact with professionals in their field. At the same time, companies have access to expertise and state-of-the-art facilities, allowing them to be involved in the education and training of a skilled workforce. Research guided by industry demands serves the society's transportation needs. Last but not least, the College of Engineering and Technology at the University of Nebraska-Lincoln is recognized among the leading institutions in transportation research.

NaBRO's collaboration efforts are not limited to the state of Nebraska or even the country. Through its research affiliate program, NaBRO members are collaborating with researchers around the world. Recently, a team of researchers from Korea worked with UNL researchers to address transportation infrastructure issues in their country.

It is an exciting time for UNL and for our College. We have a chance to be at the forefront of incredible change in the way our country looks at transportation. I am excited to have NaBRO as part of our institution and look forward to its contribution to our belief that as we grow with Nebraska, we can change the world.



-James L. Hendrix, Dean
College of Engineering and Technology
University of Nebraska-Lincoln

Evoloution of Prestressed Concrete in the United States

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curved alignments. Although the technique was used on some of the early prestressed concrete bridges, segmental construction gained fast acceptance following completion of the Corpus Christi Bridge in Texas in 1974. The main span for that bridge is 200 ft. Since then, the number of segmental concrete bridges built in the US has steadily increased to over 250, with the Houston Ship Channel having a main span of 750 ft. Many segmental bridges are several miles long, with the longest being currently the Seven Miles Bridge in Florida.

In the mid 1990's, representatives from the American Segmental Bridge Institute (ASBI), PCI, AASHTO and FHWA developed new standard sections for segmental construction. In 1998, the AASHTO Bridge Engineers approved *Segmental Box Girder Standards for Span-by-Span and Balanced Cantilever Construction*. Currently, the AASHTO-PCI-ASBI Task Force is developing standard segmental boxes for substructures. The impetus for this effort is the growing need for rapid construction of substructures. The public demands least traffic interruptions and least inconvenience. Segmental construction offers economy and rapid construction, without the need for falsework.

Late in the 1970's, with the completion of the Pasco-Kennewick Intercity Bridge in Washington State, cable-stayed construction raised the bar for concrete bridge spans to 981 ft. By 1982, the Sunshine Skyway Bridge in Tampa, Florida set a new record for concrete bridges, with a main span of 1200 ft. The following year, the Dame Point Bridge in Jacksonville, Florida, extended the record to 1300 ft.

The growth in use of prestressed concrete in bridge applications in the US is due to its economy and excellent performance. One measure of performance is "structural deficiency" as defined by FHWA. This definition is based on bridge inspection results maintained in the NBI data. The percent of structurally deficient bridges of prestressed concrete, reinforced concrete, structural steel, and timber is plotted in Fig. 2. Again, the data are extracted from the NBI database as of December 1998. The excellent performance of prestressed concrete is evident in the plot. As expected, bridges deteriorate with age. Figure 2 indicates that concrete bridges have the lowest percent deficiency of all bridge construction materials, at all ages.

Prestressed concrete has enjoyed great success in competing in today's "lowest first cost" method of material selection. As steps are taken to consider life-cycle cost for bridges, it is anticipated that the excellent performance, low maintenance, and speed of construction will continue to make prestressed concrete the material of choice for bridge construction in the US.

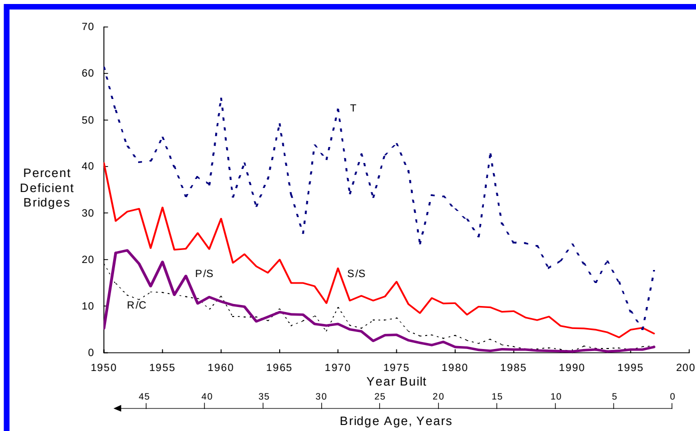


Fig. 2 Structural Deficiency, as of December 1998 NBI Data, for each of the Four Bridge Materials

State of the Art Steel Design: Innovative Structural Systems

by John M. Kulicki, Ph.D., P.E.; Modjeski and Masters, Inc.

Innovative structural systems are needed to realize the full potential of the improved properties of new steels. Enhanced performance steel, also known as high-performance steel (HPS), may be defined as any steel that has improvements in one or more of the following properties: strength, weldability, ductility, corrosion resistance, fatigue resistance, fracture toughness, fabricability, or formability.

This article will present a sample of innovative structural systems for tomorrow's bridges, namely, systems that will most effectively utilize HPS in bridge construction. The concepts to be considered should not necessarily be limited by current fabrication methods or commercial products, but not completely out of near-term reach.

Built-up I-girders with Corrugated Webs

Corrugated plates can be used to replace the flat webs of conventional built-up I-beams. The corrugated plates can be produced by cold-forming long, flat plates. The corrugations can have a trapezoidal or sine-wave cross-section as shown in Figure 1. While the trapezoidal corrugations are expected to be easier to form, the sine-wave corrugations are expected to have less residual cold-forming stresses. In addition, the elimination of the sharp corners in the sine-wave corrugations is expected to facilitate welding the web to the flanges and to produce welds with better fatigue resistance.

The corrugated webs are relatively flexible when subjected to forces parallel to the longitudinal axis of the girder and, therefore, do not contribute to the moment resistance of the girders. The required flanges of a girder with a corrugated web are larger than those of a conventional girder with the same depth. However, corrugated webs allow deeper girders that are not susceptible to web stability problems and, thus, result in thinner webs and smaller flanges. The overall weight of the resulting girders is less than conventional plate girders. A method for splicing corrugated webs will need to be developed. At least one bridge with trapezoidal corrugations was constructed in France. Lap splices with fillet welds along the edges of the two web plates were provided. The fatigue resistance of such a splice will need to be proven by testing.

Built-up Girders with Tubular, Concrete-filled Flanges

A flat flange of an I-shaped girder can be replaced by a relatively thin circular or rectangular structural tube. Various concepts for this form are shown in Figure 2. High-strength, non-shrink grout can then be used to fill the tube.

The weldability of HPS will allow easier welding of a torsionally stiff tubular flange to a relatively flexible web plate and reduce or eliminate fatigue concerns at the connection. The depth of the web of this system is smaller than that of a conventional girder with the same total depth. The shallower web depth allows thinner, still stable, web plates.

Tubular flanges can be used in conjunction with both flat and corrugated web plates. In the case of the corrugated webs, a flat or near-flat surface of the tubular flange will be required to facilitate the weld between the web and the tube. This can be achieved by using a rectangular, hexagonal or octagonal tube, or by flattening a circular tube at the side where the weld is applied. Alternatively, it may be possible to stamp corrugations into a plate and leave a flat tab on the top and bottom to facilitate welding.

In the case of tension flanges, prestressing strands may be placed inside the tube. The construction sequence can be designed to ensure that the grout inside the tube will remain in compression for all load combinations.

The apparent compressive strength of the grout inside the tubular flanges will increase due to confinement. Therefore, higher allowable stresses in the grout may be allowed.

Built-up I-girders with Double, Sheet Metal Webs

Panels consisting of two metal plates with a filling in between have been used in the aerospace industry for many years. Utilizing the same concept in constructing the webs of bridge girders may result in material savings. A typical cross-section of a bridge girder with double web plates is shown in Figure 3. The thickness of the web plates is expected to be less than what is generally viewed as minimum plate thickness and, therefore, either high corrosion resistance may be required to fully utilize the strength of the web plates or the use of stainless steel cladding or metalized coating may provide the required degree of corrosion resistance.

Providing adequate connection between the two thin web plates is essential to force the two plates and the filling to act as one unit and to eliminate the possibility of each plate buckling independently.

The connection between the filling and the web plates can be achieved
using one of the following techniques:

- Using a filling that adheres to the web plates
- Using adhesives to connect rigid fillings to the plates
- Mechanical connection

The effect of the weld heat on the filling materials and their connection to the web plates needs to be determined. The use of more advanced directed energy welding methods (e.g., laser welding) may reduce such effects. The resulting welds have less porosity and, therefore, are less susceptible to fatigue damage. In addition, the lower heat input produces lower residual stresses than what is assumed in the current design specifications. Modifying the design specification to account for the lower residual stresses may further enhance the economy of the system.

Summary

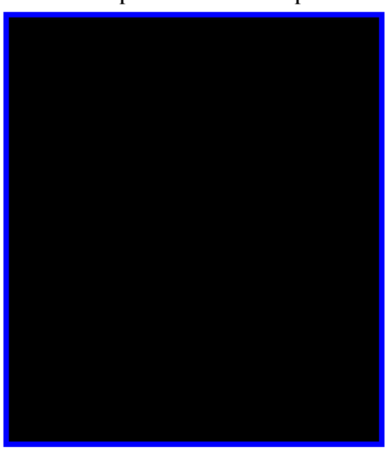
The near-term marketability of the corrugated web concepts has been enhanced by two developments. There is currently a European firm marketing equipment to corrugate steel plate in the US, and the Japanese have developed welding equipment that automatically senses and adjusts its position as it welds corrugated plate to a flat flange. Similarly, there seems to be increased industry interest in steel tubes for bridge applications.

The innovative concepts have the potential to save a significant quantity of steel. Some of the structural systems are worthy of marketplace testing now while others may need more research. Several of the concepts could be employed with conventional existing steels and still result in significant savings in structural steel weight.

Bridge Engineer Profile: Ed Wasserman, Director of the Structures Division for the Tennessee DOT

Few have had the impact on the bridge engineering profession as Edward (Ed) Wasserman, Director of the Structures Division for the Tennessee Department of Transportation. The impact of his vision and willingness to explore new frontiers has gone beyond Tennessee. Other states also have benefited from the initiatives taken by Ed Wasserman.

Ed was born in Nashville, where he completed his secondary education. He later received his B.S. in Civil Engineering from Vanderbilt University in 1965. Following his graduation from Vanderbilt University, Ed joined the Bridge Division of the Tennessee Department of Transportation. Except for a two-year tour of active service duty with the United States Army, his service has been continuous to present. He is currently the Director of the Division of Structures. As Division Director, Ed supervises approximately 130 engineers and technicians involved in bridge design, inspection and repair, as well as hydraulic design. Ed's leading role at the Tennessee Department of Transportation could be dated back to 1976, when he was appointed head of structural design for the structures division. In 1986, Ed was promoted to Director of the Division of Structures, the position he currently holds.



Ed Wasserman

During Ed's tenure as head of structures design and director, the Structures Division has produced plans for construction of over 2500 bridges, approximately 94% of which were designed by in-house staff.

With Ed at the helm of the Structures Division, the Tennessee Department of Transportation has taken a lead in pioneering the concept of design and construction of steel bridges using inelastic design approaches and High Performance Steel and innovative prestress concrete structures. These innovations and Ed's noble achievements over the past 23 years have resulted in more than thirty awards for design excellence, design and construction of longest continuous concrete bridge in the United States (2700 ft.), as well as the second longest steel plate girder span in the United States (525 ft).

Perhaps Ed's most notable contribution to the profession is his tireless devotion to voluntary service, which he provides to various national committees. His leadership role in AASHTO and other professional societies are exemplary. Ed is Chairman of the AASHTO technical committee for structural steel design. He is a member of the AASHTO committee for prestressed concrete design as well as vice-chairman of the AASHTO bearing committee. His other service includes membership in the American Iron and Steel Institute's steel bridge task force. His leadership role and ability to bring consensus among people representing various interests is extraordinary.

Ed Wasserman is a great advocate of technology transfer and is a frequent contributor to journals and professional publications. His publications related to integral abutment are among those one would find on the desk of a bridge designer. His contributions to the bridge industry have been noted by his peers, as he is the recipient of a number of national awards, including the James F. Lincoln Arc Welding Foundation Bronze Award in 1993, National Steel Bridge Alliance special award for contribution to state-of-the-art steel bridge design and construction in 1996, American Iron and Steel Institute's award for innovation in steel bridges in 1996 and the Tennessee Society of Professional Engineers 1998 Government Engineer of the Year award.

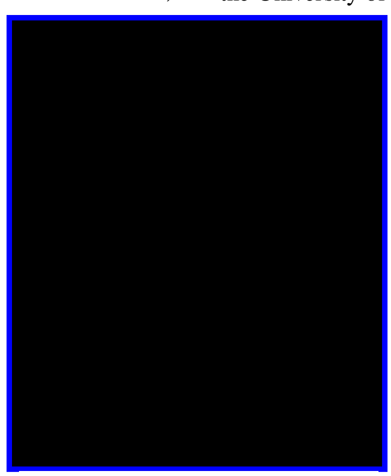
Ed Wasserman also has 28 years of service with the United States Army Reserve Corps of Engineers and is retired with the rank of Lieutenant Colonel.

Ed's professional career is certainly an inspiration for younger and older engineers alike and is bound to have even greater impact in the years to come.

NaBRO Affiliated Researcher Profile: Dr. Antonio Nanni, Univ. of Missouri-Rolla

Professor Antonio Nanni, V&M Jones Professor of Civil Engineering at the University of Missouri-Rolla, is a distinguished scholar recognized internationally as an educator and a researcher. He is dedicated in leading innovation through applied research and practical experience in construction materials, structural performance and field applications.

Tony was born in Italy where he received his B.Sc. Degree in Civil Engineering from the University of Bologna in 1978 with highest distinctions. He continued his studies in South Africa where he received his M.S. Degree in Civil Engineering from the University of Witwatersran, Johannesburg in 1980. In 1985 he earned his Ph.D. in Civil Engineering from the University of Miami, FL. The same year Tony entered the academia as an Assistant Professor in Architectural Engineering at the University of Miami. Three years later he joined the department of Architectural Engineering at the Pennsylvania State University and he was promoted to the ranks of Associate Professor in 1992 and Professor in 1996. Currently, he holds the Vernon and Maralee Jones Professorship in Civil Engineering at the University of Missouri-Rolla. In the last fifteen years he has obtained experience in concrete based systems, and has been the principal investigator and project director of numerous projects sponsored by federal and state agencies and the private industry. During his academic career Tony has been developing his liaisons with industry and other Universities internationally. He has collaborated extensively with Technicoop, CAD Lab, and the department of Civil Engineering at the University of Bologna in Italy and Mitsui Construction Co. and the department of Civil Engineering at the Science University of Tokyo in Japan.



Dr. Antonio Nanni

Professor Nanni is the Director of the Center for Infrastructure Engineering Studies (CIES). CIES is an interdisciplinary research and education program housed in the School of Engineering at the University of Missouri-Rolla. The mission of CIES is to provide leadership in research and education for solving society's problems affecting the nation's infrastructure systems. Three focus areas have been identified as R&D targets for the five-years plan: Building and Civil Infrastructure, Power Infrastructure, and Management of the Infrastructure. Tony is a leading authority in the area of Fiber Reinforced Polymers and heads the University Transportation Center (UTC) on advanced materials and non-destructive testing technologies. The UTC was established in July 1998 and is the result of the Transportation Equity Act of the 21st century (TEA-21). The center addresses national needs in the areas of transportation infrastructure focusing on advanced materials and

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International Conference on High Performance Materials in Bridges

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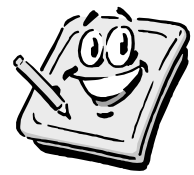
Both oral and poster papers will be presented and proceedings of the conference will be published in special ASCE publications. Papers will be reviewed according to procedures used by the ASCE Structural Division for the *Journal of Structural Engineering*. Attendance at this conference is limited. Interested individuals are invited to submit a one-page abstract for consideration by **July 30, 2000**. Authors should follow directions on the UEF web site (http://www.engfnd.org) and submit the abstract electronically. All abstracts will be reviewed by the oral and poster session chairs, and you will be notified whether your abstract has been accepted. Authors will be notified of acceptance of their abstracts before October 15, 2000. Papers will be due by January 15, 2001.

Conference will be chaired by Dr. Atorod Azizinamini, Conference Co-Chairs are Dr. Fumio Watanabe of Kyoto University and Mr. Mike Ritter, USDA Forest Service.

The format of this conference is chosen to encourage many opportunities for detailed discussions and interactions among participants. In order to preserve this atmosphere, attendance will be limited and will be by invitation only. Persons wishing to attend the conference should submit an application as soon as possible, but no later than March 15, 2001.

If you are interested in obtaining more information about this conference please visit the UEF web site at http://www.engfnd.org or the NaBRO web site at http://www.nabro.unl.edu.

NaBRO's Web Page Message Board Service



In our efforts to promote and facilitate communications among individuals with interest in bridge engineering NaBRO is sponsoring a new Internet service. Our Website www.nabro.unl.edu includes a **Message Board** that supports multiple forums. Currently, two forums are activated. A general forum is intended for general bridge information and questions. Individuals with special interest in the use of Fiber Reinforced Polymers (FRP) in structural and bridge engineering are invited to visit the FRP forum. You may register on-line for either or both forums. If you wish to start a new forum in our message board please contact Dr. Dimitris C. Rizos at (402) 472-1928, Email drizos1@unl.edu, and your request will be accommodated.

NaBRO's message board presents a unique opportunity to exchange ideas, post and retrieve messages, questions and answers related to bridge engineering. We hope that you will find this free-of-charge service useful. As always, we welcome any comments and suggestions that will help us improve our services.

Instructions

1. Visit NaBRO's web site at www.nabro.unl.edu
2. Click on the *Message Board* Button
3. To enter Message Board
   - **a. New Users:** Click on *Sign Up* link
     - ·Enter the requested information, including your email and the forums you wish to register for; Click on the *NEXT*> > button.
     - ·Please confirm that your information is correct, or click on the *BACK* button to change the information.

New users will receive an email with a notification message. The message board cannot be accessed before the notification message is sent.

   - **b. Registered Users:** Enter your *User ID* and *Password* and click on the *Log In* button.
4. Select the Forum you wish to visit. The message board supports two Message Forums. The general forum is intended for general use on bridge engineering. The FRP forum is dedicated to discussion, messages, questions and answers related to the use of Fiber Reinforced Polymers (FRP) in structural engineering.
5. To post a new message click on the *Add New Message* button.
6. To view a posted message click directly on the corresponding message link.
7. When viewing a posted message and you wish to post your reply click on the *Reply to Message* button.

Communicate with fellow bridge professionals through NaBRO's message board. A free service provided to the bridge industry by NaBRO

NaBRO Affiliated Researcher Profile: Dr. Antonio Nanni, Univ. of Missouri-Rolla

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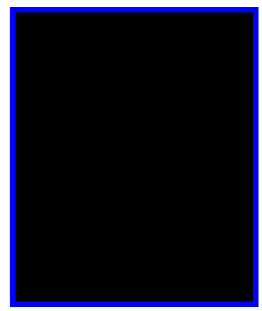
non-destructive testing (NDT) technologies. The activities of the UTC involve: the development, understanding, manufacturing and use of new construction materials; NDT methods; installation processes and engineering design; monitoring and evaluation of new and repaired structures; and standardization and code approval of products and design protocols.

Tony's contributions to the engineering profession are celebrated through his volunteer service and active involvement in national and international committees and professional societies. He is the founding chairman of ACI Committee 440 on Fiber Reinforced Polymer (FRP) Reinforcement, and a founding member of the Italian Association of Materials in Construction. He serves in the executive committee of ASCE Materials Division and is the editor-in-chief of the Journal of Materials in Civil Engineering. Dr. Nanni is currently a member of eight ACI committees, four ASCE committees, seven ASTM committees and three TMS committees. In addition he serves in the TRB committee on Structural Fiber Reinforced Plastics, the CEB Task Group 3.1 on the design of concrete structures reinforced by FRP, and the CSCE Technical Committee on Advanced Composite materials in Bridges and Structures.

Dr. Nanni has contributed over seventy publications to refereed journals and is the editor of a book and conference proceedings on the subject of FRP reinforcement in concrete. His contributions to the engineering profession as a leader in research, education and technology transfer have been greatly recognized by the engineering community. Tony is the recipient of numerous awards including the ACI Delmar L. Bloem Award in 1998, the Engineering News-Record Award of Excellence in 1997, and an Honorable Mention for the application paper on the 1997 issue, ASCE-Journal for Composites in Construction.

Visit www.NaBRO.unl.edu for more information, announcements, message board and links to interesting bridge web sites.

Note from the Editor



Dear Colleagues,

A little over a year ago the National Bridge Research Organization was established at the University of Nebraska-Lincoln. Our continuous efforts to promote research and innovation and turn ideas and theories to practice and implementation are flourishing. NaBRO has been received in the bridge engineering community as an academic nucleus that fosters collaboration between academia, industry and government in bridge engineering.

NaBRO's publication, *Bridge Talk,* reaches over 5,000 bridge and structural engineers worldwide. The first issue was published three months ago and we have received very encouraging and supportive feedback. *Bridge Talk* is also available in an electronic format in our website at *www.nabro.unl.edu/publications/*. The newsletter is in a PDF format and is available for downloading. Our website is generating an increased interest and is updated on a continuous basis. Please visit us for the latest information and announcements.

A new addition to the website is the introduction of a ***Message Board*** dedicated to enhance communications among individuals in the bridge engineering community around the world. This effort presents a unique opportunity to exchange ideas, post and retrieve messages, questions and answers related to bridge and structural engineering. The message board is organized in forums focusing on general and specialized issues in bridge and structural engineering. Please see the announcement in this issue. This service is provided free of charge and anyone with a valid email address can register. We hope that you will find this service useful.

As always, we welcome your suggestions criticism and commends. We appreciate your support and we would like to invite you to contribute technical articles and share your experiences to be considered for publication in the following issues of *Bridge Talk*.

-Dimitri C. Rizos, Ph.D.
Assistant Director

National Bridge Research Organization
University of Nebraska-Lincoln
W351 Nebraska Hall
Lincoln, NE 68588-0528