3RD ORTHOTROPIC BRIDGE CONFERENCE

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San Mateo-Hayward Bridge

Hayward/San Mateo OCEA 1968
http://www.asce.org/opal/past_ocea.cfm#1968

Lateral Load Resisting Steel Systems Workshop
Natalie Calderone - Moderator
Friday, June 28, 2013 • 1:00 - 6:00 P.M.


Dr. Marwan Nader

Seismic Design of the Single Tower of the Self-Anchored Suspension Bridge
by Marwan Nader, Ph.D., P.E., of TY Lin International; and Brian Maroney, Ph.D. of Caltrans


Dr. Brian Maroney

1:00 - 2:00 —The Self-Anchored Suspension (SAS) span of the new East Span of the San Francisco-Oakland Bay Bridge consists of a dual box girder suspended from cables which are supported on a single tower located off the eastern shore of the Yerba Buena Island. The SAS spans 565 m between piers E2 and W2, with a 385-m main span, over the navigational channel, and a 180-m back span. The 160-m tower is composed of four steel shafts interconnected with shear links along its height. These links play a significant role in resisting the seismic loads as well as to supply the tower with the proper stiffness during service load conditions. The tower shear links are designed to satisfy the following criteria:

- Supply the tower with the required stiffness for service load conditions
- Remain almost elastic during a functional evaluation earthquake (FEE)
- Plastify during a safety evaluation earthquake (SEE); thus dissipating energy and limiting the damage in the tower shafts (shafts are designed to remain almost elastic)
- To be replaceable after an SEE, if necessary.

In order to satisfy the above requirements, various configurations of the tower were evaluated where the strength and stiffness of the shear links as well as their location along the height of the tower were varied. These studies were primarily done in the form of static pushovers to determine the response of the tower during service loads, wind loads, FEE and SEE loads. Finite element analyses were then performed to evaluate the local inelastic performance of these links as well as the need for replaceability (if any) after a major earthquake. The shear link behavior was also verified by laboratory tests. The use of thick high performance steel (HPS70W) at the shear link to tower shaft connection zone controlled of the shear yielding area and maintained the integrity of the connection.

Seismic Retrofit of the Antioch Toll Bridge
Presenter: Yong-Pil Kim, P.E.

2:00 - 2:45 — Senior Bridge Engineer at Caltrans with 25 years of bridge design experience. Has received B.S. and M.S. from the University of Illinois at Chicago. Was responsible for the delivery of major projects like the replacement of the Central Viaduct in San Francisco and the structural portion in the extension of the Routes 180, 41 and 168 in Fresno, consisting of 27 bridges. Also has participated in the design of the new Bay Bridge Skyway portion and the emergency replacement of the McArthur Maze structure.

Break from 2:45 - 3:00

I-35 Bridge Collapse
Presenter: Su Hao, Ph.D.

3:00 - 4:00 —Principal of ACII, INC., Ph.D. of Solid Mechanics and Structures, Zhejiang University of China, 1986. Post Doctorate from Tsinghua University of China and Northwestern University at Evanston, Illinois. Structural Engineer of GKSS, Hamburg-Geesthacht, Germany. 25 years experiences in failure and fatigue evaluations, structures' designs and analysis, inspection and health monitoring. Conducted independent I-35W Bridge collapse analysis, participated in the inspection and residual life assessment projects of the Innerbelt Bridge, Cleveland, Ohio, and the Missouri Hurricane-Deck Bridge. Assisting CCCC for the health monitoring of the navigation channel cable-stayed bridge, HZAB project. Author of 32 publications in peer-reviewed journals such as ASCE JBE, and Int. J. of Solids & Structures. Received awards from various professional associations such as European Society of Structural Integrity (1995), and Structural Engineers Association of Illinois (2009).

Examples of Seismic Control Technologies of Steel Bridges in Japan

Presenter: Motoshi Yamauchi, P.E., Jp

4:00 - 5:00 — We have experienced a number of earthquakes in the past, and many seismic control devices and retrofit technologies developed. In this workshop, I will explain two examples of seismic control technologies. First is the axial damper for arch bridge and second is floor isolation system for the truss bridge.

Axial damper: Members of axial damper consist of low yield point steel, and seismic energy is dissipated by elasto-plastic hysteresis behavior. Applying the axial damper, energy absorption capacity of bridge system increases remarkably, and quantity of reinforcing members can be reduced.

Floor isolation system: Minato Oohashi Bridge, installed floor isolation system is the longest span truss bridge in Japan (Bridge length: 980m, Center span: 510m, Weight: 45,000 tons). According to the results of dynamic analysis of seismic motion, many members exceed the safety stress range. Main reason of this stress excess is fixed heavy floor system of truss bridge. To reduce the reaction of floor system due to the seismic motion, isolator is installed between truss and floor member. As a result, reinforcing members and reaction forces are reduced remarkably

Wood Mockup of San Francisco/Oakland Bay Bridge Tower

Antioch Bridge Seismic Retrofit

Closeup of the San Francisco / Oakland Bay Bridge Tower