



INTERNATIONAL JOINTS AND BEARING COUNCIL NEWSLETTER

NEWSLETTER # 40

ANNIVERSARY EDITION

AUGUST 2008

NANOTECHNOLOGY – A VISION OF THE FUTURE

Based on present research findings, it would be probably safe to say that no field of physics and material sciences has brought as much excitement since the discovery of the silicon chip. Private industry and the federal government are investing billions of dollars to the understanding and control of matter at dimensions of 1 to 100 nanometers. For reference, a nanometer is just one billionth of a meter, and at that scale, the physical, chemical and biological properties of materials differ in fundamental and valuable ways. For manufacturers and users of expansion joints and bearings, a lot of exciting developments are under way.

An example of nano-technology is when in the early 1900's, Goodyear revolutionized their industry with the addition of Carbon Black to enhance the strength and durability of radial tires. However, it was not known as nano-technology back then. Research is well underway in the study of nano-sized clay, carbon, gold, silver and silica and the properties they exhibit at that small scale. We already know that the addition of nano-sized particles of clay, carbon, or silica to common construction materials such as adhesives, epoxies, concrete and steel have been shown to increase such properties as strength, stiffness, durability and fire resistance.

Our current technology allows us to break down and manipulate clay, carbon, silica and other elements to molecules as tiny as 100,000 times smaller than the diameter of human hair. The molecules can be clumped together to form different shapes, such as nano-sheets, nano-tubes, nano-spheres, and nano-platelets. They can also be woven and tied together to form nano-fibers or nano-wires. Today we use them as fillers to enhance the properties of already existing commonly used materials. In the future, we will be able to create an amazing new class of materials to be used for construction and rehabilitation.

The automobile and electronics industry have a head start in the use of this technology for today's consumer products. However, the Transportation industry is finally catching up and is setting the stage for a promising future. The Federal Highway's Advanced Infrastructure Research Program is promoting this research. There are exciting possibilities in "smart bridges", self-healing materials, the miniaturization of machines, and the next generation of asphalt, concrete and steel.

In fact there is reason to believe that commonly used galvanizing of bridge components may some day be replaced with nano-enhanced coatings that are more resistant to corrosion and can quickly heal itself if damaged.

How this all will relate to bearings and expansion joints in bridges has yet to be determined but with some of our countries' greatest minds at work in hundreds of universities around the world, it seems to be just a matter of time.

R. J. Watson
Chairman, IJBRC

NEWSLETTER #40 - ANNIVERSARY EDITION

Newsletter #40 celebrates 20 years of publishing events and articles of importance to our membership. The first newsletter for the International Joints and Bearings Research Council was printed March 1, 1988. It was created after the 2nd World Congress on Joints and Bearings held in San Antonio, Texas as a format to communicate with our membership from around the world. .

In 1988, IJBRC had 102 registered members from 11 different countries. Today, we are proud to announce that the membership has grown to over 600 members representing 22 countries.

In 1988, the Executive Committee consisted of: Stewart C. Watson as Chairman, Maurice G. Baigent as Vice Chairman, Vincent Kazakavich as Secretary, Guy S. Puccio representing ACI Committee 504, James K. Iverson representing ACI Committee 554, David G. Stafford and Peter Smith as Members-at-Large. Several of these individuals continue to work on your behalf on the Executive Committee or Advisory Board.

The first newsletter included 2 articles on current research of the time: "Performance of Elastomeric Bearings" by C.W. Roeder, J.F. Stanton and A.W. Taylor of the University of Washington and "The Sliding Surfaces in Bridges" by T.I. Campbell and W.L. Wong of Queens University. In addition, a project report entitled "World's Largest Sealed Expansion Joint" by C.S. Gloyd, Bridge and Structures Engineer, Washington State Department of Transportation was printed.

IJBRC continues to solicit research, project and committee reports, suggestions and news articles of interest to our membership for future newsletters. Submissions should be under 250 words and forwarded to the IJBRC Secretary.

AMERICAN CONCRETE INSTITUTE FALL CONVENTION - 2008

ACI Committee 341 and IJBRC are co-sponsoring a Technical session on "Seismic Design and Detailing of Bridge Protection Systems" for the ACI Fall 2008 Convention, Nov. 2-6, 2008, in St. Louis, MO

Session Moderator Ronald J. Watson
Co Moderator: Joan Zhong-Brisbois

List of Presentations and Authors:

Sliding Isolation Systems for Concrete Bridges
Ronald J. Watson, President
R.J. Watson, Inc.

A New SRMD Design Tool - The Multi-Surface Sliding Isolator
Paul Bradford, P.E., PhD
PB Engineering

CFRP Jackets as an Emergency Repair and a Protection System for Bridge Columns
Sarah Witt Scott Arnold, PE
Fyfe Co LLC

Seismic/Wind Control Of The Sutong Bridge Using Hybrid Viscous Damping Devices
Douglas P. Taylor, President
Robert Schneider, Industrial/Seismic Products Sales Manager
John Metzger, Engineering Manager - Special Projects
Taylor Devices, Inc.

The Construction Phase for the Replacement of the Expansion Joint for the Alex Fraser Bridge
Eric de Fleuriot, P.Eng. Manager/Bridge Group, Transportation
Earth Tech, Inc. 1901 Rosser Avenue, 6th Floor

Selection of Expansion Joint Systems to Accommodate Large Seismic Movements
Mark R. Kaczinski, P.E.
Larry D. Durain
D.S. Brown Company

ACHIEVING PRESCRIBED TENSION LEVELS IN ALLOY STEEL FLAT SOCKET SCREWS USED IN EXPANSION JOINTS

By
J. C. Thompson, Professor Emeritus
Civil Engineering Department
University of Waterloo
Waterloo, Ontario, Canada

This note describes the results of tests carried out by the author of Braun Developments Ltd. to address concerns by the provincial highway authorities about the tightening procedure used to develop the necessary tension in the alloy steel flat socket screws widely used in expansion joint systems (see Fig. 1). The two options considered were i) to snug the screw and then tighten further by an (as yet unknown prescribed rotation, or ii) to snug the screw and then tighten it to an (as yet unknown) prescribed torque. The full details of these tests, which involved both finite element and strain gauge analyses, are available upon request. The pertinent results and their implications are described below.

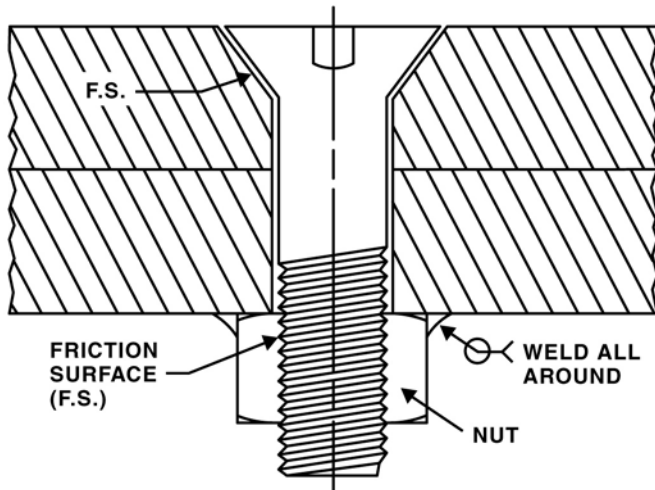


Fig. 1. Schematic of a Typical Alloy Steel Flat Socket Screw in an Expansion Joint Assembly

Figures 2(a) and 2(b) show, respectively, the Torque vs. Tension and Rotation vs. Tension results for a typical screw. The dominant characteristic for the first curve is its linearity; for the second is its high non-linearity. The linearity of the first curve indicates that the desired tension can be achieved consistently and with a minimum level of variability if a well calibrated torque wrench is used, regardless of the level of torque or the method used to snug the screw.

In contrast, because of the very non-linear character of the Rotation vs. Tension curve, two factors make it difficult to determine a prescribed rotation which will consistently achieve the desired tension. The first factor is the uncertainty, R_0 , of the "snug, zero rotation" point. As shown in Fig. 2(b) by the initial dashed portion of the curve, a large difference in rotation will occur for a small difference in the snug point. This leads directly to the second factor. Due to the increasing steepness of the curve, tightening the screw from a poorly defined snug position by a prescribed rotation will lead, as shown by the final dashed portion of the curve, to a large possible variation in the actual tension in screw. This problem is made even more serious by the fact that there is no simple field method of achieving this prescribed rotation with any reliable degree of accuracy.

The conclusion drawn from these tests is that tightening the screws by a prescribed torque rather than by a prescribed rotation is by far the best method to reliably and consistently achieve the desired tension in the screw. The conclusion drawn from these tests is that tightening the screws by a prescribed torque rather than by a prescribed rotation is by far the best method to reliably and consistently achieve the desired tension in the screw.

Finally, it should be noted that there will always be a variation in the linear Torque vs. Tension relationship between screws. Experience has shown that this variation will be within acceptable limits if careful attention is given to minimizing any misalignment between the axes of the screw and the cavity, by minimizing the roughness of the surface of the cavity under the head of the screw, and by the use of an anti-friction lubricant on the friction surfaces (FS) beneath the head of the screw and between threads of the nut and the screw.

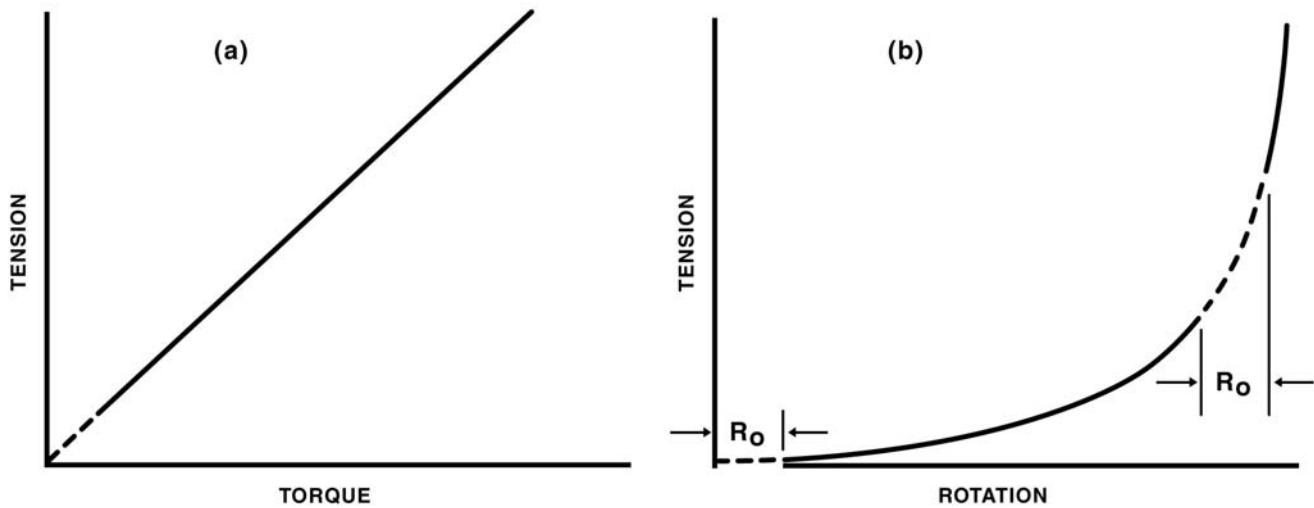


Fig. 2. Torque (a) and Rotation (b) vs Tension in a Typical Alloy Steel Flat Socket Screw in a Expansion Joint Assembly; R_o Denotes the Uncertainty in the Snug, Zero Rotation Position.

MONITORING BRIDGE PERFORMANCE

Dataloggers assist with Confederation Bridge research project

by Campbell Scientific Inc.

The Confederation Bridge is one of the world's longest continuous pre-stressed concrete box-girder bridges built over seawater and the longest span ever built over ice-covered water. It stretches 13 km from Borden, P.E.I., to Cape Tormentine, N.B. Construction of the Confederation Bridge was an awe-inspiring event and ongoing long-term monitoring and research projects add to the bridge's reputation as an engineering marvel. Built to withstand the harsh environment of the Northumberland Strait, the Confederation Bridge was designed to provide a service life of 100 years.

To better understand short- and long-term bridge performance, a multi-year monitoring and research project was established during construction. The research will contribute to the development of load models for future long-span bridges.

Instrumentation

Monitoring instruments, some of which were installed during bridge construction, include more than 500 strain-measuring devices, 450 thermal sensors, 28 ice-load panels, 12 tiltmeters, 76 vibration sensors and underwater sonar equipment. Six Campbell Scientific CR9000 measurement and control systems are at the center of the instrumentation.

These high-speed data acquisition systems are connected to a computer via fiber optics. When predetermined trigger amplitudes, caused by ice impacts, seismic activity, heavy vehicular traffic or high wind speeds, are detected, all loggers are triggered to store pre-trigger and post-trigger data.

The collected data are transmitted to researchers at Carleton University in Ottawa and the University of Calgary for further analysis. Here are some areas of the monitoring and research:

Ice flow

The interaction between ice and bridge piers is monitored and analyzed using 28 ice-load panels installed on the pier's ice shield. Each ice panel is divided into eight impact zones that function as load cells. Strain gages in each zone produce a "Wheatstone bridge" signal. The 224 differential signals are converted to single-ended signals and band limited to approximately 5 Hz before the amplified and filtered signals are sent to two CR9000s . Ice-flow and ridge impacts, the resulting forces of these impacts and the response of the bridge are measured. Long-term data will be used to better understand ice forces.

Short- and long-term deformations

Changes in the bridge concrete, movement of the foundations and loss of tension in pre-stressed steel reinforcements can cause deformations in the bridge structure over time. These deformations are monitored, using laboratory and on-site tests, to determine the relaxation of steel and the creep and shrinkage of concrete over a 20-year period.

Thermal stress

Sensors document the response of the bridge to daily and seasonal temperature variations (thermal stress). Monitoring conducted during and after construction includes laboratory testing and simulation of thermal properties of concrete and calibrations of computer models.

Traffic load and load combinations

The data from sensor measurements are being stored in a database, which will be used to determine future trends

Research will be conducted on the load combination techniques for significant load effects on bridge designs. The results will help develop load models for long-span bridges as well as future operational strategies. Before monitoring on the Confederation Bridge began, no such models existed.

Vibration

Wind, traffic, ice impact and earthquakes can cause bridge vibration. To measure vibration, 75 accelerometers are distributed throughout a 1-km section of the bridge. The accelerometer signals are filtered and sent to dataloggers distributed along the same section.

Monitoring the vibrations helps produce computer modeling and analysis techniques for determining vibration responses and the spatial variation effects of seismic-ground motion. This will advance knowledge in structural dynamics, particularly seismic and wind-resistant design engineering for long-span structures.

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Gone Electronic

In order to reach you more quickly and help reduce our mailing costs, the IJBRC Newsletter has gone electronic.

ASTM MEETING MINUTES

SUBCOMMITTEE: D04. 32 Bridges and Structures

DATE: Thursday, June 26, 2007

LOCATION: Hyatt Regency
Denver, CO

TIME: 9:00 a.m.

The following are action items discussed at the meeting:

- The revision of Specification D 6087-07 was balloted and received no negatives
- The balance of the documents in this subcommittee are current.
- A proposed new specification on two component spray applied bridge deck waterproofing membranes was passed out to the subcommittee. Comments are requested by September 1, 2008.
- The next meeting will be held in Miami, FL on Thursday December 11, 2008.
- The meeting adjourned at 9:34 a.m.

ASTM MEETING MINUTES

SUBCOMMITTEE: D04. 34 Preformed Joint Fillers & Sealers And Sealing Systems

DATE: Thursday, June 26, 2008

LOCATION: Hyatt Regency
Denver, CO

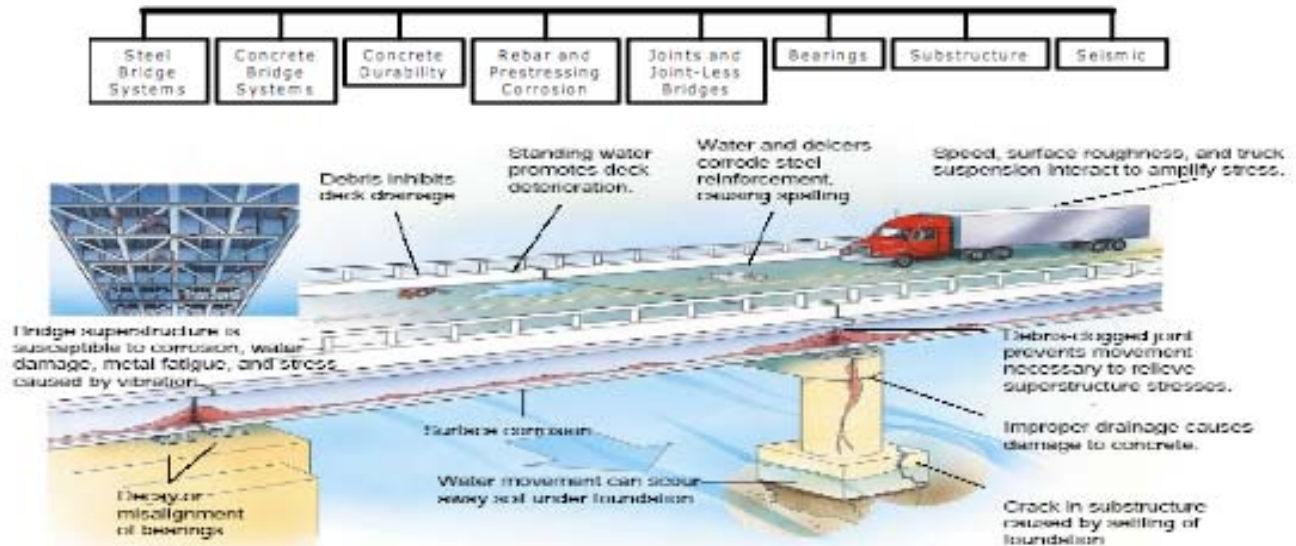
TIME: 8:00 a.m.

The following are action items discussed at the meeting:

- Specifications D 545-99 (2005) and D 4070-96 (1996) were balloted for re approval and received no negatives.
- Specifications D 1751-04 and D 1752-04 are up for review. Subcommittee members should review these documents and contact the subcommittee chairman if any modifications are necessary.
- Dan Smith made the subcommittee aware of AASHTO Specifications that are similar to ASTM Specifications. Dan has redlined some proposed changes to D 3542 (AASHTO M 297) and D 545 (AASHTO T 042) and has requested that the subcommittee review these changes so that the specifications are in conformance with one another.
- A new proposed specification on preformed silicone joint seals for bridges was passed out to the subcommittee members. Members should review and comment on the document prior to September 1, 2008
- The next meeting will be held in Miami, FL on Thursday December 11, 2008.

TRB SHRP 2 Project R19-A

Bridges for Service Life beyond 100 Years: Innovative Systems, Subsystems and Components



Source: Illustration by Jana Bronning. Copyright Jana Bronning. Reprinted with permission. Illustration first appeared in *Scientific American*, March 1993.

Project Objectives

The objective of this project is to improve existing systems, subsystems, and components that historically limit the service life of bridges, and to identify and prove promising concepts for alternative systems, subsystems, and components. As a result of this project methodologies, concepts and ideas will be developed to extend the service life of existing bridges and promising concepts will be developed to result 100 plus years of service life in a quantifiable ways. The focus of this project will be on bridges with span lengths of less than 300 ft.

Joints and Bearings are among the most important technical issues to be addressed within this project. In this regard we would like to hear from you and have your suggestions, feed back and comments. Contact us if you would like to be member of our industrial ad-hoc committee.

Research Team Members: University of Nebraska-Lincoln, PBS&J, HDR, Vector Corrosion, Celik Ozyildirim, KTA, Georgia Inst. Tech., Univ. of Delaware, William and Kenneth Engr. and COWI in Denmark

You can obtain more information about the project, as well as downloading the project proposal by visiting the following web site:

<http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=2191>

For more information, please contact project Principal Investigator at:

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National Bridge Research Organization (NaBRO), Division of Nebraska Transportation Center
University of Nebraska-Lincoln

Upcoming ACI Conventions

2008 - November 2-6,
Renaissance St Louis
Grand & America's Center

2009 - March 15-19
Marriott Rivercenter
San Antonio, TX

2009 - November 8-12 Marriott New Orleans,
Marriott New Orleans
New Orleans, LA

2010 - March 21-25
Sheraton,
Chicago, IL

For additional information contact:
Event Services, ACI, PO Box 9094
Farmington Hills, MI 48333-9094
Telephone (48) 848-3795
E-Mail: conventions@concrete.org

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Individual articles included in this newsletter are
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