

June 24, 2003

MEMORANDUM

TO: District Structures Design Engineers  
(Gerard Moliere, Rod Nelson, Keith Shores, John Danielsen,  
Neil Kenis, Kim Saing, Jose Rodriguez, Agnes Spielmann)  
District Structures and Facilities Engineers  
(Pepe Garcia, Keith Campbell, John Locke, Jorge Martos, Jim Morgan,  
Frank Guyamier, Tom Reynolds)

FROM: William N. Nickas, P.E., State Structures Design Engineer

COPIES: Assistant Secretary Ken Morefield,  
District Secretaries (Ricky Langley, Aage Schroder, Edward Prescott, Rick Chesser,  
Mike Snyder, Ken Hartmann, Jim Ely),  
State Highway Engineer, Freddie Simmons,  
Director Office of Design, Bob Greer,  
District Directors of Operations (Debbie Hunt, Jim MacLaughlin, Jimmy Rodgers,  
James Wolfe, George Gilhooley, Gus Pego, John Temple, Bruce Seiler)  
District Directors of Production (Mike Williams, Dave Byrd, Gene Martin,  
Gerry O'Reilly, Noranne Downs, Donald Skelton, Nancy Clements)  
Structures Design Engineers (William Domico, Bob Nichols, Jack Evans, Larry  
Sessions, and Marcus Ansley)  
Doug Edwards (FHWA),

SUBJECT: **Temporary Design Bulletin C03-03**  
Bolt Design in Signal, Overhead Sign, and Light Support Structures

Requirements

The Florida Department of Transportation has expanded its policy on load path redundancy and fatigue concerns in signal, overhead sign, and light support structures. As a proactive effort to ensure the safety of the traveling public, effective immediately, all sign, signal, and lighting structures designed for a minimum service life of 50 years (wind speed based on a 50-year mean recurrence interval) shall use a minimum of six ASTM F1554 anchor bolts at the pole to foundation connection (Dywidag bar are not permitted). Additionally, the arm to pole connection on mast arm structures shall be "through-bolted" (tapped connections are not permitted).

This policy is incorporated into FDOT Standard Drawings and Design Standard (General Notes, Material Specifications, and Details). These Standards shall be utilized on all designs, including special designs, and shall be met regardless of funding source (private, local, state, or federal). Structures designed for wind speeds based on a 50-year mean recurrence interval include all overhead

sign structures (Standard Drawings 2000 and 2010), cantilevered signal structures (mast arms, Design Standards 17743 and 17745), monotube signal structures (Design Standard 17746), and lighting structures over 50 feet in height (High Mast). Structures designed for 25 years recurrence interval winds include strain poles and light poles 50 feet in height or less.

#### Commentary

AASHTO has addressed concerns about fatigue in Section 11 of the 2001 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. In addition, NCHRP Report 469, Fatigue Resistant Design of Cantilevered Signal, Sign, and Light Supports, provides a comprehensive review of wind induced vibrations and fatigue on sign and signal structures ([http://gulliver.trb.org/publications/nchrp/nchrp\\_rpt\\_469-a.pdf](http://gulliver.trb.org/publications/nchrp/nchrp_rpt_469-a.pdf)). Findings regarding anchor bolts in the report state:

“There is an unfortunate trend toward using fewer very large anchor rods. It is always better to use a greater number of smaller anchor rods than fewer bigger anchor rods. Although only four anchor rods are required, there should be ideally six and preferably eight anchor rods in any joint in a non-redundant structure subject to fatigue or seismic loading. ... This gives the joint some measure of redundancy, even if the structure is non-redundant. Anchor rod joints with only four rods will fail completely only a short time after the first rod failure.”

Vulnerability due to sabotage is now an additional concern on all infrastructure facilities and can be addressed by designing redundancy into structures where feasible.

#### Background

Overhead sign and cantilever signal structures have grown in number and age over the years. Most of these structures were designed for a 50-year life, and some are now showing signs of fatigue. Failures have been reported throughout the country with weld and bolt failures most common. In particular, anchor bolt failures have been reported in Tennessee, New York, New Jersey, California, Delaware, Colorado, and Wisconsin. Surveys of state Departments of Transportation revealed that the occurrence of failures, with cantilevered support structures in particular, is increasing. Anchor bolts, especially, have been identified as being vulnerable to fatigue. Failures have heightened the awareness that overhead sign and signal structures represent a greater potential hazard than ground mounted signs because they are located directly over the roadway.

#### Follow-up

All FDOT Standard Drawings and Design Standards currently use a six-anchor bolt minimum for both the base to foundation connection (ASTM F1554 anchor bolts) and for the Mast Arm to pole connection (ASTM A325 bolts). Details in the Mast Arm Design Standard also depict “through-bolting” at the arm to pole connection.

The FDOT is working toward adopting the 2001 AASHTO code and updating all the internally developed programs and Standards including:

Atlas Program, Cantilever Overhead Sign Program and Standard, Span Overhead Sign Program and Standard, Mast Arm Program and Standard, High Mast Lighting Program, Multi Post Ground Sign Program and Standard, Single Post Ground Sign Standard, Monotube Standard, Aluminum Light Pole Standard, Steel Strain Pole Standard and Concrete Strain Pole Standard.

This effort will occur over 2 to 3 years and will be implemented in stages.