

## EXECUTIVE SUMMARY: Fatigue Tests of Welded Connections in Cantilevered Steel Sign Structures

### BACKGROUND

Freestanding “high-rise” signs of 50 feet or more are an essential tool for many businesses seeking to market their locations to customers, and are among the various types of products designed, manufactured, supplied and used by the 2,200 members of the International Sign Association (ISA). A common design known as a “telescoping” steel column is widely used for freestanding signs that reach heights of 50 feet or more. Tens of thousands of these signs are safely in use along the nation’s interstates and major highways.

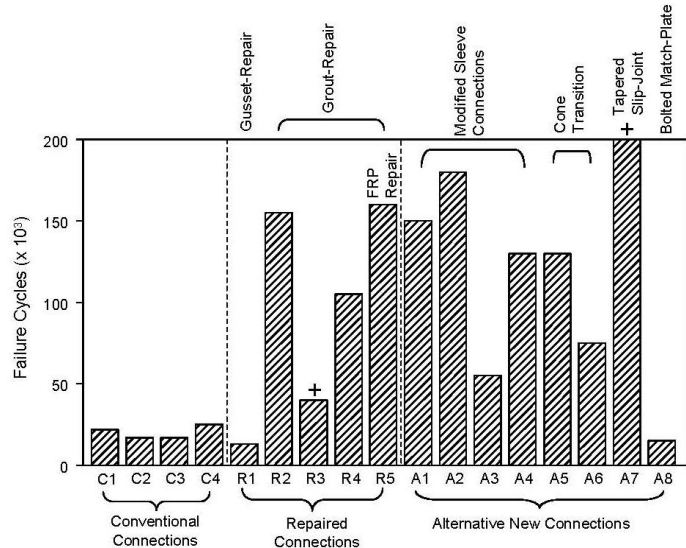


Fig. 1: Test Comparison Chart

Through the ISA Technology and Research Committee, the Association became aware of concerns about a handful of these signs falling in recent years due to unknown causes. There was little data on these incidents, and as a result, conflicting theories as to possible causes. As part of its ongoing commitment to promoting the highest standards of quality and safety, ISA decided to commission an independent engineering analysis at the University of California San Diego (UCSD) to help shed more light on the issue.

*The initial UCSD study, “Evaluation of Sleeve Connection of Cantilevered Steel Sign Structures,” completed in October 2008, suggested that, regardless of age, these types of structures are vulnerable to fatigue cracks at the telescoping connections due to wind-induced vibration.*

Guidelines were rapidly developed by ISA’s Technology and Research Committee in concert with UCSD and industry experts to identify risk profiles and inspection procedures. These were published on the ISA website and widely disseminated within the industry and to end users. In addition, further engineering evaluations were undertaken at UCSD’s Charles Lee Powell Structural Systems Laboratory.

*The second UCSD study, “Fatigue Tests of Welded Connections in Cantilevered Steel Sign Structures,” completed in October 2011, validated the need for regular inspections for all sign types and use of improved design approaches. It also found certain repair types appear to offer substantial improvements over methods sometimes used in the past.*

The full report and recommendations are available to all users at [www.signs.org/signstructures](http://www.signs.org/signstructures).

The aim throughout has been to detect all structural issues and to foster development of best practice guidelines that can be applied across the industry with the assistance of ISA and its member companies.

## LATEST INDEPENDENT ENGINEERING TESTS

### APPROACH

The second phase of independent research by UCSD, “*Testing of Cantilevered Steel Sign Structure Splice Connections*,” used tests to evaluate the relative fatigue resistance of different types of connection details for both new construction and retrofit or repair of single pole signs.

A total of 17 specimens were evaluated (see Fig. 1) to establish a baseline and to compare various, alternative connection details. The baseline was determined by testing four specimens featuring commonly used lap-splice connections (C1-C4 on Fig. 1). Test specimen selections were determined by the ISA Mechanical and Structural Subcommittee and the UCSD research team. The assumption behind the testing is that the greater the difference in fatigue resistance, or durability, between the conventional designs and a given alternative, the more significant is the finding. As Fig. 1 indicates, some alternative designs exceeded the durability of conventional designs by 9 or 10 times.

The comparison among retrofit/repair details (found in R1-R5 on Fig. 1) and the best-performing new construction design types, including the tapered pole (found in A1-A8 on Fig. 1), are described in detail in the full report and on the ISA website.

#### ***Key Recommendations***

- *Conduct ongoing, regular inspections of telescoping single pole signs*
- *Refer to ISA retrofit and repair guidelines and options for best practice results*
- *Consider tapered pole design for new construction*

### RESULTS AND IMPLICATIONS

It is reasonable to assume that by introducing better-performing alternative designs – both for new construction and retrofit and repair – end users can expect significant improvements in overall durability and lifetime. However, there is an important caveat: wind-induced vibration is a complex phenomenon, and while these studies have pointed the way to significant improvements in design features, ISA will continue to recommend the importance of regular, ongoing safety inspections as the best practice guidance to avoid structural issues with all sign types.

With regard to future single pole sign projects, more sign companies and their customers will prefer to adopt the tapered pole design, which is a proven alternative that eliminates the welded connection identified as a focus of the structural issue. But for repair and retrofit needs for the telescoping design, and for those users who will maintain current designs, ISA provides a listing of options based on the independent research tests.

### ISA MEMBERS CAN HELP

Technical guidance is being prepared for designers and manufacturers of new signs, including single-pole structures. This comprehensive guidance will include introducing the tapered pole design approach and general recommendations to enhance the safety and durability of all types of freestanding signs.

ISA members are relied on by their customers and end users to provide the facts, explain the issues, and help convey the results of this comprehensive work. ISA is looking to its members to reach out to their customers and end users, and to help communicate these guidelines and best practices as we work collectively to promote a new industry approach.

Also, ISA is leading the way to organize continued reporting of sign structure incidents and to gain comprehensive knowledge of various factors that affect the durability and safety of all types of sign designs. By developing capabilities targeted to identify structural problems with signs nationwide, ISA aims to be the industry leader in bolstering awareness and education -- and in finding solutions -- on this important issue.