There's a Flagpole Spec?

BY MATTHEW FADDEN AND JILL RAJEK

The story behind the design and construction of the world's tallest flagpoles.

JULY IN AMERICA MEANS WARM WEATHER, COOKOUTS, AND OF COURSE, INDEPENDENCE DAY. No matter where you are on the 4th, there is a good chance "Old Glory" will be flying nearby. And while the flag is a prominent and recognizable symbol of America, we often overlook an important part of its display: the flagpole.

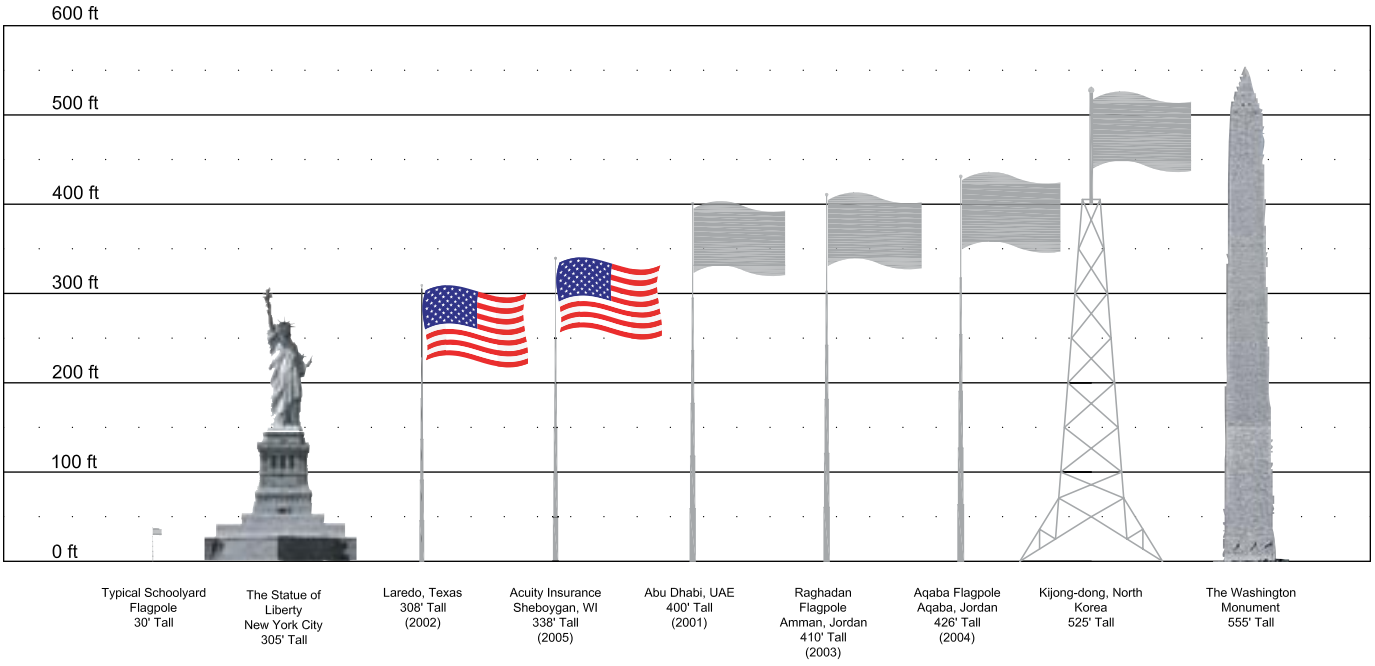
As might be expected, the design and fabrication of flagpoles is not arbitrary. The National Association of Architectural Metal Manufacturers (NAAMM) has published a guide specification that has been approved by the American National Standard Institute (ANSI), outlining the design requirements for metal flagpoles. In honor of the 4th of July, we thought it would be interesting to take a look at some of the world's tallest flagpoles and investigate flagpole design using ANSI/NAAMM FP1001-97, *Guide Specifications for Design of Metal Flagpoles*.

Lots of Flag, Lots of Steel

The United States has several tall flagpoles of its own. For example, the *Dallas Morning News* reported that on Memorial Day of 2002, a 308-ft flagpole was dedicated in Laredo, Texas at Laredo National Bank. This is 3 ft taller than another symbol of America, the Statue of Liberty. People on either side of the U.S.-Mexico border can see the 100-ft by 50-ft American flag flying from the Laredo pole. However, the desire to go taller did not stop there.

Sheboygan, Wis., a town of approximately 50,000, is best known as the home of Johnsonville Bratwurst and for its scenic lake views. Most people would consider Sheboygan to be little more than your typical American town. What they don't realize is that Sheboygan claims the distinction of having the tallest freestanding flagpole in the U.S. The flagpole was raised by Acuity Insurance in time for Independence Day in 2005, according to the *Sheboygan Free Press*. The 338-ft pole is made of tubular steel sections 6 ft in diameter at the base that decrease in diameter as the height increases. Overall, the pole contains 65 tons of steel and supports a 120-ft by 60-ft flag weighing 300 lb.

But even at this massive size, worldwide there are even taller flagpoles. The record for the tallest unsupported flagpole is held by the Aqaba Flagpole in Aqaba, Jordan. Although there is a flagpole in North Korea that is taller, it's supported by a truss structure. The figure below shows several of the world's tallest flagpoles, all



A height comparison of some of the world's tallest flagpoles, including several well-known structures.

made of steel. Materials such as aluminum can be used for smaller flagpoles, but steel is the material of choice for the world's tallest.

The Flagpole Spec

The design process presented by ANSI/NAAMM FP1001-97 consists of selecting a flagpole size, determining the flag size to be flown, calculating the loadings on the flagpole, and performing a stress analysis to ensure the design meets the specification.

There are two loading types that must be considered when designing a flagpole: flagpole loadings and flag loadings. Flagpole loadings consist of dead loads and wind loads. The dead loads include the weight of the flagpole, the weight of the flag, and the weight of any hardware and accessories that will be attached. The flagpole wind loads consist of the pressure on the flagpole due to the wind and the wind drag on the flag. The flagpole specification uses ASCE 7 to compute the wind loads on the flagpole.

According to the guide specification, flag loading is a result of the wind acting on the flag, which in turn results in loading on the pole. The formulas used in the flagpole specification for flag loadings are empirical and are based on actual data taken from flight testing of different-sized flags and different materials. Testing consisted of connecting the test flag to a tow line, which was then connected through a load cell to an airplane. This allowed for continuous readings of the drag force on the test flag. Wind load data was recorded at different air speeds. The empirical formulas in the specification provide results that reasonably match the data recorded during testing.

The flagpole loadings and the flag loadings are used to calculate shear, bending moment, and axial compressive forces on the flagpole. The wind loadings are used to determine the shear force and the bending moment, and the dead load is used to calculate the axial compressive force. These forces are then used to determine the actual stresses on the flagpole. A stress analysis is performed to ensure the actual stresses do not exceed the allowable stresses as specified in ANSI/NAAMM FP1001-97. Foundation design must be performed to meet applicable building codes, and designers should exercise good engineering judgment when designing flagpole foundations.

After the design work is completed, fabrication can begin. Flagpole fabrication consists of rolling, forming, and welding different steel sections. Because each flagpole is unique, the fabrication process is not limited to these tasks. A finishing coat is applied to the steel for maintenance and aesthetics. After fabrication is complete, the flagpole is shipped to its final destination and erected.

So the next time you see the flag flying, you can be proud to know that steel is, quite literally, supporting a symbol of America. MSC

Matthew Fadden and Jill Rajek are both interns with AISC. Matt recently received his B.S. in Civil Engineering from the University of Illinois at Urbana-Champaign and will begin his graduate studies this fall at the University of Michigan in Ann Arbor. Jill is pursuing her B.S. in Civil Engineering from the University of Wisconsin-Platteville and plans to graduate next May.