



## SCAFFOLDING, SHORING, AND FORMING SECTIONS

# SSFI TECHNICAL BULLETIN

### Common Terms Used In the Design of Construction Materials for Scaffolding, Shoring and Forming Equipment

**Ultimate Strength, Yield Strength, Safety Factors**, terms heard everyday in the construction industry, but to individuals new to our industry they can be confusing and misunderstood.

To help illustrate what the definition of *Ultimate Strength* is let's consider pulling on a steel rod. If we place the rod in a testing machine that can measure the force used to pull on the rod until it breaks we will have the ultimate tensile strength of the rod.

If we push on each end of the rod until it fails we will have the ultimate compressive strength, or buckling strength of the rod.

Using the rod as a beam supported on each end and pushing on the middle of the rod until it breaks we can determine the ultimate bending strength of the rod.

On the first example of the rod being pulled apart as the load is applied there will be a point where the rod will begin to stretch without increasing the amount of force. The amount of force where this first occurs is used to determine the *Yield Strength*. When you pull on the rod and the load is less than the load at the yield strength the rod will return to its original length. If the loading is above the yield strength of the material when the load is removed the rod will be longer than the original length.

This is a very brief description. There are detailed test procedure requirements that have been established by the American Society of Testing Materials (ASTM) on the sample size with the exact dimensions for machining the sample, and how fast the load is applied.

Once the ultimate strength is determined we can then apply Safety Factors to these values depending upon the application. The *Safety Factor* is a number that the Ultimate Strength is divided by to set a limit of how much allowable or working load can be applied to the material.

As an example of the Safety Factor that is used for scaffolding equipment. OSHA, the governmental agency for Occupational Safety and Health Administration has set a Safety Factor for scaffolding that it must be capable of supporting the weight of the equipment plus 4 times the weight of the anticipated live load, or workers and any material placed on the walkways. Other governmental agencies may require a 4:1 factor on the dead load and anticipated live load.

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This Technical Bulletin was prepared by members of the SSFI Scaffolding, Shoring, and Forming Sections.

SSFI is a trade association comprising manufacturers of shoring, scaffolding, forming, and suspended scaffolding. The institute focuses on engineering and safety aspects of scope products.

This bulletin does not purport to be all-inclusive nor to supplant or replace other additional safety and precautionary measures to cover usual or unusual conditions. If this bulletin conflicts in any way with a state, local, federal or other government statute or regulation, said statute or regulation shall supersede this bulletin and it shall be the responsibility of each user to comply therewith. This bulletin has been developed as an aid to users of SSFI scope equipment. SSFI is not responsible for the use of this bulletin.

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The allowable leg loads for shoring frames is set with a safety factor of 2.5. SSFI has established a standard method of testing and rating a shoring frame leg. A tower is erected with 3 frames high with the cross braces. Load is applied through a testing rig to apply the load equally to all 4 legs. The load at which the tower buckles, or fails is divided by the 4 legs and then the safety factor of 2 ½. This is the allowable working load.

If the tower buckled at 100,000 lbs, the rated leg load is 100,000 lbs divided by 4 legs and then divided by 2.5 = 10,000 lbs., allowable working load.

The Safety Factors to be used are dependent upon the governmental, provincial and state codes. Listed below are a few references that can be used for a more detailed listing of safety factors and how they are applied.

The members of SSFI are working with various standard organizations and government agencies to develop standard test procedures for the safe application of the equipment for the construction industry.

- ◆ ANSI A10.8, *Safety Requirements for Scaffolding—American National Standard for Construction and Demolition Operations*
- ◆ CSA Canadian Standards Association
- ◆ 29CFR1926, Subpart L (OSHA scaffold standards)
- ◆ ANSI A10.9, *Safety Requirements for Shoring—American National Standard for Construction and Demolition Operations*
- ◆ American Concrete Institute, ACI - SP4, *Guidelines for Concrete Construction*, by M. Herd

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