

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

Ultimate Strength, Yield Strength, Safety Factors: These terms are heard every day 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.

By 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.

Consider 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 for Testing and Materials (ASTM) on the sample size with the exact dimensions for machining the sample, and how fast the load is applied.

This Technical Bulletin was prepared by members of the Scaffold & Access Industry Association SSFI Committee.

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

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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 Occupational Safety and Health Administration, has set a Safety Factor for scaffolding such that the scaffolding 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.

The allowable leg loads for shoring frames are set with a safety factor of 2.5. Safety Factors vary by type of equipment. SSFI has established standard methods of testing and rating a variety of scope products.

The Safety Factors to be used are dependent upon the governmental, provincial, and state codes. The references listed below can provide more details regarding 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 equipment for the construction industry.

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

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