

ASD (ALLOWABLE STRESS DESIGN) vs LRFD (LOAD AND RESISTANCE FACTOR DESIGN)

There are two systems used for the analysis of loads in structures. Both have been used successfully, but there are reasons that one may be preferred over the other for particular situations.

Currently, the building codes that govern the factors used in the design of seismic components are migrating from one system to the other. Because there is a significant difference between the two, factors need to be introduced on some occasions to properly compare design forces and component capacities.

The two systems are ASD (Allowable Stress Design) and LRFD (Load and Resistance Factor Design).

ASD (Allowable Stress Design)

ASD has been used historically for determining forces and assigning capacities to restraints, materials, anchors and other critical items. It is also commonly referred to as “Working Stress Design”.

When using the ASD system, factors are applied to lower the peak allowable strengths of the hardware or materials used on a project to the point that, when subjected to peak design loads, a cushion is built into the materials for safety. Thus, if a component is determined to be able to withstand a tensile load of 1400 lb without failure, in the ASD world, it will be rated at only 1000 lb.

The same basic logic is also applied to the loads. The forces used for design in this system are “working” loads. While these are the biggest loads normally expected, they do not include extra factors intended to address unknowns, compounded loads and other uncommon occurrences. It is assumed that the safety factor in the materials can address these items.

Thus both the loads and the strengths of the materials are reduced to a level that is commonly referred to as the “Working Stress Based”.

LRFD (Load and Resistance Factor Design)

LRFD is used on the newer codes and is more commonly being used in identifying material or component capacities as well. It is also commonly referred to as “Working Strength Design”.

When using the LRFD design principles, the factors applied to the materials are small or non-existent. The LRFD capacity listed can be assumed to be all that you will get.

ASD vs LRFD Design

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The forces that are generated by LRFD computations are similarly not reduced. Every effort is made to identify the worst case conditions and load combinations and as a result, there are factors applied to the loads to anticipate these conditions that are not included in the ASD world.

As a result, both the forces and the material capacities used for LRFD computations are higher than those used with ASD. This is commonly referred to as the “Working Strength Based”.

For purposes of our calculations, it is possible to directly compare working strength to working stress values by introducing a factor of 1.4. Thus if we go back to our original material example, the material rated at 1000 lb tensile strength using ASD factors, would be rated at 1400 lb using LRFD.

Applicability

Currently the BOCA, SBC, and NBC (Canada) codes are ASD based. The 97 UBC, IBC and TI-809-04 Codes are LRFD based. There are multiple reasons that the codes have moved toward the LRFD. Probably the primary one however, is that it has been felt the loads and load combinations can be more accurately portrayed with LRFD factors than they can with ASD factors.

Unfortunately, there is currently a situation where some materials or hardware are rated in ASD based units and some in LRFD based units. In addition, as mentioned above, some of the codes have forces in ASD units and some in LRFD units. The differences between the values are too big to ignore and it is critical that anyone involved in comparing values, sizing components or specifying designs must have a good grasp of this and know at all times, what values he is working with.

Kinetics Noise Control currently performs most analyses on individual pieces of equipment using ASD units. This is because many of the hardware and material allowables are still in those units and because of the need to deal with many codes, we have preferred to standardize. In general, for areas where it is not clear which units might be used, it will be noted on KNC documentation. For example, on the standardized certification document that we generate, the seismic design forces listed at the top are clearly indicated to be in ASD units.

On the other hand, Kinetics Noise Control produced piping and duct design tables are in LRFD units. Again, on each of the documents produced, LRFD units are indicated. LRFD has been used here as primary because these are relatively new tables and as the codes are heading in that direction, it seemed appropriate to adopt that system.

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