2.3 LOAD COMBINATIONS FOR STRENGTH DESIGN

2.3.1 Basic Combinations. Structures, components, and foundations shall be designed so that their design strength equals or exceeds the effects of the factored loads in the following combinations. Effects of one or more loads not acting shall be considered. Seismic load effects shall be combined loads in accordance with Section 2.3.6. Wind and seismic loads need not be considered to act simultaneously. Refer to Sections 1.4, 2.3.6, 12.4, and 12.14.3 for the specific definition of the earthquake load effect E. Each relevant strength limit state shall be investigated.

1. $1.4D$
2. $1.2D + 1.6L + 0.5(L_r \text{ or } S \text{ or } R)$
3. $1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (L \text{ or } 0.5W)$
4. $1.2D + 1.0W + L + 0.5(L_r \text{ or } S \text{ or } R)$ → 1.0 Wind: Wind Load here is strength design load
5. $0.9D + 1.0W$

2.4 LOAD COMBINATIONS FOR ALLOWABLE STRESS DESIGN

2.4.1 Basic Combinations. Loads listed herein shall be considered to act in the following combinations; whichever produces the most unfavorable effect in the building, foundation, or structural member shall be considered. Effects of one or more loads not acting shall be considered. Seismic load effects shall be combined with other loads in accordance with Section 2.4.5. Wind and seismic loads need not be considered to act simultaneously. Refer to Sections 1.4, 2.4.5, 12.4, and 12.14.3 for the specific definition of the earthquake load effect E.

Increases in allowable stress shall not be used with the loads or load combinations given in this standard unless it can be demonstrated that such an increase is justified by structural behavior caused by rate or duration of load.

1.0 D: Dead load as is, thus allowable load

1. D
2. $D + L$
3. $D + (L_r \text{ or } S \text{ or } R)$
4. $D + 0.75L + 0.75(L_r \text{ or } S \text{ or } R)$
5. $D + (0.6W)$ Allowable wind, reduced to allowable stress design loads by using a 0.6 factor, reducing from 1.0 Wind (strength design load)
6. $D + 0.75L + 0.75(0.6W) + 0.75(L_r \text{ or } S \text{ or } R)$
7. $0.6D + 0.6W$

ASCE 7 Wind and Seismic Load Combinations

The ASCE 7 standard provides two design methods:

Section 2.3 of ASCE 7-2010:

- **Load and Resistance Factor Design (LRFD)** compares required strength to actual strengths. LRFD provides the actual response of the system, including deflections and loads on supports and structure, when the actual wind or seismic load is applied.

Section 2.4 of ASCE 7-2010:

- **Allowable Stress Design (ASD)** compares actual and allowable stresses. ASD uses load reduction factors (0.7 for seismic events and 0.6 for wind events) when calculating stresses.

CAESAR II uses ASD to evaluate a piping system under wind and seismic loads. To comply with ASCE 7 requirements, you must include the load reduction factors in your load cases for stress compliance.

The following table provides example load combinations showing the use of ASCE 7 load reduction factors (in bold).

Load Case	Definition	Name	Stress Type
L1	W+T1+P1+**0.7U1**	Operating case with seismic load (using the reduction factor) for computing stresses	OPE
L2	W+T1+P1+U1	Operating case with seismic load for computing loads on supports and deflections	OPE
L3	W+T1+P1+**0.6WIN1**	Operating case with wind load (using the reduction factor) for computing stresses	OPE
L4	W+T1+P1+WIN1	Operating case with wind load for computing loads on supports and deflections	OPE
L5	W+T1+P1	Operating case	OPE
L6	W+P1	Sustained case	SUS
L7	L1-L5	Preparatory case for stress evaluation due to seismic load	OCC
L8	L3-L5	Preparatory case for stress evaluation due to wind load	OCC
L9	L6+L7	Seismic sustained + occasional	SUS+OCC
L10	L6+L8	Wind sustained + occasional	SUS+OCC

For reactions and deflections, we are using allowable stress design loads, not strength design loads

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L3	W+T1+P1+**0.6WIN1**	Operating case with wind load (using the reduction factor) for computing stresses	OPE
L4	W+T1+P1+WIN1	Operating case with wind load for computing loads on supports and deflections	OPE
L5	W+T1+P1	Operating case	OPE
L6	W+P1	Sustained case	SUS
L7	L1-L5	Preparatory case for stress evaluation due to seismic load	OCC
L8	L3-L5	Preparatory case for stress evaluation due to wind load	OCC
L9	L6+L7	Seismic sustained + occasional	SUS+OCC
L10	L6+L8	Wind sustained + occasional	SUS+OCC

For reactions and deflections, we are using allowable stress design loads, not strength design loads. The WIN1 for L4 is used for LRFD steel

LRFD = Load and Resistance Factor Design