Loads and Load Combinations
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Loads specified in the codes are "nominal" (normal or service level loads) except seismic which is an ultimate load. The code tells you what loads should be included in the design of the structure.

DL = Dead load
E = Seismic or earthquake load
F = Load due to fluids, such as an elevated water tank
Fa = Flood load
H = Load due to lateral earth pressure
LL = Live load
Lr = Roof live load
S = Snow load
R = Rain load
WL = Wind load

Load combinations tell you how to combine the loads to determine the worst case loading for a member. No matter what material or method of design you must use load combinations. If you are design using strength design or load and resistance factor design you use the "ultimate" load combinations. If you are using allowable stress design you use the basic combinations for "service" loads.

Notes for both sets of load combinations. The combinations are based on probability. The probability of having 100% of the floor live load occurring at the same time as 100% of the roof live load or snow load or rain load is very small and therefore you do not include 100% of both floor and roof load in any combinations. Same with floor live loads and wind or seismic loads.

The combinations are all additive; there are no combinations with negative signs in them. It is up to YOU to use proper algebraic notation with the LOADS so that the load combinations come out correctly.

In English: WL and E may be left to right or right to left upward or downward acting. If you assign a downward acting dead load a positive sign then the combinations starting with 0.6DL or 0.9DL should use a negative sign for upward acting WL or E to determine the maximum net uplift force.

Strength Design Load Combinations

IBC section 1605.2.1 and ASCE 7 section 2.3 provide load combinations for use with strength design and resistance factor design (their wording). Steel uses the term LRFD (load resistance factored design) and concrete uses USD (ultimate strength design) for “strength design”. The service loads are multiplied by load factors to determine ultimate loads. These are then compared to the ultimate strength of the material being used for the member. The basic combinations are:

1.4DL
1.2DL + 1.6LL or 1.2DL + 1.6LL + 0.5(Lr or S or R)
1.2DL + 1.6(Lr or S or R) + (f1LL or 0.8WL)
1.2DL + 1.6WL + f1LL + 0.5(Lr or S or R)
1.2DL + 1.0E +f1L + f2S
0.9DL + 1.6WL
0.9DL + 1.0E
Allowable Stress Design Load Combinations

IBC section 1605.3.1 and ASCE 7 section 2.4 provide load combinations for use with allowable stress design (ASD). You cannot use ASD for design of concrete members. The loads are divided by the member properties (usually area or section modulus) to determine the actual stress in the member. The result is compared to the allowable stress for the member.

Seismic loads are ultimate. So in the strength load combinations the factor for seismic is 1.0. For ASD seismic is multiplied by 0.70 to "reduce" it to a service level load.

The load combinations of 1605.3.1 and 2.4 are used for checking deflections for all loads except for seismic loads. See the seismic section for discussion of deflection due to seismic loads.

DL
DL + LL
DL + (Lr or S or R)
DL + 0.75LL + 0.75(Lr or S or R)
DL + WL OR 0.70E
DL + 0.75(WL OR 0.70E) + 0.75LL + 0.75(Lr or S or R)
0.6DL + WL
0.6DL + 0.7E

Stress increase

A 33.33% increase in allowable stress for ASD design is no longer allowed under the IBC (This statement is not entirely true because of a set of alternate load combinations in the code).

The current code combination 1.0DL + 0.75WL + 0.75LL (and similar combinations) replaces the increase in allowable stress. The idea is that it the probability of having 100% of the live and wind load occur at the same time is extremely small so the code allows the design to allows design for a portion of the live load when there is wind (wind, seismic or rain).