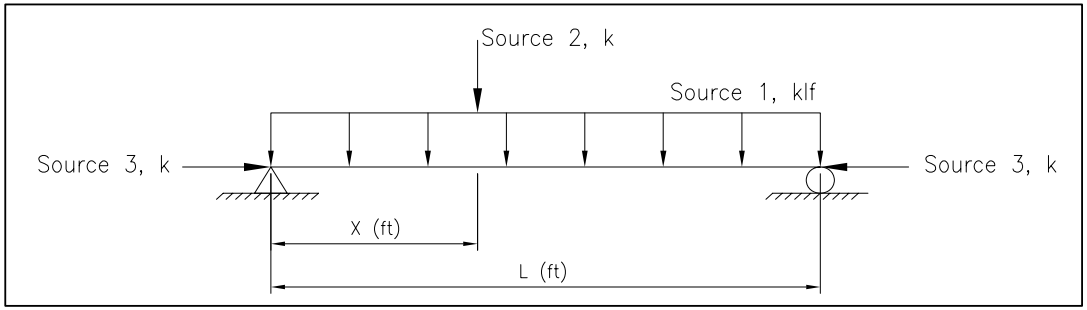
Load Combination Example #1

Given: A simply supported floor beam from the following sources:
- (Source 1) floor loads (acting as a uniform load over the entire span):
- (Source 2) a column located X distance from one end. (acts as a point load):
- (Source 3) a part of the lateral force resisting system (acts as an axial load):



Service Level Load Magnitudes by Source

	D	L	Lr	S	W	E	
Source 1	1.150	1.850	---	---	---	---	klf
Source 2	8.000	---	4.800	20.000	---	---	k
Source 3	---	---	---	---	15.000	25.000	k

Wanted: Determine the loading diagram for the beam for each of the following load combinations.

LRFD	ASD
Equation LRFD-2	Equation ASD-2
Equation LRFD-4	Equation ASD-5
Equation LRFD-5	

Note, that on a given project, you will use EITHER LRFD OR ASD… not both!
Also the beam has to be strong enough to support ALL load combinations, not just the few we show here!

Solution:

LRFD-LC2 See the SCM for equation.

Note that there are three permeatations for this equation… this means there are three different load combinations to be considered

LRFD-LC2a

	D+F+T	L+H	Lr	Comb. Value	
Ld Factor	1.2	1.6	0.5		
Source 1	1.150	1.850	0.000	4.340	klf
Source 2	8.000	0.000	4.800	12.000	k
Source 3	0.000	0.000	0.000	0.000	k

LRFD-LC2b

	D+F+T	L+H	S	Comb. Value	
Ld Factor	1.2	1.6	0.5		
Source 1	1.150	1.850	0.000	4.340	klf
Source 2	8.000	0.000	20.000	19.600	k
Source 3	0.000	0.000	0.000	0.000	k

LRFD-LC2c

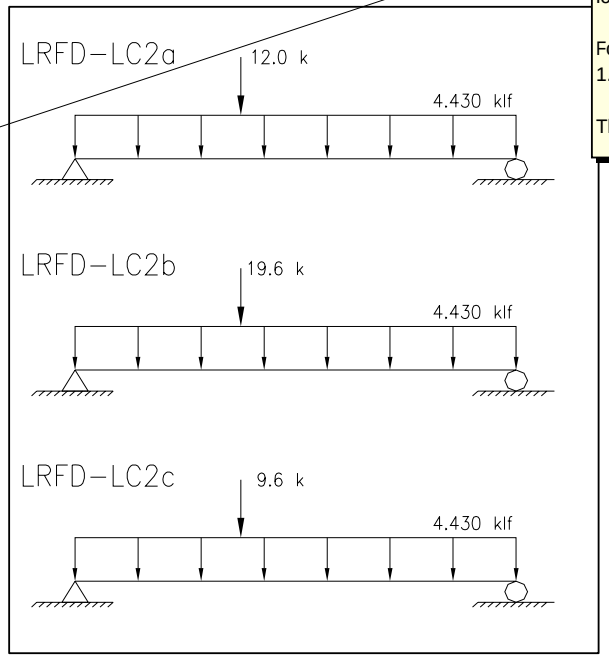
	D+F+T	L+H	R	Comb. Value	
Ld Factor	1.2	1.6	0.5		
Source 1	1.150	1.850	0.000	4.340	klf
Source 2	8.000	0.000	0.000	9.600	k
Source 3	0.000	0.000	0.000	0.000	k

The values for this part of the table come from the given data for various load sources.

The combined values are the result of multiplying the data on each row by the load factors at the top of the table.

For example, this value = 1.2*8.00+1.6*0.00+0.5*4.80

The other values are similarly computed.



In this case, it is probably obvious that LRFD-LC2b will be the controlling of this set of load combinations. There is no need to analyze for internal forces for LRFD-LC2a nor LRFD LC2c since they don't control. Also note that neither W nor E enters into this combination.

LRFD-LC4 See the SCM for equation.

Note that there are six (W and E are either + or -) permeatations for this equation… this means there are six different load combinations to be considered, however, since R = 0 for all sources we'll go ahead and ignore those two permeations.

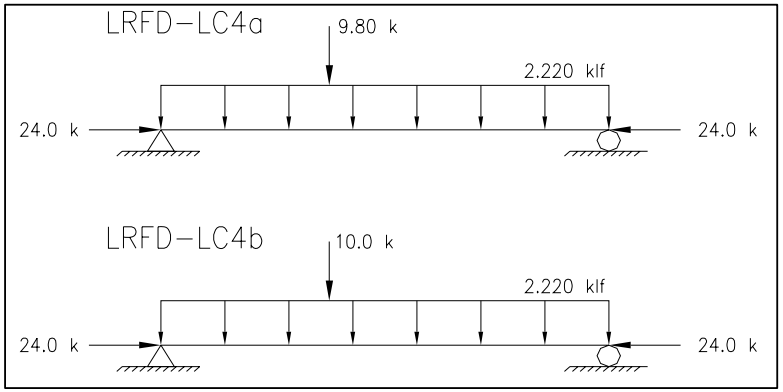
We will also only compute the compressive cases, since the tension cases just reverse the arrows!

LRFD-LC4a

	D	W	L	Lr	Comb. Value	
Ld Factor	1.2	1.6	1	0.5		
Source 1	1.850	0.000	0.000	0.000	2.220	klf
Source 2	0.000	0.000	0.000	19.600	9.800	k
Source 3	0.000	15.000	0.000	0.000	24.000	k

LRFD-LC4b

	D	W	L	S	Comb. Value	
Ld Factor	1.2	1.6	1	0.5		
Source 1	1.850	0.000	0.000	0.000	2.220	klf
Source 2	0.000	0.000	0.000	20.000	10.000	k
Source 3	0.000	15.000	0.000	0.000	24.000	k



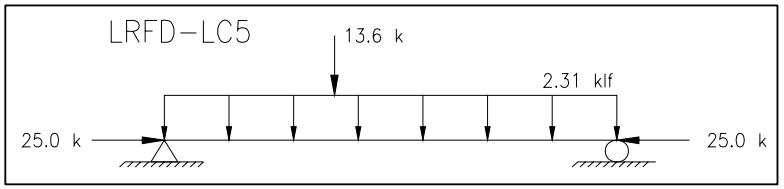
In this case, it is probably obvious that LRFD-LC4b will be the controlling of this set of load combinations.
There is no need to analyze for internal forces for LRFD-LC4a it doesn't control.
Note that source 3 now enters the picture because this combination has a "W" component to it.

LRFD-LC5 See the SCM for equation.

Note that there is only one permeatation for this equation.

LRFD-LC5

	D	E	L	S	Comb. Value	
Ld Factor	1.2	1	0.5	0.2		
Source 1	1.150	0.000	1.850	0.000	2.305	klf
Source 2	8.000	0.000	0.000	20.000	13.600	k
Source 3	0.000	25.000	0.000	0.000	25.000	k



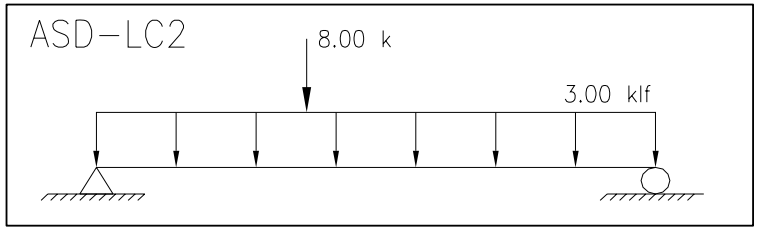
Reviewing the three equations applied so far, it seems obvious that LRFD-LC4 will not control the design since LRFD-LC5 has larger values for all sources. However it is NOT obvious that LRFD-LC2 will control over LRFD-LC5 and vice versa. Consquently we will need to check our final design against both load combinations

Let's do this again, but with ASD combinations, recalling that LRFD and ASD are not directly comparable! (LRFD is at ultimate levels and ASD is at service levels)

ASD-LC2 See the SCM for equation.
Note that there is only one permeatation for this equation.

ASD-LC2

	D	L	Comb. Value	
Ld Factor	1	1		
Source 1	1.150	1.850	3.000	klf
Source 2	8.000	0.000	8.000	k
Source 3	0.000	0.000	0.000	k



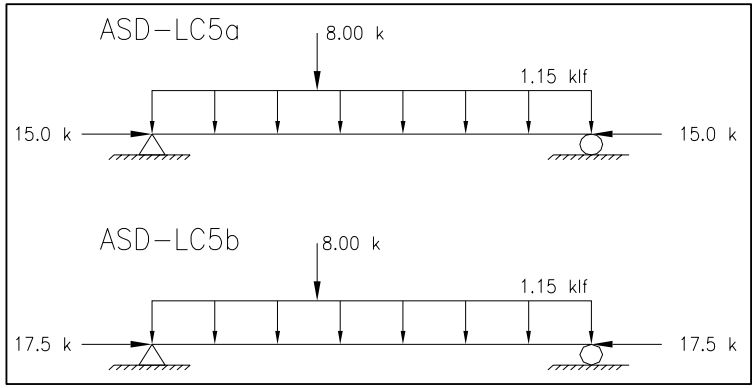
ASD-LC5 See the SCM for equation.
Note that there are two permeatations for this equation.

ASD-LC5a

	D	W	Comb. Value	
Ld Factor	1	1		
Source 1	1.150	0.000	1.150	klf
Source 2	8.000	0.000	8.000	k
Source 3	0.000	15.000	15.000	k

ASD-LC5c

	D	E	Comb. Value	
Ld Factor	1	0.7		
Source 1	1.150	0.000	1.150	klf
Source 2	8.000	0.000	8.000	k
Source 3	0.000	25.000	17.500	k



Summary

This example demonstrates the application of the ASCE 7 load combinations. Each load combination represents the application of a SINGLE permeatation of a load combination equation.

Even though we did not do a thorough job of examining all the possible load combinations, this example will help you to understand how to apply the various equations.