

Wind and earthquakes imposed lateral loads on a structure that must be resisted, and drag loads are derivatives of such lateral loads.

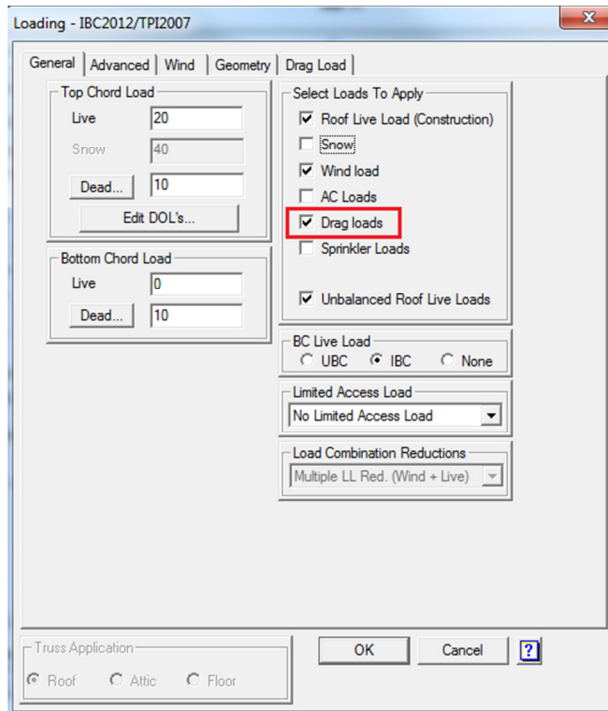
While the application of wind and earthquake loads is very different when it comes to truss designs, they both are designed as if they are horizontally applied to the structure when considering the overall resisting system. Wind loads develop the pressure on the wall and roof elements. The magnitude of this pressure is proportional to the square of wind speed. Earthquake loads create ground movements and the structure in an earthquake zone must be able to withstand shake, rattle and roll caused by these movements. Both wind and earthquakes create powerful torsional forces within the structure what can shear a building apart. Wall, floor and roof systems must be designed to resist these lateral forces in addition to supporting vertical loads. In accordance with ASCE 7, a Drag Strut is a structural element (could be a truss) installed parallel to an applied load that collects and transfers diaphragm shear forces to the vertical-force-resisting element or distributes forces within the diaphragm or shear wall. Properly designed drag strut trusses, shear walls and roof diaphragms and their connections will transfer lateral loads to the foundation and then safely into the ground.

Using MiTek Engineering software, the process of designing a drag strut truss is easy. The truss technician or the truss designer is not responsible for calculating drag loads in the structure. Location, magnitude and direction of these loads must be provided by the building designer (generally required to be a registered professional / structural engineer) as total load in pounds (lbs.) or as uniform load in pound per lineal foot (plf). Once loading information is provided, MiTek Engineering has the ability to handle drag loading using the appropriate input information in the loading dialog box.

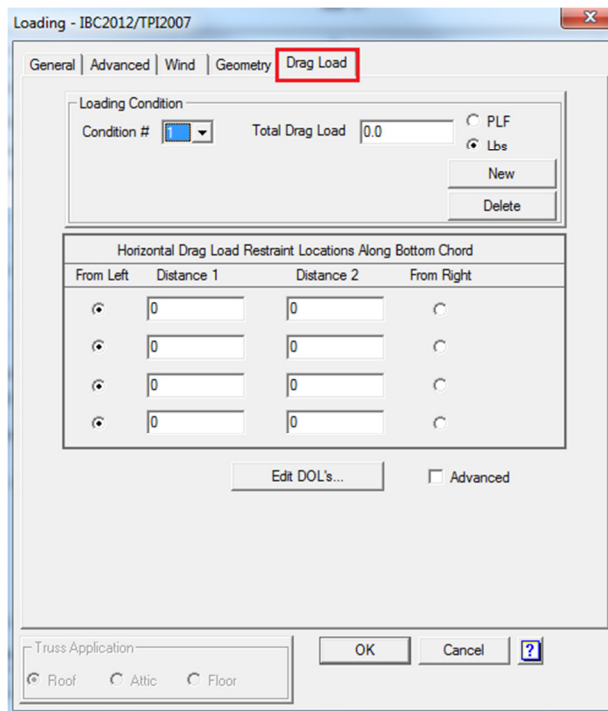
Let's run an example to see how the tool functions.

Let's assume the Framing Plan indicates $DF = 5.0K$ (DF is the abbreviation for drag force and K is short for Kip which is 1,000 pounds). First, the Truss Manufacturer must locate a truss at the location of the DF designation in line with the direction of the DF. This should be specified by the building designer on the plans. Second, the Truss Manufacturer needs to design this Drag truss to be able to collect the lateral load from the top chord, where this load is applied, and transfer it to a full or partial shear wall below. The shear wall is usually in-line with the truss, either vertically (the bottom chord of the truss bears directly on the shear wall) or horizontally (the truss spans an opening between two linear walls with blocking to transfer the load). For this example we will transfer the lateral loads vertically to a shear wall below. Let's assume the shear wall plan specifies locations of the shear walls as follow: a 5' long shear wall in line with the drag strut truss at the left end and a 7' long shear wall in line with the drag strut truss on the right end of the drag strut truss. Since the framing plan does not specify whether the drag load is due to lateral loads generated by the wind or seismic forces, the conservative approach is to apply drag load in all load cases.

Step 1 - Open the Loading Dialog Window and check on Drag loads.



Step 2 - click on the Drag Load tab at the top of the Loading Dialog Window.



Next, specify a **Total Drag Load** of 5000 lbs and the **Horizontal Drag Load Restraint Locations Along Bottom Chord**.

First Horizontal Drag Load Restraint:

Distance 1 – starting point for the drag load restraint location along bottom chord. Since the 5’ wall starts at the left end, select **From Left**, input 0.0 for the **Distance 1**.

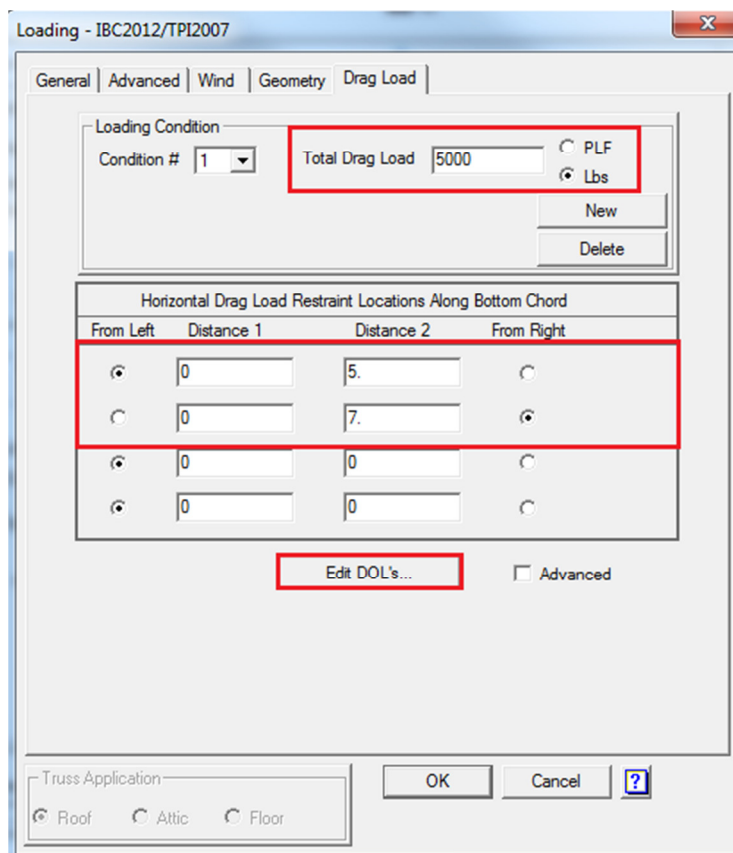
Distance 2 – ending point for the drag load restraint location along bottom chord. Since the first wall is 5 ft. long, input 5.0 for the **Distance 2**.

Second Horizontal Drag Load Restraint:

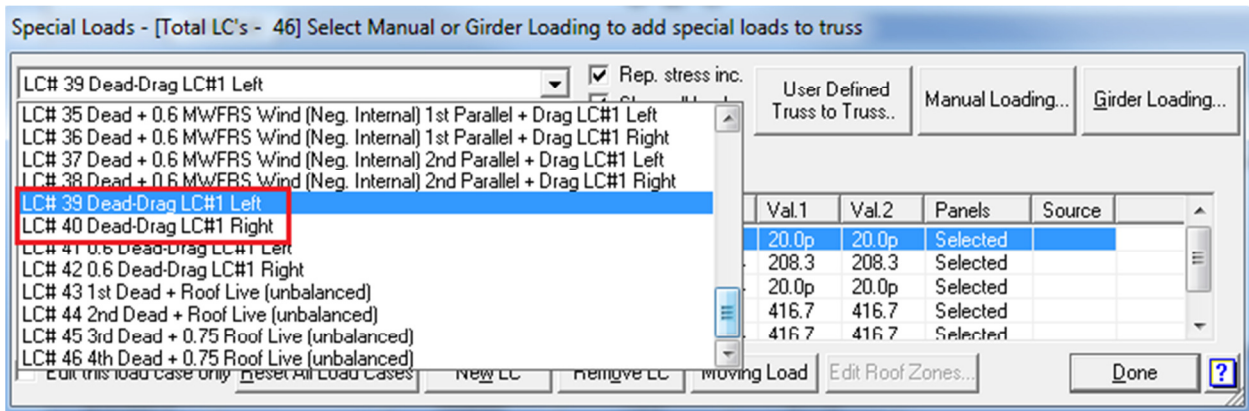
Distance 1 – Since the 7’ wall starts at the right end, select **From Right**, and input 0.0 for the **Distance 1**.

Distance 2 – Since the first wall is 7 ft. long, input 7.0 for the **Distance 2**.

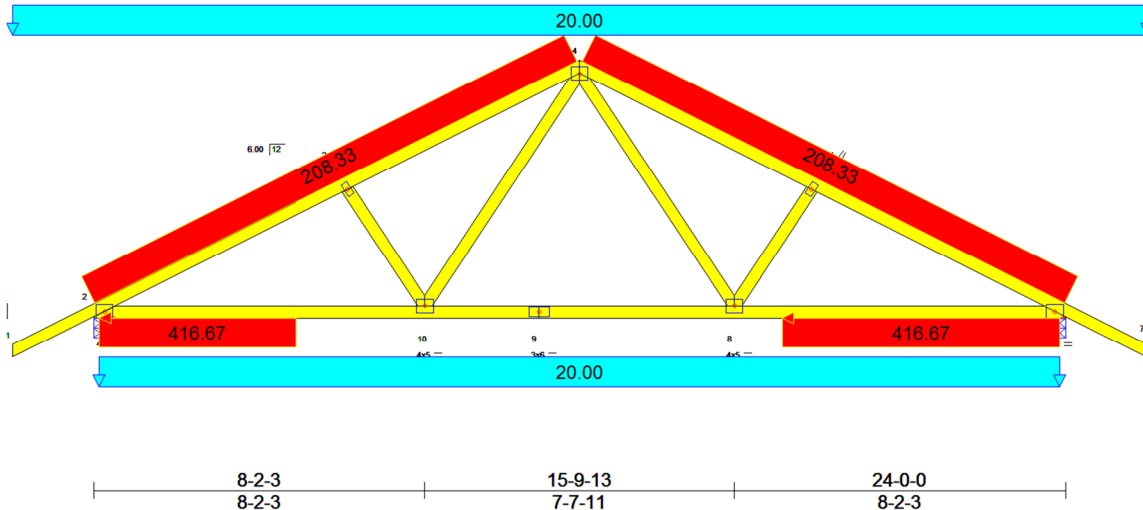
Edit DOL’s button default for Dry lumber and Plate grip sets to 1.33. You can change the duration of load to 1.60 but be aware some building jurisdictions may require 1.33.



Selecting **OK** will exit the Loading Dialog Window. The Drag Load cases will automatically be created, applying the specified drag load in load case(s) required by code. Existing load cases will be duplicated twice, once with a drag load to the left and once with drag load to the right.



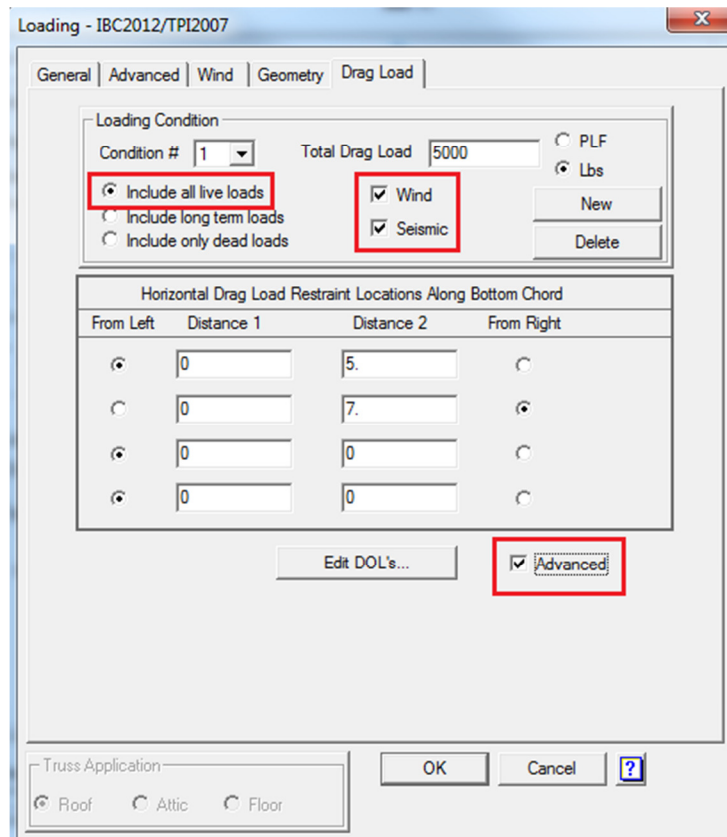
Below is the picture of the Dead-Drag Load Case #1 Left. As you can see, Drag Load is applied as a plf across the entire top chord (5000 lbs over 24' = 208.33 plf) and is resisted by an opposite force over the user specified locations on the bottom chord (5' + 7' = 12' – total length of locations specified on plan; 5000 lbs over 12' = 416.67 plf).



After the truss is analyzed a note can be found in the note section of the Engineering Drawing stating “This truss has been designed for a total drag load of 5000 lb. Lumber $DOL=(1.33)$ Plate grip $DOL=(1.33)$. Connect truss to resist drag loads along bottom chord from 0-0-0 to 5-0-0, 17-0-0 to 24-0-0 for 416.7 plf”. Uplift/overturning reactions can be found in the reaction section of the Engineering Drawing.

You can also take advantage of using the **Advanced** option on the Drag Load Dialog Window. Let's review a few combinations from the **Advanced** option that can help you make the design of a drag strut truss more accurate.

The Advanced Drag Load Dialog Window defaults to “Wind” + “Seismic” and “Include all live loads”. This is the equivalent of the original Drag Load Dialog Window that was described in the example above.



Loading - IBC2012/TPI2007

General | **Advanced** | Wind | Geometry | Drag Load

Loading Condition

Condition # 1 Total Drag Load 5000 PLF Lbs

Include all live loads Wind Seismic

Include long term loads

Include only dead loads

Horizontal Drag Load Restraint Locations Along Bottom Chord

From Left	Distance 1	Distance 2	From Right
<input checked="" type="radio"/>	0	5.	<input type="radio"/>
<input type="radio"/>	0	7.	<input checked="" type="radio"/>
<input checked="" type="radio"/>	0	0	<input type="radio"/>
<input checked="" type="radio"/>	0	0	<input type="radio"/>

Advanced

Truss Application

Roof Attic Floor

In most common roof truss designs, drag loads are mostly from the wind forces. If drag loads are due to wind, the most critical load cases to apply these loads are wind load cases.

When “Wind” and “Include all live loads” are checked, drag load will automatically be applied in each wind load cases. Existing load cases will be duplicated twice, once with a drag load direction to the left and once with drag load direction to the right.

Selecting “Wind” and “Include only dead loads” will apply drag load in all load cases that do not contain live loads. The dead loads that resist the uplift from the wind are restricted to being 0.6 times the dead loads used in general load tab, except on some Ag trusses.

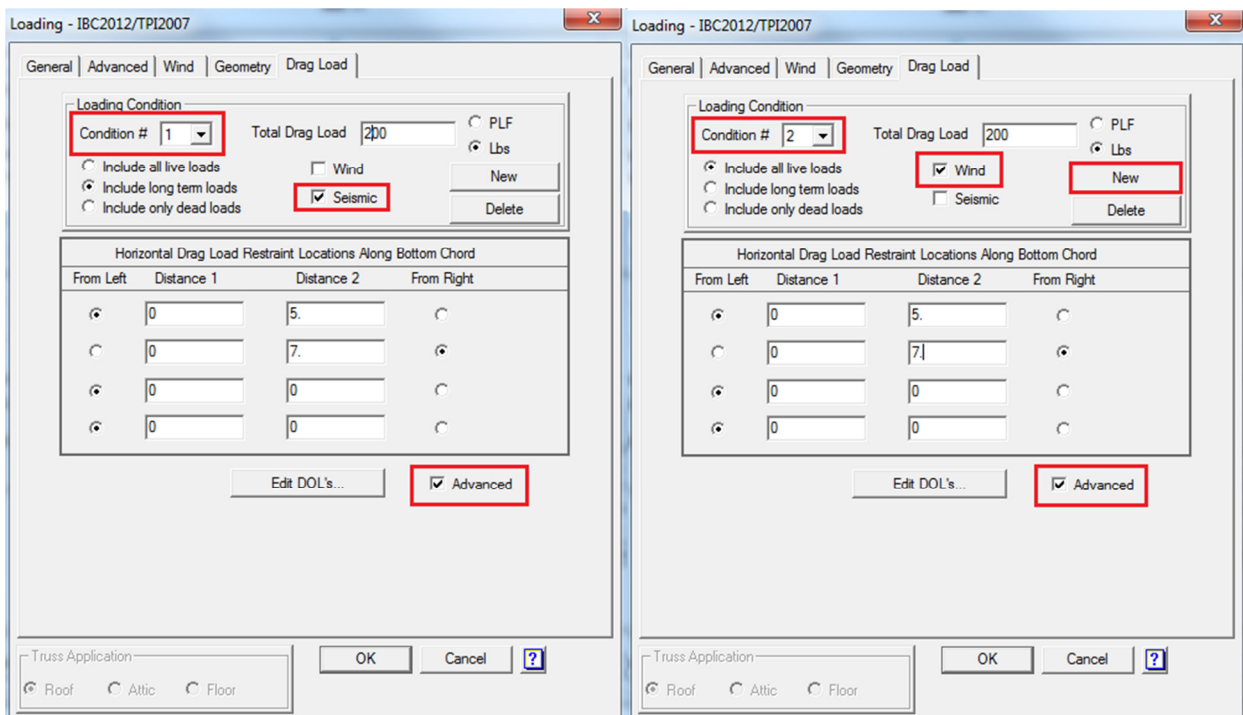
“Seismic” in the **Advanced** option is used in regions where seismic activity is the critical drag load factor. If drag load is due to seismic forces, the most critical load cases to apply this load are non-wind load cases. There will be no drag load applied to wind load cases.

According to section 1605.3.1 of the International Building Code - “Flat roof snow loads 30 psf or less need not be combined with seismic loads”. That is why, if you are in non-snow area, you do not need to have live load in drag load cases, unless otherwise specified by the building designer.

When you select “Seismic” and “Include long term loads”, the program will automatically remove short term live loads and will leave floor loading, storage loading and dead loads in the basic non-wind load cases to which drag loads are added.

If you are in an area where the flat roof snow exceeds 30 psf, select “Seismic” and “Include all live loads”. The Drag Load cases will be created automatically and applies specified drag load in each non-wind load case. Existing load cases will be duplicated twice, once with a drag load direction to the left and once with drag load direction to the right.

The **Advanced** option will cover most of requirements building designer may have with drag loads. Selecting “Wind” will create drag load cases for wind load cases only. Selecting “Seismic” will create drag load cases for non-wind load cases only. If you select “Include long term loads”, the program will remove short term live loads from the load cases but leave floor, storage and dead loads in load cases to which drag loads are added. Selecting “Include only dead loads” will remove the base load cases of all but dead loads. These items are specified for each loading condition. So it is possible to have seismic only drag and wind only drag loading conditions for the same truss.





DRAG LOADS TOOL IN MITEK ENGINEERING

The program will not print drag load cases, unless otherwise specified. It will only print the note(s) in the note section of the Engineering Drawing, similar to the one that was shown in example above. The Note will state whether truss was designed for wind or seismic drag load and what load combination was chosen.

It is the responsibility of the truss technician or the truss designer to review and understand the building designer's drag loads details and incorporate these requirements into the design of the roof truss system.

For additional information, or if you have questions on this feature, please contact MiTek Engineering