Understanding the Wind Input

As you have come to expect the, MiTek engineering software is a very powerful tool. One more example of this is the wide range of options you have available when considering wind loads and wind load cases. Magnitudes of wind loads and their application on a structure are called out in the design standard ASCE-7, Minimum Design Loads for Building and Other Structures, of which the most current edition is 2010. It should be noted that this 2010 edition is the first edition of ASCE-7 where the wind speed maps are based on the occupancy category and which provides a “strength design” or “ultimate” wind speed. These “strength design” wind speeds are higher than “allowable stress” wind speeds that you have used in the past, but do not fear, the resulting loads and reactions (uplifts) will be very similar to what you are used to.

It cannot be emphasized enough that the building designer is responsible to provide you all the criteria you need to design a truss component that will go into the final structure. Wind loading is the most complicated of the live loads considered in a truss component design and requires the most input in order to get the best results.

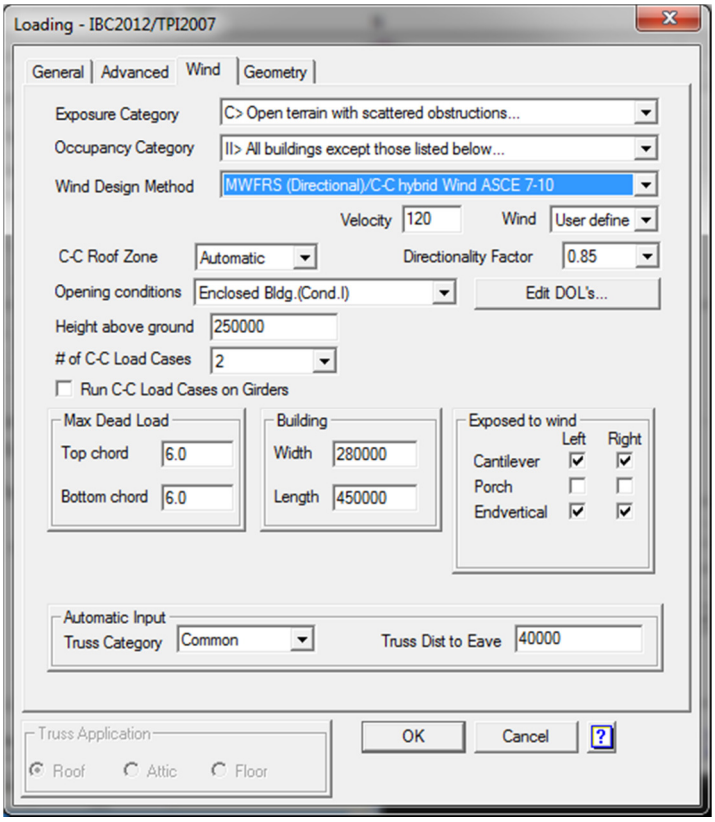

Figure 1 – General Wind Load Tab

The following is a brief discussion of the input options needed/required for wind loads. This first group is required no matter which of the ASCE 7 procedures will be used and typically won’t change for the job you are designing.

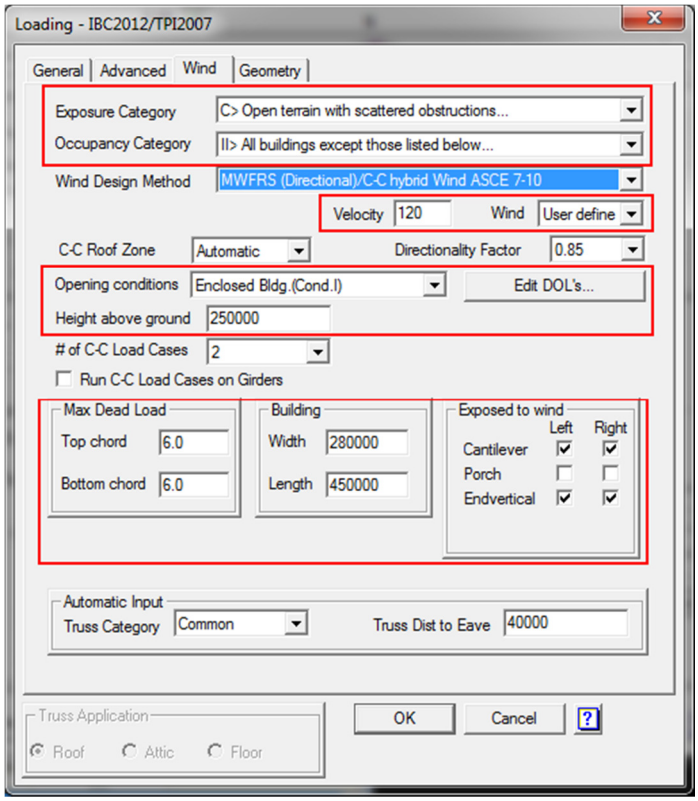

Figure 2 – Required input fields independent of the procedure used

- **Exposure Category –** This is the same as the "Terrain Exposure" under the Snow Load tab. A change here will also change the "Terrain Exposure" in the Snow tab and vice versa when in the Snow tab. This factor considers the obstacles (trees and other structures) according to the height and distance from the structure that could affect the wind loads on the truss component. There are three options.

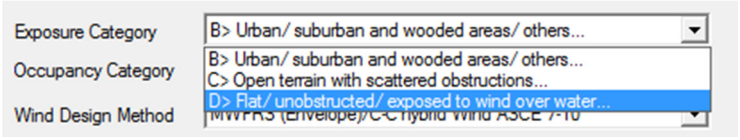

Figure 3 – Exposure Category Options

- **Occupancy Category -** This is the same as the "Occupancy Category" under the Snow Load tab. A change here will also change the "Occupancy Category" in the Snow tab and vice versa when in the Snow tab.

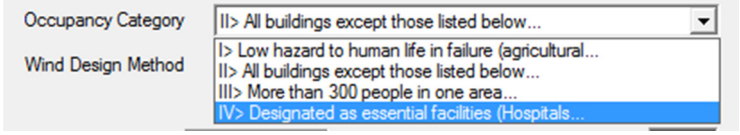

Figure 4 – Occupancy Category Options

- **Velocity –** When designing per ASCE 7-10, the wind speed you input must be "Strength - 3 second gust" wind speed. The 2012 IBC and ASCE 7-10 now have separate wind speed maps based on the Occupancy Category. For 2012 IRC projects, the IRC wind speed map is based on "allowable strength" wind speed, **but** the wind speed entered into MiTek Engineering must be the higher "strength" wind speed that is found in the references noted above. You will see two wind speeds noted in the "wind note" on a design, the first reference is the ultimate velocity or strength wind speed (used in IBC-12) and the second one is the allowable stress design velocity wind speed (used in IRC-12).

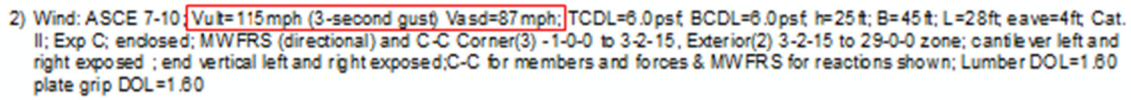
2) Wind: ASCE 7-10; Vult=115mph (3-second gust) Vasd=87mph; TCDL=6.0psf; BCDL=6.0psf; h=25ft; B=45ft; L=28ft; eave=4ft; Cat. II; Exp C; enclosed; MWFRS (directional) and C-C Corner(3) -1-0-0 to 3-2-15, Exterior(2) 3-2-15 to 29-0-0 zone; cantilever left and right exposed ; end vertical left and right exposed;C-C for members and forces & MWFRS for reactions shown; Lumber DOL=1.60 plate grip DOL=1.60

Figure 5 – Wind Loading Note on Design

- **Wind – T**his should always be set to "User Defined".
- **Opening conditions –** For all the procedures, the options available are "Enclosed Bldg (Cond 1)"and "Partially Enclosed (Cond 2)". Under the CC and Directional procedures you will find "Open Bldg (Cond 3)". Enclosed buildings are the typical condition. A basic explanation of a Partially Enclosed Building is where one side of the building is open, similar to an airplane hangar. Open Buildings have no walls on any side; picnic pavilion is an example of an Open Building.
- **Edit DOL's –** Wind load cases are permitted to use duration of load factors of 1.6 for both lumber and plates per ASCE 7. Some jurisdictions may require the lower factor of 1.33.
- **Height above ground –** This is the dimension from the "average" grade height to the middle or the "average" height of the roof.
- **Max Dead Load –** For Occupancies Category 2, 3 and 4, the magnitude of dead load shall be reduced by a factor of 0.6. These two fields will default to a maximum of the dead loads input under the "General Loading" tab multiplied by 0.6. For Category 1 (i.e. AG) trusses, the actual dead loads are permitted to be used and can match those from the "General Loading" tab, if the dead load does not exceed 4 psf per chord.
- **Building –** The "Width" variable will default to the truss span and the "Length" variable is the dimension perpendicular to the truss span. The "Length" field will only be visible when it is required by the procedure to which you are designing.
- **Exposed to wind –** You can have the program apply loads for one or more of these conditions by checking the appropriate boxes to turn on the wind loads for these elements.

Now we will break down each of the "Wind Design Methods". The following are brief descriptions of the options that are available and the additional input required by each. Once a variable has been described or defined we will not include it in the next method even it is a required input.

- **Wind Design Method –** There are a number of options available for ASCE 7-10.

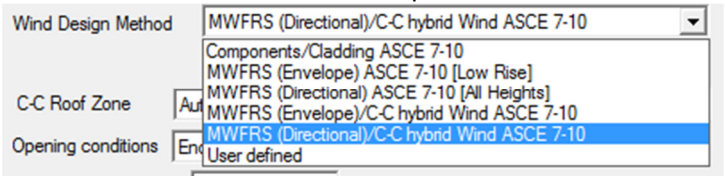

Figure 6- Wind Load Options

✓**Components/Cladding ASCE 7-10 –** Per the Commentary of ASCE 7-10 for Components and Cladding (CC), "Components receive wind loads directly or from cladding and transfer the load to MWFRS." This method is the most conservative of the ASCE methods, since the entire truss component will be checked with larger wind loads than any of the MWFRS approaches. The entire truss component and reactions will be based on the CC loading.

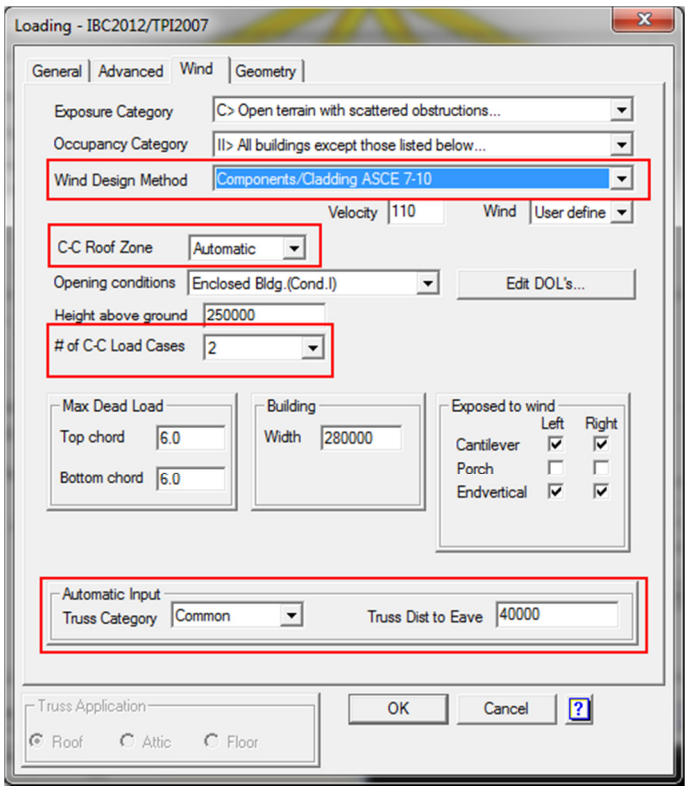

Figure 7 – CC Wind Variables

- **C-C Roof Zone –** The location of the truss component within the roof system will dictate the winds loads that need to be considered.

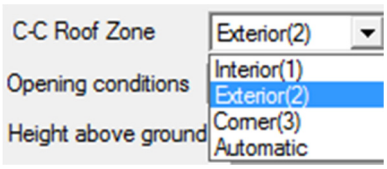

Figure 8 – CC Wind Zones

Examples: Corner Girders are probably either "Corner (3)" zone or "Exterior (2)" zone; smaller jack components are probably "Exterior (2)"; and longer jacks and common trusses can fall in both the "Exterior (2)" and "Interior (1)". The "Automatic" option requires the bottom fields to be input. From this information the program will make a determination as to the truss component location and load it accordingly.

- **# of C-C Load Cases –** Selecting "1" gives you a design that applies the wind load according to the defined wind zones per ASCE 7 across the entire truss. This load case will develop the most conservative design since the highest CC loads are applied to the entire truss all at the same time. Option "2" applies the load per the defined wind zones but only on one side of the ridge and to one end of the truss at a time, generating two conditions. Note that the program designs for two internal wind conditions for either of these options: wind acting toward the truss and wind acting away from the truss. Option "2" is required on trusses with parapets.
- **Automatic Input –** Truss Category consists of four options.

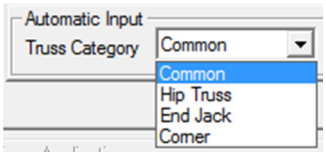

Figure 9 – Truss Categories

Based on the truss component type you are designing select accordingly.

- **Truss Dist. to Eave –** This dimension defines where the truss component is in relation to the closest end wall measured perpendicular to the truss.

✓ **MWFRS (Envelope) ASCE 7-10 (Low Rise) –** ASCE 7-10 changed the name of the "low-rise" procedure to "Envelope". This procedure has other stipulations and requirements that must be met before its use that we will not go into in this article. The Main Wind Force Resisting System (MWFRS) collects the wind load from the CC elements and transfers it to the ground. The "Envelope" procedure will typically have larger winds loads than the "Directional" procedure.

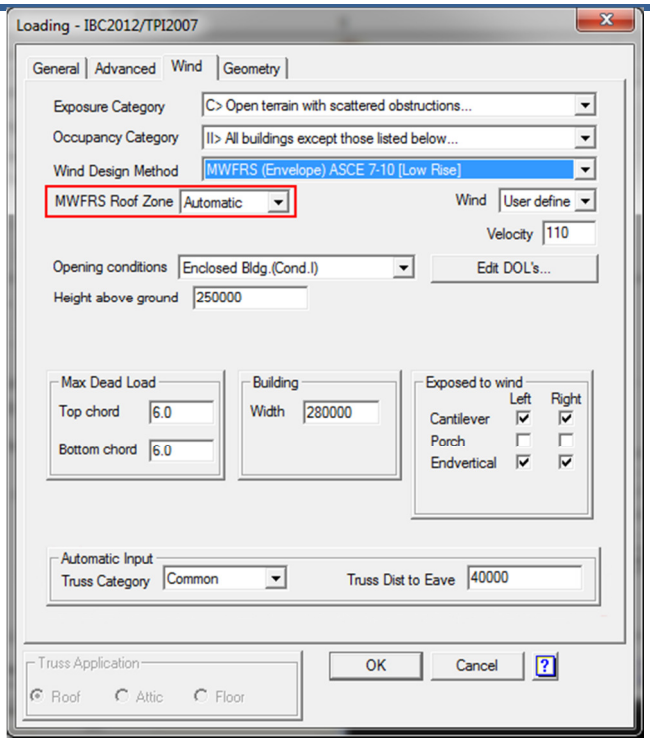

Figure 10 – Envelope or Low Rise Procedure variables

- **MWFRS Roof Zone –** There are three options: "Interior"; "Gable End"; and "Automatic".

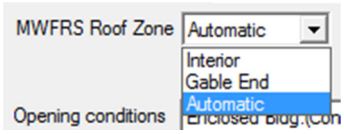

Figure 11 – MWFRS Roof Zones

If you know the specific zone within the roof system the truss component is to be placed, select that zone. Recognize that wind from all directions need to be considered. Otherwise, select "Automatic" and input the information in the lower section. Based on truss category and distance from eave the program will determine the wind loads.

✓**MWFRS (Directional) ASCE 7-10 (All Heights) -** ASCE 7-10 changed the name of the "All Heights" procedure to "Directional". This procedure has other stipulations and requirements that must be met before its use that we will not go into in this article. The Main Wind Force Resisting System (MWFRS) collects the wind load from the CC elements and transfers it to the ground. The "Directional" procedure typically has lower wind loads than the other ASCE 7-10 procedures.

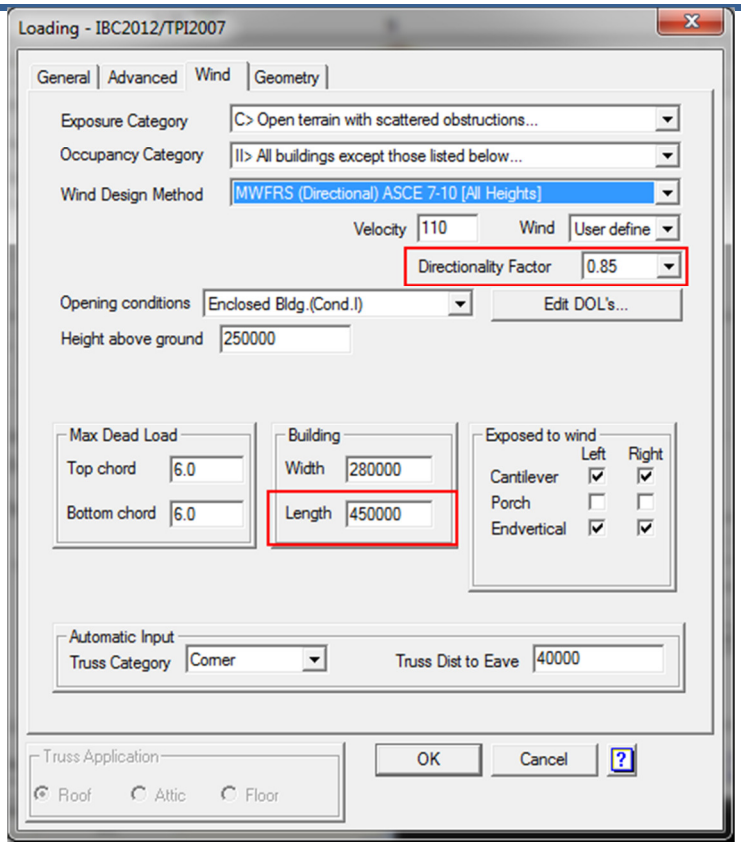

Figure 12 – Directional or All Heights variables

- **Directionality Factor-** MiTek recommends the use of a factor of 0.85. By selecting 1.0, the design will be conservative from the wind load standard viewpoint and the reactions will be conservative as well.
- **Length –** Typically this is the dimension of the building perpendicular to the span of the truss component.

✓**MWFRS (Envelope)/CC hybrid Wind ASCE 7-10-** This procedure will develop the load cases for both CC and MWFRS. Only the MWFRS/Envelope loads will be used for the uplift reactions, but the design will be based on both the MWFRS/Envelope loads and the CC loads.

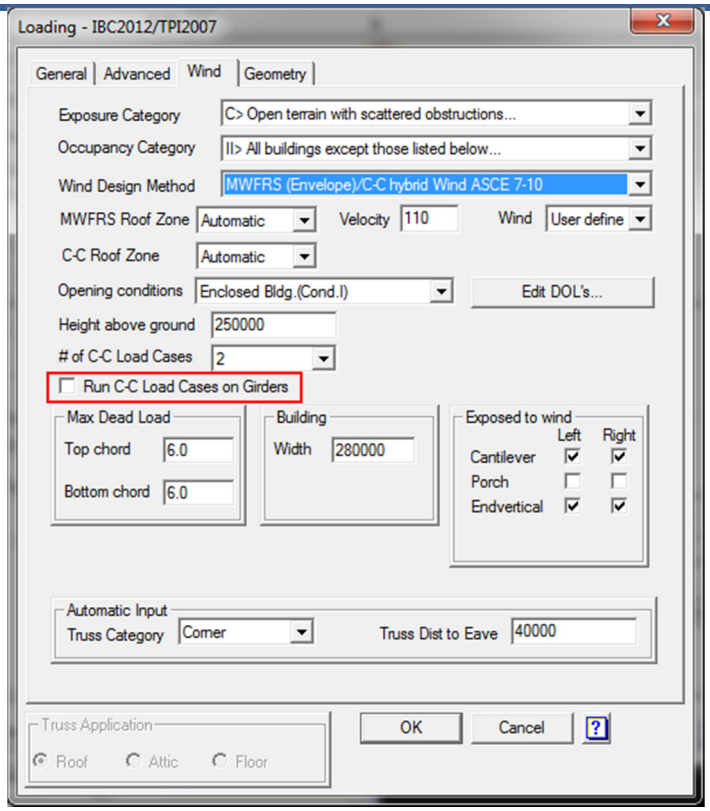

Figure 13 – Envelope or Low Rise/CC hybrid Wind ASCE 7-10

- **Run C-C Load Cases on Girders –** It is recommended that this option be used only when the building designer specifies it. The girder truss will have the CC wind load cases applied.

✓**MWFRS (Directional)/CC hybrid Wind ASCE 7-10-** This procedure will develop the load cases for both CC and MWFRS. Only the MWFRS/Directional loads will be used for the uplift reactions, but the design will be based on both the MWFRS/Directional loads and the CC loads.

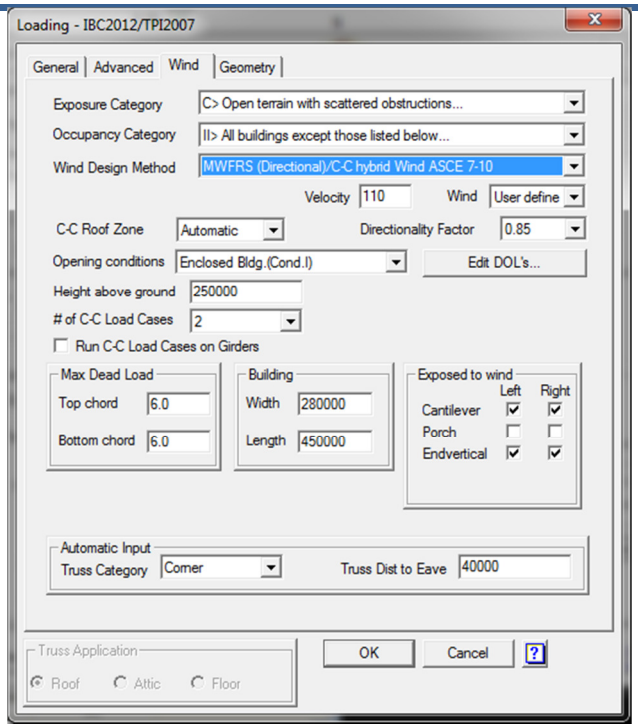

Figure 14 – Directional or All Heights/CC hybrid procedure

✓**User Defined-** This wind design method allows you to enter and design a truss component with a specific magnitude of load that the building designer specifies.

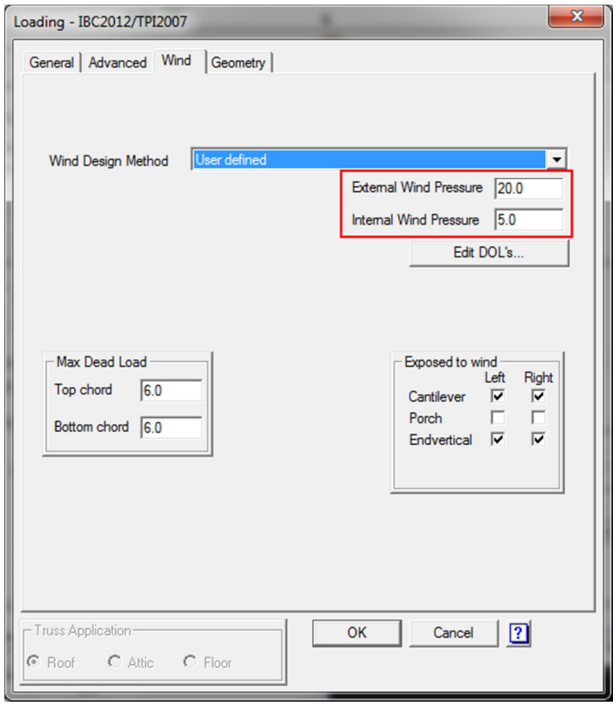

Figure 15 – User Defined procedure

- **External Wind Pressure –** If the building designer has specified a specific wind load to use, here is where you input that. The design will be checked with this load and no other load cases.
- **Internal Wind Pressure –** If the building designer has included an internal wind pressure, here is where that can be input.

Special Conditions to look for:

1. **Parapets –** When the project contains parapets, the wind procedure is required to be either CC or one of the Hybrid methods. The parapet members need to be checked with the 2 CC load cases as noted above.