User Interface

Create New Load Items dialog Response Spectra tab

Used to apply response spectrum loads on the structure.

This option can be accessed from the General > Load page also, as explained in Section 2.2.11 of this manual.

The dialog updates dynamically to reflect the Code selection.
Common Parameters for all Code options

Combination Method

The various methods available in STAAD for combining the contribution from the individual modes is listed under this heading. The details of these methods are explained in Section 5.32.10.1 of the STAAD Technical Reference manual.

- **SRSS** is the square root of summation of squares method.
• **ABS** is the absolute sum method. This method is very conservative and represents a worst case combination.

• **CQC** is the complete quadratic combination method. This method is recommended for closely spaced modes instead of SRSS.

• **ASCE** is the NRC Regulatory Guide Rev. 2 (2006) Gupta method for modal combinations and Rigid/Periodic parts of modes are used. The ASCE4-98 definitions are used where there is no conflict. ASCE4-98 Eq. 3.2-21 (modified Rosenblueth) is used for close mode interaction of the damped periodic portion of the modes. This method should only be used for a general response spectrum.

• **TEN** is the Ten Percent Method of combining closely spaced modes as per the NRC guideline 1.92 (1976).

• **CSM** is the closely spaced modes method. The peak response quantities for closely spaced modes (considered to be within 10 percent of each other) are combined by Absolute method. This peak response quantity for closely spaced modes is then combined with those of widely spaced modes by SRSS method.

**Save**

Select this option to generate a file (with .ACC extension) containing the joint accelerations in g’s and radians/sec²

**Period vs. Acceleration table**

Provide the values of period (seconds) and corresponding acceleration (current length units/sec²) or displacement (current length unit). Spectrum pairs should be provided in ascending value of period. As we provide the curve points, the program displays the curve at the bottom of the dialog box.

**Spectrum Type**

Choose whether the response spectrum curve will be input as Period vs. Acceleration or Period vs. Displacement (Custom and IS 1394 only).

**Interpolation Type**

From the spectrum data that are provided under the Define Spectrum Pairs tab of the dialog box shown above, STAAD fetches the spectral value for the actual modes of the structure using one of two interpolation methods – Linear and Logarithmic. Linear interpolation is the default method. Since Spectra versus Period curves are often linear only on Log-Log scales, the logarithmic interpolation is recommended in such cases; especially if only a few points are entered in the spectra curve.

**Damping Type**

- **Damping**: This is to be used for specifying a single modal damping ratio which will be applied to all modes. The default value is 0.05.

- **CDAMP**: Select this option to use Composite Modal Damping. This evaluates the damping from that defined in the material or constant definitions. A Damping ration is defined by selecting **Commands > Material Definition > Damping Ratios**. If there is no damping information entered in the material or constant definitions, the behavior is the same as MDAMP.

- **MDAMP**: Selection this option to use Modal Damping, which is used for
individual damping ratios for each mode. Individual mode damping ratios are defined by selecting Commands > Define Damping for Dynamics.

**Scale**

Linear scale factor by which the spectra data will be multiplied. Usually to factor g’s to length/sec² units. This input is the appropriate value of acceleration due to gravity in the current unit system.

You may choose to provide the spectral acceleration or displacement data as a set of un-normalized values or as a set of normalized values. For normalized values, the normalization factor is specified through the means of the Scale factor. For example, if the curve is input in terms of “g” - the acceleration due to gravity - and the current length unit is feet, the Scale would be 32.2. For un-normalized values, the scale factor is provided as 1.0, which also happens to be the default. The spectra data will be multiplied by the scale factor during the analysis. For more information, please refer to section 5.32.10.1 of the STAAD Technical Reference manual.

**Missing Mass**

Select this option to apply the Missing mass correction. The static effect of the masses not represented in the modes is included. For more information, please refer to section 5.32.10.1 of the STAAD Technical Reference manual. If this option is selected on any spectrum case it will be used for all spectrum cases.

**ZPA**

Zero Period Acceleration: It is used only with the missing mass option. If no value is entered or a zero value is entered, the default considered by the program is 33 Hz. If an acceleration is entered corresponding to the Missing mass mode, then the ZPA value is ignored. If no acceleration value is entered for the missing mass mode, then spectral acceleration corresponding to the ZPA frequency is used.

**Direction**

Specify the global direction(s) in which the spectrum is to be applied. The response spectrum may be applied in one or more directions simultaneously. Directions not provided will default to zero.

**Signed Response Spectrum Results Options**

Two method are available for added mathematical signs to the spectrum response output:

- **Dominant Mode No.** - Select this option and (optionally) specify a mode number to define as a dominant mode. The sign (sense) of this mode will be applied to other modes.

- **Signed** - Select this option to create signed values for all results by comparing the sum of the squares values for positive and negative values to determine the governing sign.

**Individual Modal Response Load Case Generation**

Select this option to have the program automatically generate primary load cases from the mode shape scaled to the magnitude that the mode has in this spectrum analysis case before it is combined with other modes. A load case is generated for each of first number of modes specified, starting with the specified load case number.

The Individual Modal Response case generation is not available for SNiP II code response spectra.

**Custom**
Generate Spectrum

Opens the Spectrum Parameters dialog, which is used to generate a response spectrum curve per the International Building Code.

This is the response spectrum type that is explained in section 5.32. 10.1 of the STAAD Technical Reference manual.

**IS 1893**

**Use Torsion (IS1893)**

Select this option to consider the torsional moment (in the horizontal plane) arising due to eccentricity between the centre of mass and centre of rigidity during analysis. If this option is used for any one spectrum case it will be used for all spectrum cases.

**Soil Type**

Check this box to get a pull down menu & choose the soil type for the site (hard, medium or soft). Depending on the type of soil & time period, average response acceleration coefficient Sa/g is calculated.

This is the response spectrum type that is explained in section 5.32.10.1.2 of the STAAD Technical Reference manual.

**EURO (EC8) -1994**

**Load Type**

Select either a Elastic or Design response spectrum for the loading type.

**Design Ground Acceleration**

Specify a design ground acceleration expressed in terms of acceleration due to gravity(g). For most of the application of Eurocode 8, the hazard is described in terms of a single parameter (i.e., the value of effective peak ground acceleration in rock or firm soil). This acceleration is termed as the design ground acceleration.

**Behaviour Factor**

Specify the value used to reduce the elastic response spectra to the design response spectra. The behavior factor is an approximation of the ratio of the seismic forces, that the structure would experience, if its response was completely elastic with 5% viscous damping, to the minimum seismic forces that may be used in design- with a conventional linear model still ensuring a satisfactory response of the structure.

**Subsoil Class**

Used to define the subsoil conditions based on which the response spectra will be generated. Based on the subsoil conditions the soil types may be of three kinds

- **Type A**: for Rock or stiff deposits of sand
- **Type B**: for deep deposits of medium dense sand, gravel or medium stiff clays.
- **Type C**: Loose cohesionless soil deposits or deposits with soft to medium stiff cohesive soil.
Please refer section 3.2 of Eurocode8 for detailed guidelines regarding the choice of soil type.

This is the response spectrum type that is explained in section 5.32.10.1.3 of the STAAD Technical Reference manual.

**EURO (EC8) - 2004**

**Load Type**

Select either a Elastic or Design response spectrum for the loading type.

Two types of response spectra curve can be generated based on either **RS1** (for response spectra type 1 curve) or **RS2** (for response spectra type 2 curve)

**Design Ground Acceleration**

Specify a design ground acceleration expressed in terms of acceleration due to gravity (g). For most of the application of Eurocode 8, the hazard is described in terms of a single parameter (i.e., the value of effective peak ground acceleration in rock or firm soil). This acceleration is termed as the design ground acceleration.

**Behaviour Factor**

Specify the value used to reduce the elastic response spectra to the design response spectra. The behavior factor is an approximation of the ratio of the seismic forces, that the structure would experience, if its response was completely elastic with 5% viscous damping, to the minimum seismic forces that may be used in design- with a conventional linear model still ensuring a satisfactory response of the structure.

**Subsoil Class**

Used to define the subsoil conditions based on which the response spectra will be generated. Based on the subsoil conditions the soil types may be of three kinds

- **Type A**: rock or other rock-like geographical formation.
- **Type B**: very dense sand, gravel or very stiff clay.
- **Type C**: Deep deposits of dense or medium dense sand, gravel or stiff clay.
- **Type D**: Deposits of loose-to-medium cohesionless soil or of predominantly soft to firm cohesive soil.
- **Type E**: Surface alluvium layer

Please refer section 3.2 of Eurocode8 for detailed guidelines regarding the choice of soil type.

This is the response spectrum type that is explained in section 5.32.10.1.4 of the STAAD Technical Reference manual.

**IBC 2006**

**Zip**

The zip code of the site location to determine the latitude and longitude and consequently the Ss and S1 factors.

**Latitude / Longitude**

The geographic coordinates of the site used to determine the Ss and S1 factors. This option may
be used if no value is entered for Zip.

**S1 / SS**

Mapped MCE for 0.2s spectral response acceleration and spectral acceleration for a 1-second period, respectively. These values may be entered if not geographic coordinate or postal code is provided.

**Long Period (TL)**

Long-Period transition period in seconds.

**Fa / Fv**

Optional Short-Period site coefficient at 0.2s and Long-Period site coefficient at 1.0s, respectively. Values must be provided if the selected **Site Class (SCL)** is F.

**Site Class (SCL)**

Select A through F for the Site Class as defined in the IBC code.

This is the response spectrum type that is explained in section 5.32.10.1.5 of the STAAD Technical Reference manual.

**SNiP II-7-81**

Only the SRSS and ABS combination methods are valid for the SNiP code.

**Zoning Factor**

Specify the zoning factor per SNiP II-7-81.

**Subsoil Class**

Defines the subsoil conditions on which the response spectrum will be generated.

1. Non-weathered rock and rocklike geological formation or permafrost subsoil.
2. Weathered rock or deep deposits of medium dense sand, gravel or medium stiff clays.
3. Loose cohesion less soil deposits or deposits with soft to medium stiff cohesive soil.

**Direction**

The SNiP code allows an alternate method of specifying directional factors. You may input individual parameters such as KWX, KX1 the product of which is used as the factor along that direction.

This is the response spectrum type that is explained in section 5.32.10.1.6 of the STAAD Technical Reference manual.