

Stade des Alpes - Grenoble
Etudes et Techniques Internationales (ETI)

Manual

3D Wind-Load Generator

Table of contents

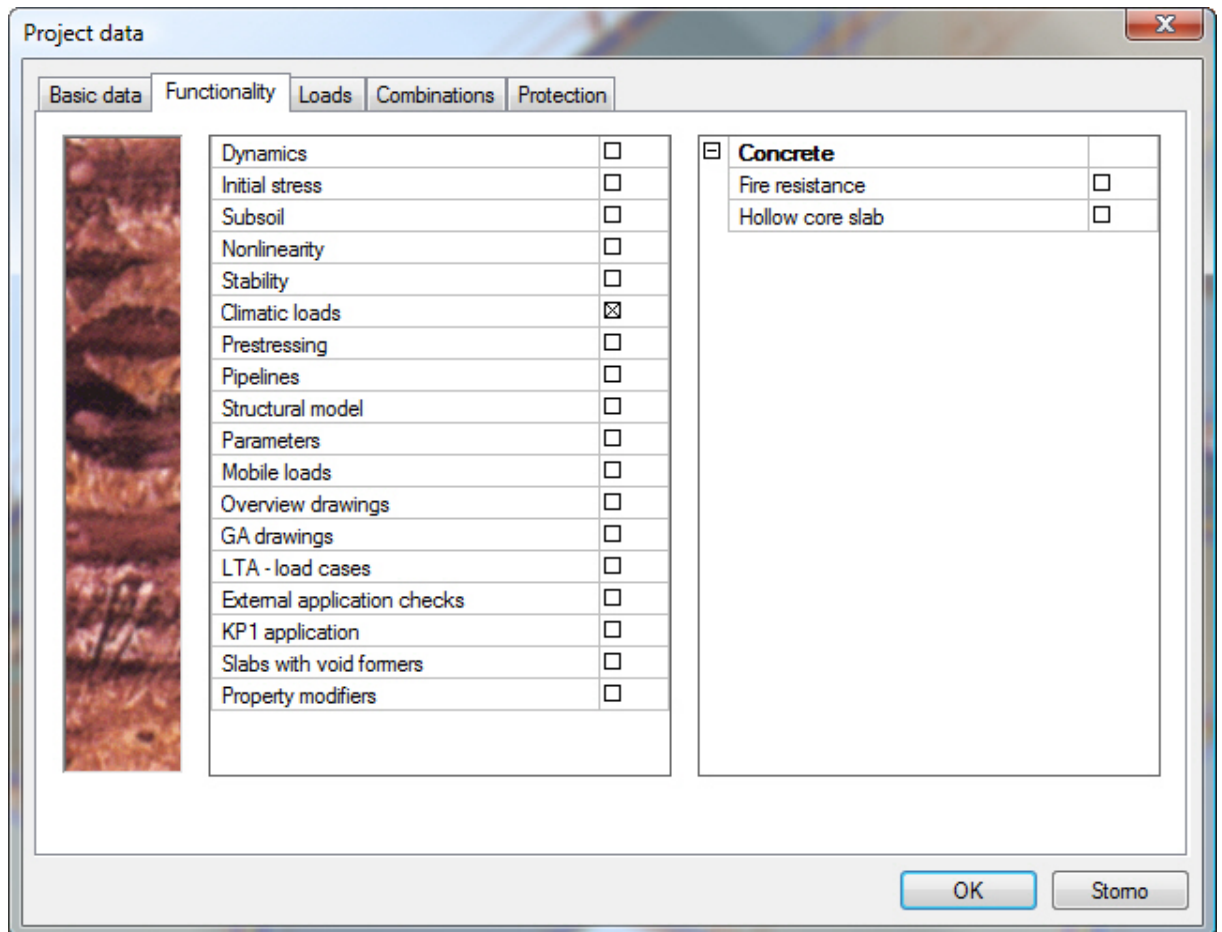
| | |
|--|-----------|
| Introduction | 3 |
| Project settings | 4 |
| Definition of the outer surface of the building | 6 |
| Generation and editing of zones | 7 |
| Zones..... | 7 |
| Zones editor..... | 8 |
| Load Case | 9 |
| Generation of load cases | 11 |
| Manual definition of a 3D wind load case..... | 12 |
| Generation of load..... | 14 |
| View flags..... | 15 |

Introduction

The 3D Wind-Load Generator is a complex tool for generation of wind load acting against buildings. The module is available for the following codes: EC-EN (Eurocode), BS (British Standard) and IBC (International Building Code).

Project settings

In the Project data dialogue, functionality **Climatic load** must be selected. In addition, the code for the wind loads must be selected.



The screenshot shows the 'Project data' dialog box with the 'Loads' tab selected. The 'Climatic loads' checkbox is checked. The 'Concrete' section is expanded, showing 'Fire resistance' and 'Hollow core slab' checkboxes.

| Category | Item | Selected |
|-------------------------|-----------------------------|-------------------------------------|
| Basic data | Dynamics | <input type="checkbox"/> |
| | Initial stress | <input type="checkbox"/> |
| | Subsoil | <input type="checkbox"/> |
| | Nonlinearity | <input type="checkbox"/> |
| | Stability | <input type="checkbox"/> |
| | Climatic loads | <input checked="" type="checkbox"/> |
| | Prestressing | <input type="checkbox"/> |
| | Pipelines | <input type="checkbox"/> |
| | Structural model | <input type="checkbox"/> |
| | Parameters | <input type="checkbox"/> |
| | Mobile loads | <input type="checkbox"/> |
| | Overview drawings | <input type="checkbox"/> |
| | GA drawings | <input type="checkbox"/> |
| | LTA - load cases | <input type="checkbox"/> |
| | External application checks | <input type="checkbox"/> |
| | KP1 application | <input type="checkbox"/> |
| Slabs with void formers | <input type="checkbox"/> | |
| Property modifiers | <input type="checkbox"/> | |
| Concrete | Fire resistance | <input type="checkbox"/> |
| | Hollow core slab | <input type="checkbox"/> |
| | | |

Buttons: OK, Stomo

Project data

Basic data Functionality **Loads** Combinations Protection

Acceleration of gravity 9,810 m/sec²

Location ...

Wind Region

Code ... EC 1 / 26.2m/s² / 0

Snow Region

Code ... EC 1 / Sk=0.00kN/m² Ce=1.00 Ct=1.00

OK Stomo

DATA for calculation

| Name | EC-EN1 |
|---|-------------|
| Wind | |
| Wind pressure according to EC1 | |
| basic wind velocity ... m/s [m/sec] | 26,200 |
| directional factor [-] | 1,00 |
| season factor [-] | 1,00 |
| orography factor [-] | 1,00 |
| turbulence factor [-] | 1,00 |
| probability factor [-] | 1,00 |
| kg/m ³ air density | 1,25 |
| Probability | |
| probability p for an annual exceedence... | 200 |
| shape factor [-] | 0,20 |
| exponent [-] | 0,50 |
| Roughness | |
| Roughness | category II |
| Kr [-] | 0,19 |
| z 0 [mm] | 50,000 |
| z min [mm] | 2000,000 |

Definition of the outer surface of the building

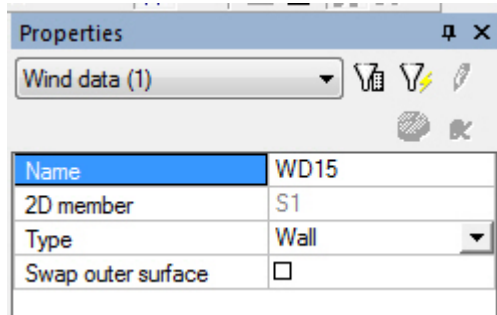
Prior the load can be generated it is necessary to select (mark) those 2D members in the model of the structure that are supposed to form the outer surface of the building. 2D members of type plate or (flat) wall have property called **3D wind**. If this property is set to ON, the 2D member is taken into account by the wind load generator.

The property **3D wind** is available for slabs and flat walls and for panels. It is not available during the input of the member but only after. If ON, blue contour (Wind data) is displayed on the member.

The outer surface of the 2D member can be selected using parameter **Switch outer surface**. This switch is useful as the direction of the wind is defined in the local coordinate system of the 2D member.

Generation and editing of zones

Once the **3D wind** property is set to ON in the property dialogue of the member, entity called “wind data” is automatically generated on the 2D member. This “wind data” entity collects all the wind information.



2D members with the **3D wind** property set ON must form a closed “block”. If the outer surface of the building is not closed or if an interior 2D member has the **3D wind** property set to ON, the wind load cannot be automatically calculated.

The Wind data entity can be of either of **Wall** type or **Roof** type. At least one roof member must be defined in the project

The roof types available are:

- flat
- monopitch
- duopitch
- hipped

Zones

The load the structure is subject to is, following the regulations of the appropriate code, divided to zones according the arrangement of the structure. This division is saved for every wind direction and it can be either automatically generated or, if required, input or edited manually. This is done in the Zones editor. The editor can be opened from the Wind data property dialogue using action button **[Edit zones]**.

Zones editor

Load direction 0

Design

Template acc. to code

Manual design

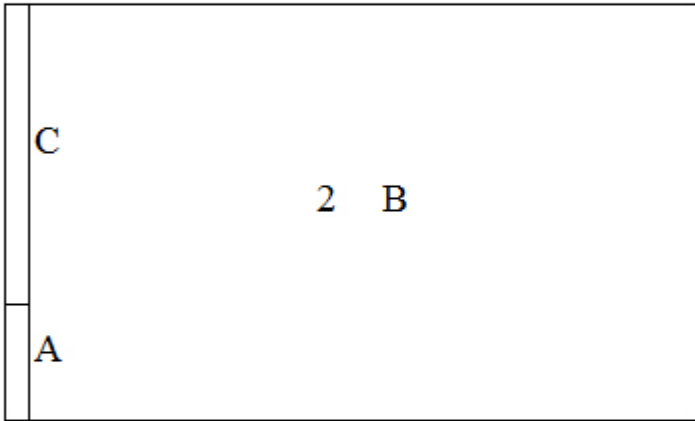
Generate

Setting according to code

e = 1

Base edge 1

Zone design Wall: e<d



Display label

Region

Zone

Edge

Ref. edge

Manual design mode

Edit zones

Edit geometry

| Region | Zones | +Cpe | -Cpe | | | Divide hierarchy |
|--------|-------|------|------|--------|------|------------------|
| 1 | A | 0,00 | 0,00 | Divide | Join | 2,3, |
| 2 | B | 0,00 | 0,00 | Divide | Join | |
| 3 | C | 0,00 | 0,00 | Divide | Join | |

OK
Cancel

There are three modes for editing of zones.

Template acc. to code

This option enables the user to divide the geometry to zones according to templates based on the appropriate code. The user must input the value of **e**, select the **Base edge** and **Zone design**. The values of Cpe coefficient are predefined by the program and can be adjusted manually. For projects with EC-EN code selected, we refer to EN 1991-1-4:2005(E), Chapter 7 for more information.

For IBC code, the **Template** option is not available.

Manual design

In this mode all the values are defined manually by the user.

If the **Manual design** mode is activated after the **Template mode**, all the values in the dialogue remain AS IS and the user can modify them as required.

However, if the **Manual design** mode is activated after the automatic **Generate** mode, all the values are deleted and the user must define everything from scratch.

Individual zones can be divided or merged using buttons **Divide** and **Join**. When a zone is divided there are three types of dividing available:

Parallel = the "cut" goes along the selected edge.

Horizontal = the "cut" goes horizontally

Vertical = the "cut" is vertical

Generated zones

In this mode the zones and values of Cpe coefficient are calculated automatically by the program. If the user swaps from the **Generate** option to another one, the zones are deleted.

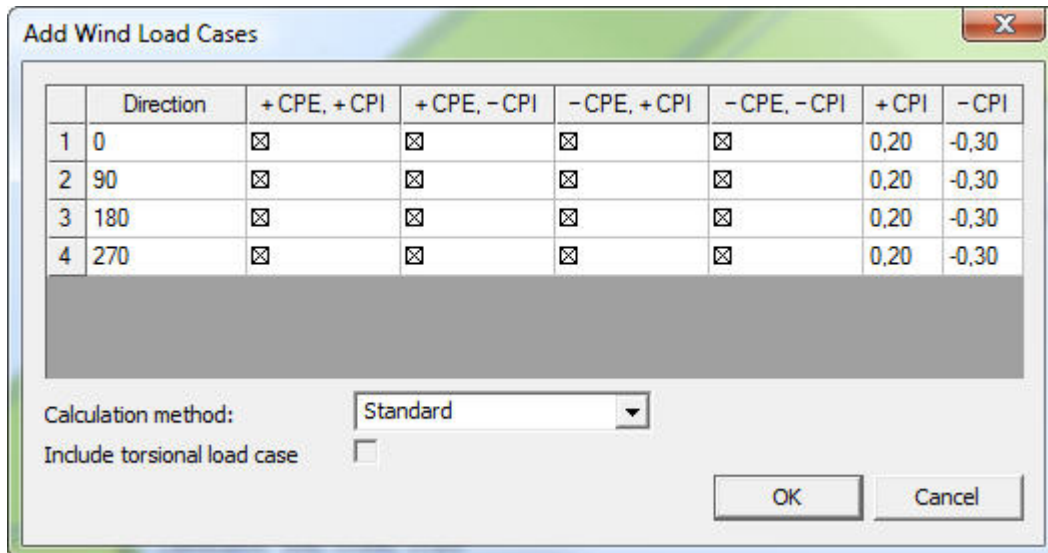
Load Case

Load cases can be generated automatically using the defined criteria or defined manually.

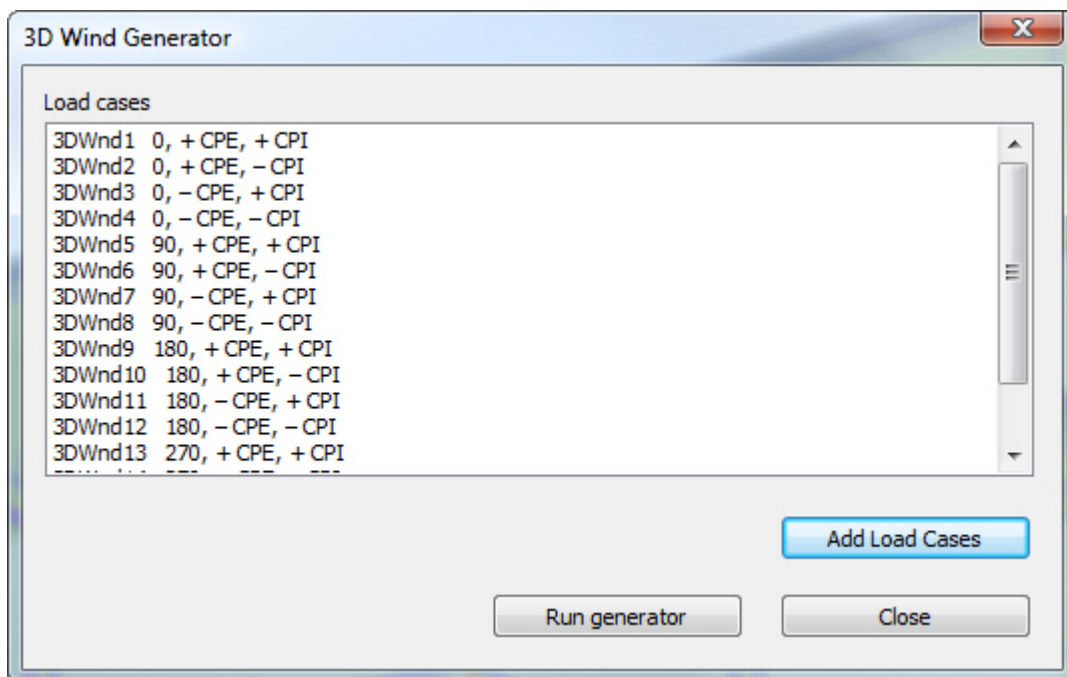
Automatic generation of load cases

Load cases can be defined using function **3D wind generator** in the **Load** service. On first opening the list of wind load cases is empty. The program can generate required load cases after the criteria are specified. To do so, click button **Add load cases** to open the dialogue where these criteria can be input.

The user defines the wind direction and selects which "plus"+"minus" combination of Cpe/Cpi coefficients is to be used. Also the value of the Cpi coefficient is input here (manually).

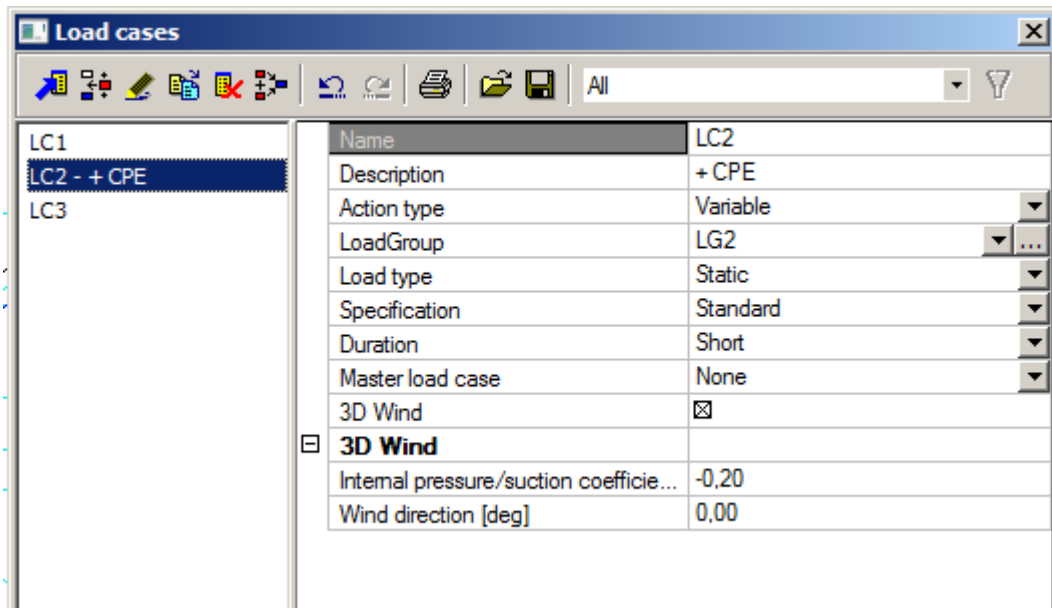


On closing the **Add wind load cases** dialogue the load cases are generated.



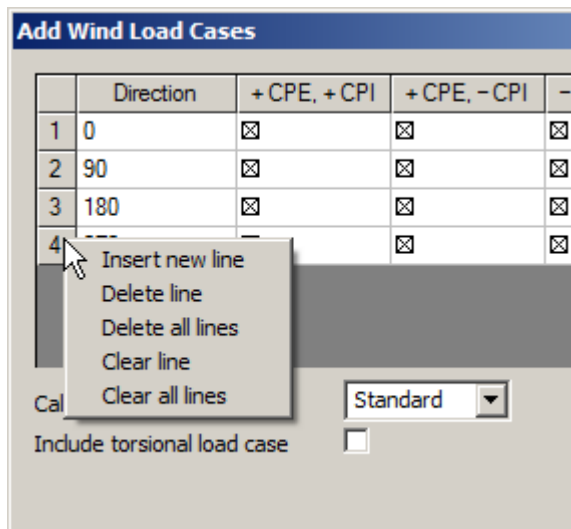
Manual input of load cases

When the wind load case is input manually, item Description MUST contain text either "+ CPE" or "- CPE" written in uppercase with one space character between the sign and the text "CPE". This defines which Cpe coefficient will be used. The +/-Cpi coefficient and direction are taken in account from the group 3D Wind.



Generation of load cases

When the “Add load cases” in the main dialogue is clicked, the main dialogue shows settings for the generation of load cases for individual directions. For each direction, any sign combination of C_{pe} and C_{pi} coefficients can be defined. Directions 0,90,180,270 are predefined. If you want to add another – use the right mouse button click to activate the menu – see below.



| | Direction | + CPE, + CPI | + CPE, - CPI | - CPE, + CPI | - CPE, - CPI | + CPI | - CPI |
|---|-----------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------|-------|
| 1 | 0 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 0.20 | -0.20 |
| 2 | 90 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 0.20 | -0.20 |
| 3 | 180 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 0.20 | -0.20 |
| 4 | 270 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 0.20 | -0.20 |

Calculation method:

Include torsional load case

OK Cancel

Calculation Method

For EC and BS only method "Standard" is available.

For IBC three methods are possible (see the IBC code for details):

- Method 1 – simplified procedure
- Method 2 –analytical procedure
- MWFRS – Main Wind Force-Resisting System

Include torsional load case

This checkbox is available only for the IBC code (see the IBC code for details).

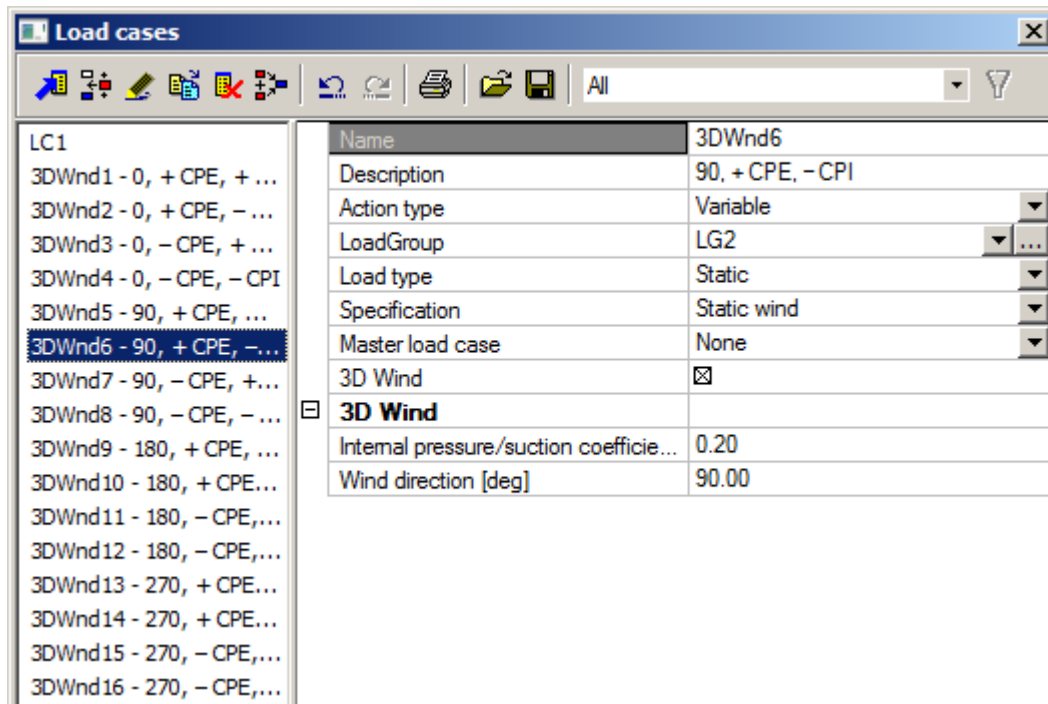
Manual definition of a 3D wind load case

In the properties of a variable load case you can select option "3D wind". When the option is ticked, new properties relating to the wind load are added to the property dialogue. This load case is later user to store the generated load.

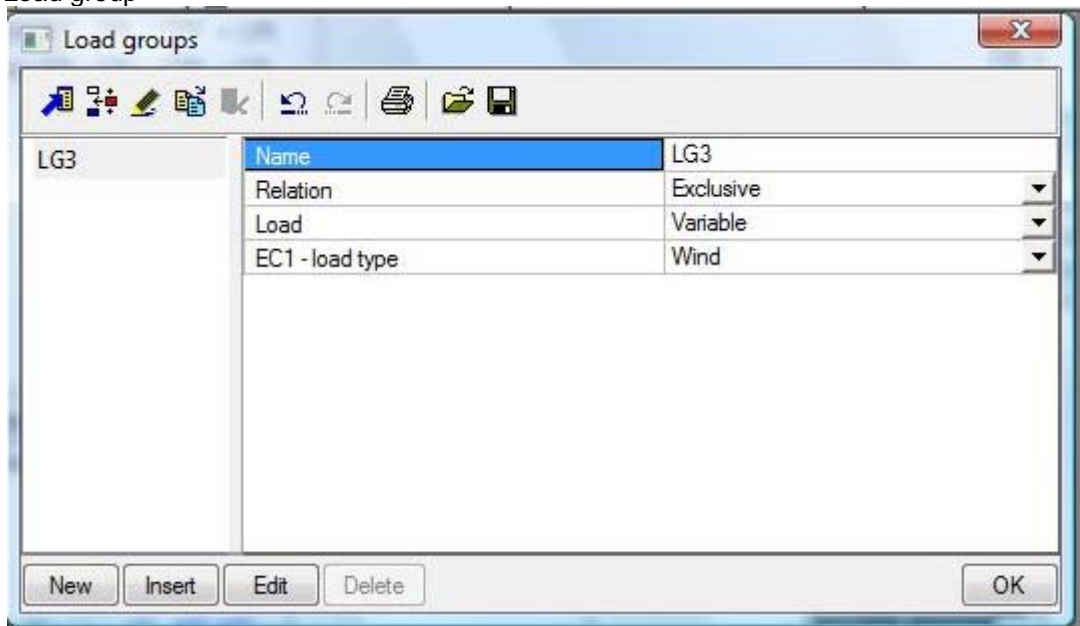
Direction – wind load direction in GCS

Internal pressure/suction coefficient – value of Cpi coefficient (see the appropriate code for details)

The 3D wind option is available only for **Action type = Variable**.

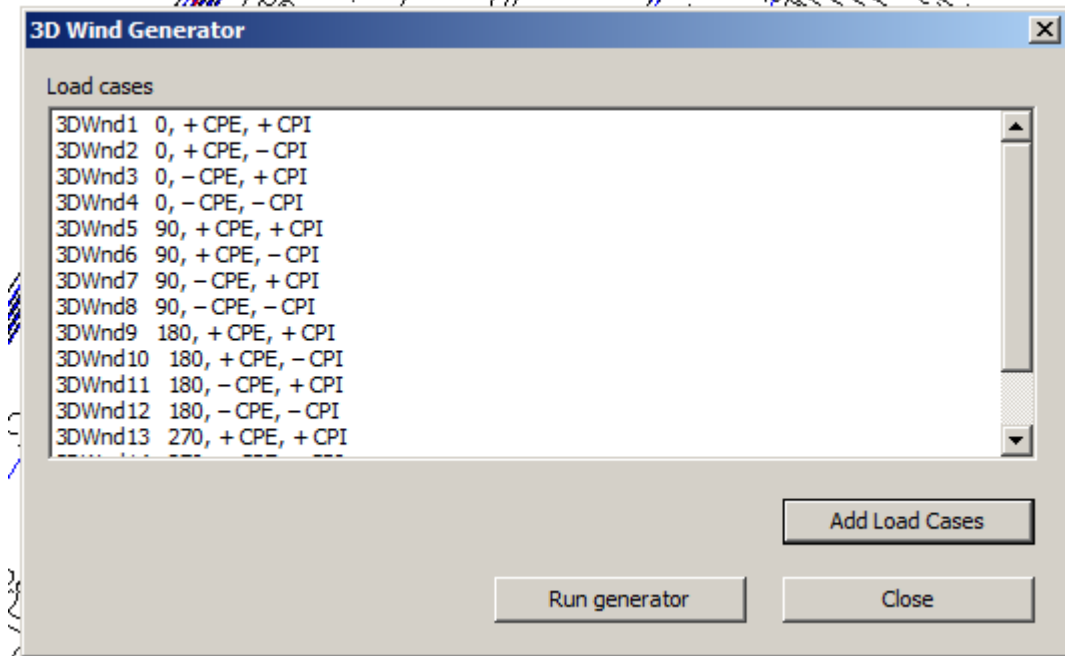


Load group



Generation of load

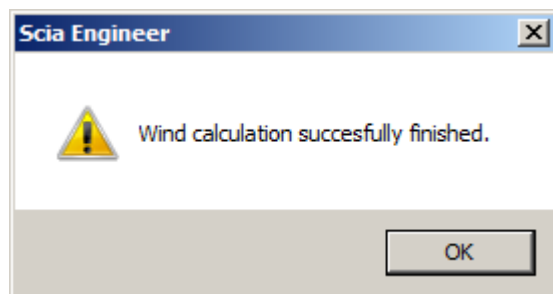
The load is generated only to load cases of “3D wind” type. The generated load is of “3D wind” type. The value is set to the generated or manually input value of the Cpe coefficient. The geometry of the load is defined by the arrangement of wind zones across the 2D element.



Run generator button

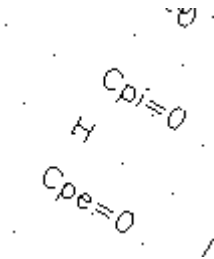
It runs the Wind Load Engine that calculates wind zones according to the appropriate code and calculates the load values.

After successful calculation a message box is shown.



View flags

Cpi, Cpe labels and the name of the zone is displayed using the settings from **Palette settings > Screen > Font > item Slab**.



In the View parameters Setup dialogue, you can control what is displayed on tab **Loads/masses**.

| | | |
|--------------------------|----------------------------|-------------------------------------|
| | Eccentricity label | <input type="checkbox"/> |
| <input type="checkbox"/> | Wind data | |
| | Display | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | Labels of wind data | |
| | Display label | <input checked="" type="checkbox"/> |
| | Cpi | <input checked="" type="checkbox"/> |
| | Cpe | <input checked="" type="checkbox"/> |
| | | |