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SCIA Engineer Fact Sheet

Dynamics (advanced) - frames

P E esas.23

As an extension to the calculation of natural modes (esas.21), the advanced dynamics module (esas.23) includes harmonic, seismic and Von Karman vibration analysis as well as direct time integration method for frame structures.

- Harmonic load calculation can be required to check vibrations due to machinery, to verify structural integrity of a floor loaded by an aerobics class… Calculation is performed according to harmonic load frequency and damping of the structure specified by the user.
- The calculation under seismic load is used to simulate earthquake. The behaviour of the structure under a dynamic load of the spectral type (i.e. a load of which the spectral density is known) is calculated. This calculation method is typically used to check structures against earthquakes.
- Von Karman vibration can be used for examination of transverse vibration of cylindrical structures due to wind.
- Direct time integration can be used e.g. for simulation of explosion, running load .

Highlights

For the harmonic load, the frequency and the damping will be defined.

The calculation under seismic load is used, amongst others, for simulating earthquakes; the spectra of the EC 8, DIN 4149 (German standard), SIA 261 (Swiss standard) and the Turkish standard are available by default and can be extended by the user.

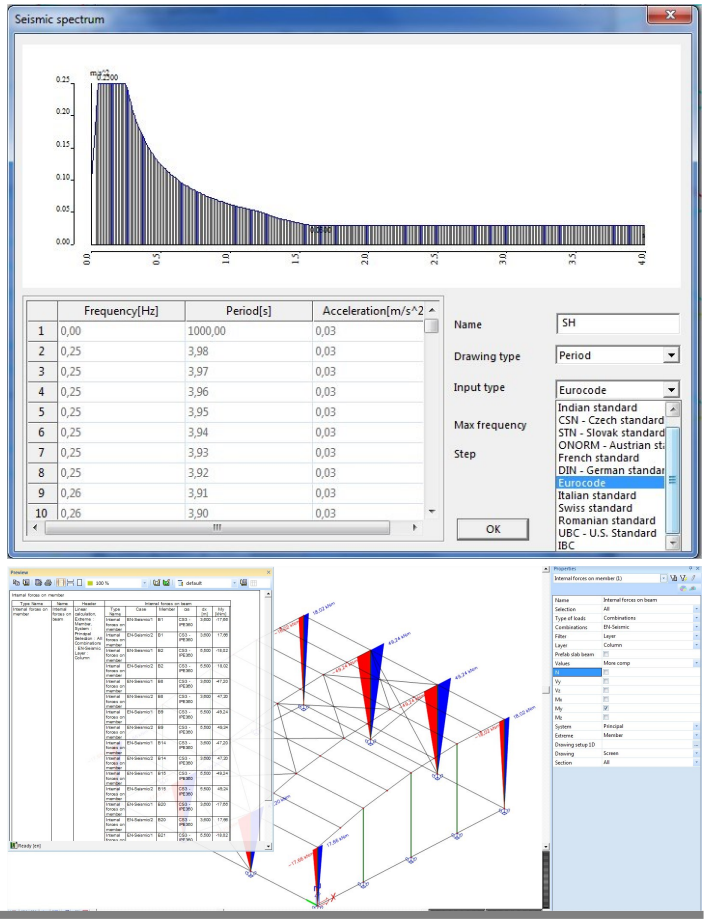
The modal participation factors are indicated. For both analyses, the results can be combined with the results from a static calculation.

Harmonic calculation

- User input of load frequency and overall damping (logarithmic decrement) for each load case
- More than one harmonic load case can be input, each with a different value of frequency
- Results from modal analysis are available: eigen frequencies, mass participation factors and eigenmode shapes
- The same menus as for static load cases are available to view numerical or graphical results: displacements, internal forces and reactions

Seismic calculation

- Spectrum of the EC 8 and national codes: Austria, Czech Republic, France, Germany,India, Italy, Slovakia, Romania, Switzerland, and U.S. are available by default
- The Netherlands standard NPR 9998 is also included.
- Additional spectrum can be defined by the user using table input (copy/paste from Excel is also possible).
- Type of modal superposition: SRSS or CQC method can be selected by user
- Accidental eccentricity or torsion can be taken into account for buildings
- Automatic generation of Newmark seismic combinations
- Results from modal analysis are available: eigen frequencies, mass participation factors and eigenmode shapes
- The same menus as for static load cases are available to view numerical or graphical results: displacements, accelerations, internal forces and reactions



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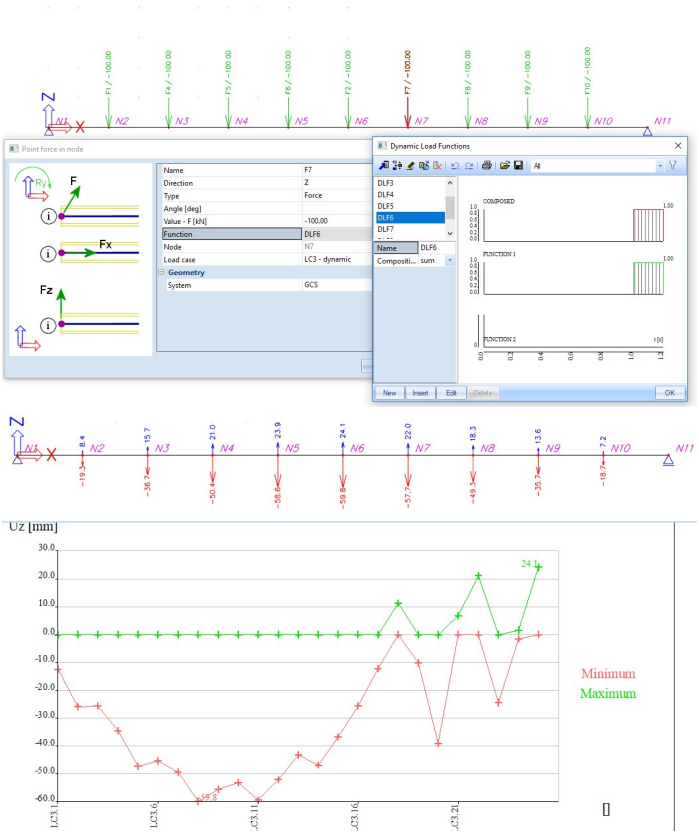
Direct Time Integration

- Can be used for different purposes, for example: harmonic loads, explosions, …
- The user has to input a dynamic function which presents the frequency in function of the time.



Vortex shedding: Von Karman vibration analysis

- The transverse vibration of cylindrical structures due to wind can be examined.
- Vortex shedding as special case of harmonic loading.
- Implemented according the Czech loading standard.
- The effect is only taken into account if the critical wind velocity calculated
- It is possible to specify the length of the structure where the Von Karman effect can occur.
- For each geometric node of the structure, it is possible to relate a length of the cylinder to the node.
- The effect can occur over the entire height of the structure however, when there are specific obstacles on the surface of a chimney for example, these obstacles will hamper the formation of the vortices and thus reduce the Von Karman effect.

Calculation protocol

Linear calculation

Number of 2D elements	**0**
Number of 1D elements	**150**
Number of mesh nodes	**151**
Number of equations	**906**
Loadcases	LC1
Start of calculation	16.06.2017 13:22
End of calculation	16.06.2017 13:22

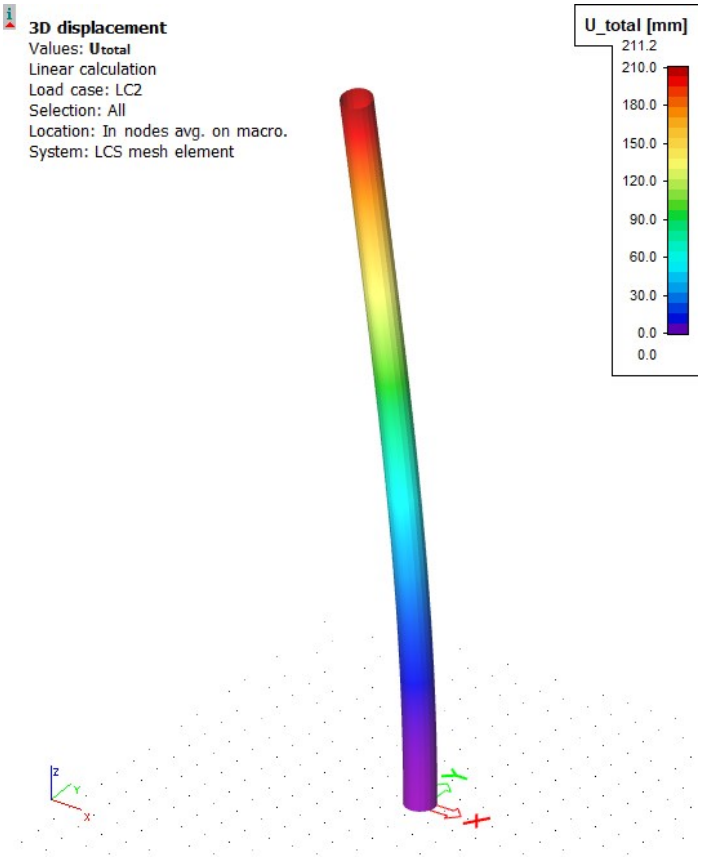
Sum of loads and reactions.

	[kN]	X	Y	Z
Loadcase LC1	loads	0.0	0.0	-52.0
	reactions in nodes	0.0	0.0	52.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase LC2	loads	0.0	0.0	0.0
	reactions in nodes	0.0	0.0	0.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0

Dynamic loadcase: 2 : LC2

Mode	Freq. [Hz]	G(j)
1	1.1834	-0.0000
2	1.1834	-8.8099
3	7.3341	0.0000
4	7.3341	0.0000

Karmans vibration is analyzed for eigen shape 2
Maximum horizontal translation 0.02397
Critical velocity 7.10
Reynolds number 585346.64
Ct ratio 0.57
Maximum load on cylinder 21.50
Reduced load on cylinder 896.92



Required modules

esas.21