Vortex shedding calculation according to EN13445 Clause 22.10

It is possible to calculate the effect of the vortex shedding on the column according to clause 22.10 of EN13445.
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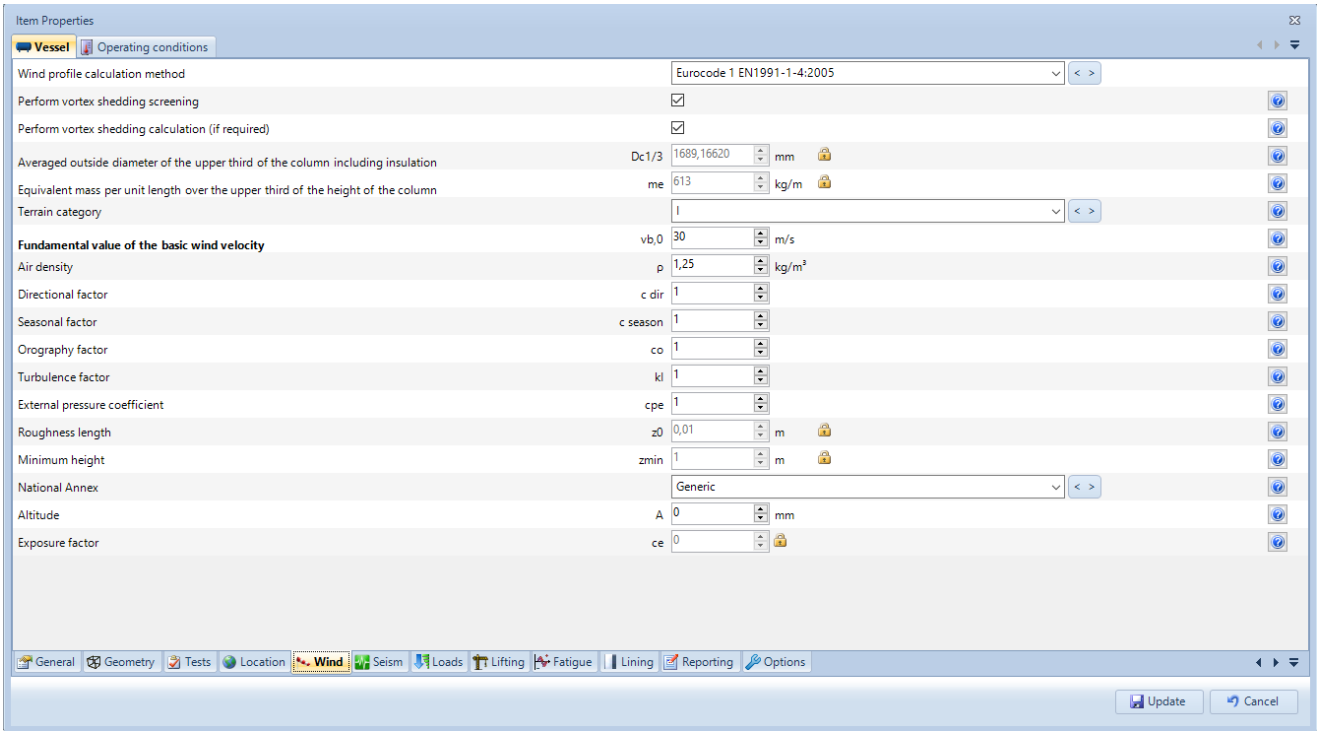
It is possible to calculate the effect of the vortex shedding on the column according to Clause 22.10 of EN13445-3. In NextGen, for vertical items, the user can find the properties related to vortex shedding under the "Wind" tab of the "Item properties" window. **The structural analysis must be abilitated in order for the user to be able to perform the vortex shedding calculations.**



"Wind" tab of the "Item Properties" window

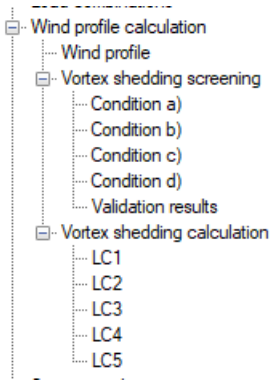
Clause 22.10.2 describes a screening procedure necessary for determining whether the vortex shedding calculation is requested. The user can activate this calculation by clicking on "Perform vortex shedding screening". This procedure is performed for every load combination in which wind is present.

Clause 22.10.3 and clause 22.10.4 describe the calculation procedure necessary for determining the shear force and the bending moment generated by the vortex shedding at a given height. The user can activate this calculation by clicking on "Perform vortex shedding calculation (if required)". This calculation will be performed only for load combinations where this procedure is necessary, i.e where the screening procedure determined that the vortex shedding calculation is necessary.

The "averaged outside diameter of the upper third of the column including insulation" and the "equivalent mass per unit length over the upper third of the height of the column" are automatically calculated by the sofware for all load combinations and are used both on the screening procedure and on the calculation procedure. The user can overwrite these values on an item level (i.e. for all load combinations) by clicking on the padlock icon.

The final output of both procedures will be printed on the report as subsections of the "Wind Profile

calculation".



Report structure

From the "Validation results" table in the "Vortex shedding screening" section the user can see for which load combinations a calculation is necessary:

Validation results

Load combination	Validation result
LC1	None of the conditions were satisfied, the effect of vortex shedding on the column should be investigated
LC2	None of the conditions were satisfied, the effect of vortex shedding on the column should be investigated
LC3	None of the conditions were satisfied, the effect of vortex shedding on the column should be investigated
LC4	None of the conditions were satisfied, the effect of vortex shedding on the column should be investigated
LC5	None of the conditions were satisfied, the effect of vortex shedding on the column should be investigated
LC9	At least one condition was satisfied, the effect of vortex shedding need not be investigated

Screening validation results

The user can see the calculation performed for load combinations where the screening procedure determined the calculation is necessary under "Vortex shedding calculation". For instance, for load combination LC2:

LC2

Structural damping expressed by the logarithmic decrement	δs	=	0.04000
Scruton number	$Sc = \frac{2 \cdot \delta_s \cdot m_e}{\rho \cdot D_{c1/3}^2}$	=	13.74978
Kinematic viscosity of the air	ν	=	$15 \cdot 10^{-6}$ m²/s
Reynolds number	$Re = \frac{b \cdot V_{crit}}{\nu}$	=	215 776.95755
Basic value of lateral force coefficient	Clat,0 = f(Re)	=	0.70000
Lateral force coefficient	Clat = Clat,0	=	0.70000
	$\lambda = \frac{h}{D_{c1/3}}$	=	61.45221
	Lj/b(iterative calculation)	=	6.00000
Correlation length factor	$K_w = 3 \cdot \frac{L_j b/}{\lambda} \cdot \left[1 - \frac{L_j b/}{\lambda} + \frac{1}{3} \cdot \left(\frac{L_j b/}{\lambda}\right)^2\right]$	=	0.26524
Largest displacement on top of the column caused by vortex shedding	$Y_{F,max} = \frac{1}{St^2} \cdot \frac{1}{Sc} \cdot K \cdot K_w \cdot C_{lat} \cdot D_{c1/3}$	=	91.52 mm
Inertia force per unit length	$F_0 = m_e \cdot (2 \cdot \pi \cdot n_1)^2 \cdot y_{F,max}$	=	0.09 N/mm
Bending moment at the base	$M_B = \frac{1}{4} \cdot F_0 \cdot h^2$	=	248 739.2 N·m

Component	Elevation	Shear force	Bending moment
Skirt #1	0 mm	3 195 N	248 739.2 N·m
Ellipsoidal head #1 copy #1	635.00 mm	3 195 N	246 710.4 N·m
Cylindrical shell #1	1 065.00 mm	3 195 N	245 336.5 N·m
Conical shell #1	101 065.00 mm	246 N	340.1 N·m
Cylindrical shell #2	101 498.00 mm	208 N	241.7 N·m
Ellipsoidal head #2	103 498.00 mm	28 N	4.3 N·m

The elevation is referred to the lowest point of the component

Vortex shedding calculation for load combination "LC2"

The final result of the calculation is a table containing shear force and bending moment values generated

by the vortex shedding at the lowest point of each component. The user can use these values to perform the fatigue analysis requested by Clause 22.10.5 (according to Clause 18).