Period of vibration of items supported by brackets or rings

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Online version: https://nextgen.sant–ambrogio.it/KB931679
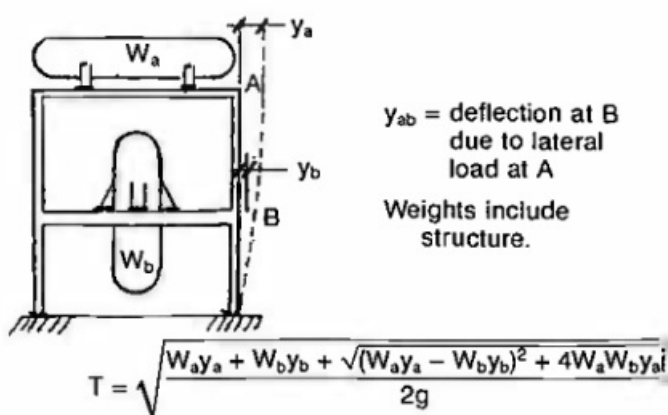
Latest update: 14 set 2018

In a recent NextGen update, we removed the automatic vibration-time calculation for vessels not supported from the bottom. The vibration period continues to be calculated automatically on items with skirts, legs, etc. The calculation of the vibration period is part of the larger seismic calculation and therefore intervenes if the latter is enabled.

The removal was necessary because we realized that the method adopted was not actually suitable for half-height supported structures. To complicate the calculation, the fact that a device supported by brackets can be placed on racks or other structures that are subject to oscillations that cannot be estimated by our program.

Our users can therefore end up with -- even on a calculation that did not show messages in previous editions -- a report like this:

Load combination: Operating (Pi + Phi + Dmax + L + E + W)		
Period of vibration	$T =$	0 s
Unable to automatically calculate the period of vibration, please manually set the required value for every load combination		
Horizontal seismic acceleration	$S_e(T) = a_g \cdot S \cdot \eta F_o \cdot \left[\frac{T}{T_B} + \frac{1}{\eta \cdot F_o} \left(1 - \frac{T}{T_B} \right) \right] =$	0.233 g
Horizontal seismic load multiplier	c_sh =	1.00
Effective seismic acceleration considered in load combination	$Sh = c\_sh \cdot Se(T) =$	0.233 g
Vertical seismic acceleration	$S_{ve}(T) = a_g \cdot S \cdot \eta F_v \left[\frac{T}{T_B} + \frac{1}{\eta \cdot F_o} \left(1 - \frac{T}{T_B} \right) \right] =$	0.085 g
Vertical seismic load multiplier	c_sv =	1.00
Effective seismic acceleration considered in load combination	$Sv = c\_sv \cdot Sve(T) =$	0.085 g

Our advice is to rely on the "Pressure Vessel Design Manual" by Dennis R. Moss, chapter "Design of vessel supports", paragraph "Period of vibration", which includes a configuration of this type:

y_{ab} = deflection at B due to lateral load at A

Weights include structure.

$$T = \sqrt{\frac{W_a y_a + W_b y_b + \sqrt{(W_a y_a - W_b y_b)^2 + 4 W_a W_b y_{ai}}}{2g}}$$

In the notes, the following is stated:

Notes

1. Vessels mounted in structures at some elevation other than grade generally will experience amplified base motion near and above the natural frequencies of the support structure.

   - *Light vessels* (less than 1% of structure weight):
     a. If vessel frequency > structure frequency, then vessel is subjected to maximum acceleration of the structure.
     b. If vessel frequency < structure frequency, then vessel will not be affected by structure. It will respond as if it were mounted at grade.

   - *Medium vessels* (less than 20% of structure weight): Approximate methods may be used to develop the in-structure response spectra. The method used should account for interaction between vessel and structure (energy feedback). Consideration should be given to account for ductility of the vessel.

   - *Heavy vessels* (single large vessel or multiple large vessels): The vessel(s) is the principal vibrating element. It requires a combined seismic model, which simulates the mass and stiffness properties of vessel and structure.

Once the value of the vibration period T has been obtained, it is possible to insert it manually in NextGen, in each affected Load Combination: