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Using CSA S37-01 in TOWER and PLS-POLE

Introduction

TOWER and PLS-POLE now provide explicit support for the Canadian Standards Association standard S37 2001 for Antennas, Towers and Antenna-Supporting Structures (hereafter referred to simply as "S37"). Prior to now, some engineers have used the TIA/EIA 222-F code in TOWER and PLS-POLE to analyze structures according to S37 through careful use of load and strength factors. The new support for S37 eliminates the need for this workaround and will make the modeling and analysis process faster and more accurate. This document will briefly explain how you can use this new capability in TOWER and PLS-POLE to meet some of the requirements of S37.

Notes for Users of ANSI/TIA/EIA Standards

S37 models are very similar to models made with 222 Revisions E-G. However, S37 uses an hourly mean wind based on a 30-year return period. This wind definition is not compatible with either 222-F or 222-G, so you will need to make a separate ".eia" loads file for your S37 projects. Fortunately, the geometry and other input are compatible with S37. So, you can easily convert any models you may have already made to use the new explicit S37 loading option merely by switching to it in *General/General Data* and creating the new ".eia" loads file with the *Loads/EIA Loads*.

Getting Started With CSA S37-01

The geometry of a TOWER or PLS-POLE model will not require any changes to be used with S37. You can switch to the S37 strength check in TOWER and loading in PLS-POLE and TOWER simply by selecting it in *General/General Data*. Please note that throughout the software the phrase "EIA" may be used to refer to information or commands that are only applicable in a telecommunications context. In these cases the information or command applies to S37 as well. For example, the "A_f Flat Factor For Face EIA Only" and "A_r Round Factor For Face EIA Only" columns in *Geometry/Sections/Define* in TOWER apply to models that use S37. In addition to using terminology borrowed from the ANSI/TIA/EIA 222 standard, any ambiguity in interpreting S37 is resolved the same way ANSI/TIA/EIA 222 would.

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Revisions

February 2009, TOWER version 10.01:

6.3.4.2   Now calculate $A_{net} = 0.70(A_{eff} - h \times t \times n_h)$ rather than the more conservative $A_{net} = (0.70 \times A_{eff}) - (h \times t \times n_h)$

March 2009, TOWER version 10.03:

6.2.5.3   Now automate the special cases given in table 7 if select eccentricity and restraint codes of 31, 32, 33, 34 or 35 (corresponding to the rows in table 7) for your welded solid round bracing members.

Detailed Notes

      Prior to making use of S37 in PLS-POLE or TOWER you should read that code in detail along with these notes and the Commentary on CSA Standard S37-01. The following notes correspond to section numbers in S37-01 (with the 04 update applied) and will help you to understand the implementation of S37 in PLS-POLE and TOWER.

C4.1   You can make the "allowance of about 5% of the structure weight" by entering 1.05 in the *Dead Load Factor* column in *Loads/EIA Loads*.

4.2.1   Ice density as well as all other loading parameters may be input in the table reached via the *Loads/EIA Loads* command.

              The software does not automate the case where the gap between two adjacent parallel members is less than twice the radial ice thickness.

4.2.2   No provision is made for increasing the ice thickness with height.

4.3.1   The software calculates the gust effect factor, C_g, and height factor, C_e,
4.7   automatically. Note that in order for C_e to be based on the height of the structure above ground when it is mounted on a building you must do the following: TOWER: input the building elevation in *General/EIA Options*. PLS-POLE: the Z coordinate entered in Steel/Wood/Concrete Poles Geometry must correspond to the elevation at the base of the pole.

              The software does not automate the calculation or the application of the Roof Speedup Factor C_a.

4.3.3   You may input a 10-year return hourly wind pressure for q when this clause applies, but the software will always calculate C_g as per 4.6.1.

4.5.1 C_e is always automatically calculated as $(H_x/10)^{0.2}$.

4.5.2   TOWER: q_h will be calculated at the mid-elevation of each section defined in *Geometry/Sections/Define*; therefore, these sections must not exceed 6m in height.
              PLS-POLE: q_h will be calculated at the mid-elevation of each beam element the pole is broken into; therefore, the maximum pole segment length input in *General/General Data* must not exceed 6m.

4.5.4   For equipment entered in Geometry/Equipment, q_h is calculated at the elevation of the attachment joint.

4.6.1	TOWER: A C_g of 2.0 is always applied automatically for you. PLS-POLE: A C_g of 2.5 is always applied automatically for you. If you manually account for vortex shedding and wish to use 2.0 for C_g then you should reduce the *Wind Load Factor* in *Loads/EIA Loads* accordingly.
4.6.3	No special provisions are made for dynamic effects of wind on towers that exceed 250m or for checking vortex shedding or fatigue for pole structures.
4.7	The roof speed-up factor C_a is always 1.0. You may manually account for this factor through the factors in *Geometry/Sections/Define* in TOWER or by adding fictitious areas in *Geometry/Dead Loads and Drag Areas* in PLS-POLE.
4.9.1.1	TOWER: A_g is based on the horizontal distance between the axes of the members in the model (not on the outside dimensions) unless you have a mast with round legs and have selected the *General/EIA Options* "Member face width based on out-to-out dimensions" option.
	Any ice thickness specified for a given load case is included in the calculation of A_g.
	TOWER does not automatically account for connection plates. You must manually account for them by increasing the factors Af and/or Ar in *Geometry/Sections/Define*.
	The drag factors for round and flat members are calculated as per this section. C_{df} is printed as *Face CF* and C_{dr} is not printed, but the Round Reduction factor component of C_{dr} is printed as *Face RR*.
	The factor K_d is calculated separately for round and flat members and reported as the *Face DF* (directionality factor flat) and *Face DR* (directionality factor round).
4.9.1.2	TOWER does not automate the calculation of shielding. Wind will be incident on any member in the face or any Linear Appurtenance with *Include In Wind Load* set. Remove the member from the face and/or clear the *Include In Wind Load* setting for a Linear Appurtenance should you decide that it is completely shielded and should not have wind applied to it.
4.9.1.3	Linear appurtenances in the face will be included in the net projected area A_s.
	See notes for 5.5.1.1. You are responsible for modeling the structure in such a way that the Face is the face with the largest area of linear appurtenances.
4.9.1.5	The drag factors described in this section are automatically applied to linear appurtenances with *Include In Wind Load* set to yes.
	You can control whether the wind load is limited as per this section with the *Apply actual calculated wind load instead of limiting…* option in *General/EIA Options*.
4.9.2.2 Table 2	When calculating C_d, PLS-POLE will first calculate R_a as the ratio of the area of linear appurtenances mounted outside the pole to the area of the pole for each section. Only the linear appurtenances are considered in the

calculation of R_a and all of the appurtenances outside the pole are considered exposed to wind.

Linear appurtenances are always considered to contribute to the wind load if they are mounted outside the pole regardless of the value of R_a. Brackets or other discrete, but repeating appurtenances should be modeled as equivalent linear appurtenances if you want them included in the calculation of R_a.

4.9.3   A drag coefficient of 1.2 is always used internally overriding whatever you input in *Components/Cable*.

If you need to account for attachments such as spoilers or markers then create a new guy property in *Components/Cable* and input an effective diameter that accounts for the attachments.

A uniform wind pressure and ice thickness is applied to each guy calculated at the mid elevation of the guy.

4.9.4   Using your engineering judgment you may opt to use the antenna loading methodology prescribed in ANSI/TIA 222-G Annex C by selecting one of the EIA Microwave Antenna types for the equipment you enter in *Geometry/Equipment*. In this case you must carefully review *Equipment Load Case Information* output in the *Analysis Results* report to make sure the calculated loads are appropriate for your antenna and meet the manufacturer's recommendations. Alternately, you may calculate antenna loads manually and input them in the *Point Loads* subtable of *Loads/EIA Loads*. Note that concentrated loads input in the *Point Loads* subtable of *Loads/EIA Loads* are already assumed to be factored (the load factors in *Loads/EIA Loads* are not automatically applied to them).

4.9.4.3   The software does not automatically account for any possible shielding of one antenna by another.

4.10   Temperature effects are considered for all load cases where the temperature input in *Loads/EIA Loads* does not correspond to that input in *General/EIA Options* as the *Guy Installation Temperature*.

4.11   Earthquake effects can be calculated manually (as an equivalent lateral acceleration) and input as point loads or calculated automatically if the ANSI/TIA 222-G code is used.

5.2   You should input the load combinations from 5.2 and any additional load cases that are necessary in the *Loads/EIA Loads* table.

5.3
Table 3   Input the dead, wind and ice load factors in the *Loads/EIA Loads* table.

You should multiply the input wind and ice factors by the importance factor.

A thermal expansion (temperature) factor is not provided, but you may input a temperature that incorporates the desired factor.

Note that concentrated loads input in the *Point Loads* subtable of *Loads/EIA Loads* are already assumed to be factored (the load factors in *Loads/EIA Loads* are not automatically applied to them).

5.5.1.1   TOWER: Unless you know without a doubt that a face is the controlling face for wind loading you should create three separate TOWER models (one for

each face) to make sure that all loading possibilities are considered for all wind directions.

5.7   The software does not automate the application of a cantilever factor.

6   The strength check implemented in TOWER is described in the TOWER manual.

6.4   No CSA S37-01 strength check is implemented in PLS-POLE for tubular steel
C6.4   poles. However, careful inspection of 6.4 reveals that it is similar to
           ASCE 48-05 (manual 72) which may be used to approximate it given the
           appropriate strength factors. If you have an 18 sided pole then you may
           wish to use the ANSI/TIA 222-G strength check which is also similar to 6.4.

6.2.3.3.   If you select CSA S37-01 for the Crossing Diagonal check in *General/General
           Data* and place any crossing diagonals in a "Crossing Diagonal" group then
           TOWER will automatically calculate ADL when at least one member in the
           crossing diagonal pair is in compression. For more information see the
           Crossing Diagonal Check Technical Note at
           http://www.powline.com/products/tower-crossing-diagonal-check.pdf

As you can see from these notes the implementation of CSA S37-01 involves a number of assumptions and approximations. Therefore when using S37 you should carefully review the output from the program and compare it to hand calculated values to make sure that you have properly understood and accounted for all of the assumptions, approximations and factors involved in the modeling. In particular you should review the *S37 Load Case Information* table in the *Analysis Results* report in PLS-POLE and the *S37 Section Load Case Information* table in the *Analysis Results* report in TOWER.