

# SAP2000 v22.2.0 Release Notes

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**Notice Date: 16-October-2020**

This document lists changes made to SAP2000 since v22.1.0, released 06-June-2020. Items marked with an asterisk (\*) in the first column are more significant.

## Analysis

### Enhancements Implemented

*	Ticket	Description
*	2103	The biaxial friction-pendulum isolator link element now uses tangent stiffness for iteration when running nonlinear static, staged-construction, and nonlinear direct-integration time-history load cases. Previously this isolator used the initial stiffness for iteration in versions 19.1.0 to 22.1.0. Using the tangent stiffness is generally more efficient, although convergence behavior is always problem dependent. This change may cause some differences in analysis results from previous versions. These will usually be within the convergence tolerance except for numerically sensitive or ill-conditioned models. Results for Verification Example 6-011, which can vary with different processors, are slightly affected by this change. The tension-compression (T/C) friction-pendulum isolator already was using the tangent stiffness for iteration, while the triple friction-pendulum isolator will continue to use initial stiffness for iteration. Note that the use of tangent stiffness for the biaxial and tension-compression friction-pendulum isolators also makes them suitable for pure event-to-event solution methods, but the same is not true for the triple friction-pendulum isolator using initial stiffness.
	4900	The initial rigid stiffness of parametric PMM hinges was improved and is now based on the stiffness of the frame object containing the hinge. This change is intended to prevent excessive stiffnesses which can adversely affect the convergence behavior of the model and will not significantly affect analysis results for well-conditioned models.
*	5134	An enhancement has been made to speed-up the recovery of analysis results, with particular improvement for hinge response. In addition, new options are now provided to control advanced parameters affecting analysis, design, and response recovery. These include: (1) Use of memory-mapped file IO for design and response recovery. This can speed-up retrieval of saved analysis results. Systems with Solid State Drives (SSDs) and adequate RAM (memory) will benefit the most. (2) Number of analysis threads. Using more threads (up to number of physical cores) will speed-up analysis, but also uses more RAM (memory) to be efficient. (3) Maximum file size for storing analysis results. This may affect certain backup or archival systems. (4) Merging results from non-identical models. Normally this is not recommended, but it can be permitted.
	5137	An enhancement was made to the Nonlinear Parameters form (Define menu > Load Cases) to provide a clearer interface. The options "Use Iteration" and "Use Event-to-Event Stepping" have been merged into one parameter "Solution Scheme", which specifies the overall solution method used in the analysis. The new Solution Scheme options are: (1) Iterative Only, equivalent to "Use Event-to-event stepping" = No and "Use Iteration" = Yes (2) Iterative Event-to-Event, equivalent to "Use Event-to-event stepping" = Yes and "Use Iteration" = Yes (3) Event-to-Event Only, equivalent to "Use Event-to-event stepping" = Yes and "Use Iteration" = No. Only the nonlinear parameters relevant to the selected solution scheme will be shown in the form. It is suggested to select the solution scheme first before specifying the nonlinear parameters, since the nonlinear parameters may be reset when the solution scheme is changed. See also Ticket 5187 for additional parameters and changed behavior for the Event-to-Event Only solution scheme.

*	5140	An enhancement has been made to speed-up repeated solving of the stiffness matrix when using the Multi-threaded Solver option. This should significantly increase the speed of nonlinear static, nonlinear multi-step static, and nonlinear direct-integration time-history load cases, especially when using Newton-Raphson iteration and/or event-to-event stepping. Staged-construction load cases will similarly benefit within stages and between stages where the structure does not change. Eigen modal load cases will benefit when many frequency shifts are performed, and linear direct-integration time-history loads cases will benefit when the time-stepping is not constant. This change does not affect the default Advanced Solver or the Standard Solver. Use the command Analyze > Advanced SAPFire Options to select the Multi-threaded Solver.
*	5187	An enhancement was made to nonlinear static and nonlinear direct-integration load cases that use the "Event-to-Event Only" solution method to better handle how equilibrium unbalances are passed to each subsequent step. This change may affect results for non-iterative event-to-event analyses where the relative unbalance reported in the .LOG files are large, but the change is expected to reduce the relative unbalance in the analyses. Additionally, four parameters are added to the Nonlinear Parameters form (Define menu > Load Cases) to allow more user control for the Event-to-Event Only method: (1) Stop Analysis when Maximum Events per Step is Exceeded. Selecting Yes for this option enables a new feature where the analysis will terminate if the specified Maximum Events per Step is reached in an analysis step. (2) Minimum Event Step Size. The minimum event size that is allowed during analysis. When the Maximum Null Events per Step is exceeded, events that are smaller than this value are increased and counted as Null Steps. (3) Maximum Null Events per Step. If this is set to a non-zero value, this is the number of events smaller than the specified Minimum Event Step Size allowed in an analysis step. If set to zero, the Minimum Event Step Size will not be enforced. (4) Use Correction Step for Large Unbalance. The options are "None", "Every Step", and "Last Step". When "Every Step" is specified, an additional correction step with no applied load will be taken at the end of any step where the relative unbalance is larger than 1.0e-4 to resolve unbalances in the model before moving to the next step. If "Last Step" is specified, this correction step will be taken at the end of a Nonlinear Static load case or at the end of every stage for a Staged Construction load case. This parameter is only applicable to Nonlinear Static load cases. Event-to-Event Only analysis can be defined by setting the "Solution Scheme" option to "Event-to-Event Only" in the Nonlinear Parameters form. See also Ticket 5137 for changes to the Nonlinear Parameters form.

## API

### ***Enhancements Implemented***

*	Ticket	Description
	2247	An enhancement has been implemented to allow API plugins written in .NET to be added by specifying their file location. This removes the previous requirement for .NET plugins to be visible to COM and registered.

## Database Tables

### ***Enhancements Implemented***

*	Ticket	Description
*	4919	An enhancement was performed to allow the name of the database file that is automatically saved after the analysis is run to include a path. Also, multiple files can now be specified to be automatically saved after the analysis is run.

## Design – Cold Formed Frame

### Enhancements Implemented

*	Ticket	Description
*	790	An enhancement has been implemented, adding the cold-formed frame design according to AISI 2016.

## Design – Concrete Frame

### Enhancements Implemented

*	Ticket	Description
	4928	An enhancement was added for CSA A23.3-14 concrete frame design code where torsional longitudinal rebar required on the tension and compression sides is now designed when combined axial force, torsion and shear exceeds the code allowable limit. Torsional longitudinal rebar is reported at top and bottom separately when tension and/or compression caused by combined axial, shear and torsion are more than the flexural longitudinal rebar.

## Design – Steel Frame

### Enhancements Implemented

*	Ticket	Description
	4045	An enhancement has been made in the Russian steel frame design code SP 16.13330.2017 for buckling calculations of channel sections under the combined action of axial compressive force and moment in the plane coinciding with the symmetry plane. Now the design no longer checks interaction Eqn. 70 of SP 16.13330.2017 section 8.1.4, which corresponds to the case of bending without axial force. Only Eqns. 109 and 111 of SP 16.13330.2017 section 9.2 need to be checked in the presence of compressive force, and this has not been changed. Previous results were overly conservative when also considering Eqn. 70.
	4055	An enhancement has been made in the Russian steel frame design code SP 16.13330.2017 to distinguish between the two $\phi_c$ factors which are reported: (1) $\phi_c$ from Table 21, and (2) the $\phi_c$ factor from clause 7.1.5 to be used in Eq.10. The second one is calculated only for channel sections. This is now clarified by specifying the corresponding clauses in the header of the table. This was a reporting only issue.
	4058	An enhancement has been made to the Russian steel frame design code per the Change 2 of SP 16.13330.2017 (SP 16.13330.2017 7.1.3, Table 7), where for the buckling check of I-shaped sections, the following buckling curves are now used: (i) The buckling curve "b" is used for the major direction buckling for all rolled or welded, doubly-symmetric I-shapes except for case (ii). (ii) The buckling curve "a" is used for the major direction buckling of all rolled, doubly-symmetric I-shapes with the depth of the section along the web direction more than 500 mm. (iii) The buckling curve "c" is used for the major direction buckling for all rolled or welded, singly-symmetric I-shapes, and (iv) The buckling curve "c" is used for the minor direction buckling for all rolled or welded, singly-symmetric or doubly symmetric I-shapes. The buckling curves are used in the determination of axial compression capacity per clause SP 16.13330.2017 7.1.3.
	4064	An enhancement was made to the Russian steel frame design code SP 16.13330.2017 where now the maximum elastic shear-stresses and the maximum elastic combined-stresses are checked by comparing them with $R_s \cdot \Gamma_c$ and $R_y \cdot \Gamma_c / 0.87$ , respectively, at the critical points per the code (SP 16.13330.2017 Eqn. 42, Eqn 44, Section 8.2.1) for the following sections: Singly-symmetric I-shape, Channel, T-shape, Double Angle, and Box sections per the code (SP 16.13330.2017 Eqn. 42, Eqn 44, Section 8.2.1.). Previously, those checks were performed only for the following sections: Doubly-symmetric I-shape, Double Channels, Rectangular shape, Pipes, and Circles. These checks are not performed for any Section Designer, General, or Angle sections. The average shear checks based on $Q3/Av33$ and $Q2/Av22$ are checked by comparing them with $R_s \cdot \Gamma_c$ for all shapes as a simplified measure. These simple checks are still done. The previous results were slightly unconservative for the new considered shapes.

* Ticket	Description
4671	An enhancement has been made for the Eurocode 3-2005, Italian NTC 2008, and Italian NTC 2018 steel frame designs to allow the shear center coordinate, $z_s$ , and lateral-torsional buckling (LTB) moment capacity, $M_{cr}$ , for bending about major axis to be overwritten in the design overwrites form. In addition, the design buckling resistance moment $M_{b,Rd}$ for section designer and general sections have been updated to include the factor $ChiLT$ due to effects of $M_{cr}$ in the calculation.

## External Import and Export

### *Enhancements Implemented*

* Ticket	Description
4652	The CSI Cloud Explorer has been made compatible with SAP2000 v22.
4734	An enhancement was made to import solid primitives from AutoCAD DWG files.
5172	An enhancement was made to the import of .exr files from Revit. The Revit orientations of framing elements with angle, double-angle, tee, and channel sections are now imported. Note that this enhancement requires that the .exr files be created in Revit 2021.
5359	Two related enhancement were made to the export of area objects to .exr files. (1) Nearly vertical area objects, with up to 15 degrees inclination from the vertical plane, are now exported to .exr files. Previously they were omitted. (2) Area objects with an inclination included between 15 degrees and 45 degrees from the vertical are now exported as slanted Revit walls instead of Revit ramps. Note that slanted walls can only be imported into Revit 2021 and that several Revit related restrictions, documented in the CSiXRevit 2021 Manual, apply.
* 5364	An incident was resolved affecting the import of IFC files that describe structures in "structural analysis view". When importing IfcStructuralPointConnection, IfcStructuralCurveMember, and IfcStructuralSurfaceMember objects whose ObjectPlacement attribute referred to an IfcLocalPlacement that in turn had a PlacementRelTo attribute, SAP2000 did not take into account that last attribute. The PlacementRelTo attribute indirectly referred to in IfcStructuralPointConnection, IfcStructuralCurveMember, and IfcStructuralSurfaceMember objects is now taken into account when these objects are imported in SAP2000. Not taking that attribute into account typically shifted the entire structure from its location in the originating software, but did not affect the analysis results. The import of IFC files that describe structures in "architectural coordination view" was not affected. This incident affected all versions of SAP2000 capable of importing IFC files that describe structures in "structural analysis view". A related enhancement was also made. Objects imported from all IFC files are now imported in local coordinates relative to the site coordinate system, instead of in global coordinates. The location and rotation of the site coordinate system are stored in the SAP2000 model. If the structure is re-exported, the location and rotation of the site are included in the export, and the ObjectPlacement attribute of the exported IFC objects is exported as a compound transformation that explicitly refers to the location of the site and to the relative coordinates visible in the SAP2000 model.

## Installation and Licensing

### *Enhancements Implemented*

* Ticket	Description
* 4594	The version number has been changed to v22.2.0 for a new intermediate release.

## Loading

### *Enhancements Implemented*

*	Ticket	Description
	5351	An enhancement was made to the Eurocode 8:2004 auto seismic load pattern and response spectrum function for the Portugal National Annex where the S factor now incorporates the ground acceleration $a_g$ when greater than $1.0 \text{ m/s}^2$ .

## Results Display and Output

### *Enhancements Implemented*

*	Ticket	Description
*	920	An enhancement was done to update the Response Spectrum Generation form and Response Spectrum Curves form used when creating a response spectrum from a joint time history to more clearly display the data.

## Structural Model

### *Enhancements Implemented*

*	Ticket	Description
*	4718	An enhancement has been made to allow auto-hinges for steel and concrete beams and columns to be defined (backbone curve and acceptance criteria) based on rules in ASCE 41-17. This is an update to hinge definitions based on ASCE 41-13, which option is still available.

## User Interface

### *Enhancements Implemented*

*	Ticket	Description
	4868	The Display Deformed Shape form as been modified so that it fits better on monitors with lower resolution.

## Analysis

### Incidents Resolved

*	Ticket	Description
	4365	An Incident was resolved where a steel or concrete parametric PMM hinge with an "Elastic Perfectly Plastic" curve shape and with strength loss enabled would use axial force and moment values at points D and E that were different than the values specified in the Force-Deformation Data form. The axial force and moment values at points D and E used for analysis were equal to the force or moment at point U multiplied by the force parameter "Ratio Point D/Point B" and the force parameter "Ratio Point U/Point B", which are hidden for a "Elastic Perfectly Plastic" but have a default value of 1.5. This issue only affected the force and moment values at points D and E for Elastic Perfectly Plastic parametric PMM hinges, and it affected all nonlinear load cases.
*	5124	An issue was resolved where a Nonlinear Static load case with the Load Application Control option set to "Displacement Control" could produce results that were dependent on the scale factor of the applied load. This occurs if the model had shell objects, the Geometric Nonlinearity Parameter was set to "P-Delta", and the Nonlinear Parameters options "Use Event-to-event Stepping" and "Use Iteration" were set to "Yes" and "No", respectively. This issue only occurred for non-iterative event-to-event analysis and, generally, a larger load scale factor would result in smaller equilibrium error at each step. Very small differences may now still be exhibited for sensitive models, but they are not of engineering significance.
	5252	An incident was resolved where the analysis failed to run with a nondescript error message, and then caused the user interface to become non-responsive, if the full path to the model file contained illegal characters and/or characters from a Windows System Locale different than the current setting. Now a proper error message is displayed and the control is returned to the user. Corrective action by the user will still be required to run the model, either by modifying the model filename and path or the Windows System Locale to be consistent with each other.

## API

### Incidents Resolved

*	Ticket	Description
	4637	An incident was resolved for the Application Programming Interface (API) functions CableObj.AddByCoord and CableObj.SetLoadTargetForce which did not correctly convert the input parameters from the API current units to the model database units. When this issue occurred, the changes were consistent with the model shown in the graphical user interface.
	4918	An incident was resolved for the Application Programming Interface (API) where the function Results.FrameForce returned an error when used over the entire structure by setting the first parameter, "Name", to "ALL" and second parameter, "ItemTypeElm", to GroupElm (2). This issue only occurred for models that contained frame elements that were internally created from objects that were not frames, such as when edge constraints were used.
	5249	An issue was resolved for the Application Programming Interface (API) where the function Results.BaseReactWithCentroid was not able to complete successfully and always returned 1. Results were not available using this function. No other results were affected.

## Database Tables

### Incidents Resolved

*	Ticket	Description
	3406	An incident was resolved where on import the "Combination Definitions" table did not recognize the "None" option for the design items (e.g., field SteelDesign). This issue was corrected for version 22.0.0, but inadvertently omitted from the release notes.

	4360	An incident was resolved where displaying a report when using user-defined table names may have caused an exception.
	4697	An incident was resolved in which the ASCE 7-16 response spectrum database table was not exported to Excel. This was a table export issue only and did not affect results. Other export formats were not affected.
	4898	An incident has been resolved to properly export and import the core dimensions of section designer sections with rectangular or polygon shape to/from the model text file (.s2k). In addition, the program determined core dimensions are also updated immediately after the shape is changed using the reshaping tool.

## Design – Cold Formed Frame

### Incidents Resolved

*	Ticket	Description
	4733	An incident has been resolved to correctly select the lightest section within the auto-select list for cold-formed design. Previously the lightest section was not always selected. Design results may change for existing models run in the new version.

## Design – Concrete Frame

### Incidents Resolved

*	Ticket	Description
	5354	An incident was resolved for AS 3600-2018 concrete frame design where torsional longitudinal rebar was reported by combining the top and bottom longitudinal torsional rebar instead of reporting the additional torsional longitudinal rebar at the top and bottom separately. This was producing overly conservative results. Now, additional torsional longitudinal rebar is reported in both the design output and the tabular output for top and bottom locations separately. Reported torsional longitudinal rebar is in addition to the flexural reinforcement.

## Design – Steel Frame

### Incidents Resolved

*	Ticket	Description
	1833	An incident was resolved in the steel frame design codes AISC 360-05, AISC 360-10, and AISC 360-16 in which the moment capacity in the major principal direction of an angle section for the limit state of yielding was being calculated based on the geometric axis instead of the principal axis. The design moments are now transformed to the principal axis. This issue was resolved for version 22.1.0 but was inadvertently omitted from the Release Notes.
	3022	An incident was resolved to correct the calculation of the lateral-torsional buckling moment for singly-symmetric I-sections using the AISC 360-10 ASD steel frame design. Previously, the calculated moment was relatively conservative.
	4036	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where the Phi buckling factor could be calculated incorrectly for the buckling curve "c" when lambda_bar was near zero due to the numerical sensitivity of the code equation at that limit. Phi should be equal to 1.0 for lambda_bar = 0.0 per the specification SP 16.13330.2017 Annex E, Table E.1. Now the value of Phi will be set to 1.0 as lambda_bar approaches zero.
	4038	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where now the factor phi_y (phi for minor direction bending, or phi for major direction bending only if I22 > I33) is used in the calculation of beta per Table 21 and in the calculation of c per Eqns. (113) and (114). Previously the minimum of phi for the major and minor directions of bending was being used. This change affects the calculation of factor c, which is used in the interaction Eqn. (111) (SP 16.13330.2017 section 9.2.4, Table 21).

4040	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where, for non-rolled I-sections (user-defined/parametric/welded frame section properties or for frame members with assigned "Rolled = No" overwrite), the height $h$ is now taken as equal to the distance between centerlines of the top and bottom flanges per the code specification (SP 16.13330.2017 Eqn. G.5, Annex G). Previously the full height of the section was used instead of the distance between centerlines of the top and bottom flanges, and the results were slightly unconservative.
4042	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where now, when simply-supported beams are checked against shear at the support stations, flanges are ignored in Eqn. 42 of SP 16.13330.2017 section 8.2.1, which is used for shear strength calculation. According to the code, shear force shall be undertaken by only the web at the support stations. Previously flanges were included in the calculation, which could be slightly unconservative.
4046	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where, for a Channel section when the moment about the axis of symmetry is zero (major axis bending, $M_{33}=0$ in ETABS terms), the power term $n$ used in the interaction equation SP 16.13330.2017 9.1.1 is now taken as equal to 3 when $M_{22}$ is zero or positive (the flange tips are in tension), and equal to 1 when $M_{22}$ is negative (the flange tips are in compression) based on SP 16.13330.2017 Annex F, Table F.1 case 9. Previously, for a Channel section when the moment about the axis of symmetry was zero, $n$ was taken as 1 whether $M_{22}$ was positive, negative, or zero. However, when the major axis bending moment is nonzero or nontrivial, the power term $n$ is taken as 1.5, which has not changed. Previously the design was slightly conservative.
4047	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where now the calculation $A_f/A_w$ for box tube shapes uses the ratio of the flange area bounded by the web centerlines to the web area bounded by the flange centerlines. Previously, $A_f/A_w$ was calculated using the gross flange area and the clear web area. This affects the calculation of $c_x$ and $c_y$ per the code (SP 16.13330.2017 Annex F, Table F.1).
4051	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where the calculation $A_f/A_w$ for minor axis bending of singly-symmetric I-shaped sections now takes the area of the web $A_w$ as the sum of the two unequal flanges (SP 16.13330.2017 Annex E, Table E.2). Previously, $A_w$ was taken as two times the top flange area. The value of $A_f$ is taken as the clear area of the web, which is unchanged. The calculation of $A_f/A_w$ for major axis bending remains unchanged. The $A_f/A_w$ ratio affects the calculation of $\eta$ , which then affects $m_{ef}$ and $\phi_{y_{ey}}$ per the code (SP 16.13330.2017 Annex E, Table E.3, 9.2.2).
4054	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 in which the buckling factor $\phi_e$ for $\lambda_{bar}$ between 0.0 and 0.5 ( $0.0 < \lambda_{bar} < 0.5$ ) was previously determined by linear interpolation between the values of $\phi_e$ for $\lambda_{bar} = 0.0$ and $\lambda_{bar} = 0.5$ . However, since the $\phi_e$ for $\lambda_{bar} = 0.0$ is not given in the code (SP 16.13330.2017 Annex E, Table E.3), $\phi_e$ for $\lambda_{bar} = 0.0$ was conservatively assumed to be 1.0 for all values of $m_{ef}$ . Now, the $\phi_e$ for $\lambda_{bar}$ between 0.0 and 0.5 is calculated instead by linear extrapolation backward from the values of $\phi_e$ for $\lambda_{bar} = 0.5$ and $\phi_e = 1.0$ . The previous method was conservative for large values of $m_{ef}$ .
4059	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where now, when the buckling check for box sections subjected to axial compression with uniaxial or biaxial flexure is performed, the design checks both Eqn. 120 and Eqn. 121 (SP 16.13330.2017 section 9.2.10). Previously, this check was performed using only one of these equations, depending on the plane in which the moment was applied. The previous approach was slightly unconservative.
4060	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where the shape influence coefficient ( $\eta$ ) for T and double-angle sections for bending in the plane of the minor axis is now calculated assuming section type 8 per the specification SP 16.13330.2017 Annex E, Table E.2. Previously, section type 5 was assumed for this case. The $\eta$ factor is used in clause SP 16.13330.2017 9.2.2.



4061	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where now, when the buckling check for box sections subjected to axial compression with uniaxial or biaxial flexure is performed, the design checks both Eqn. 120 and Eqn. 121 (SP 16.13330.2017 section 9.2.10) with the replacement of $\phi_x$ for $\phi_{ex}$ or $\phi_y$ for $\phi_{ey}$ as appropriate ( $I_x > I_y$ and $M_y = 0$ for Eqn. 120; $I_y > I_x$ and $M_x = 0$ for Eqn. 121). Previously, this check was performed using only one of these equations, depending on the plane in which the moment was applied. The previous approach was slightly unconservative.
4062	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 where, for a singly-symmetric I-shaped section when the moment about the major axis is zero (major axis bending, $M_{33}=0$ in SAP2000 terms), the power term $n$ used in the interaction equation SP 16.13330.2017 9.1.1 is now taken as equal to 3 based on SP 16.13330.2017 Annex F, Table F.1 case 6, similarly to doubly-symmetric I-shapes. Previously for this case, $n$ was taken as 1.5. Now, for a singly-symmetric I-shaped section: (a) $n=2$ when $M_{33}$ is significant and $M_{22}=0$ (case 2) or when neither of them is significant, (b) $n=3$ when $M_{22}$ is significant and $M_{33}=0$ (case 6, similar to doubly symmetric I-shapes), and (c) $n=1.5$ when both moments are significant (table note*). The only change was for condition (b). Conditions (a) and (c) are unchanged. Previously condition (b) was treated as a condition (c).
4063	An incident has been resolved in the Russian steel frame design code SP 16.13330.2017 for singly-symmetric sections, especially for a singly-symmetric I-shaped section and when plastic strains are allowed, where now the different values of the section modulus $W_y$ for the tips of the top flange and the bottom flange are used in the calculation of interaction ratios per Eqn. 105 of SP 16.13330.2017 section 9.1.1. Previously, the design was using the minimum of $W_{y,top}$ and $W_{y,bottom}$ for both top and bottom corner points. Now the design uses Eqn. 105 for all extreme corner points with the appropriate section modulus for each point. All singly symmetric sections (singly-symmetric I-shape, Channel, T-shape, and Double Angle) are affected.
5215	An incident was resolved for the NZS 3404-1997 steel frame design where requesting the right-click design details for a solid rectangle (flat plate) section would generate an error. This was a results display issue only and did not affect the on-screen and database table results.

## Documentation

### Incidents Resolved

*	Ticket	Description
	4716	An incident was resolved where the steel frame design manuals for EC 3-2005 and NTC 2018 incorrectly documented the equation used for plastic shear resistance accounting for torsion for hollow shapes. This was a documentation issue only and did not affect the design algorithm or any results.

## Drafting and Editing

### Incidents Resolved

*	Ticket	Description
	4667	An incident was resolved where an unexpected error message was generated when attempting to join two or more frame objects using the command Edit > Edit Lines > Join Frames. This occurred even when the operation should have been valid.

## External Import and Export

### Incidents Resolved

* Ticket	Description
3038	An incident was resolved which affected the import of DXF files. After importing a DXF file defined in AutoCAD units other than the model current units, the model current units were changed but the units drop-down list at the bottom right of the user-interface did not reflect the change. This was a display problem in the user-interface and did not affect the validity of the imported model.
5329	An incident was resolved where using the File > Import > Modify STRUDL Section Cut command was not prompting for a file, therefore preventing the command from functioning.

## Graphics

### Incidents Resolved

* Ticket	Description
3394	An incident was resolved where the colors of back face would not display correctly when transparency was turned ON and the directional light was off in DirectX graphics mode.
4583	An incident was resolved related to legends on contour plots when using DirectX graphics mode. For 3D views the numbers were not located correctly and for 2D views the legend itself was missing.
4607	An incident was resolved where springs applied to solid object surfaces would not display in the analysis model view.
4644	An incident was resolved where joint symbols would not display correctly when animation was turned on in DirectX graphics mode. The joint display size was too small and has been corrected.

## Loading

### Incidents Resolved

* Ticket	Description
* 4506	An incident was resolved where importing a KBC 2009 or a KBC 2016 or a TSC 2018 Response Spectrum function from a text file (.S2K, \$2K), database-table file (Excel, Access, XML), or the interactive database editor caused the two specified site coefficients Fa and Fv to be ignored and set to 1.0. This generated an incorrect response-spectrum function that could significantly affect analysis results when used in a response-spectrum load case. Using the menu command Define > Functions > Response Spectrum Functions to modify/show the function would restore the affected site coefficients to correct program calculated values, and the curve displayed correctly. Clicking OK would then save the correct values for analysis, but clicking Cancel would not. The new version will automatically correct the response spectrum when the model is rerun.
* 4939	An incident was resolved where a nonlinear static, staged-construction, or direct-integration time-history load case that had loads with a scale factor of exactly zero (0) could apply additional frame loads that were not specified in the load case. This issue only occurred for load cases that continued from the end of another nonlinear static, staged-construction, or direct-integration time-history load case and that applied frame loads in a load pattern, scaled by zero, that was also applied in the previous nonlinear load case (or one if its predecessors). When this issue occurred, the load pattern scaled that was scaled by zero was being applied with a scale factor from some other load pattern in the same load case. The extra loads were reflected in all analysis results, including base reactions and frame reactions. This issue affected SAP2000 v21.1.0 to v22.1.0.

## Results Display and Output

### Incidents Resolved

*	Ticket	Description
	3034	An incident was resolved where the weight modifier specified for the section was not being applied when calculating the deformed shape of a frame for display when the cubic curve option was on. This was a display issue only and no results were affected.
	5203	An incident was resolved in which the generated reports were sometimes unable to be opened in Word when they contained images. This was a report generation issue only and did not affect results.
	5245	An incident was resolved where elements that are removed during a Direct-Integration Time History load case using the "Consider Collapse" option were still displayed in the deformed shape after removal in SAP2000/CSIBridge v22.1.0. This was a display issue and did not affect the analysis results.
	5306	An incident was resolved where the signs of forces shown for a Section cut drawn on screen was flipped when in DirectX display mode. This did not affect standard-graphics mode.

## Structural Model

### Incidents Resolved

*	Ticket	Description
	3036	An incident was resolved where section cut forces defined by a group and including a shell joint where the shell edge has specified releases could be incorrect. This has been corrected. This error did not affect section cut forces where the cut line was itself defined.
*	4808	An incident was resolved for bridge foundation modeling where deleting all the soil layers when defining an advanced foundation property would cause the software to terminate abnormally next time the same foundation property was viewed for editing. Note that when an affected model from a previous version is opened in the new version of the software, the affected foundation properties will be lost and will need to be redefined. The new version allows foundation properties to be defined that have no soil layers.
	4902	An incident was resolved where, for a Parametric P-M2-M3 hinge with a Moment-Curvature hinge specification type, the tension and compression deformation scale factors were shown with displacement units in the Hinge Property Data form, but are actually considered as strains for analysis. The Hinge Property Data form has been updated to be consistent with analysis.
	5305	An incident has been resolved for Section Designer in which the rebar material for rebar objects (single bar, line, rectangle, circle) could not be changed as intended. Attempts to change the rebar material would result in the last available rebar material being selected. Results agreed with the actual rebar material shown in the rebar shape definition.
	5348	An incident was resolved in the New Zealand material property library in which the modulus and strength values of the aluminum material were previously defined in the wrong units. Existing models using the aluminum material from this library should be reviewed. Results agreed with the property values as imported into the model from the library.

## User Interface

### Incidents Resolved

*	Ticket	Description
	2197	An incident was resolved where custom menu shortcut keys for plugins on the Tools menu were not being saved.
	2388	An incident was resolved in which the software would not start from a Windows shortcut if the "Run" option in the shortcut properties was changed to "Maximized".
	3005	An incident was resolved where the drafting reshaper tool would not work correctly for area objects. This usually happened when multiple joints of the area were moved in one edit. When this happened the error was obvious.
	3033	An incident was resolved where the joint offsets were not correctly interpolated when dividing frames using the frame divide command on the edit menu.

*	Ticket	Description
	4659	An incident was resolved where two items were corrected in the form for Interpolating Damping by Period or Frequency parameters in a time history load case: (1) An abnormal condition occurred when deleting a row. (2) When modifying a damping value the new value would be lost when the Modify button was clicked.
	4719	An incident was resolved on the TSC-2018 seismic load pattern form where the SD1 input label was shown as SDS. This was only an error with the text on the form and did not affect results.
	5174	An incident was resolved where, for the Pratt truss new-model template, the image showing the parametric parameters would not display. This was a user interface issue only.
	5219	An incident was resolved where changing the load case list order in the load case definition form changed the damping values assigned to the cases.
	5292	An incident was resolved in which an error was generated when creating or editing a load case while the model alive feature was enabled. No results were affected.