SAP2000® Version 18.1.0
Release Notes

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Notice Date: 2016-02-12

This file lists all changes made to SAP2000 since the previous version. **Most changes do not affect most users.** Incidents marked with an asterisk (*****) in the first column of the tables below are more significant.

Changes from v18.0.1 (Released 2015-11-12)

User Interface
Enhancements Implemented

*	Incident	Description
	84548	An enhancement has been implemented on the Change Labels form to leave the form open if any of the rows are found to contain invalid data. Previously the form would close without changing the model and all edits in the form would be lost.
	85315	An enhancement has been implemented to add an Apply button to some of the Display menu command forms and allow them to remain open (floating) for continual use.
	87304	An enhancement has been implemented to update the icons on some of the toolbars to be consistent with the icons on the menus.

Graphics
Enhancements Implemented

*	Incident	Description
*	17606 18914 22354 42071 58825	An enhancement was implemented to display in a single view all loads (joint, frame, area, solid, and link) applied in a single load case using the Display > Show Load Assigns > Load Case command. Individual load patterns within a load case can also be displayed.
*	85379	An enhancement has been implemented to graphically display the loads acting on the model for each stage of a staged construction load case using the Display > Show Load Case Tree command.

Modeling
Enhancements Implemented

*	Incident	Description
	83548	An enhancement has been implemented to provide an option to replicate or copy/paste the load transfer options assigned to a frame object.
	87413	An enhancement has been implemented to incorporate a library of steel, concrete, and rebar material properties for New Zealand.
*	88449	The behavior of fiber PMM hinges has been enhanced to remove double-counting of the elastic flexibility in frame members. The elastic flexibility of the frame section now will be set to zero for a tributary length of the member equal to the hinge length of the fiber hinge, so that all elastic flexibility over that length is represented only by the fibers in the hinge. For bending behavior this works best when the hinge is located at the center of its tributary hinge length (axial behavior is not affected significantly by location). The tributary hinge lengths will be shifted as necessary so that they do not overlap the ends of the member or end offsets, and so that they do not overlap each

*	Incident	Description
		other in the case of multiple hinges. In some cases this may mean that the hinge is not centered in the tributary hinge length, particularly for hinges at the ends of the member. In this latter case better results will be obtained if the hinges are located a half hinge length from the end. For hinge lengths that exceed the length of the element, adjacent elements will not be adjusted and some double counting of elastic flexibility will remain in the model due to the adjacent elements. For this reason it is not recommended to use object or element discretizations that are smaller than the hinge lengths. When frame hinge overwrites are assigned to automatically subdivide at hinge locations, this discretization will now be limited at fiber hinges to be no smaller than the hinge length, provided that no other specified discretization is applied near the hinge. Overall this enhancement will tend to affect the results for all models that use fiber hinges when compared with previous versions of the software, although the effect will be limited in most models where the hinges do not dominate the model. Affected models will tend to be stiffer. Only fiber PMM hinges are affected by this enhancement.

Section Designer
Enhancements Implemented

*	Incident	Description
*	86848	The calculation of the idealized Caltrans moment-curvature relationship has been changed to better capture the significant failure of concrete material. This may change results obtained from nonlinear static and nonlinear direct-integration load cases when using Caltrans hinges in frame members. Hinges with a single concrete model (one material, all confined or all unconfined) will not be affected. Affected models are likely to be more ductile now. By definition, the Caltrans idealized moment-curvature relationship exhibits an ultimate curvature based on the first failure of the steel (rebar or tendon), concrete, or a user-specified curvature. This enhancement affects only the determination of concrete failure. Previously, the failure curvature for concrete was determined as being when the extreme compression fiber over all concrete in the section reached a specified ultimate strain. That ultimate strain was either the maximum or minimum of the ultimate strains over all concrete models in the section, as specified by the user, with the default being to use the maximum. For the common case of a confined concrete core with an unconfined concrete outer ring, this resulted in checking when the outer edge of the unconfined concrete reached the ultimate strain of the confined concrete, which tended to be over-conservative. Three changes have been made: 1.) The user can choose whether to consider the maximum or minimum ultimate strain over all concrete models, or just over the confined concrete models. When the section has no confined concrete models, then both methods are the same and consider all the unconfined concrete. Note that materials having user-defined stress-strain curves are considered as unconfined for this purpose. 2.) The failure curvature for concrete is now determined as being when the extreme compression fiber of only the concrete having the controlling ultimate strain reaches its ultimate value. All other concrete is ignored. 3.) The default for Caltrans hinges is to consider the minimum ultimate strain over just the confined concrete if any confined concrete is present. If there is no confined concrete models in the section, then the previous default will be used, which will consider the maximum ultimate strain over all concrete models. Considering these three changes, most models having confined concrete in the core will only be affected by the fact that the extreme fiber will now exclude the outer layer of unconfined concrete which spalls off. This will produce a more ductile and meaningful result. This new behavior is available in Section Designer for plotting the moment-curvature relationship, but the only effect upon results is for Caltrans frame hinges.

Loading
Enhancements Implemented

*	Incident	Description
	86425	An enhancement has been implemented to update the Chinese auto wind load to GB 50009-2012.

Analysis
Enhancements Implemented

*	Incident	Description
*	68068 85147	An event-to-event solution strategy has been implemented as an option for nonlinear direct-integration time-history load cases. This is similar to the use of events as already available for nonlinear static load cases. Time steps will be automatically subdivided where significant changes occur in the stiffness of certain elements and hinges, such as at yielding, unloading, or strength loss. Iteration is performed at the end of the full time step as needed to achieve convergence. Previously the event-to-event option was available but had no effect. By default event-to-event stepping is turned off for each time-history load case so as to preserve the previous behavior. Additionally, events have been added for more types of elements and hinges. Previously events were only implemented in nonlinear static load cases for single-degree-of-freedom hinges and isotropic interacting hinges. Events are now implemented for the following nonlinear models: all frame hinges; layered shells with directional or coupled nonlinear behavior; and links with multi-linear plasticity, gap, hook, friction pendulum, and triple pendulum behavior. Event-to-event functionality has also been enhanced for frame hinges to better handle cyclic reversals. As a result of these additions, results for nonlinear static load cases using events may differ somewhat from previous versions, although the results are expected to be within the specified convergence tolerance for most models. Differences may be more pronounced for sensitive or ill-conditioned models. The purpose of using events is to increase the speed of analysis, but for certain models and load cases it may have little effect or even the opposite effect. Analysis verification example 6-003, has been updated to reflect this change.
*	86727	The option to change link properties has been added to staged-construction load cases. When this operation is performed on one or more link objects in a construction stage, the objects are effectively removed from the structure along with the loads they are supporting, new unstressed link objects added in their place having the specified new properties, and the previously supported loads reapplied. This is the same behavior as is currently available for changing frame sections and shell sections. In addition, link properties can be changed to and from "None", which is equivalent to the object being absent from the model. The "None" property can also be assigned to a link object as well, such that the default is for the link object to be absent from the model until the link property is changed during staged construction. Note, if the original link property is defined with any 'fixed' degrees of freedom, those 'fixed' degrees of freedom from the original link property will still be present after changing the link property.
	87461	The analysis log file (.LOG) now produces a warning message whenever negative stiffness eigenvalues are detected during the linear equation solution phase that precedes linear static, multi-step static, modal, buckling, moving load, and/or hyperstatic load cases. The number of negative stiffness eigenvalues was already being reported as the number of eigenvalues below the shift, but now an explicit warning is added when this number is not zero to emphasize that these may represent instabilities in the model, possibly due to P-delta effects.

Frame Design
Enhancements Implemented

*	Incident	Description
*	83107	An enhancement has been implemented to add concrete frame design according to the Russian SP 63.13330.2012 code.
	86108	The simplified column design procedure previously available for Chinese 2010 concrete frame design has been removed. Only the PMM (Appendix F) design method is now available for concrete column design which provides a more rational approach for designing columns.
	86407	An enhancement has been implemented for the NTC 2008 steel frame design code to assume a root radius dimension equal to the flange thickness when the root radius dimension is not specified for rolled sections.

Results Display & Output
Enhancements Implemented

*	Incident	Description
	83384	An enhancement was implemented to display an error message when attempting to display shell reinforcement design data for shells with defined reinforcement cover values that are not valid compared to the thickness of the shell.

Database Tables
Enhancements Implemented

*	Incident	Description
	87270	An enhancement has been implemented to add an Order column to the Connectivity - Area database table. This field indicates the order of the rows when an area object has more than four points, requiring multiple rows to present the joint connectivity.

Application Programming Interface
Enhancements Implemented

*	Incident	Description
	61002	An enhancement has been implemented, adding new API functions to allow working with the response spectrum function, auto seismic load pattern, and auto wind load pattern, according to NTC 2008.
	81245	An enhancement has been implemented in the API to allow setting of the design option Automatically Generate Code-Based Design Load Combinations.

Installation and Licensing
Enhancements Implemented

*	Incident	Description
	85637	An enhancement was implemented to associate the *.sdb file type with SAP2000 such that double-clicking a *.sdb model file will directly open it in SAP2000.

Miscellaneous
Enhancements Implemented

*	Incident	Description
	85447	The version number has been changed to v18.1.0 for a new intermediate release.

User Interface and Display
Incidents Resolved

*	Incident	Description
	85686	An incident was resolved in which the Define Grid System Data form mistakenly labeled the Y Grid data as X Grid Data. This was a user interface issue only.
	85767	An incident was resolved in which it was not possible to delete a row from the elevation and diameter data table in the storage structures template form. This was a user interface issue.
	85868	An incident was resolved in which reviewing a response spectrum load case in the Load Case Data form after running the analysis would not show the loads applied. This was a user interface issue only and did not affect results.
	85892	An incident was resolved in which the Analyze > Modify Undeformed Geometry command was not enabled when only a modal and/or buckling load case was run. This was a user interface issue only.
	86530	An incident was resolved in which the Replicate Options form would initially open displaying the wrong set of checkboxes in the leftmost column. After switching to the Loads and Design tab and switching back, the correct checkboxes were available. This was a user interface issue only.
	86751	An incident was resolved in which an abnormal termination could occur when trying to assign the same load combination to both strength and deflection checks for steel frame design. No results were affected.
	87210	An incident was resolved in which an abnormal termination could occur on some machines when trying to add a Mexico CFE-2008 response-spectrum function. No other results were affected.

Modeling
Incidents Resolved

*	Incident	Description
	83231	An incident was resolved in which the active degrees of freedom of a model were all reset to being selected when importing and appending a model file that didn't define the active degrees of freedom.
	86348	An incident was resolved in which assigning a None joint constraint via the Assign > Joint > Constraints command did not work and would therefore would not remove previously assigned joint constraints. Only versions 18.0.0 and 18.0.1 were affected.
	87570	An incident was resolved in which the major axis plastic section modulus, Z33, was incorrectly calculated for unsymmetrical I/Wide-flange sections in the rare case the plastic neutral axis was located in the top flange. Any design results for these sections would have reflected this plastic section modulus value.
	88178	An incident was resolved in which the shear center eccentricity value for Section Designer sections was incorrectly being reported as having a value. The shear center eccentricity is currently not calculated for Section Designer sections and as such should have been displayed as zero. This only affected the value displayed in the Property Data form. The analysis results were not affected.

Section Designer
Incidents Resolved

*	Incident	Description
*	81352	An incident was resolved where Fiber P-M2-M3 nonlinear hinges assigned to frame objects having Section Designer frame section properties used the fiber layout specified for the first Section Designer section that was defined in the model, regardless of the actual Section Designer section assigned to the frame object. This error only affected fiber hinges that took their fiber layout from the section, not user-defined fiber layouts. When this occurred, the actual fiber layout used could be seen in the definition of the generated hinge, and results were consistent with that layout.
	83483	An incident was resolved for Section Designer in which the section properties could be calculated incorrectly for a section having more than one shape and where straight edges from two of the shapes were coincident, but only in the uncommon case where one or both of the coincident straight edges contained an intermediate point between the two ends of the straight edge.

*	Incident	Description
*	84279	An incident was resolved for Section Designer where the stress-strain curve used for rebar when calculating the moment-curvature relationship could be incorrect in the case where: (1) the rebar material was defined with a parametric nonlinear stress-strain curve and the Parametric Strain Data option was selected to "Use Caltrans Default Controlling Strain Values (Bar Size Dependent)", and (2) the Section Designer (SD) section included either a rectangular or polygonal concrete shape with rebar or a rectangular rebar shape. When both were true, all rebar in the shapes of item (2) used the Caltrans controlling strain value corresponding to a #5 rebar (0.625 in. or 15.875 mm diameter), regardless of the specified rebar sizes. This could affect the displayed moment-curvature relationship, as well as any frame hinge properties generated from the SD section, whether a Caltrans or fiber PMM hinge. Only nonlinear static and nonlinear direct-integration time-history load cases were affected by this error, including automated bridge seismic design. Concrete frame design and bridge superstructure design and rating were not affected except possibly to the extent that a nonlinear static or direct-integration load case with significant nonlinear deformation was included in a design load combination. Note that by default the option of item (1) is NOT selected, and hence most models were not affected. Caltrans and circular shapes were not affected. The actual stress-strain curve used for the rebar was shown in Section Designer by right-clicking on the concrete shapes of item (2). This has been enhanced to be displayed for individual rebar depending on their actual size.
	84937	An incident was resolved for Section Designer where the axial stress (S11) contours plotted in the Elastic Stress form could be incorrect for unsymmetrical sections having a non-zero cross-product of inertia Ixy. The error was particularly noticeable when one of the boxes Mx or My was unchecked, which should behave as if the corresponding moment value is set to zero. This was a display issue only and no other results were affected. In addition, minor cosmetic changes were made to show the x-y and 2-3 axes, and to rename the shear stresses shown for torsion from S2z and S3z to S12 and S13. The Elastic Stress form is shown using the Section Designer command Display > Show Stresses.
	85991	An incident was resolved in which the list for the name of a shape in a section designer section would not drop down when left-clicked. This was a user interface issue.

Loading
Incidents Resolved

*	Incident	Description
	83616	An incident was resolved in which modifying frame temperature loading using the interactive database editor would result in the new load value being added to the old value instead of replacing it. Reviewing the applied loads would show the additional loads and analysis results would also reflect the additional loads.
	86982	An incident was resolved in which the Assign > Area Loads > Wind Pressure Coefficients (Shell) command would always assign the pressure coefficients as windward even if specified to be assigned as Other. The results agreed with the model.
*	87055 87103	An incident was resolved where area uniform loads applied to areas with "None" properties could cause an error when the analysis is run or the load may get transferred to a joint connected to a different area. This error only affected loads applied as area uniform loads to "None" areas. It did not affect wind pressure or other types of loads on "None" areas or any load to areas with real properties.
	87891	An incident was resolved in which some of the auto-lateral seismic load pattern parameters could have been saved incorrectly when using region settings that used a comma as the decimal separator. This affected the UBC 94, UBC 97, UBC 97 Isolated, BOCA 96, and IS 1893:2002 auto-seismic loading. When this occurred the database tables would display the incorrect parameters and the analysis results would reflect the use of these incorrect parameters.

Analysis
Incidents Resolved

*	Incident	Description
	85558	An incident was resolved in which frame fiber hinges generated from Section Designer sections could get corrupted when opening a model saved by SAP2000 v15 and creating the analysis model. Usually the corrupted hinge definitions prevented the analysis from running, albeit it was possible for the analysis to run to completion using the corrupted data causing the results to be incorrect. Models that are originally created/saved in SAP2000 v15 and contained frame fiber hinges from SD sections should be re-translated and re-analyzed.
	87739	An incident was resolved where a file error message was generated when running the analysis using the Standard Solver and the equation block size was larger than 2 GB. This only occurred on machines having a large amount of RAM memory. When this occurred, analysis results were not available. This error did not occur when using the Advanced Solver (the default) or the Multi-threaded solver. This has been resolved by limiting the equation block size to 2 GB for the Standard Solver. Versions 17.2.0 to 18.0.1 were affected.

Frame Design
Incidents Resolved

*	Incident	Description
	85797	An incident was resolved for the Norsok N-004 steel frame design in which the design results for non-tubular sections could change after exporting and re-importing the model. The change in results was obvious, and was due to seismic provisions being considered after import for the non-tubular sections per the Eurocode-3 2005 code. Normally the Eurocode-3 2005 code without seismic provisions is used for the design of non-tubular sections when steel frame design is performed using the Norsok N-004 code. The effect of this error was over-conservative.
	85808	An incident was resolved where the moment and shear modification factors for seismic design of concrete columns under the Chinese design codes were not always correct for certain conditions.
	86174	An incident was resolved in which the steel frame design preference deflection limits could not be set to zero. Setting the value to zero is used to indicate that an individual type of deflection check should be ignored, and as a result all deflection checks were being performed if any deflection checks were requested. All steel frame design codes were affected. This error was over-conservative.
	86770	An incident was resolved for Eurocode 2-2004 concrete frame design using the Norwegian national annex, in which the minimum required reinforcement for columns was incorrectly calculated. The value previously calculated was conservative.

Results Display and Output
Incidents Resolved

*	Incident	Description
	86916	An incident was resolved in which the Pushover Capacity Curve table was not fully populated after closing and reopening a previously analyzed model.
	87793	An incident was resolved where the plotting of frame forces could be slow for models containing nonprismatic sections, particularly for load combinations. No results were affected.
	87964	An incident was resolved for ACI 318-11 and ACI 318-14 concrete frame design in which the right-click shear details output was not reporting the correct values for the shear rebar design phi*vc and phi*vmax. This was a reporting issue only and did not affect results.

Database Tables
Incidents Resolved

*	Incident	Description
	83542	An incident was resolved where the Lane Definition table had errors when edited in the interactive database.

*	Incident	Description
	83806 84187	An incident was resolved where the effective stiffness of Multilinear Plastic links was set to zero, after changing the effective properties using the interactive database editor table named Link Property Definitions 11 - Multilinear Plastic.
	84546	An incident was resolved in which an abnormal termination could occur when using the interactive database and trying to use the Excel > Retrieve Table from Excel command if the Excel file had already been manually closed.
*	85799 85835	An incident was resolved in which exporting tables to Microsoft Excel would fail on certain machines.
	85862	An incident was resolved in which the following database tables could include inaccurate data when the model included section designer sections made up of multiple materials with different mass and/or weight densities: 1) Group 3 - Masses and Weight, 2) Material List 1 - By Obj Type, 3) Material List 2 - By Sect Prop. Analysis results were not affected.
	87734	An incident was resolved in which the interactive database exported numbers to Excel using a text format rather than a number format.
	88139	An incident was resolved where models imported with user-defined wind loads may give an error message when the analysis is run.
	88289	An incident was resolved where editing frequency-dependent link properties in the interactive database when there were no regular link properties defined caused the frequency-dependent link properties to be deleted.

Data Files
Incidents Resolved

*	Incident	Description
	85668	An incident was resolved in which importing models via *.s2k, *.xls, *.mdb, or *.xml into v18.0.0 or v18.0.1 could fail if the steel frame design code was set to Eurocode 3-2005. Models opened from the *.sdb file were not affected.

Application Programming Interface
Incidents Resolved

*	Incident	Description
	86827	An incident was resolved in which the API documentation topic 'Accessing SAP2000 from an External Application' was out of date. This topic has been updated to use the cHelper class for connecting to SAP2000.
	87575	An incident was resolved where the results for torsion design of reinforced concrete members given through the API were inconsistent with those reported through the tables. When this happened the tabulated results and the onscreen display results were correct.

External Import/Export
Incidents Resolved

*	Incident	Description
	84220	Two incidents affecting the export of SAP2000 models to Revit Structure were resolved: (1) When some of the line object concentrated or distributed loads had duplicate GUID's, SAP2000 was unable to generate an .exr file. When this happened, no .exr file was available for further export to Revit Structure. Deselecting the export of point loads and line loads in the form displayed when launching the export allowed it to proceed successfully. (2) When the definition of some of the area objects included intermediate nodes along the edges, these area objects were not always exported to Revit Structure. When this happened, a warning was issued in the .EXRLog file and the rest of the export was unaffected. These two incidents affected all versions of SAP2000 which can export models to Revit Structure.
	86871	An incident was resolved where point loads applied in load patterns not selected for output were not exported to SAFE. Now point loads are exported for all necessary load patterns.

*	Incident	Description
	88172	An incident was resolved where importing a DXF file on a computer using region settings with a comma for the decimal separator would generate incorrect geometry.
	88216	An incident was resolved when importing files from STAAD or STRUDL where the mass source was defaulted as nothing. It is now defaulted as from material mass property. The user was/is able to reset the mass source.

Documentation
Incidents Resolved

*	Incident	Description
	85216	An incident was resolved in which the context sensitive help had some mentions of v17 and some of the example problem pages had formatting issues. No results were affected.
	87890	An incident was resolved in which the context sensitive help topic 'Merge Numbers' incorrectly indicated that points in the same location and with the same merge number would get merged when running the analysis. This is not the intent of the assignment. Merging of the joints only occurs when importing a model, editing using the interactive database, using the edit menu commands, or performing on-screen editing. The behavior of the software has not been changed.