SAP2000® Version 20.1.0
Release Notes

Notice Date: 2018-05-03

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 v20.0.0 (Released 2017-12-18)

Graphics
Enhancements Implemented

*	Incident	Description
	78015	An enhancement was implemented to support multiple monitors when capturing images using the File menu > Capture Picture commands.
	213408	DirectX graphics mode has been enhanced for better line quality and shading to improve the clarity of the model and better distinguish between edges and line objects, and to more clearly render symbols and text.

Loading
Enhancements Implemented

*	Incident	Description
	207093	An enhancement has been implemented to add the Singapore national annex for the auto-seismic load pattern and response-spectrum function according to Eurocode 8-2004.
*	212925	An enhancement has been implemented to add auto lateral loading per the NTC 2018 code. This includes auto wind, auto seismic, and the response-spectrum function.

Analysis
Enhancements Implemented

*	Incident	Description
*	42047	Linear time-history analysis can now be performed in the frequency domain, allowing the consideration of frequency-dependent properties, sub-systems, and/or boundary conditions represented by link elements. Loading is identical to that used for modal or direct-integration time-history analysis, and may be by ground acceleration or load patterns applied using one or more independent time-history functions. Damping is of the hysteretic type, and may be constant or vary with frequency.

Frame Design
Enhancements Implemented

*	Incident	Description
	101900	An enhancement was implemented to add more detailed output for Chinese 2010 concrete frame design. Specifically, the output now includes shear stresses from both the shear force and torsion, the total shear stress, and its comparison with the limit. Previously, only the shear stress from shear force was output even if there was significant torsion.

*	Incident	Description
*	212396	An enhancement has been implemented, adding steel frame design according to the NTC 2018 code.
	212652	An enhancement was made in steel frame design according to the Chinese 2010 code in which additional parameters, namely the equivalent moment coefficients Beta_t and Beta_m, are now reported in the design details. This is a reporting change only. The results are unaffected.

Results Display and Output

Enhancements Implemented

*	Incident	Description
*	20965 26037 40977 67817 89276 201510 208097	Strain response is now available for shell objects similar to stress response that was already available. Strains can be displayed graphically, in plot functions, in tables, and accessed using the API (Application Programming Interface). Strain components and principal values are presented in a one-for-one correspondence with the stress values. The strains reported are due to stress. Stress-free strains caused by temperature load, strain load, creep, and/or shrinkage are not included. Response is available for homogeneous and layered shells.
	78561	An enhancement was made to report the joint forces for internal frame elements created for area and solid element edge constraints. They are reported as part of the frame joint forces table for selected area and solid objects.
	84242 208588	An enhancement has been implemented to allow displaying either the min or the max soil pressure results.
	208320	An enhancement was implemented to speed up calculation of enveloped response quantities of frame elements for nonlinear multi-stepped load cases and/or load combos.
	208752	An enhancement was implemented in steel frame design codes Eurocode 3-2005 and NTC 2008 in which a new columns for Mspan is added in the PMM design database table to report the Med,span moment. The Med,span was and still is reported in the design details window. This is a display change only. No calculations were changed.
*	214318	Strain response is now available for solid objects similar to stress response that was already available. Strains can be displayed graphically, in plot functions, in tables, and accessed using the API (Application Programming Interface). Strain components and principal values are presented in a one-for-one correspondence with the stress values. The strains reported are due to stress. Stress-free strains caused by temperature load and strain load are not included.

Database Tables

Enhancements Implemented

*	Incident	Description
	206784	An enhancement has been implemented to provide a database table containing soil pressure results. These results were previously only available as a display.

Data Files

Enhancements Implemented

*	Incident	Description
	212218	An enhancement has been implemented to provide new section property libraries for AISC 15 and ASTM A1085 steel sections.

Application Programming Interface
Enhancements Implemented

*	Incident	Description
	99706	A change was made to consider multi-step External Results (user specified through the API) the same as multi-step nonlinear static case results for frame design purposes. This allows them to be designed step-by-step. Previously the frame design for these forces was based on enveloping results.
	211953	An enhancement was implemented to provide API functions for getting and setting design preferences and overwrites for the Russian steel frame design code SP 16.13330.2011 and concrete frame design code SP 63.13330.2012.
	212833	An enhancement was implemented to provide API functions for getting and setting Italian NTC 2008 steel frame design preferences and overwrites.

Miscellaneous
Enhancements Implemented

*	Incident	Description
*	208853	The version number has been changed to v20.1.0 for a new intermediate release.

User Interface and Display
Incidents Resolved

*	Incident	Description
	85713	An incident was resolved for two cases in which non-English characters were not correctly handled. 1) The name input on the Auto Select Section form did not allow the characters to be input. 2) The grid system bubbles did not correctly display certain characters.
	95862	An incident was resolved where adding a display window when some parts of the structure were selected could in some cases cause the program to become unresponsive.
	102335	An incident was resolved in which the program could terminate if a model window was undocked to a secondary monitor that had a height larger than the primary monitor. This was a rare condition.
	208964	An incident was resolved where the program could crash if a mass source definition was deleted when it was in use within a load case. Now mass source definitions cannot be deleted when they are used by a load case.
	208980	An incident was resolved in which the Edit > Replicate command would open multiple copies of the Replicate form if the command was used multiple times without closing the form. This was a user interface issue only.

*	Incident	Description
	212154 212696	An incident was resolved where the parameters used to control target-force iteration were not available on the Nonlinear Parameters form when defining a nonlinear static or nonlinear staged-construction load case. These parameters could be changed using the interactive database editor. Even though the parameters were not available on the Nonlinear Parameters form, any values previously defined using the interactive database editor or from a model created in a previous version of the software would still apply. Newly created load cases would use default values. Results were consistent with the parameters visible in database table "Case - Static 4 - Nonlinear Parameters". This user-interface issue only affected v20.0.0.
	212169	An incident was resolved where setting design overwrites to "Program Determined" while the user interface was translated into a language other than English would result in a warning message. This was a user interface issue only.
	212558 212603	An incident was resolved where the software could terminate unexpectedly when clicking on the already open Set 2D View form (command View > Set 2D View) after performing a Replicate operation or other editing command that adds point objects to the model. No results were affected.

Graphics

Incidents Resolved

*	Incident	Description
	79358 79359	An incident was resolved where the rubber band zoom or rubber band selection in DirectX graphics mode was not working on some machines.
	96456	An incident was resolved where the color of extruded areas in deformed shape plots was incorrect in certain cases.
	101948 203296	An incident was resolved where area contours were not shown in 2D views in DirectX graphics if the area fill was also on.
	201265	An incident was resolved where in DirectX graphics when contours were showing on deformed shapes the area element edges did not plot correctly.
	203553	An incident was resolved where the contour plots of shell stresses showed some discontinuity when DirectX graphics was used.
	203596	An incident was resolved in DirectX graphics where all joints were always being displayed even if located behind other objects.
	207644	An incident was resolved in which the software could close unexpectedly when one of the model windows was closed while using DirectX graphics.
	207697 212304	An incident was resolved where the extruded shape display for areas was not correct in DirectX graphics mode. The areas were shown as twice the actual thickness. This error was inadvertently introduced in v19.
	209919	An incident was resolved where user was not able to set the color of the frames to pure black, instead the frames were shown in red. Other colors were possible.

Drafting

Incidents Resolved

*	Incident	Description
	208614	An incident was resolved in which replicating or mirroring joints that had the special joint option set to no, and no other objects were replicated or mirrored, would result in the new joints not being generated. This was a modeling issue only.

Modeling
Incidents Resolved

*	Incident	Description
	208453	An incident was resolved where creation of the analysis model would generate illegal area element warnings for certain area objects to which general meshing was assigned. This was a rare occurrence and happened when the mesher incorrectly tried to create very small elements of the order of the merge tolerance.
	208977	An incident was resolved where using the interactive database would remove previously assigned frame hinges even when working with tables that were not related to the hinge assignments.
	209702 211551	An incident was resolved where models from a version prior to v20 that contained frame section properties from a section library (*.pro) with a section name containing lowercase letters would be reset to a general section if the model was edited through the interactive database or imported from a text file. Old models will be corrected when opened in v20.1.0.
	212244	An incident was resolved for auto hinges using ASCE 41-13 where the program was adjusting the downward slope (between points C and D) of the backbone curve to avoid a vertical drop. This adjustment had a scaling error making it units dependent. Only the deformation at Point D was affected. The adjustment has been corrected.

Loading
Incidents Resolved

*	Incident	Description
	210085	An incident was resolved for ASCE 7-16 auto seismic load and response spectrum function where parameters Fa and Fv were not editable when Ss >= 1.0 and S1 > 0.2 sec for Soil Category E. Also, for ASCE 7-16 response spectrum function, parameters S1 and TL were not previously saved.
*	210140	An incident was resolved where load patterns included in a staged construction load case but with a scale factor of zero could cause spurious loading to occur in a subsequent stage of the load case. This did not occur is the load pattern was omitted from the load case or applied with a negligible scale factor. When this occurred the effect on results was generally very obvious.

Analysis
Incidents Resolved

*	Incident	Description
	203968	An incident was resolved where the Change Modifiers and Change Releases operations were not being applied in a nonlinear staged-construction load case when all the following conditions were met simultaneously: (1) The nonlinear staged-construction load case did not have any applied loads in any of its stages, (2) The stage with the Change Modifiers/Releases operation had no Add, Remove, or Change Section operations specified, and (3) The stage with the Change Modifiers/Releases operation was either ((a) not the last stage of the load case, or (b) was the last stage and that stage had non-zero duration and time-dependent effects were being considered for the load case. When this issue occurred, the Change Modifiers/Releases operation was ignored for the affected stage or stages.

*	Incident	Description
*	209069 213129	An incident was resolved where the temperature, strain, and deformation loads applied in a linear load case could, in some cases, be incorrect for certain objects in the model if the linear load case used the stiffness from the end of a nonlinear staged-construction load case. This error would not occur if the linear load case was run in a subsequent session from the preceding nonlinear staged-construction load case. A subsequent session would be anytime the software was restarted, the model was re-opened, or anytime the analysis was run in a separate process (command Analysis > Analyze > Analysis Options > Solver Options). This error was uncommon, model-dependent, and machine-dependent. When it occurred, the results were generally erratic and obviously incorrect. Temperature and strain loads are available for frame, shell, solid, asolid, and plane objects. Deformation loads are available for frame objects. Time-dependent creep and shrinkage act as a strain load can could also affect frame and shell objects. This error could affect SAP2000 versions 17.1.0 to 20.0.0, although no incidents have been reported until recently (2018).
*	211888	An incident was resolved where frame loads, including self-weight, could have been incorrectly applied during nonlinear load cases where the Geometric Nonlinear Parameters were set to "P-Delta plus Large-Displacements". Load-case types that could be affected are nonlinear static, nonlinear staged construction, and nonlinear direct-integration time-history. This error only occurred when the number of threads used in the analysis procedure, which is reported in the .LOG file, was greater than 1. When this issue occurred, it created a discrepancy between the applied loading and computed results. In most cases this caused the analysis not to converge, and no results were available for the affected load cases. In some cases, the analysis would converge, and the results could then be incorrect. Only self-weight, gravity, concentrated-span and distributed-span loading applied to frames was affected. Temperature, strain, deformation, and target-force loads on frames were not affected. Loads on joints and other types of elements, including cables, were not affected. Nonlinear load cases with the Geometric Nonlinear Parameters set to "None" or "P-Delta" were not affected. This issue was present in SAP2000 versions 19.1.0 to 20.0.0. Affected load cases in the affected versions should be re-run in the new version to check the results.
	212118	An incident was resolved where nonlinear static load cases with zero load applied may fail to converge if starting from a previous load case. This issue may also occur in staged construction load cases during the instantaneous load application portion of a stage where no major stage operations (loads applied, objects added, or objects removed) have been defined. In this release, the following changes are made: (1) For nonlinear static load cases where no loads are applied, the relative iteration convergence tolerance will be determined relative to the total force present in the model. Normally the convergence tolerance is relative to the magnitude of the applied load, and that is still true when loads are applied, no matter how small. (2) In nonlinear staged construction load cases, a stage that does not have any major stage operations defined will skip the instantaneous load application portion of that stage during analysis if the stage has duration for time-dependent effects. For a stage with no major operations and no duration, iteration will be performed based on a convergence tolerance relative to the total force present in the model. When iteration is performed with tolerances relative to the total force in the model, most models will converge immediately or with just a few iterations that improve equilibrium. Changes in results from previous versions are expected to be small and within the specified convergence tolerance for well-conditioned models.
	212654	An incident was resolved where a model having more than one Parametric PMM hinge was unable to run modal time history load cases (linear or nonlinear FNA) that used the modes from a Ritz or eigen modal load case that in turn used the stiffness from the end of a nonlinear static, staged-construction, or direct-integration time-history load case. When this error occurred, no results were available for the modal time history load case. No other results were affected.

Frame Design
Incidents Resolved

*	Incident	Description
	101547	An incident was resolved for concrete column design based on the Chinese 2010 code where the P-M-M interaction diagram was using a compression cap factor of 1.0 instead of 0.9 for computing Pmax. Also, there was a slight inaccuracy from converting fyk to fy.
	101592	An incident has been resolved for steel frame design using codes "AISC 360-05", AISC 360-10", and "KBC 2009" in which the reported load combinations corresponding to the governing beam/column capacity ratios (BCCR) in tables and in the design details were incorrect. The reported design combination was always the last load combination in the list of considered combinations instead of the governing one. This was a reporting problem only. The BCCR values themselves were correct.
	101901	An incident was resolved for concrete frame design using the Chinese 2010 code in which the calculation of λ (lambda) for columns was not correct for two reasons: (1) In the calculation of λ, the full depth of column was used instead of the effective depth h0. λ should be equal to M/(V*h0). (2) The program used the values of M and V after seismic modification magnification factors instead of using the unmodified values. The calculated λ values should not change with the overwrites of magnification factors for columns. This issue was only present for columns. The lambda values for beams are calculated based on the actual presence of a point load, if any. If there is no point load on beam, then λ is taken as 1.5. The calculation of λ for beams was not changed.
	101903	An incident was resolved for Chinese 2010 concrete frame design where the concrete joint-shear design Gamma_RE value of 0.75 was used instead of 0.85. Now the program uses the correct value of 0.85 and it reports it in the design details accordingly.
	101907	An incident was resolved in the Chinese 2010 concrete frame design code for SDG=II the bottom rebar to top rebar ratio for beams was not ensured to be no less than 0.3 at supports. This issue was only present when the loading was low and the minimum required reinforcement for top rebar governed. When the top rebar was based on actual loading this issue was not present and the required ratio for bottom rebar was enforced.
	101908	An incident was resolved for concrete frame design using the Chinese 2010 code in which the calculation of the minimum rebar for columns was not correct. This affected only the concrete column design. This did not affect column checking and beam design.
	202276	An incident has been resolved for beam flexure design in the Chinese 2010 steel frame design code in which the PhiB factors for tee and double-angle sections have been updated to consider the simplified formula for Lambda_y < 120*Sqrt(235/fy). The program has also been updated for PhiB factor calculation for both rolled and welded I-shaped members based on GB50017-2018 App C equations App C.0.1-1 and App C.0.1-2 which covers both doubly- and singly-symmetric I-shaped sections. The program has also been updated to consider bending stability of columns and braces in addition to the beams. In addition, the program allows overwriting PhiB.
	202493	An incident has been resolved in the steel frame design code AISC 360-10 in which the right-button click and the database report gave inconsistent error messages. This did not affect the demand/capacity ratio calculations. This was a reporting problem only. The design details window did not have any issue regarding this error message.
	203781	An incident was resolved in aluminum frame codes AA-ASD 2000 and AA-LRFD 2000 in which some of the terms like Feb, Fcr, and Frb were being displayed as zeros for certain types of sections. These values were not calculated when not used. These values are now calculated and displayed even if not later used. This was a display issue only.
	206924	An incident has been resolved for concrete frame design code Eurocode 2-2004 where the value of Ec was being recomputed from material strength instead of using the value already provided by user as part of the material property.

*	Incident	Description
	207430	An incident has been resolved in the steel frame design code AISC 360-10 in which the design details table erroneously showed a warning message stating that Fy is greater than 50 ksi for some elements, even though the Fy =36 ksi for those members. This does not affect the demand/capacity ratio calculations. This is a reporting only problem. The design details window does not have any issue regarding this error message.
	208699	An incident was resolved in steel frame design code AISC 360-10 in which the design details showed a warning stating that the section did not comply with F13.2, but the design summary table did not show any message. Now the summary table also shows the warning message. This was only a reporting issue.
	209816	An incident was resolved in steel frame design codes Eurocode 3-2005, Italian NTC 2008, and Indian IS 800:2007 in which the PMM interaction ratio for section capacity check for rectangular hollow sections became very large (towards infinity) when the axial force ratio *n*, (*n=Ned/Npl,Rd*), became slightly larger than 0.9407 *(n>1/sqrt(1.13))* but still less than 1.0. In this case the denominator of the expressions of Alpha and Beta became a very small negative number causing Alpha and Beta to be a very large negative number. The code does not specify any lower limit for Alpha and Beta. This very large negative number, when applied as powers for [My,Ed/Mn,y.Ed] and [Mz,Ed/Mn,z.Ed], produced incredibly large numbers. The problem has been resolved by putting a limit on *n* to be used in the expression. Effectively the limit of 6 is applied on both Alpha and Beta. This issue was causing a problem in creating certain database tables for certain models.
	212651	An incident was resolved for steel frame design according to the Chinese 2010 code in which the reporting of "Transfer Column" was not correct in the steel design details. It was always reported as "No" even if the overwrite "Is Transfer Column?" was set to "Yes". The overwrite item "Is Transfer Column?" is changed to "Is Transfer Member?". The seismic modification factor was always taken as 1.0. Now it is taken as 1.5 if the member is a Transfer Member.

Results Display and Output

Incidents Resolved

*	Incident	Description
	206614	An incident was resolved where in certain rare cases when displaying reactions, the display would become unresponsive. This happened when the following path was taken: display reactions in tabular mode, unlock model, rerun analysis; the display would then freeze when trying to refresh the reactions display.
	208754	An incident was resolved in which the right-click design details for Eurocode 3-2005, Italian NTC 2008, and Indian IS 800:2007 steel frame design always reported 'Envelopes' for the multi-response option used in the design, irrespective of the option selected in the design preferences. This was a reporting issue only and did not affect results.
	214956	An incident was resolved where the display of the analysis and design results for nonlinear staged construction cases and linear cases using the stiffness of a nonlinear staged construction case in the model window could be slower than expected for larger models. This issue affected v19.2.0 to v20.0.0.

Documentation

Incidents Resolved

*	Incident	Description
	207880	An incident was resolved where the Eurocode 3-2005 steel frame design manual incorrectly documented in Chapter 2 that torsion design is not considered when it is considered for doubly-symmetric I-shapes, box, and pipe shapes.