

SAP2000 v24.1.0 Release Notes

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This document lists changes made to SAP2000 since v24.0.0, released 11-March-2022. Items marked with an asterisk (*) in the first column are more significant.

Analysis

Enhancements Implemented

| * | Ticket | Description |
|---|--------|---|
| * | 896 | A change has been made to the reporting of joint reactions and base reactions for nonlinear static and staged-construction load cases. Previously joint-force loads and acceleration loads applied at restrained degrees of freedom were excluded from the reported joint reactions at these degrees of freedom, including their contribution to overall base reactions. This was intentional for matching the reactions to the force reported in the connected frame objects when performing pushover-types of analyses. However, this is now changed to be consistent with the reactions reported for most other types of load cases, including linear static, nonlinear direct-integration time history, and modal time history, including FNA. This is a reporting issue only. No other results are affected, including the reactions at flexible supports (spring support and one-joint links). The only change in restraint reactions will be due to joint-force loads applied directly on the joint and apportioned acceleration loads from connected objects, including from mass directly assigned to the joint. |

API

Enhancements Implemented

| * | Ticket | Description |
|---|--------|---|
| | 8406 | A new page has been added to the API documentation with guidance on creating a client application using .NET 6. This can be found in the Release Notes section of the documentation. |
| | 8414 | The Application Programming Interface (API) has been enhanced with the addition of functions get and set design preferences and design overwrites for steel frame code CSA-S16-19. |
| * | 8449 | The following enhancements have been made to the Application Programming Interface (API): (1.) The new function cHelper.GetObjectProcess() can be used to attach to any running instance of SAP2000 given its process ID. (2.) A new command "Set as active instance for API" has been added to the Tools menu. This command will make the current instance of SAP2000 the "active instance" so that it will then respond to subsequent calls to cHelper.GetObject() function. If the current instance is the active instance, then this command is disabled. In either case, the process ID of the current instance is displayed with the menu command for use with the new function cHelper.GetObjectProcess(). (3.) A new interface cPluginContract has been added to simplify plugin development. (4.) Speed has been improved for external .NET clients that call the API by chaining properties and methods (e.g. mySapObject.SapModel.PointObj.GetElm) in deeply nested loops. |
| | 8875 | The Application Programming Interface (API) was enhanced so the function SapModel.PropFrame.GetPropFileNameList() can now retrieve names from .XML section property files, in addition to its current retrieval of names from .PRO files. |

Data Files

Enhancements Implemented

| * | Ticket | Description |
|----------|---------------|--|
| | 8119 | Three new section-property database files have been added for steel sections produced by certain Indian manufacturers: (1.) TATA_Steel.xml, containing data for steel Pipe/Tube sections manufactured by the TATA group of companies. (2.) Jindal_Steel.xml, containing data for steel I/Wide Flange sections manufactured by Jindal Steel Ltd. (3.) APL_Steel.xml, containing data for steel Pipe/Tube sections manufactured by APL Apollo Ltd. |
| | 8486 | A built-in material library has been added for Canada. The library contains steel materials per the CSA G40.20-13/G40.21-13 standard, concrete materials per the CSA A23.3 standard, and rebar materials per the CSA G30.18:21 standard. |
| | 8769 | The Chinese frame-section database has been updated where section properties for some of the frame sections have been corrected and several new frame sections have been added for I/Wide Flange, Tee, Angle, and Pipe shapes. |

Design – Aluminum Frame

Enhancements Implemented

| * | Ticket | Description |
|----------|---------------|--|
| | 8873 | An enhancement has been made to the EN 1999:2007 aluminum frame design to improve the calculation of the C1, C2, and C3 factors. It includes more appropriate determination of the unbraced length and the moment diagram, resulting in a less conservative value of the C1 factor. Previously, the design algorithm was not identifying the bracing point at the intersection of two frame members. This intersection was within the length of the member that was not divided into two elements and whose design was performed over the entire length. Consequently, the condition of the moment diagram used to determine C1, C2, and C3 was incorrect. In addition, to give the users more flexibility, an option to select the method of calculating C1, C2, and C3 is added in the design overwrites including the one specified in Tables I.1 and I.2 in the Annex I of the EN 1999:2007, the one applied to general moment diagrams as shown in EN 1999:2007 Annex I Eq. I.9, and input by the users. The issue with the bracing point at the intersection of two frame members is also resolved for the AA 2015 and AA 2020 aluminum designs. |

Design – Cold Formed Frame

Enhancements Implemented

| * | Ticket | Description |
|----------|---------------|--|
| | 8874 | An enhancement has been made to the Eurocode 3 1-3 2006 cold-formed steel frame design to improve the calculation of the C1, C2, and C3 factors. It includes more appropriate determination of the unbraced length and the moment diagram, resulting in a less conservative value of the C1 factor. Previously, the design algorithm was not identifying the bracing point at the intersection of two frame members. This intersection was within the length of the member that was not divided into two elements and whose design was performed over the entire length. Consequently, the condition of the moment diagram used to determine C1, C2, and C3 was incorrect. In addition, to give the users more flexibility, an option to select the method of calculating C1, C2, and C3 is added in the design overwrites including the one specified in EN 1993-1-1:1992, the one applied to general moment diagrams as described in Section F.1(c) of the AISC 360-16, and input by the users. The issue with the bracing point at the intersection of two frame members is also resolved for the AISI 2016 cold-formed steel design. |

Design – Concrete Frame
Enhancements Implemented

| * | Ticket | Description |
|---|--------|---|
| | 8893 | An enhancement has been made to the concrete frame design to make the reporting of the joint shear details and the beam/column capacity ratios more consistent and complete in the “Design Details: ETABS Concrete Frame Design” form. Now these results will only be reported at the top station of the columns, and only for certain codes and under the appropriate conditions. When these results are not reported (including at stations other than the top of the column), a message listing the required conditions will be provided. This affects the ACI 318-19, ACI 318-14, ACI 318-11, ACI 318-08, AS 3600-2009, AS 3600-2018, CSA A23.3-14, CSA A23.3-19, IS 456-2000, KBC 2009, KBC 2016, Mexican RCDF 2004, Mexican RCD 2017, TS 500-2000 and TS 500-2000(R2018) design codes. This is only a reporting change and design results are not affected. |

Design – Slab
Enhancements Implemented

| * | Ticket | Description |
|---|--------|---|
| * | 8288 | An enhancement has been made to the concrete shell design per Eurocode 2-2004 to include a check for cracking in concrete and the design of transverse shear reinforcement in accordance with Annex LL of Eurocode 1992-2:2005. |

Design – Steel Frame
Enhancements Implemented

| * | Ticket | Description |
|---|--------|---|
| | 4998 | An enhancement was made to the Chinese 2018 steel frame design code where now the design will still display the stability check equation information with most of the terms shown as zero and with the calculated phiB factor even when the design preferences or overwrites are set with "Ignore beam phiB" as "Yes". Previously, in this case, the information was displayed for the stability check by setting the phiB factor to 1.0. |
| | 6596 | An enhancement has been made to the Eurocode 3-2005, Italian NTC 2008, and Italian NTC 2018 steel frame design to improve the calculation of the C1, C2, and C3 factors. It includes more appropriate determination of the unbraced length and the moment diagram, resulting in a less conservative value of the C1 factor. Previously, the design algorithm was not identifying the bracing point at the intersection of two frame members. This intersection was within the length of the member that was not divided into two elements and whose design was performed over the entire length. Consequently, the condition of the moment diagram used to determine C1, C2, and C3 was incorrect. In addition, to give the users more flexibility, an option to select the method of calculating C1, C2, and C3 is added in the design overwrites including the one specified in EN 1993-1-1:1992, the one applied to general moment diagrams as described in Section F.1(c) of the AISC 360-16, and input by the users. |

| * | Ticket | Description |
|---|--------|--|
| | 7212 | An enhancement has been made to the Canadian steel frame design codes "CSA S16-19", "CSA S16-14", and "CSA S16-09" codes where now the section class ("H" or "C") of the HSS box and pipe sections can be overwritten in the Overwrites form. This enhancement simplifies the class determination and calculation of the power n of HSS sections, which is used for axial compression capacity calculation per CSA 13.3.1 for flexural-buckling mode. Previously, and still by default, the value of n is taken as 1.34. However, if a section name prefix is "WWF" for an I-shape, n is taken as 2.24. For box and pipe sections, if the section name prefix is "HSS" or "HS" and the name postfix is "H," the value of n is taken as 2.24. If the postfix is "C" instead of "H," n is taken as 1.34 for box and pipe sections. For all other sections, n is taken as 1.34, except if any plate thickness is greater than 25.4mm, in which case n is taken as 1.0. By default, the overwrite item "Is HSS section Cass H?" is taken as "Program Determined," meaning the previous procedure remains in effect. With this enhancement, the section class can be directly specified as an overwrite and the HSS section name does not need to be modified with a postfix anymore. If the section is not a box or pipe section, or if the member is not overwritten, there is no change in result. The value of n for torsion or torsional-flexural buckling mode is taken as 1.34 per CSA 13.3.1, and unaffected by the changes in this ticket. |
| | 8595 | The "Chinese 2018" steel frame design code now has improved reporting of the appropriate load amplification factorN (0.8 vs. 1.25) used for Euler buckling of Double Angle, T-section, and Channel sections. Generally, the amplification factor is $1.0 / (1.0 - \text{factorN} * N / N_E)$, where the factorN = 0.8 for all sections with some exceptions: for the Double Angle and T-sections, factorN is 1.25 when considering the major direction, and for the Channel sections, factorN is 1.25 when considering the minor direction (GB50017-2017 8.2.1-1 =0.8, 8.2.1-4 =1.25, 8.2.4-1 =0.8, 8.2.5-1 =0.8, 8.2.5-2 =0.8). Previously the value of factorN was only reported when it was equal to 0.8. Now it will also be reported when the value is 1.25. This is a change in reporting only. In both cases, the correct value was used internally and design results are not changed. |

External Import and Export Enhancements Implemented

| * | Ticket | Description |
|---|--------|---|
| | 7218 | An enhancement to the export of vertical shell objects to .EXR files has been implemented. Vertical shell objects with a sloping base are now exported. Walls with a clearly sloping base (more than 2 degrees off the horizontal and more than one-eighth of an inch difference in base elevations) are exported with their actual geometry, while walls with a slightly sloping base are exported with a rectified base and a corresponding warning in the .EXR log file. Previously, vertical shell objects with a sloping base were omitted from the export, with a corresponding warning in the .EXR log file. |
| | 8864 | An enhancement to the import and export of Revit .EXR files was implemented. SAP2000 supports new features introduced in CSiXRevit 2023, namely the import of the new Revit analytical links, and the export of structural column cardinal-point offsets. SAP2000 remains compatible with earlier versions of CSiXRevit. |
| | 8899 | An enhancement to the import of Revit .EXR files was implemented. When importing Revit steel frame member family types, SAP2000 attempts to match each Revit frame member family type to an identically named section profile defined in the default .XML property file, or in one of the user-specified .XML or .PRO property files. Now the name comparison ignores blank spaces, meaning that "W12 x 14" and "W12x14" are considered equivalent. The SAP2000 sections are imported with their original Revit names, including any blank spaces originally present. |

Graphics

Enhancements Implemented

| * | Ticket | Description |
|----------|---------------|---|
| | 7105 | An enhancement has been made to allow users to choose colors for Hinge State and Hinge Status for analysis of models with nonlinear frame hinges. This can be accessed using menu command Options > Color > Output. The colors are now consistent in deformed-shape display, plots of hinge force-deformation, and in the forms where the nonlinear properties are specified. |
| | 8767 | An incident was resolved where the maximum and minimum font sizes set in the Dimensions/Tolerances Preferences form were not being properly applied to printed graphics. Now the behavior should be similar to the effect of these font sizes on the screen display, with adjustments for the size of the printed image. |
| | 8768 | An incident was resolved where the Maximum and Minimum Font Sizes used for drawing text and symbols in the graphical model windows were not consistent between the two graphics modes, DirectX and Classical Plus (GDIPlus). Now the two graphics modes are more nearly consistent in how they vary the font size with distance from the front of the view. Note that these font sizes can be set using the command Options > Dimension Tolerances. |

Installation and Licensing

Enhancements Implemented

| * | Ticket | Description |
|----------|---------------|--|
| * | 8269 | The version number has been changed to v24.1.0 for a new intermediate release. |

Results Display and Output

Enhancements Implemented

| * | Ticket | Description |
|----------|---------------|---|
| | 8766 | An enhancement has been implemented that allows users to specify the scale when printing graphics to a printer or a PDF file. The option is available for both the Classic Plus and DirectX graphic modes. The scaling for the graphics being printed can be specified using the drop down box on the print preview form. |

Structural Model

Enhancements Implemented

| * | Ticket | Description |
|----------|---------------|---|
| * | 8380 | The program-calculated yield forces, yield moments, and interaction surfaces for reinforced-concrete type nonlinear hinges have been changed to use the expected strength of the rebar material. Previously, the minimum strength was used for the program-calculated values. Models from previous versions that are re-run in the new version may produce somewhat different results due to this change in the common case where the expected strength of the material is slightly larger than the minimum strength. |
| * | 8593 | The viscous damper type link properties "Damper - Exponential" and "Damper - Bilinear" (Define menu > Section Properties > Link/Support Properties) have been enhanced to add a Fixed Length Damper option for the axial (U1) degree of freedom. When enabled, the Fixed Length Damper option allows the user to define the damper length as a fixed value and the modulus of elasticity and cross-sectional area for the extender which will span the additional length of the link that is not taken up by the damper. For analysis, the extender is effectively a linear spring that is in series with the damper. Note that this is in addition to the stiffness specified for the damper itself, which is primarily due to the fluid column in the device, and whose value should be obtained from the manufacturer of the device. The stiffness of the damper and the extender, when present, act in series so that their flexibilities are additive. |

**Analysis
Incidents Resolved**

| * | Ticket | Description |
|---|--------|---|
| | 902 | An incident was resolved where the reported joint reactions did not always include the load applied to the joints for certain types of linear load cases, whether the load was applied directly on the joint or on connected elements. These load cases included linear direct-integration time history, linear frequency-domain time history, steady state, and PSD types. This issue only affected the reported reactions at restrained joints that included force loads, acceleration loads, and/or temperature/strain loads from connected elements, as well as force loads on the restrained joints themselves. Similarly affected were the reactions due to ground-displacement loads applied at joints grounded by springs. Reactions due to displacement loads on joints grounded through restraints or one-joint links were not affected. This was a reporting error only. No other results were affected. |
| | 8218 | An incident was resolved where link elements with a triple-pendulum property that had the U2 and/or U3 degrees of freedom set to linear did not use the specified linear effective stiffness in nonlinear load cases. The triple-pendulum link property has been changed so that now the U2 and U3 degrees of freedom are always nonlinear, similar to the U1 degree of freedom. Older models that had triple-pendulum link properties with the U2 and/or U3 degrees of freedom set to linear will have these degrees of freedom changed to nonlinear upon opening the model in SAP2000 v24.1.0. For such older models, the nonlinear properties will default to zero unless they had been previously defined, and this may make the model unstable or change the behavior from the previous version. Note that such models are uncommon, but they should be updated with realistic nonlinear values for affected triple-pendulum property definitions. |
| * | 8437 | An incident was resolved where link elements with a viscous damper property (Linear with non-zero damping coefficients, Exponential Damper, or Bilinear Damper) could experience forces that did not correspond to the velocity of the element. This issue only occurred in direct-integration time-history analyses where the Geometric Nonlinearity option was set to "P-Delta plus Large Displacements". When this issue occurred, the damper elements notably did not return to a small or nearly-zero force value after the structure had come to a standstill. |
| * | 8514 | An incident was resolved where the flexibility of fiber hinges in frame objects was not included in the stiffness-proportional damping used for direct-integration time-history load cases. This issue was most apparent when all or most of the frame-object length was modeled as fiber hinges and resulted in very large stiffness-proportional damping forces which could prevent the frame object from experiencing significant deformations in time-history analyses. The effect on frame objects with fibers hinges that covered a small part of the object length was significantly less pronounced. This issue was only present in SAP2000 v24.0.0 and did not affect older versions of the software. This issue only affected direct-integration time-history load cases where stiffness-proportional damping was used. Models that were affected by this issue should be rerun in the new version. |
| * | 8607 | An incident was resolved where the program-generated load case for computing accidental eccentricity (~Torsion) in a response spectrum load case always started from the initial state. This behavior has been changed so that the accidental eccentricity load case will use the stiffness consistent with the modal load case specified in the response spectrum load case. Using the wrong stiffness state for the torsional load case could lead to inconsistent torsional results when there were significant P-delta or other nonlinear effects in the modal-stiffness load cases, or if the structure was different between the stiffness states due to staged-construction. In most common situations, the effect was minimal. |
| * | 8687 | An incident was resolved where response spectrum load cases exported to SAFE did not properly consider the additional eccentricity loads. Now the eccentricity effects will be properly exported to SAFE versions 20.3.0 and later. |

| * Ticket | Description |
|----------|--|
| 8798 | An incident was resolved where, for the coupled concrete material in the layered shell element, the compression strength reduction under perpendicular tensile strain was not applied when the compression was in the linear range (not yielded). For locations where a large tensile strain was experienced in one direction while the perpendicular compressive behavior was linear, the material could have experienced a sudden drop in compression strength after reaching the unreduced compressive yield strength. |
| * 8805 | An incident was resolved where a model that had P-M3 Fiber hinges assigned to frame objects may have experienced larger than expected stiffness-proportional damping in linear direct-integration time-history load cases when stiffness-proportional damping was enabled. This issue was more pronounced when the hinge length was a significant portion of the length of the frame. This issue only affected models where the analysis model for nonlinear hinges option (Analyze menu > Analysis Model for Nonlinear Hinges) was set to "Model Hinges as Separate Link Elements". This issue did not affect static, modal, or nonlinear direct-integration time-history load cases, and it did not affect models where the hinges were modeled within elements. This issue affected SAP2000 versions 22.1.0 to 24.0.0. The effect was rarely significant. |

API

Incidents Resolved

| * Ticket | Description |
|----------|--|
| 7676 | An incident was resolved for the Application Programming Interface (API) where the wind direction angle (DirAngle) value was not set or retrieved when the ExposureFrom value included frame objects (value of 3 or 4). This affected the API 4F 2008, API 4F 2013, ASCE 7-02, ASCE 7-05, ASCE 7-10, and ASCE 7-16 auto wind API functions. |
| 8907 | An incident affecting the Application Programming Interface (API) was resolved. When importing a section from an .XML section properties file, the function PropFrame.ImportProp() did not account for its first parameter "Name", but instead always named the newly imported section after its designation in the .XML file. Sections imported from .PRO section properties files were correctly given the requested Name parameter. This issue affected versions 23.3.0 to v24.0.0, but it had no effect on results when it occurred. |

Data Files

Incidents Resolved

| * Ticket | Description |
|----------|--|
| 8111 | An incident was resolved to fix incorrect or missing torsional constant (J) values for double angles in the AISC14, AISC15, AISC14M and AISC15M XML section libraries. In these XML section libraries, the J value for the double-angle sections were either incorrect or missing. Upon import, missing J values were calculated (using formulas if the fillet radius was zero or using FEM analysis if fillet radius was present), but the calculated values were different from the expected values that should be twice that given in the same sections database for the single angle comprising the double angle. This change involved updating the incorrect or missing J values using the J values as available for the corresponding single angles in the same section library. |
| 8332 | An incident was resolved where response-spectrum function data files immediately failed to load without checking the model folder when the function definition referenced either a relative file path or a non-existing file path, and resulted in zero loading for the affected function. Response-spectrum function definitions referencing full, valid data file paths were not affected. This issue only affected version 24.0.0. |

| * Ticket | Description |
|----------|--|
| 8909 | An incident was resolved where importing a model from a database-table file that had area-object joint offsets and/or thickness overwrites assigned using the joint-pattern option would cause an error and the assignments would not get imported. The issue affected the import through all of the available database-table formats (text, Excel, Access, XML). Import of area-object joint offsets and/or thickness overwrites specified directly by joints was not affected. |

Database Tables Incidents Resolved

| * Ticket | Description |
|----------|---|
| 8306 | An incident was resolved where step-by-step hinge response tables failed to display when response for a linear or nonlinear, modal or direct-integration time history load case was requested. This was a display issue only and the results were otherwise not affected. |
| 8731 | An incident was resolved where database import using an XML file and the Add to Existing Model option did not work. |
| 8749 | An incident was resolved where, in some instances, the LoadSF field in the "Case – Steady State 2 – Load Assignments" database table was not displayed or exported. When this occurred, the load-case data could be incorrect after importing an exported file or editing the table in the interactive database editor. |
| 8771 | An incident was resolved for certain steel frame design codes where the frame design overwrites items "FrameType", "LLRat", "LLAbs", "ElemType", and "SDG" were not saved properly when they were modified through the Tables using the Interactive Database Editor. The affected codes were: "AISC-ASD89", "AISC-LRFD93", "API RP2A-WSD2000", "API RP2A-WSD2014", "API RP2A-LRFD 97", "ASCE 10-97", "BS5950 2000", "Chinese 2010", "Chinese 2018", "CSA S16-19", "CSA S16-14", "CSA-S16-09", "Eurocode 3-2005", "Italian NTC 2018", "Italian NTC 2008", "Italian UNI 10011", "Indian IS 800:2007", "KBC 2009", "KBC 2016", "Norsok N-004 2013". The last two items were only applicable to the "Chinese 2018" code. This issue affected versions 21.0.0 to 24.0.0. The overwrites could be updated using the Design Overwrites form without any problem. |

Design – Aluminum Frame Incidents Resolved

| * Ticket | Description |
|----------|--|
| 8719 | An incident has been resolved for the EN 1999:2007 aluminum frame design in which the software could terminate abnormally when designing aluminum frame objects with general, circular, or rectangular sections. |

Design – Cold Formed Frame Incidents Resolved

| * Ticket | Description |
|----------|---|
| 8481 | An incident has been resolved to correct the calculation of effective section moduli for symmetric cold-formed sections under negative moment. These sections include C, C with lips, hat, hat with lips, Z, and Z with lips. Previously, the effective modulus due to negative moment was slightly incorrect due to the effective neutral axis being calculated using the outside height (or width) of the section instead of those measured from the centerlines of the webs or flanges. The effect on design results was insignificant. There was no error for positive moment. In addition, the extruded view of cold-formed Z sections is also fixed to be shown in undeformed shape, which was incorrectly displayed only in v24.0.0. |
| 8634 | An incident was resolved for the AISI 2016 cold-formed steel frame design where the governing design could be reported incorrectly if pattern live load was included in any of the design load combinations. When this occurred, the last load combination that included pattern live load was reported instead of the governing load combination. This could be unconservative. This error did not occur if none of the design load combinations included pattern live load. |

| * Ticket | Description |
|----------|---|
| 8715 | An incident has been resolved for the AISI 2016 cold-formed steel frame design in which the major and minor moment demand-capacity (D/C) ratios were incorrectly swapped when the design section was in tension and the combined D/C ratio was governed by Equation H1.1-2. This was only a display issue in the design report. The design results were not affected. |

Design – Concrete Frame Incidents Resolved

| * Ticket | Description |
|----------|--|
| 7401 | An incident was resolved for concrete frame design code "Chinese 2010" where the concrete frame design details have been changed in two places: (1) The term Shear Span Lambda has been changed to L0/b. (2) The unnecessary term Lambda has been removed from the paragraph "Axial Compression Ratio". These were reporting issues only. There is no change to the design calculations or results. |
| 7403 | An incident was resolved for concrete frame design code "Chinese 2010" where the shear reinforcement shown in design details did not match with that shown in the "Column Design Information" form or that shown in the "Concrete Details 1 - Column Summary Data - Chinese 2010" database table. The shear reinforcement shown in the design details was correct. The "Column Design Information" form and the "Concrete Details 1 - Column Summary Data - Chinese 2010" database table consistently showed the same wrong value. This was a display issue only. All detailed calculations were correct. |
| 8886 | An incident was resolved for concrete frame design codes "Eurocode 2-2004" and "Italian NTC 2008" in which the beam/column capacity ratio was being calculated as the ratio of the sum of the design moment capacities of the beams (with design values of γ_c and γ_s) to the sum of nominal moment capacities of columns (with $\gamma_c = 1$, $\gamma_s = 1$). In both cases, the design values of the moment capacities with appropriate strength reduction factors γ_c and γ_s are now used per EN 1998-1:2004 sections 4.4.2.3(4) and 5.2.3.3(2). The previous implementation was unconservative. |
| 8952 | An incident was resolved for Mexican RCDF 2014 and 2017 concrete frame design codes where computation of the u factor was incorrect. The u factor was computed based on sustained and total moments instead of sustained and total axial load. |

Design – Slab Incidents Resolved

| * Ticket | Description |
|----------|--|
| * 8295 | An incident was resolved in which the design values were not reported correctly in the Concrete Shell Design table for envelope-type load combinations. Now, the design values reported (As1Top, As1Bot, As2Top, As2Bot, V1Ratio, and V2Ratio) for an envelope-type load combination are the envelopes (only maxima) over all the designs for each contained load case or load combination, including over all the steps within each of these load cases or combinations. The same is true for each contained lower-level, envelope-type load combination, except that an envelope-type combination will utilize the envelopes of the shell forces rather than envelopes of shell designs if it is contained within a higher-level, non-envelope load combination. For most practical cases, it can simply be stated that envelope-type load combinations produce the more meaningful envelope of shell designs for different sets of forces rather than the design for the envelope of these forces. Note that when the top-level load case or combination is of envelope type, Max and Min results are produced: the design results for both sets are the Max values, and the Max and Min refers to the reported values of the shell forces. |

| * Ticket | Description |
|----------|--|
| * 8370 | An incident was resolved to correct the design of concrete shell elements with only a single layer of reinforcement in the middle of the section. Previously, after the design was performed for the top and bottom layers of concrete, only the results for the top layer were reported. This resulted in zero reinforcement being reported if only the bottom concrete layer required reinforcement. Now the single layer of reinforcement at the middle that is required to satisfy the design for both the top and bottom layers of concrete will be reported correctly. Note that it is reported as being for the top layer in the contour plot and table for concrete shell design results, although it applies for both positive and negative bending, as applicable. |

Design – Steel Frame Incidents Resolved

| * Ticket | Description |
|----------|--|
| 4816 | An incident was resolved for steel frame design code "AISC 360-16" where, when using SCBF, the results were reporting "Section is not seismically compact for moderately ductile members" instead of "Section is not seismically compact for highly ductile members", as per AISC 341-16 section F2-5a. |
| 5512 | An incident was resolved for the "AISC 360-16" steel frame design code where the HSS minor-axis moment capacity was taken as the fully plastic moment capacity irrespective of section compactness for minor-axis bending when the web was compact for major-axis bending. Now the minor-axis moment capacity is calculated based on the section compactness for minor-axis bending. Previous results were correct for compact sections, but were unconservative for noncompact and slender sections under minor-axis bending when the web was compact for major-axis bending. |
| * 7856 | An incident has been resolved for the Eurocode 3-2005, Italian NTC 2008, and Italian NTC 2018 steel frame design codes to perform the design of angle sections about the principal axes instead of the geometric axes. The design includes the calculation of the design moments, the effective section moduli ($W_{eff,y}$ and $W_{eff,z}$), the plastic section moduli ($W_{pl,y}$ and $W_{pl,z}$), the equivalent uniform moment factor (C_m), the critical moment coefficients (C_1 , C_2 , and C_3), etc. Previously, these design parameters were computed about the geometric axes. |
| 7976 | An incident was resolved for steel frame design codes "Chinese 2018" and "Chinese 2010" where the shear-stress calculation in the minor direction was incorrect for box sections. The previous calculation was conservative, giving higher stress ratios as the stress was doubled. |
| 8301 | An incident was resolved for certain steel and other metal frame design codes where the critical buckling capacity was not calculated correctly for unequal-legged angle sections having web height (t_2) greater than flange width (t_3). However, the critical buckling capacity was calculated correctly for equal-legged angle sections and for unequal-legged angle sections with flange width (t_3) larger than the web height (t_2). The affected codes are as follows: (a.) Steel: AISC-ASD89, AISC 360-10, AISC360-05/IBC2006, AISC-LRFD93, API RP2A-LRFD 97, API RP2A-WSD2014, API RP2A-WSD2000, Chinese 2018, CSA S16-19, CSA S16-14, CSA-S16-09, Indian IS 800:2007, KBC 2009, KBC 2016, SP 16.13330.2017, SP 16.13330.2011. (b.) Aluminum: AA 2015, AA 2020. (c.) Cold-formed Steel: AISI-ASD96, AISI-LRFD96. |
| 8317 | An incident was resolved for the CSA S16-14 and CSA S16-19 steel frame design codes where the section classification limits reported in Table "COMPACTNESS" may have been incorrect for I-shaped, channel, and double channel sections. This was a reporting issue only and design was not affected. |
| 8382 | An incident was resolved for steel frame design code "Chinese 2018" where the reported interaction equation name was wrong when "Classify Beam as Flexo-Compression Member?" was set to "Yes". The program reported the equation name as "GB50017 8.2.5" while it was supposed to be "GB50017 6.2.3". The reported ratio was correct. No other results were affected. |
| 8430 | An incident was resolved for CSA S16-19 steel frame design where the design documentation for angle section bending capacity was referencing the sections from the AISC 360-16 code instead of CSA S16-19. The document has been updated to reflect the reference sections from CSA S16-19. |

| * Ticket | Description |
|----------|--|
| 8526 | An incident was resolved for displaying and exporting the interactive database tables 'Overwrites - Steel Design - Italian NTC 2008' and 'Overwrites - Steel Design - Italian NTC 2018'. Previously these tables would not be displayed nor export the data of shear forces Vc2Rd and Vc3Rd to the .s2k text file. As a result, the values of Vc2Rd and Vc3Rd are not imported from the .s2k text file generated from v24.0.0. These Vc2Rd and Vc3Rd values are read properly when opening the .sdb file of any version. Design results agree with the model and overwrites visible in the user interface. |
| 8577 | An incident was resolved for steel frame design to remove the display of the section class from the deflection-check detailed report for the codes AISC360-05/IBC2006, AISC 360-10, AISC 360-16, AS 4100-1998, Eurocode 3-2005, Italian NTC 2018, Italian NTC 2008, Indian IS 800:2007, NZS 3404-1997, KBC 2009, and KBC 2016. The section class is not applicable to the deflection check, and the section class reported could be wrong in the sense that it was not the same as that reported for strength design. |

Documentation Incidents Resolved

| * Ticket | Description |
|----------|---|
| 7808 | An incident was resolved in the AS 4100-1998 steel frame design manual where the equation for eta in section 3.7.3.2 of the design manual (AS 6.3.3) incorrectly showed 0.0326 instead of 0.00326. This was a documentation issue only. The design algorithm was using the correct value. |
| 8257 | An incident was resolved to correct the documentation for the Application Programming Interface (API) for the functions in SapModel.EditGeneral. The documentation previously listed these as EditSolid functions which was incorrect. This was a documentation issue only and did not affect the API. |
| 8387 | An incident was resolved for steel frame design codes "Eurocode 3-2005" and "Italian NTC 2018" where the description of the item "Consider Torsion?" in the Steel Frame Design Preferences form indicated that torsion was checked for Channel sections in addition to the I, Rectangular Hollow, Square Hollow, and Circular Hollow sections. Now the word "Channel" has been removed from the list, since channel sections are not checked for torsion. This was a change to the description only. Design behavior has not been changed, and now this description is consistent with the manual and the actual design behavior. |

External Import and Export Incidents Resolved

| * Ticket | Description |
|----------|--|
| 5555 | An incident affecting the import of Revit curved walls from .EXR files has been resolved. Curved walls with notches at their bases or tops, such as curved walls with a door opening, were not imported. When this occurred, the error was obvious and the .EXRLog file included a message reporting the omission. Revit curved walls with notches at their bases or tops, or the associated analytical panels in the case of Revit 2023, are now imported as expected. |
| 8563 | An incident was resolved where large DXF files (around 80,000 CAD objects) did not import into SAP2000, eventually running out of memory. DXF files with approximately 80,000 objects can now be imported, subject to machine limitations. Three related enhancements have been implemented: (1.) The import of DXF files is now faster. (2.) Arcs drawn on the layer selected for importing frame objects are now imported as curved SAP2000 frame objects instead of being tessellated into series of straight frame objects. (3.) "Lighthouse" polylines, drawn with the AutoCAD "Poly" command, are now able to be imported. |
| 8589 | An incident was resolved where the models exported to Perform3D were only fully correct when the database units in SAP2000 were either lb-in or lb-ft. The database units are those in effect when a model is first created or imported in SAP2000. For SAP2000 models with database units other than lb-in or lb-ft, the exported geometry and nodal loading were not correct. Note that other features in the exported model, such as the various properties, were not affected by this error. |

| * | Ticket | Description |
|---|--------|--|
| | 8881 | An incident was resolved where the sign of the of the local-axis angle for horizontal and inclined frame members was reversed when importing models from IFC files. This did not affect frame members where the default orientation (zero angle) was used. |
| | 8883 | An incident affecting the export to Revit .EXR files of models featuring steel columns with angle, tee, or channel sections has been resolved. These were exported to Revit with an incorrect rotation which differed from the correct orientation by 180 degrees. Concrete columns and steel column with rectangular, circular, pipe, tube, double-channel sections were not affected because their orientation is unaffected by a 180 degrees rotation. Also note that concrete column trapezoidal sections and steel double-angle sections are not available in Revit. Beams and braces were exported with the correct orientation. This issue affected all versions of SAP2000 capable of exporting .EXR files to Revit and when it occurred, the error was obvious. |
| | 8890 | An incident affecting the import of IFC 4 files describing structures in terms of the IFC "architectural coordination view" was fixed. The insertion point of all imported frame objects was left at its default middle center position, even when a different insertion point was specified in the IFC file. This error affected all versions of SAP2000 capable of importing IFC 4 files and was visually obvious when it occurred. Frame object insertion points were properly imported from IFC 4 files describing structures in terms of the IFC "structural view". |

Graphics

Incidents Resolved

| * | Ticket | Description |
|---|--------|--|
| | 4658 | An incident was resolved where the graphical user interface could become unresponsive after clicking the "Rotate 3D View" toolbutton while displaying an animated deformed shape. This issue did not affect Classical Plus (GDIPlus) graphics mode. |
| | 5438 | An incident was resolved where restraints were not displayed in the correct location when animating the deformed shape in DirectX graphics mode for 2D views. |
| | 5722 | An incident was resolved where, when creating animation videos (command File > Create Video), joints and their supports that were located behind other objects were shown instead in front of those objects. This only affected DirectX graphics mode, not Classical Plus mode. |
| | 7092 | An incident was resolved for DirectX graphics mode where selecting the Back Face option when using the command View > Set 2D View did not properly reverse the location of the joint restraints in the X-Z and Y-Z planes. This issue did not affect the Classical Plus graphics mode. |
| | 7941 | An incident was resolved where joint symbols were not displayed in the correct locations in exported EMF graphics files. |
| | 8065 | An incident was resolved where the Highlight and Selection colors chosen using the command Options > Colors > Display had no effect on the display. This has been corrected for the Highlight color, while the selection color has been removed as it is no longer used. Note that the Highlight color is only used in DirectX graphics mode. The highlight color shows, for example, the member referenced in the selected row of a displayed table, or the member under consideration during the design process. |
| | 8969 | An incident was resolved where joint offsets assigned to area objects with 3 or 4 points were not shown in extruded views of the model when the area-object transparency was set to zero (opaque). This only affected DirectX graphics mode. The joint offsets were correctly shown in extruded views when the transparency setting was non-zero. No results were affected |

Installation and Licensing
Incidents Resolved

| * Ticket | Description |
|----------|---|
| 8956 | An incident was resolved with cloud licensing where a client machine running with a lower level license could unexpectedly pick up a higher level license when a second instance was started or the license was refreshed, and a higher level license was available in the same account. Typically this would only happen when the higher level license was in use by another machine when the client initially started the program, and the higher level license was returned from the other machine while the client machine was still using the program. |

Miscellaneous
Incidents Resolved

| * Ticket | Description |
|----------|---|
| 7638 | An incident was resolved where certain object labels which could be construed as numeric but were not meant to be (like 53E8), which could generate an error condition when saving the model. |

Results Display and Output
Incidents Resolved

| * Ticket | Description |
|----------|---|
| 7011 | An incident was resolved where information has been added on the Color selection forms to clarify that in DirectX Graphics mode, screen colors are always used for printing. When grey-scale printing is desired from DirectX, this can be selected in the printer settings rather than in the SAP2000 Colors form. |
| 7096 | An issue was resolved where the input energy from frame-element loading was not calculated correctly in nonlinear analyses with the nonlinear geometry option set to "Large Displacements Plus P-Delta". This issue caused large energy errors to be reported for affected load cases. This was a reporting issue for the energy output only and did not affect other analysis results. |
| 7788 | An incident was resolved where the multivalued options were not enabled in the Display Solid Stresses form. |
| 8806 | An incident was resolved that addressed the following issues affecting the concrete frame design reports for ACI 318-19, AS 3600-2018, and Chinese 2010 codes: (1.) For the ACI 318-19 code, the table "Beam Capacities and Angles (Overstrength factor = 1.25, Phi(capacity) = 1.0)" presented in the design Joint Shear Details was showing the "Tension for +ve Moment" and "Tension for -ve Moment" as zeros. (2.) For the AS 3600-2018 code, the Joint Shear Details were not calculated and reported. This is now not available from the Concrete Column Design Form. (3.) For the Chinese 2010 code, the table "Beam Capacities and Angles" presented in the design Joint Shear Details was showing the "Tension for +ve Moment" and "Tension for -ve Moment" as zeros. In addition, the resulting joint shear stress ratios were wrong. The above items were only a reporting issue for the ACI 318-19 and AS 3600-2018 codes, and design results were not affected. For the Chinese 2010 code, the design results were affected. |

Structural Model
Incidents Resolved

| * Ticket | Description |
|----------|--|
| * 7195 | An incident was resolved where the capacity calculated for auto-M2 and auto-M3 SDOF (single degree-of-freedom) hinges for a column-type concrete section was assuming the total rebar to be distributed half on compression face and half on the tension face, regardless of the direction of loading. The capacity will now based on the actual distribution of rebar specified in the section property for column-type sections. This issue did not affect any of the P-M2-M3, P-M2, or P-M3 hinges which would normally be used for column-type sections. |

| * Ticket | Description |
|----------|--|
| 7301 | An incident was resolved where the thicknesses of area section properties were not being set correctly for models created through the Pipes and Plates new-model template when the region for default materials was anything other than United States. Additionally, the template was only creating a single default area section property even when the model for the selected component type required multiple sections with different thicknesses. |
| * 8282 | An incident was resolved where the center-of gravity (CG) offsets for the 2 and 3 directions were switched for user-defined channel frame sections (steel and cold-formed steel) that had a zero fillet radius. This only affected channels directly defined, not channels that were imported from a section-property database file (.PRO or .XML). Channel sections with a non-zero fillet radius were not affected. When this error occurred, the shear-center eccentricity was increased by the amount of the CG offset, which could increase shear-torsion (V2-T) coupling. In addition, when insertion points other than the default (10 - Centroid) were used, they were off by the amount of the CG offsets, which would affect the coupling between axial force P and bending moments M2 and M3. Results were consistent with the CG Offsets and Shear Center Offset as reported in the Property Data form (Define > Section Properties > Frame Sections > ModifyShow > Section Properties) and in the "Frame Section Properties 01 - General" database table. This error affected versions 23.3.1 to 24.0.0. Models opened in the new version will correct any affected channel section properties. |
| 8559 | An incident was resolved where the properties of sections that were not available in the XML section libraries were being set to zero when the sections were imported from the respective libraries. All missing section properties for the section being imported are now calculated at the time of import. |
| * 8578 | An incident was resolved where importing a channel section from a section library while working in one of the new-model templates could cause the software to terminate abnormally. This did not occur if the section was imported after the model had been created from the template. |
| 8812 | An incident was resolved where assigning nonlinear panel-zone properties to joints and running a Ritz modal analysis with starting vectors based on Links would cause a warning message in the analysis .LOG file that loads were being applied to one or more massless degrees of freedom. To resolve this issue, the analysis model now adds a very small mass to the to panel-zone degrees of freedom, based on the mass of connected frame objects. Note that in spite of the warning, no significant effect on results was expected for this case, and no significant change in results is expected with the new version. Only in certain uncommon cases, the new version may provide better convergence behavior for nonlinear modal time-history (FNA) load cases based on the affected Ritz modal cases if the nonlinear behavior was dominated by the panel zones. |

User Interface

Incidents Resolved

| * Ticket | Description |
|----------|--|
| 7370 | An incident was resolved for the export to Perform3D where some of the generated property names were longer than 40 characters and were therefore not able to be imported into Perform3D when the first 40 characters were common to more than one property. This could occur because property names in Perform3D are limited to 40 characters. Now all generated property names are limited to 40 characters and are unique. |
| 8334 | An incident was resolved where the values for analysis-model items (point, line, area, plane, solid, and link elements) in the right-button click properties form did not update when the units were changed in the drop down box in the form. Instead they remained in the units shown in the lower right corner of the graphical user interface. This affected the display of the analysis model (meshed elements), not the display of the drawn objects. This was a user-interface issue only and did not affect results. |