SAP2000® Version 22.0.0
Release Notes

Notice Date: 2020-01-10

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

The reference number for each change below is now the development Ticket rather than support Incident which was used in previous Release Notes. Emails sent when an Incident is released will now indicate this Ticket number as well.

Changes from v21.2.0 (Released 2019-11-15)

Analysis
Enhancements Implemented

*	Ticket #	Description
*	2973	Multiple copies of the same model can now be run on different machines, and the analysis results merged together on a single machine for performing design and processing results. This can be particularly useful for running a large number of load cases (e.g., earthquakes for performance-based design, P-delta load cases for design by the Direct Analysis Method, etc.), and there are multiple machines available for running different load cases simultaneously.

Design – Concrete Frame
Enhancements Implemented

*	Ticket #	Description
	2249	An enhancement has been implemented in the concrete frame design codes ACI 318-14, ACI 318-11, and ACI 318-08 in which the delta_ns factor is now limited to 1.4 based on sections 6.2.6 and 6.6.4.5.1 of ACI 318-14, section 10.10.2.1 of ACI 318-11, and section 10.10.2.1 of ACI 318-08.

Design – Steel Frame
Enhancements Implemented

*	Ticket #	Description
*	871	An enhancement has been made to the steel frame design codes Eurocode 3-2005, Italian NTC2008, and Italian NTC2018 in which the expression of Mcr is now being calculated according to Equation F.2 in Section F.1.2 of EC3:1993. It includes the C2*zg and C3*zj terms, where zg is the distance between the load application point and the shear center (zs), zj is defined in EC3:1993 Section F.1.2, and C2 and C3 are coefficients which depend on load conditions. Previously these terms were ignored and a simplified version of the formula for Mcr was being used. The term C2*zg considers the destabilizing effect of a compressive load placed on top of the beam and that passes through the shear center. This term can be ignored when either the bending moment diagram is linear along a part of a member due to restraints or when the load is applied at the shear center and therefore no destabilizing moments can occur. However, the term C2*zg cannot be assumed as zero for simply supported beams without lateral restraint and with the load applied at the top or bottom flanges. The second term C3*zj considers the effect of the section being singly-symmetric. The results were previously unconservative when the load was destabilizing and the beam was a deep beam.

*	Ticket #	Description
		There are limitations in the handling of Angle, Box, Pipe, Solid, Section Designer, General, and Non-prismatic sections as follows: • Angle section: The equation to calculate Mcr given by the design code is not strictly applicable to Angle sections. The design still calculates Mcr using the new equation but with the following assumptions: (1) The value zs is taken as the projection of the shear center coordinate onto the axis along which the load is applied when calculating zg; (2) zs is taken as the projection of shear center coordinate onto the minor principle axis when calculating zj. • Box, Pipe, and Solid sections: Calculation of Mcr is conservative as the warping constant (Iw) is not calculated and assumed to be zero. • Section Designer and General sections: These sections are classified as Class 2 or 3. AlphaLT is assumed to be 0.76 (buckling curve d). Warping constant (Iw) is not calculated and is assumed to be zero, as the shape of the section is generally not known. The shear center coordinate zs is assumed to be zero with respect to the centroid. • Nonprismatic sections: All properties required for calculation of Mcr within each nonprismatic segment are linearly interpolated from those of the two sections at the ends of that segment. This is done for each segment within the length of the frame object. This only makes sense if the sections at the two ends of each segment have the same shape (e.g., both I-sections or both box sections). If not, a warning is provided in the design results. These assumptions are made with the intent that the design of non-standard (not typically used) sections will tend to be on the conservative side.
	2059	An enhancement has been made to improve reporting for all concrete frame design codes for columns in which the reported design axial forces and bending moments were reported apparently randomly instead of the maximum values of a multi-valued combination, especially when the required rebar was the minimum. This also happened when a combination for which the case of minimum eccentricity moment about one of the axes was to be reported. Now the program reports the worst set of forces even if the rebar is not affected. This was not a bug. No design results are affected.

Installation and Licensing

Enhancements Implemented

*	Ticket #	Description
*	3233	The version number has been changed to 22.0.0 for a new major release.

Loading

Enhancements Implemented

*	Ticket #	Description
	3270	An enhancement was implemented to add an option to the NZS 1170.5 auto-seismic load pattern to consider the structure as a single story. When this option is selected the Ft value is set equal to zero and that load is instead redistributed over the height of the structure.
	3465	An enhancement has been made so that individual modes from modal and buckling load cases can now be added to load combinations. Multiple modes can be added from the same load case, each with its own scale factor.

Structural Model

Enhancements Implemented

*	Ticket #	Description
*	3321	Detailed foundation properties can now be defined and used to generate parametric foundation assemblies which can be added to the model. Here the term "assembly" refers to a collection of component objects (points, lines, areas, and links) that are created to represent the foundation. Foundation assemblies are automatically regenerated when the properties of the foundation or its location are changed. The available foundation properties are Isolated Footing, Combined Footing, Pile Group, Pile Pier and Pile Shaft. The combined footing is of the strip-type foundation and the rest are of the isolated-type foundation. Draw commands are used to create foundation assemblies by clicking a single point for an isolated-type foundation or two points for a strip-type foundation. The top of the generated foundation assembly will connect to the clicked point. Note that the foundation property data is currently only saved as binary data, and as such cannot be imported from the model text file (.S2K, .$2K) or database table files (Excel, Access, XML). Import capability will be implemented in a later version.

User Interface

Enhancements Implemented

*	Ticket #	Description
	3487	An enhancement was implemented to improve the speed of the graphical user interface when opening or manipulating a model with a large number of area objects and also a large number of spring assignments to some or all of the area objects. No results were affected.

API

Incidents Resolved

*	Ticket #	Description
	194	An incident was resolved for the Application Programming Interface (API) where the function GetCoordSys_2 was returning incorrect values for the X and Z coordinates of the origin of the grid system.
	3149	An incident was resolved for the Application Program Interface (API) in which the SapModel.PropLink.GetTriplePendulumIsolator function would either return incorrect data or generate an error.

Design – Concrete Frame

Incidents Resolved

*	Ticket #	Description
	3047	An incident has been resolved in which the design forces (axial, minor and major moments) were reported as zero in the design report for "Step-by-Step" and "Step-by-Step All" case design. This was only an issue with the display. Design results were not affected.
	3054	An incident has been resolved for the Eurocode concrete column design in which the design forces were incorrect for the case when the second-order method was "None." As a result, the design was overconservative.
	3375	An incident has been resolved for the design of non-prismatic concrete columns using Eurocode 2 and Italian NTC08. Previously, the design results were not available for non-prismatic elements.
	3512	An incident was resolved where the software would terminate when clicking the Tabular Data button on the Concrete Check Information form that is shown when right-clicking a designed concrete member. This did not affect the results displayed by other methods.

Design – Steel Frame

Incidents Resolved

*	Ticket #	Description
	2159	An incident was resolved for steel frame design according to the Chinese 2010 code in which the seismic modification factor (SMF) was always applied to overall load-combination forces. Now the SMF is applied to only seismic part of the load in the load combination. All non-seismic loads are scaled as specified in the load combination, but the SMF applies on top of the factor specified for seismic loads. The previous implementation was slightly conservative.
	2493	An incident has been resolved to properly determine the effective length factor used in calculation of nominal axial capacity of steel members of models in which General Second-Order Analysis is selected for the Analysis Method and the Frame Type is Moment Frame (Sway Frame). The determination includes a check for seismic loading condition. Previously, design results were overly conservative.
	2732	An incident has been resolved in the Chinese 2018 steel frame design code in which the stress calculation for angle sections was not correct as the section moduli in the principal directions were not being used, while the moments were determined correctly in the principal directions. Instead, the section moduli about the geometric directions were being used. The resulting stress ratios were not correct. The resulting PMM ratios could be either conservative or unconservative, depending on the load direction.
	3213	An incident has been resolved in the Chinese 2018 steel frame design code in which the Beta_x and Beta_y factors for circular pipe sections were calculated based on the corresponding Nex and Ney values, which are based on the corresponding lambda_x and lambda_y values. Now both Beta_x and Beta_y factors for circular pipe sections are calculated based on the minimum value of Nex and Ney, which is based on the largest lambda and the appropriate values of M2/M1per GB50017-2017 section 8.2.4. This affects the calculation of Beta (Beta =Beta_x * Beta_y) per equation GB50017-2017 8.2.4-3 and calculation of PMM interaction ratio per equation GB50017-2017 8.2.4-1.

*	Ticket #	Description
	3238	An incident has been resolved in the steel frame design code Chinese 2018 in which the phi_b factors were not matching perfectly for members which had a linear moment diagram and end moments that were nearly equal. The upper limit of the beta_b factor, which is 2.3, was not being imposed when the equation given in Item 10 of GB50017-2017 App C TableC.0.1 produced a beta_b more than 2.3.
	3239	An incident was resolved for steel frame design per the Russian code "SP 16.13330.2011" in which the equation Eq. 116 of section 9.2.9, which is related to axial compression with biaxial bending, will no longer be checked for pure compression. The Eq. 115 of section 9.2.8 frequently captures the interaction ratio in this situation. The results are not affected as the stress ratio does not change. Effectively, the program now will report a different governing load combination because of this change.
	3347	An incident has been resolved in the steel frame design codes in which the software failed to complete joint design/check when there was at least one live load present and when the pattern live load factor was set to a nonzero value in the preferences. The affected codes were all supported codes that perform joint design/check including AISC 360-16, AISC 360-10, AISC360-05/IBC2006, AS 4100-1998, CSA S16-14, CSA-S16-09, Eurocode 3-2005, Italian NTC 2018, Italian NTC 2008, Indian IS 800:2007, and NZS 3404-1997. The design reported “Error during steel check of frame …” when this occurred.

Documentation

Incidents Resolved

*	Ticket #	Description
	1921	An incident was resolved in which the documentation for design verification example Eurocode 3-2005 Ex003 contained an older equation for computing alpha. The program was already using the correct equation. This was a documentation error only.

Graphics

Incidents Resolved

*	Ticket #	Description
	3211	An incident has been resolved for displaying loads for a selected load case from the Load Case Tree form when the name of the load case contained a parenthesis "(" character.

Loading

Incidents Resolved

*	Ticket #	Description
*	3380	An incident was resolved where joint-pattern values were set to zero for the area (shell) object on one side of an edge release, while the area object on the other side of the edge release kept the joint-pattern values originally assigned to the joints on that edge. This could affect the following assignments to the affected area object, but only when that assignment used joint patterns: thickness and joint-offset overwrites, material temperature, surface-pressure load, temperature load, and strain load. Only joints along the edges with releases were affected.
*	3407	An incident was resolved where, if more than one element load is applied on a solid element (e.g. self-weight, surface pressure, pore pressure, etc.) in one load pattern, the load factor used for nonlinear static, staged construction, or nonlinear direct-integration time-history load cases would be multiplied by the number of element loads in the load pattern. When the issue occurred, the response of the structure reflected the increased load factors. This issue did not affect linear or modal load cases and only affected solid elements. This issue was present in version 20.2.0 to v21.2.0.

Results Display and Output

Incidents Resolved

*	Ticket #	Description
	1976	An incident was resolved where the tables of material lists did not account for weight modifiers assigned to the sections that compose a non-prismatic frame member. For prismatic members the material tables accounted for these modifiers. The analysis did properly account for these modifiers for both prismatic and non-prismatic members. No results were affected.
*	2757	An incident was resolved in which some of the content in the Chinese 2010 concrete frame design right-click design details was not being populated. This was an output error only and did not affect design results which were still available on-screen and in database tables.

Structural Model

Incidents Resolved

*	Ticket #	Description
	1871	An incident was resolved where the joint patterns generated when using the underground concrete templates were not correct.