SAP2000® Version 16.0.0

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SAP2000 v16.0.0 is a major upgrade from SAP2000 v15.2.1, and is distributed electronically by download from the internet using the CSI Installation Wizard.

PLEASE READ THIS FILE!

It contains important information that may be more current than what is in the Manuals.

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1. Installation Instructions for SAP2000 Version 16.0.0

SAP2000 Version 16.0.0 is available electronically as a full installation by download from the internet using the CSI Installation Wizard, or on DVD by request. Installing SAP2000 will not uninstall older versions of SAP2000.

Whether you are using a standalone license or a network license, the full application must be installed on each workstation where SAP2000 will be used.

Use the Installation Wizard to guide you step-by-step through the process of installation and licensing. If you choose instead to use the DVD, follow the instructions provided in the installation browser that automatically starts up when the DVD is inserted into the drive on your computer.

Before installation, be sure you have your Activation Key available if you will be using a Standalone license. You should have received this by email from CSI or your dealer. If you will be using a Network license, it is necessary to have the licenses already activated on the license server that is accessible to the workstation.

To begin the CSI Installation Wizard, click this link:

http://www.csiamerica.com/go/installation-wizard

The Wizard will start and guide you through the process. The actual files needed for installation will be downloaded as necessary. An active internet connection is required throughout the installation and licensing process.

The license activation server ports are 8080 and 8443. If either of these ports is blocked, they need to be opened. Otherwise license activation will not be possible.

Windows User Account Control (UAC)

For recent versions of the Windows operating system (Windows 8, 7, Vista, and XP SP3), User Account Control (UAC) is enabled by default. When UAC is turned on, you must explicitly give permission to any program that wants to use "Administrative" privileges. Any program that tries to use Administrative privileges without your permission will be denied access.

The installation of the SAP2000 and the activation of the license require "Administrative" privileges to run. When installing SAP2000 with UAC enabled, you should expect to be prompted to allow the installer access to system folders and Windows registry. Please allow it to continue so that the installation can complete.

2. Installation Instructions for License Manager 8.5

The information in this section does not apply if you are using Standalone licenses.

If you will be using a network license to run SAP2000, the License Manager and Utilities should be installed on a license server, which is usually not one of the client workstations. The Installation Wizard (and DVD) provide the following installations:

Sentinel RMS License Manager 8.5

- If you have an earlier version of Sentinel RMS License v8.x.x running, uninstall it after making sure no licenses are currently in use and no commuter licenses are checked out. Make a backup of the license file "lservrc", and then proceed with the installation of License Manager 8.5.

- If you are already running the Sentinel RMS License Manager 8.5 or a later version, you can skip this installation.

- If you have an earlier version of Sentinel RMS License v7.x.x running, you will need to leave this installed as v8.5 does not recognize v7.x.x licenses. Install the Sentinel RMS License Manager 8.5 on a different server.

Sentinel RMS License Manager 8.5 Utilities

- The Sentinel Utilities for License Manager 8.5 needs to be installed even if you are running a later version of the License manager. The Utilities are to be installed on the same license server as License Manager. During the installation you will be prompted for a Network Activation Key. You should have received this by email from CSI or your dealer. Enter the key and click on Activate; a Network license will then be generated and copied to the server location or appended to an existing license at the server location. Note that the License Manager 8.5 needs to be running to activate the license.

On the client workstations

To speed up finding a network license when SAP2000 is launched, you can do either or both of the following:

- Create a text file, LEVEL.TXT, and enter the *ProgramLevel* in a single line. The *ProgramLevel* should be one of the following:

  > BASIC / PLUS / ADVANCED / ULTIMATE / BASICC / PLUSC / ADVANCEDC
  > ULTIMATEC / ADVANCEDI / ULTIMATEI

  Save this file to the folder where SAP2000 is installed. This file will cause the program to find the license faster.

- Create a text file, LMHOST.INI, and enter the network name or IP address of the machine that is running the License Manager. If you are serving licenses on more than one machine, enter each name or IP address on a separate line of text. Save this file to the folder where SAP2000 is installed.

- Either the LEVEL.TXT file or the LMHOST.INI file can also be placed in the user settings folder, which can be found by entering "%LocalAppData%\Computers and Structures\SAP2000 16" (without quotes) in Windows Explorer. Accessing this folder does not require administrative permissions like the installation folder does. Files located in the user settings folder will take precedence over those in the installation folder.

As an alternative to using the LEVEL.TXT file, you can specify the program level as a command-line option. To do this, use the Windows Run command or create a shortcut pointing to SAP2000.exe in the installation folder. Add the following text to the command line after "…\SAP2000.exe"

> /L *ProgramLevel*

where *ProgramLevel* is one of the values listed above for the LEVEL.TXT file. Specifying *ProgramLevel* on the command line will supersede the value in the LEVEL.TXT file.

3. New Features for SAP2000 Version 16.0.0

SAP2000 v16.0.0 is a major new release, and significant new features have been added or enhanced since Version 15.2.1.

For a full list of features and capabilities, please visit the SAP2000 news page at
http://www.csiamerica.com/SAP2000/news-V16

4. File Compatibility with Older Versions

SAP2000 Version 16.0.0 can open model files (*.SDB), from older versions of SAP2000, as well as import older SAP2000 database files (*.S2K,*.$2K, *.XLS, and *.MDB). Note that once you save or run these models in Version 16.0.0, they will not be usable by older versions of the program, so you should save them under a new name after opening or importing them in v16.0.0. By default, this is done automatically.

Models from SAP2000 version 14 and prior that contain Bridge Modeler data, lanes defined from bridge layout lines, or vehicles with code-dependent features should use product CSiBridge instead of SAP2000. These models can be opened in SAP2000 v16, but not all of the bridge-related data will be accessible or retained, as follows:
- If bridge objects are detected, you will be asked whether or not you wish to retain Bridge Modeler data.
    - If Yes, this data will be protected, but will not be accessible within SAP2000. You should import this model into CSiBridge to access the data.
    - If No, this data will be deleted.
- If Bridge Modeler data is detected but no bridge objects are found, all Bridge Modeler data will be deleted.
- Lanes defined from frames will be retained, but lane-width data will be removed. Lanes defined from bridge layout lines will be deleted. In SAP2000 v16, lanes are now called "paths".
- Code-based standard vehicles will be deleted. General vehicles will be retained, but code-based features, length effects, and width effects will be removed.

See the CSi Analysis Reference Manual, chapter "Moving Load Analysis", for more information on the features supported in SAP2000 and CSiBridge.

5. Significant Changes from Versions 15.2.1

Significant changes that have been made since Version 15.2.1 (released 2013-03-08) are listed here. For a complete list of all changes, please see the separate file ReleaseNotes.PDF in the Manuals subfolder of the SAP2000 installation and available by using the *Help > Documentation* command in SAP2000. Note that most incidents do not affect most users.

Graphics
Enhancements Implemented

Incident	Description
39556 56948	The graphical user interface has been improved in terms of responsiveness when using the GDI+ graphics mode. Specific items that have been addressed include: (1) The sensitivity to mouse movement for 3D rotation has been reduced for more user control. (2) Mouse movements are smoother and faster. (3) The speed to refresh the graphics screen has been increased. (4) The speed to draw multiple objects using the quick-draw commands is improved. (5) Joints now remain visible at all levels of zoom and scale with zoom within the limits specified in the Options.

Modeling
Enhancements Implemented

Incident	Description
15970	A new link property has been added to represent the triple-pendulum isolator (bearing). This bearing has four spherical sliding surfaces that act as three independent friction-pendula in series. By adjusting the friction coefficients, radii, and edge stop distances of the sliding surfaces, this bearing can produce multiple levels of stiffness and energy dissipation to accommodate a range of seismic excitation.

Loading
Enhancements Implemented

Incident	Description
43404	Ground-displacement loading assigned to a joint will now act through single-joint links connected to that joint and through distributed springs assigned to frames, areas, and solid faces connected to that joint. Previously ground displacement loading only acted at joints connected to ground directly by joint restraints or joint springs. Now, single-joint links in the object model are converted to two-joint link elements in the analysis model, with the newly generated joint being fully restrained. Ground displacement loading is applied to the generated restraint joint. Similarly, two-joint link elements are now automatically generated to represent distributed spring supports for frames, areas, and solid faces, and ground displacement loading is interpolated to the generated restraint joints from the joints of the parent object. Joint reactions were previously reported at joints connected to ground by restraints, springs, and single-joint links, and this has not changed. Similarly, base reactions were previously calculated as the sum of the reactions at all joints connected to ground by restraints, springs, and single-joint links, and this also has not changed. Older models with ground-displacement load applied to distributed springs and to joints connected to single-joint links may now produce different results than in previous versions.
53533	Automated wind loading has been added according to the Australian and New Zealand code AS/NZS 1170.2-2011.

Incident	Description
53975	Automated lateral loading has been added according to the IBC 2012 code. This includes seismic loads and response-spectrum functions.
53976	Automated response-spectrum functions have been added according to the AASHTO 2012 code.
53977	Automated lateral loading has been implemented according to the Italian NTC 2008 code. This includes seismic loads and wind loads. NTC 2008 response-spectrum functions had previously been implemented.
53979	Automated lateral loading has been implemented according to the Turkish TSC 2007 code for seismic loads and response-spectrum functions, and the TS 498-97 code for wind loads.

Analysis
Enhancements Implemented

Incident	Description
42467	The ability to define multiple mass sources has been added. This does not affect most users. Previously there was a single mass source definition that specified whether the mass used for analysis should be calculated from elements and additional masses; or from loads present in specified load patterns; or both. Now multiple, named specifications of mass source can be defined. This could be used, for example, to represent different equipment configurations in a structure or different locations of eccentric mass. There is always a default mass source that is used for all analyses unless otherwise specified, and this behavior is unchanged from previous versions of the software. Now an alternative definition of mass source can be specified to be used for any nonlinear static, staged-construction, or nonlinear direct-integration time-history load case. This mass source will be used for all other load cases that continue from, or use the stiffness of, that load case. Automated lateral loads will be calculated using the mass source specified for the load case in which they are assigned. The same lateral load pattern cannot be used with different mass sources, so additional lateral load patterns can be defined for use with different mass sources as required. The assembled joint mass is reported for each defined mass source actually used in a load that has been analyzed.
57640	A change has been made to how negative values are processed when generating mass from the mass source. All mass from materials, properties, and added mass are always positive, except joint mass which may be positive or negative. Mass generated from loads, when requested, is positive when the loads are downward (-Z), and negative when the loads are upward (+Z). Previously, the positive and negative contributions to mass were summed for each individual element and set to zero if negative. This was done before adding the contribution of the element mass to the structure. Now, instead, positive and negative values from each element will be retained, assembled for the structure, and reported in the database table "Assembled Joint Mass". During equation solution, if any negative values are detected after accounting for constraints, they will be set to zero and a warning will be printed in the analysis log file. Most users and most models will be unaffected by this change. However, the results may differ from previous versions in cases

Incident	Description
	where significant upward loads were included in the mass source. The purpose of this enhancement is to enable users with special needs to change the mass distribution in a model, such as for investigating the effect of eccentric story mass on mode shapes. See also Incident 42467 for multiple mass sources.

Frame Design
Enhancements Implemented

Incident	Description
43712	The specified concrete strength as used for Chinese materials and design codes has been changed to refer to the characteristic strength, whereas in SAP2000 v15 and earlier versions the concrete strength referred to the grade. The built-in Chinese concrete materials have been changed accordingly, and so have the concrete frame design checks. For example, the Chinese material C30 previously specified the strength as 30 N/mm^2, but now specifies the strength as 20.1 N/mm^2. Models created in v15 and prior versions that are opened in v16 will have the concrete strength of ALL concrete materials converted from grade to characteristic strength if the concrete frame design preference in the older model specifies the Chinese code. This should have no effect on the results between versions for Chinese design. Users should review the concrete materials carefully when first opening a model from an older version in v16 if the concrete frame design was set to use the Chinese code.
53426	Steel frame design has been implemented according to the American "AISC 360-10" code, including the seismic provisions of the AISC 341-10 code.
53431	Steel frame design has been implemented according to the Italian "Italian NTC 2008" code ("Norme Tecniche per le Costruzioni - D.M. 14 gennaio 2008").
53432	Concrete frame design has been implemented according to the American "ACI 318-11" code.
53434	Concrete Frame Design has been implemented according to the Italian "NTC 2008" code ("Norme Tecniche per le Costruzioni - D.M. 14 gennaio 2008").
53438	Concrete frame design has been implemented according to the Mexican "RCDF 2004" code ("Technical Norms for Design and Construction of Concrete structures, October 06, 2004").
53439	Concrete frame design has been implemented according to the New Zealand "NZS 3101-06" code ("The New Zealand Standard NZS 3101-06").
54805	Two new verification suites have been added, one for concrete frame design and one for steel frame design. Each suite consists of a set of example problems covering the various supported codes, and includes documentation, model files, and an Excel spreadsheet to automate the running and checking of the models. The two new suites are similar to the existing analysis verification suite.
56949	Concrete Frame design has been added according to Hong Kong CP 2013 code.

Results Display & Output
Enhancements Implemented

Incident	Description
37440 38265 38376	Stress output for frame members has been enhanced to include shear stresses S12 and S13, the principal stresses Smax and Smin, and the von Mises stress SVM. These stresses are available for certain thin-walled sections, as well as for rectangular and circular sections. Section Designer sections can produce stresses as defined by the user. Stresses can be plotted and are available in tabular form.
56115	A new option has been added to display the bearing pressure acting on area (shell) objects as calculated by analysis due to the presence of area springs assigned to the top and/or bottom faces of the objects.

Application Programming Interface
Enhancements Implemented

Incident	Description
47723	A new type of load case, "External Results", has been added. This type of load case, while visible in the graphical user interface, must be defined using Open API functions. Using Open API functions, internal forces and moments determined from an external source can be specified for each frame element in the model for External Results load cases. These load cases can be added to load combinations and used for frame design like any other load case. All other response quantities (displacements, reactions, shell stresses, etc.) will be reported as zero for these load cases.
52267	Two new Open API (OAPI) functions have been added to obtain the steel-frame design results corresponding to the design database tables for certain codes as documented in the OAPI help file. These functions are SapModel.DesignSteel.GetDetailResultsText and SapModel.DesignSteel.GetDetailResultsValue. Functions for obtaining summary results were already available.

External Import/Export
Enhancements Implemented

Incident	Description
16069 24529 30038 42087 45305 49074 51454 55670 55997	The export and import of IFC files has been enhanced and corrected as follows: (1) IFC 4 format is now supported. IFC 2x3 files can still be imported and exported. (2) Several IFC entities that previously were not imported or were not imported correctly can now be imported. See the IFC Import Export Technical Note for supported entities. (3) The exported file now has an .ifc extension. Previously it was given a .stp extension. (4) Exported GUIDs of SAP 2000 objects are now consistent with their internally stored GUIDs. In the case of models converted from earlier versions of SAP 2000 in which there are no internally stored GUIDs, the assigned GUIDs are stored when the SAP2000 model is saved. (5) Pipe and circular sections were previously exported to IFC with a diameter twice their actual diameter. In addition, pipe sections were not being exported as hollow sections.

Incident	Description
	These issues have been corrected. (6) Files can be exported either as a "structural analysis view" or an "architectural coordination view". Previously only the "architectural coordination view" was available. Both can be imported, as before. (7) Options are now provided on export and import to select the types of objects to process.

Installation & License
Enhancements Implemented

Incident	Description
41626	Licensing has been upgraded to the latest SafeNet version, providing support for virtual servers, and allowing more flexibility for using commuter licenses.

Section Designer
Incidents Resolved

Incident	Description
39070	An incident has been resolved for Section Designer in which very small overlaps between two shapes could cause the incorrect calculation of the section properties, depending on the angle of rotation of the section. This error was very rare.
52384	An incident was resolved for Section Designer where the plastic modulus for a section with multiple materials was computed using transformed areas based on the Young's moduli of the different materials rather than based on the yield strengths. The plastic modulus has no effect on analysis results but could affect steel-frame design results for the rare case where a steel Section-Designer section uses mixed materials.

Analysis
Incidents Resolved

Incident	Description
53144	An incident was resolved where two issues were corrected for the channel frame section property: (1) The Shear Center Eccentricity displayed in the Property Data form when defining the channel section property is intended to be the distance from the centroid to the shear center, but the value displayed and used for analysis was the smaller distance from the nearest face of the channel to the shear center. This same value is shown in the database table "Frame Section Properties 01 - General" as "EccV2". This has been corrected so that the value displayed and used is the distance from the centroid to the shear center. When this value is zero, there is no coupling between shear and torsion. (2) The shear and torsional internal frame response was previously defined at the centroid of the section. This has been changed to be defined at the shear center of the section. Only versions 15.2.0 and v15.2.1 were affected. See also Incident 53819.

Incident	Description
53819	An incident was resolved where the fixed-end forces and moments calculated for a frame element having a channel section property and subjected to concentrated or distributed span loads acting in the element local 2 direction were incorrectly distributed to the two ends. Distributed span loads include the self-weight of the member. The resultant of these forces and moments were in equilibrium with the applied load, so the effect on the structure was localized. When the span loads were part of a load pattern used in the mass source, this could result in the incorrect mass being calculated for the frame element. The effect of this error was more significant for shorter elements, and was caused by calculations related to the shear center of the channel section. Only version 15.2.1 was affected. See also Incident 53144.
53854	An incident was resolved where joint patterns used to assign thickness and/or offset overwrites to shell-type area objects were not being properly applied in the following two cases: (1) If the analysis was run out-of-process, the joint pattern values were ignored (set to unity) for calculating shell element stiffness, mass, loads, and the force/stress response. (2) If the analysis was run in-GUI-process, the joint pattern values were correctly used for calculating shell element stiffness, mass, and loads. The joint patterns were also correctly used for displaying the force/stress response after running the analysis, but were ignored (set to unity) for results displayed or exported in tables, and for all force/stress response displayed after the model was closed and reopened without re-running the analysis in-GUI-process. For analyses run out-of-process, the effect on the stiffness, mass, and loads could affect the analysis results of the entire model. For analyses run in-GUI-process, the displacement/force/stress response of the entire model was correct except for the force/stress response of only the shell elements using joint patterns for thickness and/or offset overwrites. For the common case of shell thickness and/or offset overwrite assignments that do not reference joint patterns, the results were correct.
54046	An incident was resolved where an angle section property imported from a property database file could, in certain cases, use an incorrect value for the cross-inertia term I23 if a user-specified section property with non-zero I23 was defined before the imported property. When this occurred, the imported property took on the value of I23 from the most recently defined section-property with non-zero I23. The actual values of I23 used for each section property can be seen from the table "Frame Section Properties 01 - General" after running the analysis. This error was not common. Only single-angle sections were affected. Only versions 15.2.0 and v15.2.1 were affected. Prior versions did not use I23 for analysis.

Frame Design
Incidents Resolved

Incident	Description
51148	An incident was resolved where the frame design (steel, concrete, aluminum, cold-formed) would not consider a multi-valued load case in a design combination if step-by-step results were requested but the particular case was not the last case in the combination. When this error occurred, the contribution of the affected load case to the load combination was zero. This error did not occur if enveloping results were requested or the case was not multivalued or the case was the last one in the combination list.