SAFE v20.0.0 Release Notes

Notice Date: 27-September-2021

This document lists changes made to SAFE since v16.0.2, released 02-January-2018. Items marked with an asterisk (*) in the first column are more significant.

Analysis

Enhancements Implemented

*	Ticket	Description
	873	An enhancement was added with the command Analyze > Set Load Cases to Run which allows controlling which load cases are to be run and other related options. This can be useful to turn off nonlinear load cases when results are not needed at a particular time. The "Run Analysis and Design" tool-button will only run those load cases that have been selected by the Set Load Cases to Run command.
*	1806	An enhancement has been made to add a general mesher for floor area objects. The generated mesh will primarily consist of quadrilateral elements, with triangles as needed near transitions and discontinuities. The general mesher has less reliance on edge constraints to provide continuity between floor elements than does the older rectangular mesher. The general mesher is the new default. However, the rectangular mesher has not been removed so as not to change results for older models.
	3479	An enhancement was made to store analysis model generation warnings in the model so they are available in the Analysis Message dialog from session to session.
	4176	Optimizations have been made to speed up the plotting of deformed shapes and generation of .AVI files for multi-stepped load cases. This will primarily affect direct-integration and staged construction load cases in models with a large number of elements.
	5255	An enhancement was made to the Nonlinear Parameters form (Define menu > Load Cases) to provide more control over the iterative solution scheme used for a nonlinear static load cases. For most problems the default parameters will be appropriate, but the user can make changes for models where convergence behavior is difficult.
*	7171	An enhancement has been made to improve the consistency of analysis results on Intel and AMD CPUs with an AVX2 instruction set. Most Intel and AMD CPUs released on 2015 or later support AVX2 instruction set and should benefit from this enhancement. For nonlinear analyses of numerically sensitive models, results should be more consistent when run on different CPUs. For typical well-conditioned models and linear analyses, no significant change is results is expected.

API

Enhancements Implemented

*	Ticket	Description
*	6620	An Application Programming Interface (API) has been added to SAFE that allows external client applications to run SAFE or attach to existing instances of SAFE so as to manipulate models. This includes such operations as opening and saving models, creating and modifying models, running analysis and design, and extracting results. The client applications can be written in several different programming languages, and can connect to SAFE through a .NET or COM interface. Languages include Visual Basic, Visual C++, Visual C#, Python, Matlab, and VBA (such as in Microsoft Excel). Access to SAFE model information is through API calls that utilize the same database tables that are available in the graphical user interface (GUI). Unlocked models can be created and modified using API functions that get and set tables similar to how the interactive database editor works in the GUI. Data can be extracted from locked or unlocked models using API functions that get tables similar to how tables are displayed in the GUI. Documentation for how to use the API is provided in the help file "CSI API SAFE v1.chm". Documentation for the data available in the tables can be obtained from inside SAFE using the command Options > Database > Documentation to Word.

Database Tables

Enhancements Implemented

*	Ticket	Description
*	7167	An item was added to the Options > Database menu to allow printing database table documentation to Microsoft Word.

Design – Composite Beam

Enhancements Implemented

*	Ticket	Description
*	6458	Composite beam design has been added as a wholly new design feature in addition to the existing concrete slab design. Horizontal steel beams can be drawn and assigned for design. The design procedure considers composite and non-composite behavior as required, and considers axial forces and vibrations when requested. Beams with web openings, including castellated and cellular beams, can be designed. Design can be performed on the model as a whole or interactively on individual members. With interactive design, various design sections can be tried out, and the percentage of composite action and their camber can be adjusted. Complete design results are available in comprehensive reports, tables, or interactively. The following design codes are supported: AISC 360-16, AISC 360-10, AISC 360-05, BS5950-1990, Chinese 2010, CSA S16-14, and Eurocode 4-2004. Beams with user-defined web openings can be designed per the AISC 360-16, AISC 360-10, and AISC 360-05 codes only. Beams subject to significant axial forces, castellated beams, and cellular beams can be designed per the AISC 360-16 code only. The Chinese 2010 code requires a Chinese license.

Design – Slab

Enhancements Implemented

*	Ticket	Description
*	1014	An enhancement has been made to report integrated forces on a Section Cut. Three methods are available to define these section cuts: (1) Define a group of shell and frame objects whose nodal forces at joint objects also included in the same group are summed and reported in tables. (2) Define a quadrilateral (quad) by its coordinates and a group of shells and frame objects. In this case only the shell and frame elements of the analysis mesh of the objects in the group that are cut by the quad are included in the sum of nodal forces. The analysis nodes included in the summation are automatically picked based on which side of the cut the summation is to be made. The results are reported in tables. (3) Draw a line on a results view and the summation of nodal forces of the analysis elements cut are displayed on screen for the load case of the results view. This cut can be saved as a Section Cut defined by a quad. The program automatically creates the group of objects and the quad to define it. The save can only be made if the results are displayed on an undeformed 2D view showing force or stress results.For all three methods the user has options to obtain results about a defined point, in a defined coordinate system, and using either an analysis-results or a design-results sign and reporting convention.
	2160	An enhancement was added for the command Display > Show Slab Design, and the corresponding table "Concrete Slab Design Summary - Flexure and Shear Data", where span-location details are now available based on the maximum moment and maximum shear acting at the Start, Middle, and End of a span for a PT slab.
	2891	An enhancement was made to the slab punching shear check for the CSA A23.3-14 design code where a tolerance has been added when checking fy and f'c for enforcing the simplified check based on CSA section 11.3.6.3. The purpose of this is to help avoid unexpected changes in results due to small changes in material strengths.
*	3982	The concrete code “ACI 318-19” has been added for reinforced concrete and post-tensioned design.
*	4687	An enhancement has been made where pre-compression due to PT is now reported for every design strips in the tabular output.

*	Ticket	Description
*	4688	An enhancement has been implemented where the moment capacity of design strips in a model with PT are now reported for every strip station. Strip-moment capacities can also be plotted in the graphical user interface.
*	4903	The National Annexes for Bulgaria, Germany, Ireland, Poland and Portugal have been added as an option to the Eurocode 2-2004 reinforced-concrete and PT slab design.
*	5933	An enhancement has been made to the concrete beam and strip-based slab design to allow user control to either include or exclude axial compression in flexural design if the axial compression reduces the required reinforcement. Axial tension and axial compression that increases the required flexural reinforcement is always considered. For post-tensioned construction, all axial load is always considered. This user option is accessed through concrete beam-design and slab-design preferences.
	7102	An enhancement was made when using Chinese design code for checking slab punching shear capacity in the presence of shear studs or shear rails which now uses GB50010-2010 Eqn. 6.5.3-1; previously GB50010-2010 Eqn. 7.7.3-1 was used.
	7118	An enhancement was added for IS 456:2000 reinforced concrete slab design where option to increase flexural rebar in slab has been added in the Design Preferences for enhancing concrete slab shear capacity. When this option is activated and shear links are needed, flexural rebar is increased to avoid shear links in slab/mat. Flexural rebar is increased only when shear stress does not exceed the code specified maximum limit and when percentage of reinforcement in slab is less than 3 percent.

Detailing

Enhancements Implemented

*	Ticket	Description
*	6135	A change has been made to separate the production of detailed drawings from SAFE into a standalone product, CSiDetail v20, that interacts with SAFE. Detailing can still be performed in SAFE, and the results displayed in the model windows and used for further design checks. Detailing performed in SAFE can be exported to CSiDetail v20, when it becomes available, to produce schematic drawing sheets that can be further edited.

Documentation

Enhancements Implemented

*	Ticket	Description
	1157	The Help topic for Frame Property Modifiers has been updated to document the default torsion-stiffness modifier used for Beams.
	1313	A design verification example has been added for the punching-shear check of a circular column per the ACI 318-19 slab design code.
	1359	An enhancement was made in "Concrete Beam Flexure Envelope" and "Concrete Beam Shear Envelope" tabular output by expanding the description for column "Location". The description now includes the details of End-I, Middle and End-J locations.
	1925	An enhancement was made by documenting the Modulus of Rupture used for floor cracked-deflection calculations under "Material Property Data Form" when "Program Default" option is used. This default is dependent on the slab design code and is documented for each code.

Graphics

Enhancements Implemented

*	Ticket	Description
*	825	The DirectX graphics used for model display has been upgraded to version 11. When SAFE is run on machines that do not support DirectX 11, the graphics mode will revert to GDI+ (Standard graphics).
	1105	An enhancement was made so that DirectX capabilities are now available on virtual machines.
	2155	The behavior of the graphical interface has been changed so that the zoom level is not affected by editing operations such Move and Replicate. Previously these operations would cause the view to zoom out to show the full model.

*	Ticket	Description
*	3482	Enhancements have been made to DirectX graphics by using Direct2D in conjunction with Direct3D. Specifically: (1.) Plan and elevation (XY, XZ, YZ and developed) views are generated much faster and are clearer. (2.) Line quality for dashed lines, wide lines and selection lines during editing, drafting and display has been improved for both 2D and 3D views. (3.) Windows True Type fonts, including foreign language fonts, are available in both 2D and 3D views. Previously only Arial fonts were available and did not cover some languages.

Installation and Licensing

Enhancements Implemented

*	Ticket	Description
*	823	SAFE is now available as a 64-bit application, providing increased speed and the ability to handle larger models. SAFE v20 must be installed on a 64-bit computer running 64-bit versions of Windows 8.1 or Windows 10. The 32-bit version is no longer available starting with v20.0.0.
*	2323	The version number has been changed to v20.0.0 for a new major release.
*	6424	SAFE now utilizes cloud licensing by default, allowing access to the license by multiple users and/or from multiple machines. The number of simultaneous users corresponds to the number of licenses owned. Cloud licensing requires connection to the internet while using the software, either directly or through a proxy. Connection to a company network or VPN is not necessary. Licenses can be checked out for a limited time period to allow use while disconnected from the internet. Legacy licensing options (Standalone and Network) are still available upon request.

Loading

Enhancements Implemented

*	Ticket	Description
*	2436	An enhancement was made to update the default load combinations for Chinese design codes based on recent changes to the National Standard for Reliability of Building Structures.

Results Display and Output

Enhancements Implemented

*	Ticket	Description
	507	An enhancement has been made to compute and report the elongation in tendons due to the prestressing force at transfer. The elongations can be output in a tabular format or can be displayed on the model in the graphical user interface (command View > Set Display Options > Other Assignments > Tendon > Elongation)
*	691	An enhancement was made to expose non-structural geometric entities to the model called Slab Panels. The Slab Panels are defined as portions of slabs surrounded by lines of support or free slab edges. In earlier versions these were being generated internally using rectangular grids and used in the program for automatic pattern loading and summarizing displacement and soil pressure results. Slab Panel edges are now also used as lines for meshing. Slab Panels can be added automatically using rectangular grids or already defined support lines. They can also be drawn and edited onscreen. Replication is also available.
*	4689	An enhancement was made to provide more display options in the model window(s) for PT tendons, including Number of Strands, Tendon System, Vertical Profile Control Points, Vertical Profile Values, Total Length, Jacking Force, and Elongation. These can be turned on and off using the command View > Set Display Options > Other Assignments.

Structural Model

Enhancements Implemented

*	Ticket	Description
	1027	The definition of new material properties has been enhanced as follows: (1) The "Add New Material" button now uses the "Quick Material Definition" form. (2) The Quick Material form now has an additional control to allow selecting pre-defined materials by country and/or design code. (3) The country/code selector includes type "User" to allow immediate editing of the property values. (4) Material type "Other" can now be selected, which only allows the "User" option in the country/code selector.
	1028	An enhancement was added allowing the aging coefficient to be specified in Nonlinear (Long Term Cracked) analysis. Previously, the aging coefficient was always taken as 0.8, which is still the default.
	1045	An enhancement has been made to include bar spacing and the vertical offset from datum in the form to Set View Options > Other Assignments > Slab Rebar Objects.
	1376	An enhancement was made to allow more user control of wall meshing and restraint duplication on added meshed joints. The old option of meshing based on floor mesh and a maximum mesh size is the default.
*	1805	An enhancement was made to add non-structural geometric entities to the model called Support Lines. The user can draw these objects as poly-lines to connect support points (columns, walls, beams, restraints and springs) with each segment representing a span. A layer tag (A or B) can be associated with these Support Lines. Each layer representing Support Lines running essentially parallel to adjacent ones. The Support Lines in the two layers then represent an interconnected mesh demarcating Slab Panels. The Support lines can be used in the program to automatically generate Slab Panels, layout Design Strips and layout Post-tensioning Tendons. The Support Lines are also used for meshing. The Support Lines can be drawn and edited on-screen. They can also be generated by the program along grid lines with some tolerance to allow for slightly offset columns and walls. Replication is also available.
*	4331	An enhancement has been made to expand the Edit > Edit Shell > Merge Shells command to merge two or more selected shell objects into a single shell. Previously only two selected shells could be merged at a time. Additionally, a form is now provided to view the merge prior to the operation being performed and select the existing shell from which the new shell will inherit assignments. The following restrictions apply: (1.) Only floor elements can be merged. (2.) Only shells with the same property and located at the same elevation are merged. The new form will group the selected shells by property, and each group can be viewed in the form by changing the property selection. For each group you can choose the shell from which any assignments will be inherited. (3.) If more than two shells are selected in a group, they should not overlap. If only two shells are selected, then any overlap will be removed. (4.) Curved edges are not supported. Instead, they will be converted to multi-segment straight lines.

*	Ticket	Description
*	4332	An enhancement has been made by allowing shell objects to be defined by user-defined internal meshes. The internal mesh must be made only of quadrilaterals and/or triangles. These are used directly as analysis elements and no further meshing is done. The internal mesh must be defined in the horizontal plane at the level of the model datum. The internal mesh gets replicated when the shell object is replicated. The following commands are provided for working with user-defined internal meshes: (1.) Draw > Draw Floor/Wall Objects > Import User Mesh as Shell Object. This allows the import of ACAD3dFace entities from a DXF file. The import allows for scaling and rotation and provides for an insertion point. The outer boundary is stored as an area object with the internal mesh already defined for analysis. (2.) Edit > Edit Shells > Explode User Mesh to Shells. This allows the stored internal mesh of the selected shell objects to be converted to individual shell objects. All shells created take their assignments from the parent and the parent object is deleted. (3.) Edit > Edit Shells > Merge Shells to Create User Mesh. This allows selected shells that are contiguous to be merged and made into fewer shell objects with internal meshes. The merged shells created take their assignments from the first internal mesh object. This is the opposite of the Explode command. (4.) Edit > Edit Shells > Convert Current Mesh to User Mesh. This allows the current meshing for the selected shells to be converted to user-defined internal mesh. This causes the meshing to remain constant from run to run, but the user is responsible to assure that changes to the model should not require a change in meshing. Otherwise the internal mesh should be removed and the appropriate meshing option should be applied. (5.) Edit > Edit Shells > Remove User Mesh from Shell Object. This allows the internal mesh to be removed and the outer boundary remains as a shell object with all its assignments, and it is assigned the default meshing type for analysis which can be modified by the user.
*	4333	An enhancement was done to speed up the creation of the analysis model. The area mesh for each object is now saved from one run to another unless any item affecting its mesh is changed in the model.
*	4685	Several enhancements have been made to the tendon vertical layout form designed to collate all editable information related to tendon profile, geometry, loads, and losses in one location. In addition, the drawing of the tendon profile has been enhanced and certain parameters added to the display options in order to improve the readability of the tendon profile and other information related to it. The parameters available for display include the CG distance of tendon from the nearest concrete edge, the tendon radii of curvature, and the balancing load due to pre-stressing force in tendon at transfer or after all long term losses. The right-click information form has been removed as the enhancements implemented provide all necessary information on the tendon layout form itself.
*	4884	An enhancement was made to add layer information for tendon, slab-rebar, and support-line objects similar to what was already available for design-strip objects. The enhancement is intended to streamline the grouping of various objects for the purpose of display and selection.
*	6940	An enhancement was made to slab edge releases by allowing in-plane releases in addition to the out-of-plane releases already available, and also by allowing partial fixity along the edges for in-plane and out-of-plane behavior.
*	6973	An enhancement has been made to expand the Edit > Edit Shell > Merge Shells command to merge two or more selected shell objects into a single shell. Previously only two selected shells could be merged at a time. Additionally, a form is now provided to view the merge prior to the operation being performed and select the existing shell from which the new shell will inherit assignments. The following restrictions apply: (1.) Only floor elements can be merged. (2.) Only shells with the same property and located at the same elevation are merged. The new form will group the selected shells by property and elevation, and each group can be viewed in the form by changing the property and elevation. For each group you can choose the shell from which any assignments will be inherited. (3.) If more than two shells are selected in a group, they should not overlap. If only two shells are selected, then the overlap will be removed. (4.) Curved edges are not supported. Instead, they will be converted to multi-segment straight lines.

*	Ticket	Description
	7204	An enhancement was made to the model-initialization form to allow selection of the geographical region for generating default material properties. Material types (steel, concrete, rebar, etc.) not available for the selected region will default to built-in material properties.

User Interface

Enhancements Implemented

*	Ticket	Description
	578	An enhancement was added where Joints, Frames, Shells, Strips, Tendons and other objects can now be selected by their labels using the commands Select > Select > Labels and Select > Deselect > Labels.
	820	An enhancement was made to add two new tool buttons, Move Up in List and Move Down in List, have been added for scrolling through plan views or elevation views.
	1555	A new command, View > Set 3D View, has been added to provide more control over the view angle and aperture (degree of perspective).
*	1926	An enhancement was made by adding an Apply button to many of the forms available under the Assign and Display menus. This allows the form to remain open so that repeated operations can be performed more easily, often with different selections of objects or with different parameters.

Analysis

Incidents Resolved

*	Ticket	Description
	1188	An incident was resolved where the integrated Strip results for enveloping type combinations (where correspondence between different responses is lost) could be incorrect when the strips were skewed. In some cases, the envelope results could be smaller than those for the contributing load cases.
	1287	An incident was resolved where slab meshing was failing in some rare cases with overlapping area objects, causing the slab area to be deleted from analytical model. When this occurred, the error was obvious. Manually subdividing the slab before meshing avoided this problem. This affected rectangular meshing, not the new general mesher.
	1310	An incident was resolved where small triangular elements created due to the area mesh were missing from analytical model.
	2145	An error was resolved where a message "A fatal analysis error has occurred: AnalysisModel::runSelf() Access violation..." was displayed when analysis was executed. This issue occurred in rare cases where the analysis model was not correctly created by the software for representing spring supports.
	2221	An incident was resolved where clicking OK on the Response Spectrum Load case dialog after viewing it would cause an invalid load case error when the model was run.
	2893	An incident was resolved where running the analysis mode or creating the area mesh sometimes displayed the message "An error occurred attempting to create analysis mesh! Index was outside bounds of the array." This error generally occurred when the area difference before and after meshing was higher than the tolerance value.

Database Tables

Incidents Resolved

*	Ticket	Description
	2469	An incident was resolved where some models were unable to be saved when certain beam-design data was missing, generating the error message "Error Creating database table for tablekey Beam Properties 06". This was able to be corrected by importing the .$SF text data file.
	2909	An incident was resolved where changing a material name via interactive database editing was not generating a warning or error message when material name change was not carried over in all other tables that referenced the same material. Opening the Interactive Database Editing form again in the same model caused form to not display correctly. This was a cosmetic error and restarting SAFE did resolve this issue.

Design – Slab

Incidents Resolved

*	Ticket	Description
	1937	An incident was resolved where concrete slab design sometimes reported required bottom steel when there was only negligible negative moment in the slabs. This was a tolerance issue. The results were conservative.
	1948	An incident was resolved for the concrete frame design per code “TS 500-2000” in which the design longitudinal and transverse rebar sometimes did not match with hand calculations because of the lack of enforcement of the fy limit of 420 MPa.
	1949	An incident was resolved for concrete beam design per the codes “BS 8110-97”, “Hong Kong CP 2013”, and “Singapore CP 65-99” where the design minimum flexural rebar was not being enforced for certain conditions, which then in turn affected the shear rebar design.
	1994	An incident was resolved where the punching-shear check could fail to find the correct punching perimeter for a drop panel when the model default length units were either m or ft. This was due to a tolerance issue and only affected certain models.
	2029	An incident was resolved for slab design where the punching-shear check was not performed when the column had an insertion-point assignment.

*	Ticket	Description
	2894	An incident was resolved for BS 8110-97, Hong Kong CP 2013, and Singapore CP 65:99 design codes where the punching-shear design report was reporting "Concrete Shear Capacity" instead of "Allowable Shear Stress Limit" when the design failed at a column face. This was just a reporting issue and design results were not affected.
	2903	An incident was resolved where slab opening was not considered for punching shear check at the drop panel location.
*	6009	An incident was resolved where in certain cases openings were not detected near columns for floor punching shear checks or the excluded perimeter was not correct. This usually happened when the column local axis was rotated. When this occurred the error was obvious.
*	6853	An incident was resolved where the average punching-shear stress instead of the maximum punching-shear stress was being checked against the stress limit for determining whether shear reinforcement should be allowed.

Drafting and Editing

Incidents Resolved

*	Ticket	Description
	1134	An incident was resolved where editing a curved wall using Reshaper tool was causing an error message under certain unexpected conditions.
	1397	An incident was resolved where the commands Edit > Copy followed by Edit > Paste were only copying points, columns, and beams. Now selected slabs and drop panels will also be copied and pasted.
	2901	An incident was resolved where the program would sometimes terminate abnormally if the mouse was double-clicked in any of the column-header cells of the data grid table on the Tendon Vertical Layout Definition form. This form can be accessed by selecting a tendon object and using the command Edit > Add/Edit Tendons > Edit Vertical Profile”.

External Import and Export

Incidents Resolved

*	Ticket	Description
	7193	An incident was resolved that addressed the following issues related to the export of models to .DXF files: (1.) Exporting a SAFE model to .DXF while selecting CAD units other than the model database length units resulted in grid systems and slab strips being exported at incorrect locations. (2.) Grid lines were always exported with their grid bubbles located at their ends, irrespective of the grid bubble location specified in the model. Both of these issues affected all versions of SAFE capable of exporting models to .DXF files. When these errors occurred, the effect was obvious. Analysis and design results in SAFE were unaffected.

Graphics

Incidents Resolved

*	Ticket	Description
	619	An incident was resolved where shell uniform loads would not display correctly due to internal tolerance issues when merging overlapping areas with curved edges, sometimes causing the software to terminate. This was a display issue only and did not affect results.
	1552	An incident was resolved where the graphical display of loading or results over curved beams would not show correctly. This was a display issue only and results were not affected.
	1991	An incident was resolved where the perpendicular-projection snap was not working with the reshape tool.
	2007	An incident was resolved where deleting an object in DirectX view would reset the view back to the default zoom level. This was not an issue with Standard Graphics.

Results Display and Output

Incidents Resolved

*	Ticket	Description
	1936	An incident was resolved where support reactions were not shown in either the graphical user interface (GUI) or the tabular output for slab edges where edge releases were assigned. This was just a display/reporting issue and analysis and design results were not affected.
	1999	An incident was resolved where the text for moment/force-response diagrams and/or for the reinforcement was being hidden behind the fill color used for the slabs when using the command File > Print Graphics.
	2564	An incident was resolved where the punching-shear detailed calculation report created via the command File > Create Report option was showing the incorrect combination name and was missing the design shear stress, concrete shear capacity, and punching shear ratio. This was just a reporting issue and design results were not affected.
	2568	An incident was resolved where an Error number 3024 could occur while printing reports. This issue occurred when a temporary file could not be created in users local App Data folder, and was not common.

Structural Model

Incidents Resolved

*	Ticket	Description
	2333	An incident was resolved where Elasto-Plastic line springs were not working as expected. This error did not affect area or point springs that were Elasto-Plastic or line springs of any other type.

User Interface

Incidents Resolved

*	Ticket	Description
	6020	An incident was resolved where the software would sometimes terminate unexpectedly when changing the tendon profile from linear to reverse parabola for a span in the Tendon Vertical Layout form.