CSiBridge v25.0.0 Release Notes

Notice Date: 07-July-2023

This document lists changes made to CSiBridge since v24.2.0, released 15-February-2023. Items marked with an asterisk (*) in the first column are more significant.

API

Enhancements Implemented

*	Ticket	Description
*	7822	A comprehensive set of properties and methods have been added to the Application Programming Interface (API) which provide access all the functionality of the CSiBridge parametric Bridge Modeler. The top level class, SapObject.SapModel.BridgeModeler_1, supersedes the previous property which contained limited Bridge Modeler capabilities. While the previous property is not deprecated and can still be used, API developers are encouraged to use the new BridgeModeler_1 property for complete coverage of Bridge Modeler capabilities. The new Bridge Modeler API is fully documented in the new and separate Help file, CSI_OAPI_Bridge_Modeler.chm. This help file includes copy-and-paste examples in C#, VB.NET, and VBA. The examples demonstrate how to use the new Bridge Modeler methods with existing API methods to create and analyze a bridge object and retrieve analysis results. CSI_OAPI_Bridge_Modeler.chm is intended as a companion document to the current API help file, CSI_OAPI_Documentation.chm.

Bridge Design and Rating

Enhancements Implemented

*	Ticket	Description
	8951	An enhancement has been implemented for the Bridge Modeler where, for the flat-slab bridge section, the longitudinal rebar vertical location can now be specified from the bottom of the slab. Previously only distances from top of the slab could be specified. In addition, parametric variation of depth of the bridge section can now be rendered In the Girder Reinforcement Layout Plot, whereas previously the rebar layout was always displayed for the base section (without parametric variation).
*	9027	The service cracking design check of substructure (bent) columns has been added according to the AASHTO LRFD 2020 code Section 5.6.7. This supplements the corresponding strength check that is already available in the software. Design is controlled by defining one or more Design Requests which can specify a set of load combinations, bent columns, column stations, and other parameters to be considered. Similar columns and stations with similar reinforcement can be designed together. The cross section used to calculate capacity can be different from that used for demand, so that different section shapes, materials, and rebar layout can be quickly iterated for design. Results for each Design Request are provided in the form of an Excel spreadsheet that can be used for further calculations and for inclusion in reports. The spreadsheets include plots of the stresses in the individual reinforcement rebars and demand over capacity ratios based on provided over required bar spacings. Design results are also available in database tables for display, export, and reporting.

*	Ticket	Description
*	9045	The strength design of substructure (bent) columns has been added according to the IRC 112-2020 code. Design is performed by defining and running one or more Design Requests, which can specify a set of load combinations, bent columns, column stations, and other parameters to be considered. Similar columns and stations with similar reinforcement can be designed together. The cross section used to calculate capacity can be different from that used for demand, so that different section shapes, materials, and rebar layout can be quickly iterated for design.Results for each Design Request are provided in the form of an Excel spreadsheet that can be used for further calculations and for inclusion in reports. The spreadsheets include plots of the PMM interaction for visualizing demand and capacity. Design results are also available in database tables for display, export, and reporting.
*	9136	California Amendments to AASHTO LRFD Bridge Design Specifications - 8th Edition are now incorporated in the concrete and steel bridge design and rating requests for the AASHTO code. The result tables and calculation reports show the additional/modified checks as specified in the amendments.
	9647	An enhancement has been implemented for bridge superstructure design of steel U-girder bridge sections to output the shear-connector demands in the output tables and calculation report for the strength design request per the AASHTO code, all versions.

Bridge Modeler

Enhancements Implemented

*	Ticket	Description
*	929	A new Wall type of bridge bent (pier) has been added to the Bridge Modeler. The wall can be defined with or without a cap beam. The height of the wall can be divided into one or more continuous segments, each with fixed or variable width, thickness, and horizontal offset. The foundation can be modeled with restraints, springs, or a single footing. The wall is modeled using shell objects.
*	7272	An enhancement has been made to the Bridge Modeler where now the section properties for certain bridge sections will more closely agree for bridge objects updated as area (shell) objects or solid objects. The overlap of the area objects representing vertical and sloping webs with those representing the horizontal slab both left and right of the web could cause the cross-sectional area to be overestimated compared to solid-object models. This effect was only significant where three area objects intersect, not where two objects intersect such as within a slab or at the corner of a U-girder. This change affects all concrete box-girder bridge sections, the concrete T-beam bridge section, flat slab, and the user-defined (Section Designer) bridge section. The composite bridge sections and the solid-girder section are not affected. For the affected bridge sections, all area objects representing slabs and webs of the bridge section will have property modifiers applied that adjust their weight, mass, and stiffness factors f11 and m11 to match solid-object models. These latter factors affect the longitudinal stress S11, which will primarily affect the axial force P and the vertical moment M3. This new feature is presented as an option when updating the bridge object as an area object (shell) model. The default for new models is to apply the modification, while for older models the default is to not apply the modification so as to not change the results without user action. The same value is used for all four modifiers, and the range is typically between 0.9 and 1.0.

*	Ticket	Description
*	9372	A new option has been added to the Bridge Modeler to keep support bearings vertical at bents where the layout line has non-zero grade. By way of background, the longitudinal station specified for a support (bent or abutment) location is used to locate the centerline of the support and also the superstructure section cut that ends each span, measured at the top of the deck. By default, this superstructure section cut is perpendicular to the grade of the layout line. In the presence of non-zero grade, this means that the bottom of the section cut is shifted longitudinally from the centerline of the support, causing the connection between the top of the bearings and the bottom of the superstructure to be inclined. Now an option is available when updating the bridge object to keep this section cut vertical at the supports, such that the connection between the bearing and the superstructure is also vertical at the ends of the spans. Note that all other section cuts will remain perpendicular to the layout line (rather than vertical), except when they are close enough to the vertical cut at the support bearings to intersect the vertical cut, in which case they will also be made vertical.
*	9535	A new composite bridge section type, the Precast Concrete Box Girder, has been added to the Bridge Modeler. This uses a new frame section type, the Precast Concrete Box Girder, together with a concrete top slab. The precast box girder sections can be defined with included straight tendons. In the bridge section, the girders can be defined as having zero or non-zero gap between them. An optional grout condition can be specified between each pair of girders. When present, the grout connects the top and bottom corners of adjacent girders, and can be automatically included in a bridge group for use in staged construction. Stresses, force, and moments at section cuts along the length of the bridge object are available for graphical display and in tables.
	9556	A change has been made to the bridge modeler Bridge Layout Line Data form when using segments, to change the horizontal layout option 'Straight at New Bearing to Station' as well as the vertical layout option 'Constant at New Grade to Station' so that they can no longer be used at the start of the layout line. This change will prevent unintended kinks from being generated at the start of the layout line, which could cause unexpected bridge and lane geometry to be created. Models created in previous versions that used this option will be corrected when opened in the new version. This may affect the orientation of supports or lanes at the start of bridge objects that start at the beginning of the layout line, but this is not common, and the new behavior is more consistent.
	9641	The Bridge Modeler has been enhanced to add a new option for modeling brace-type diaphragms where now the bottom work point can be specified as an elevation change from the bottom or top of the adjacent girder. Previously the elevation change was always measured from the bottom of the adjacent girder. With this new option, brace-type diaphragms can now have constant depth even when the depth of the girders on either side of the diaphragm are different.
	9733	The Bridge Modeler has been enhanced by adding editing options to the tables that define plate sizes in the Steel Beam Editor. Operations include cut, copy, paste, insert, and delete using the mouse right-button click on the table or standard keyboard commands. These are available the tables for defining top and bottom flanges and the web for steel I-girder and U-girder beam sections.

Data Files

Enhancements Implemented

*	Ticket	Description
	9334	An enhancement has been implemented where high-strength steel materials per the JGJ/T 483-2020 standard have been added to the Chinese material library. The steel frame design per the Chinese 2018 code has also been updated to account for these materials.

*	Ticket	Description
	9625	The Indian frame section library in XML format has been updated where numerous new double-angle and double-channels sections have been added to the library. Additionally, 1) The overall depth for one of the existing sections (ISMC250) has been corrected. The depth was incorrectly listed as 350mm instead of 250mm in the XML library. 2) Missing section properties have been added for some of the existing frame sections. Previously, the missing properties for the affected sections were being calculated internally by the program when importing the section.
	9744	An enhancement has been made to Function definition (response spectrum, time history, steady-state, power-spectral density) to allow the specification of a Default Function Folder that applies to all functions of type "From File". This is a global setting: It applies to the current CSiBridge session, but it is not saved with the model; instead, it is saved for the user when CSiBridge is closed. If the function data file is not found in the path specified in the function definition, the software will recursively search the following locations in the order given below, then load and use the first matching data file: (1) Folder where the model file is saved, (2) Default Function Folder, (3) Program installation folder. The corresponding API (Application Programming Interface) functions have been updated as well.

Database Tables

Enhancements Implemented

*	Ticket	Description
*	9529	An enhancement was made to the tabular display to show detailed data for a single database table row after double clicking on the row header on the left. Detailed data for each row include the parameter (column/field) names, values, units, and descriptions for each cell of the row and are presented in a separate table. This information can be exported to Excel. In addition, the column header tool-tip on the database table display form now displays full column description in multiple lines, with each line being no longer than 80 characters. Previously, only first 80 characters of the description were displayed.

Design – Concrete Frame

Enhancements Implemented

*	Ticket	Description
	9104	Error and warning reporting for bridge substructure design checks has been enhanced to provide more specific messages where the previously generic error message "Bridge Substructure Design Check Failed!" was displayed. No other results are changed.

Installation and Licensing

Enhancements Implemented

*	Ticket	Description
*	9357	The version number has been changed to v25.0.0 for a new major release.

Structural Model

Enhancements Implemented

*	Ticket	Description
*	9629	The frame hinge assignment feature has been enhanced with four new preset hinge assignment distribution types: (1.) Beam Column, which adds a moment or PMM hinge at the ends of the frame object. This is intended to be used for most typical beam and column members which are governed by flexural behavior and expected to yield at one or both ends of the member while maintaining elastic or nearly elastic behavior at the mid-span. (2.) Distributed Plasticity, which adds hinges along the length of the frame object based on a specified integration rule. This is intended to be used for frame objects that are expected to have complex yielding behavior over the entire length. (3.) Equal Spacing, which adds hinges at a fixed spacing along the length of the frame object. Similar to the Distributed Plasticity option, this is intended to be used for frame objects with complex yielding behavior but may be used where yielding is expected to be evenly distributed or concentrated at mid-span. (4.) Continuous Support, which adds one hinge at the center of every frame element associated with the selected frame object. This is intended to be used for piles or grade beams, which are supported by springs at specified intervals and are meshed at the intersection with these supports, to facilitate the placement of hinges between each support. A User Defined hinge distribution type is also available to allow free-form assignment of hinges, which corresponds to the previous method of hinge assignment. When a model from a previous version of the program is opened, the hinge assignment is automatically translated as a User Defined hinge distribution. A new Hinge Length Overwrite parameter is available for hinge assignments using User Defined hinge distribution type. This parameter overwrites the hinge length of the assigned hinge with either an absolute length or a relative length as a ratio to the clear length of the frame object. The overwrite is intended to facilitate the use of Fiber or strain/curvature-type hinge properties in multiple locations or frame objects without having to redefine the hinge property to change the hinge-length setting. The database table "Frame Hinge Assigns 00 - Hinge Distribution Type" has been added to the interactive database. This table can be used to view or edit the hinge-distribution types for the frame hinge assignments. Additionally, the database tables Frame Hinge Assigns 02-08 and 10-21 have been updated to include the new Hinge Length Overwrite parameters. A new API function cFrameObj.GetHingeAssigns_2 has been added which includes parameters for hinge distribution type and hinge length overwrite.
	9650	The Frame Hinge Overwrite (Advanced > Assign > Frame > Hinge Overwrites) option for auto subdividing line objects at hinges has been enhanced to add an additional parameter "Use Hinge Length Overwrite Instead, if Available". This option is available when auto subdivide is enabled. When this new option is selected, the line object will be subdivided around the hinges using the hinge length overwrite value from the frame hinge assignment instead of the specified auto subdivide length. This option has also been added to the database table "Frame Hinge Assigns 09 - Hinge Overwrites" and is available for interactive database editing. Additionally, the default relative length for auto subdivide has been changed to 0.2 (previously 0.02).

Analysis

Incidents Resolved

*	Ticket	Description
	9599	A change has been made to not to allow multi-stepped moving load and wind load pattern assignments to linear and nonlinear static load cases or to stages of nonlinear staged-construction load cases. Previously such assignments were permitted, but the load was not applied or it used the first step of the load pattern, which was not consistent with the multi-stepped nature of load pattern itself. In addition, multi-stepped wind load pattern assignments are not allowed for time history load cases, since the multiple steps represent spatial angles rather than a sequence of load steps. When run, such load cases will be skipped and a corresponding message will be added to Analysis Messages.

Bridge Design and Rating

Incidents Resolved

*	Ticket	Description
	9253	An Incident was resolved for substructure bent-column design per the AASHTO LRFD 2020 code where the number of resistance interaction points specified on the "Substructure Column Design Request Parameters" form was being ignored, and instead the default number of 11 resistance points was always being used. Design results were correct based on the use of 11 points.
	9446	An incident was resolved to remove an erroneous reference to AASHTO Section 5.7.2.1 for negative flexure in the superstructure rating calculation report. No design results were affected. The affected rating requests were Multicell Concrete Box Flexure Rating according to the AASHTO 2017 and newer codes.
*	9613	An incident was resolved for the superstructure design and rating of precast concrete bridges where precast concrete girders were modeled as straight in a curved bridge, bridge tendons assigned to the girders near mid-span may not have been included in the design/rating. When this occurred, the design/rating results would be incorrect at the section cuts where tendons were excluded from girders. Note that this did not affect analysis results: the tendon load was properly included in the full length of the girders. However, the design and rating algorithms could be affected, and the effect was visually obvious when looking at design/rating results at the center of the span compared with the ends of the girders.

Bridge Modeler

Incidents Resolved

*	Ticket	Description
*	9335	An incident was resolved for the Bridge Modeler where, for a curved composite bridge with girders modeled as straight, the section properties of the bridge section cuts were incorrectly calculated as being based instead on the geometry as if the girders were curved rather than straight. This error would affect the following items: (1.) The program-generated bridge line loads for each girder haunch weight, if any, would still be along the curved girder lines instead of straight girder lines. This effect on analysis and design/rating results was usually very small. (2.) For a bridge object updated as a spine model, the extruded model view would incorrectly show curved girders. Analysis and design/rating results were consistent with these curved girders. The effect on the superstructure moment M3 was very small, but could be more significant for the moment M2. (3.) For a bridge object updated as an area model, the girders were correctly generated as straight and the analysis results were not affected except by the haunch load. Likewise, design/rating results were not affected except by the haunch load when the Live Load Distribution method was set to use girder forces directly from analysis or user-specified factors. When the Live Load Distribution method was set to use code-based factors, the girder spacing and overhang lengths were based on the geometry of the girders as curved, and this could have a small effect on the live-load distribution toward the center of each span.

*	Ticket	Description
	9417	An incident was resolved for the Bridge Modeler where a single-span bridge object could not be updated when a double-bearing bent having a nonzero "Distance to End of Girder" was assigned to one or both of the abutments.
	9425	An incident was resolved for the Bridge Modeler where the components (girders, webs, top slab and bottom slab) of a user-defined bridge section, when edited in Section Designer, could be generated incorrectly if the cut-line used to separate the components was a multi-linear line. Previously, Section Designer tended to separate the components by using the first segment of the multi-linear cut-line.
	9443	An incident was resolved for the Bridge Modeler where, in certain rare cases for larger models, a bridge object with a composite bridge section (steel-I, steel-U, precast-I, precast U) could not be updated as an area-object model when double-bearing bents with nonzero girder end distances were assigned to some of the spans.
	9445	An incident was resolved for the Bridge Modeler that affected the Bridge Girder Reinforcement Layout form where, for a multiple-span bridge with the number of girders differing between spans, it was not always possible to assign reinforcement at the desired start and end locations. This issue typically affected the right exterior girder and its adjacent girders, depending on how different the number of girders was between spans. Design results agreed with the reinforcement as assigned.
	9487	An incident was resolved for the bridge modeler where, for steel I/U girder bridge sections, the area (shell) objects modeling girder flanges in the overhang location at supports with a double-bearing bent would be deleted after updating and saving the model if (1) the distance from the bent centerline to the girder end was not zero as defined in the double-bearing bent property, (2) the bridge superelevation was not zero at the bent, and (3) the girders were modeled as all area (shell) objects. When all three conditions were met, the error was visibly obvious in the generated model, bridge response plots would not be available in the Bridge Response Display form, and the design/rating results would be affected near the supports. This issue did not affect girders modeled as mixed or as frames.
	9598	An incident was resolved in the bridge modeler where a concrete-solid type diaphragm was assigned as a staggered diaphragm to a precast I-girder bridge and the diaphragm depth was always the same as the girder depth even though the option to Use Girder Depth was not selected. Results agreed with the model as generated.
	9627	An incident was resolved for the bridge modeler where the link objects representing support bearings may not have been generated when updating the bridge object if (1) at least two supports (bents or abutments) were assigned to use the general bearing type, and (2) the number of the bearings assigned to the last general support was less than the number of girders at that support. When this occurred, the effect was visually obvious in the generated model, and results agreed with the model as generated. This was not common.
	9665	An incident was resolved for the bridge modeler where an abnormal termination could occur when the auto update option was turned off for bridge objects and any of the bridge object parameters were changed without updating the bridge object, then bridge tendons or diaphragms were edited. This did not occur if the bridge object was updated first.
	9684	An incident was resolved for the Bridge Modeler where trying to add more than eight rows in the tables defining plate sizes in the Steel Beam Editor could generate an error, and the table data could be entered incorrectly or not at all. This affected the tables for defining top and bottom flanges and the web for steel I-girder and U-girder beam sections. Changes could be made using the Interactive Database Editor without problem. Result agreed with the model as generated from the table data as displayed in the form if the OK button was clicked.
	9778	An incident was resolved for the Bridge Modeler where the elevations of the top of the support bearing at abutments did not match the elevations specified in the Bridge Object Abutment Assignments form when the superelevation was not zero at the abutment locations. Results agreed with the model as generated. The effect of this error on analysis results and design/rating results was generally small.

Data Files

Incidents Resolved

*	Ticket	Description
	9649	An incident has been resolved to update the strain value at compressive strength for the concrete materials in the Canadian material library. Previously, the strain values were too low compared to the elastic strain at the compressive strength. This caused an unrealistic nonlinear stress-strain relationship of the concrete materials based on Mander's model, and consequently resulted in an error computing moment-curvature relationships. The updated strain values are now based on Hognestad's model (see Hognestad, 1951 - A Study of Combined Bending and Axial Load in reinforced Concrete Members).

Database Tables

Incidents Resolved

*	Ticket	Description
	9349	Incident was resolved where interactive database editing of the "Bridge DesReqSubstr 02 - Station Ranges" table added the rows that were edited as new rows at the end of the existing table instead of modifying the existing rows.
*	9369	An incident was resolved where the following database tables failed to import on machines with Windows regional settings format set to Turkish. This could affect the import of database files and the use of the interactive database editor even if these specific tables were not included among those being imported: "Bridge Object Definitions 31 - Wind Loads", "Bridge Object Definitions 32 - Wind Load - LoadPattern List", "Bridge Girder Section Cuts 01 - General", "Bridge Girder Section Cuts 02 - Slab Data - Groups", "Bridge Girder Section Cuts 03 - Beam Data - Groups", "Bridge Object Definitions 33 - Girder Transv Stiffeners - General", "Bridge Object Definitions 34 - Girder Transv Stiffeners - Uniform", "Bridge Object Definitions 35 - Girder Transv Stiffeners - Custom", "Bridge Object Definitions 36 - Girder Longit Stiffeners", "Bridge Object Definitions 30 - Wet Concrete Loads", "Function - Response Spectrum - JTGTB02-2013", "Function - Response Spectrum - JTGT2231-01-2020", "Function - Response Spectrum - NZS 1170.5-2016", "Frame Section Properties 17 - PCC Super-T", "Rail Track Support Property Data", "Rail Track Temperature Load Data", "Frame Rating Resistance - Axial Service", "Frame Rating Resistance - Axial Ultimate", "Bridge Section Definitions 29 - PCC Super-T 1 - General", "Bridge Section Definitions 30 - PCC Super-T 2 - Spacing", "Bridge Section Definitions 31 - PCC Super-T 3 - Sections", "Bridge Section Load Definitions 01 - Haunch", "Bridge Section Load Definitions 02 - Stay In Place Form", "Bridge Section Load Definitions 03 - ConcPour Permanent", "Bridge Section Load Definitions 04 - ConcPour Temporary", "Bridge Section Load Definitions 05 - Barrier", "Bridge Section Load Definitions 06 - Sidewalk", "Bridge Section Load Definitions 07 - Wearing Surface", "Bridge Section Load Definitions 08 - Temperature Change", "Bridge Object Definitions 31 - Wind Loads", "Bridge Object Definitions 32 - Wind Load - LoadPattern List", "Bridge Girder Section Cuts 01 - General", "Bridge Girder Section Cuts 02 - Slab Data - Groups", "Bridge Girder Section Cuts 03 - Beam Data - Groups", "Bridge Object Definitions 33 - Girder Transv Stiffeners - General", "Bridge Object Definitions 34 - Girder Transv Stiffeners - Uniform", "Bridge Object Definitions 35 - Girder Transv Stiffeners - Custom", "Bridge Object Definitions 36 - Girder Longit Stiffeners", "Bridge Object Definitions 30 - Wet Concrete Loads","Named Sets - Run Bridge Design", "Named Sets - Run Bridge Column Design", "Named Sets - Run Bridge Rating", "Named Sets - Run Bridge Seismic Design", "Named Sets - Run Member Rating", "Named Sets - Bridge Seismic Design Report".

*	Ticket	Description
*	9685	An incident was resolved where the following nine database tables could not be exported to Excel: Bridge DesReqSuper 23 - Param - AASHTOLRFD07 - SteelICompFatigue, Bridge DesReqSuper 23 - Param - AASHTOLRFD12 - SteelICompFatigue, Bridge DesReqSuper 23 - Param - AASHTOLRFD14 - SteelICompFatigue, Bridge DesReqSuper 23 - Param - AASHTOLRFD17 - SteelICompFatigue, Bridge DesReqSuper 23 - Param - AASHTOLRFD20 - SteelICompFatigue, Bridge DesReqSuper 31 - Param - AASHTOLRFD12 - SteelUCompFatigue, Bridge DesReqSuper 31 - Param - AASHTOLRFD14 - SteelUCompFatigue, Bridge DesReqSuper 31 - Param - AASHTOLRFD17 - SteelUCompFatigue, Bridge DesReqSuper 31 - Param - AASHTOLRFD20 - SteelUCompFatigue. These tables were all related to bridge superstructure design checks for steel I- and U- girder bridges. Only the export to Excel was affected, not interactive database editing or the export to other file formats.

Graphics

Incidents Resolved

*	Ticket	Description
	8990	An incident was resolved where the extruded view of frame objects and elements with section properties of type precast Super-T were not displayed correctly. This has been corrected. Note that the precast super-T section is normally modeled in bridge objects using shell (area) objects for the webs and flanges rather than as whole frame objects, so this was not a common issue.

Results Display and Output

Incidents Resolved

*	Ticket	Description
*	9702	An incident was resolved where stress plots might not be available in the Bridge Response Display form for steel I-girder bridges if both (1) the bridge was curved with skewed supports and with staggered diaphragms near the skewed supports, and (2) the bridge object was updated with option "Mesh Slab at Critical Steel I-Girder Locations" turned Off. When this error occurred, bridge superstructure design and rating results for steel I-girder bridges might not be available either, to the extent that they depended upon stresses rather than only superstructure forces and moments.