RAM Conce*pt* V8*i* Release 4.0 Quick Start Guide

RAM Concept *V8i* Release 4.0 contains a number of powerful new features and enhancements designed to make the user experience more intuitive and productive. This document will provide the basic information necessary to get started using the new features and tools. The primary new features are:

- New tendon layers and tools for more intuitive and efficient specification of post-tensioning and creation of PT design drawings.
- New properties in existing tendon objects to increase flexibility and ease of use.
- "Check only" feature that allows the user to check a specified longitudinal design and report failure locations.
- Automatic hook tool to generate hooks on user reinforcement near slab edges.
- RAM Structural System Integration Enhancements
- A number of minor enhancements and error corrections.

New Tendon Tools

The new tendon layers and objects in RAM Concept are high level tendon parameters that are used to generate Concept tendon objects. These high level objects can be displayed graphically in Concept in such a way that an exported Concept plan could be used as an Engineer's tendon design plan with very little additional drafting effort. Engineers who prefer to work directly with Concept's tendon objects can use these high level tendon parameter objects to automatically generate a starting tendon layout which can be further manipulated as desired by the user. It is also possible that a user might want to use a combination of these objects.

A brief description of the new layers and objects

Latitude/Longitude Tendon Parameters Layers – these new layers contain new high level tendon and profiling control objects and tools to facilitate the creation of RAM Concept tendons.

Generated Latitude/Longitude Tendon Layers – these new layers contain the objects that are generated from the high level tendon objects drawn on the Tendon Parameter Layers.

Manual Latitude/Longitude Tendon Layers – these are the traditional RAM Concept layers containing user drawn RAM Concept tendons.

RAM Concept Post-Tensioning terminology and definitions

Strand – a single wire or group of wires. This would also be used in RAM Concept to represent a prestressing bar.

Duct – a tube, conduit, or sheathing containing one or more strands. The maximum number of strands that can be contained in a duct is defined in the prestressing material properties. For monostrand tendons (bonded or unbonded), each duct contains a single strand.

Tendon – a collection of ducts representing a grouping of strands. For bonded multistrand, there is usually only a single duct in a tendon. For unbonded monostrand, there may be a number of sheathed strands in a tendon. Note that this definition is convenient and consistent for RAM Concept but is somewhat of a departure from standard field terminology, where a single unbonded monostrand with grease, sheathing and accessories is normally referred to as a tendon.

Example workflows

1. *All work done on tendon parameters layer*

The user specifies all prestressing on the Tendon Parameters Layer, allowing Concept to automatically generate individual tendons from the tendon parameter objects. When making changes, the user will add, delete, or edit objects on the tendon parameters layer only. The user might use the tendon parameter plans or the generated tendon plans for their tendon design plans.

2. *Most work done on tendon parameters layer*

The user specifies most prestressing on the Tendon Parameters Layer, but wants to supplement with isolated individual tendons on the Manual Tendon Layer. The motivation for doing this is that it might be much faster to make minor adjustments/additions on the Manual Tendon Layer than to edit objects on the Tendon Parameters Layer. The drafting workflow would be to export tendon parameter and manual tendon objects on the plan, then modify those objects in CAD to produce their final drawings.

3. *All work done on manual tendon layers*

The user prefers working with individual tendons for both design and for production of final plans. The user can draw the individual tendons manually as has been traditionally done, or they can use the tendon parameters layer to quickly generate many tendons that can then be manipulated manually. In order to manipulate the generated tendons, they will need to be cut and pasted from the generated tendon layers to the manual tendon layers. The objects on the tendon parameters layer would then be deleted.

Objects and tools on the Tendon Parameters Layer

Banded Tendon Polyline Objects ( )

Description: A single polyline or group of connected polylines that represent a group of tendons at a fixed spacing.

Banded Tendon Polyline properties

- Specification Type – "Force" or "Strands".

- Effective Force – Enabled if "Force" is selected, represents the total force in the generated tendons.
- Number of Strands – Enabled if "Strands" is selected, represents the total number of strands in the generated tendons (can be non-integral).
- Strands per tendon – the maximum number of strands to place in a single tendon. This parameter determines the number of tendons that will be generated.
- Layout Type – "Spacing" or "Width". When "spacing" is selected the width of the group of generated tendons is determined from the calculated number of tendons required and the specified tendon spacing. Where "width" is selected, the spacing between tendons is determined from the specified width and calculated number of tendons. Note that the "width" parameter includes a half space on either side of the group.
- Tendon Spacing – Enabled if "Spacing" is selected. The spacing of the generated tendons.
- Layout Width – Enabled if "Width" is selected. The total width of the detailed tendon groups (including a half space on either side of the generated tendon group.
- Tendon Type – "Primary" or "Added" determining whether the tendon is part of the primary group continuing through the span or if it is meant to terminate part of the primary group within the span. When a tendon polyline is defined as "Added", RAM Concept will automatically adjust its force to keep the total joint force balanced.
- Added Tendon Generation – "None", "Fixed Length", or "Span Fraction" controls the automatically generation of added tendons. If two tendon polylines with different forces are drawn to be connected at their ends, RAM Concept will automatically create an added tendon to be terminated in the appropriate span.
- Added Tendon Length – when "Fixed Length" is specified for Added Tendon Generation, this controls the termination length beyond the banded tendon polyline connection point.
- Added Tendon Span Fraction – when "Span Fraction" is specified for Added Tendon Generation, this controls the termination length beyond the banded tendon polyline connection point (as a fraction of the total span length where the termination occurs).
- PT System – The PT System to use for the generated tendons
- Inflection Point Ratio – the I.P. ratio to use for the generated tendons.
- Harped –whether or not the generated tendons are to be harped.

"Presentation" tab for Banded Tendon Polyline properties

- Description – a user controlled format string. The codes for values that can be inserted into the string can be displayed by hovering the mouse over the text box.
- Max. Fillet Radius – read only text box that displays the maximum radius that can be used to fillet the segments in the polyline.
- Fillet Radius – specify the radius that will be used to fillet two adjacent segments in the polyline, or select "Use Maximum".
- Symbol @ End 1 – "None", "Stressing End", or "Dead End" to specify the symbol that will be displayed at end 1. It does not affect the detailed tendons.

- Symbol @ End 2 – "None", "Stressing End", or "Dead End" to specify the symbol that will be displayed at end 2. It does not affect the detailed tendons.

Note: Fillets and End symbols are for drawing presentation only and do not affect the analysis/design results in any way.

Visual Display and Labeling of Objects

The presentation of the objects is meant to be suitable for exportation and use on a tendon design plan. For this purpose, generally the profile polylines will be turned off on the plan. The tendon polyline intersections with the profile polylines are displayed on the plan to provide profiling information for a design plan.
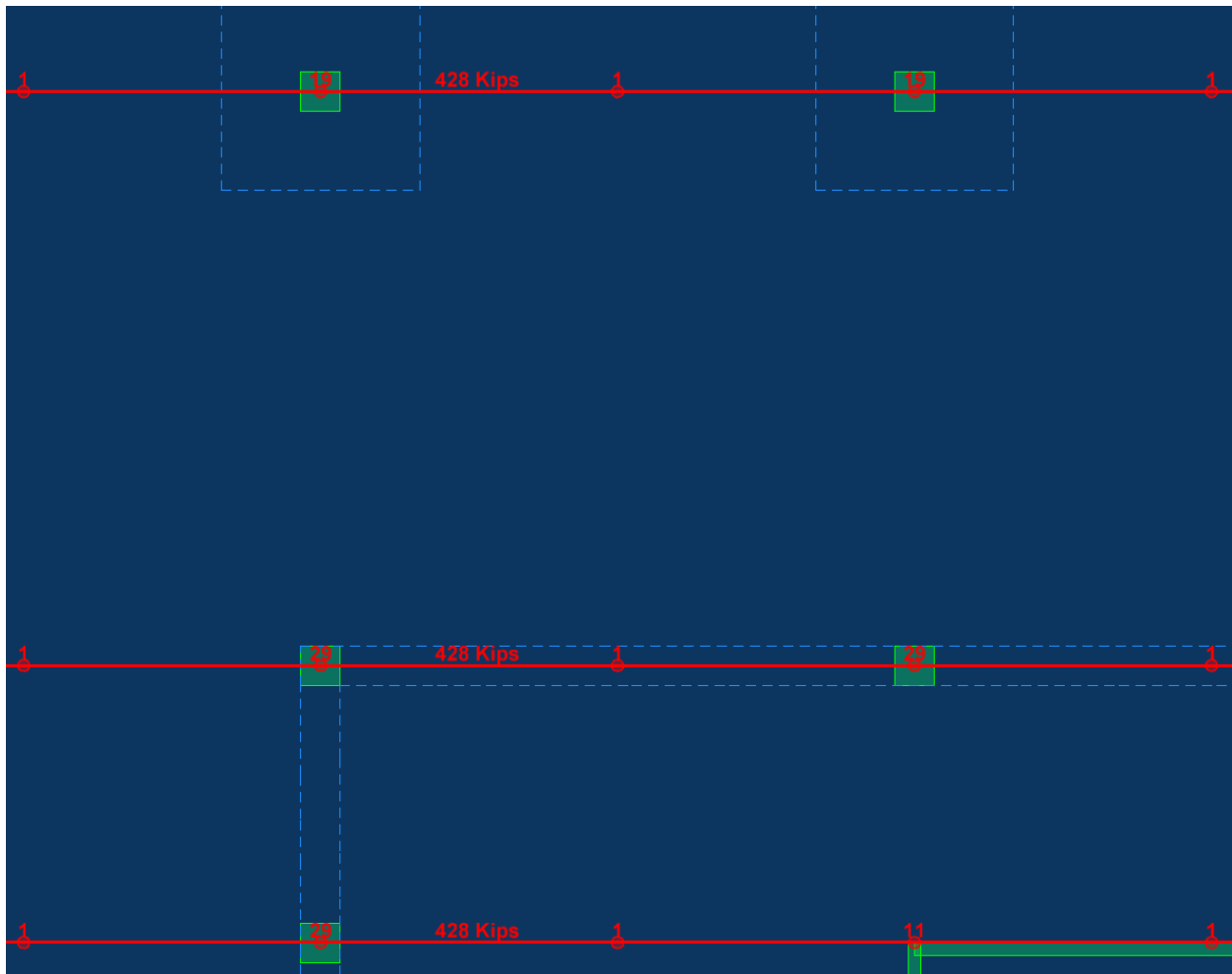
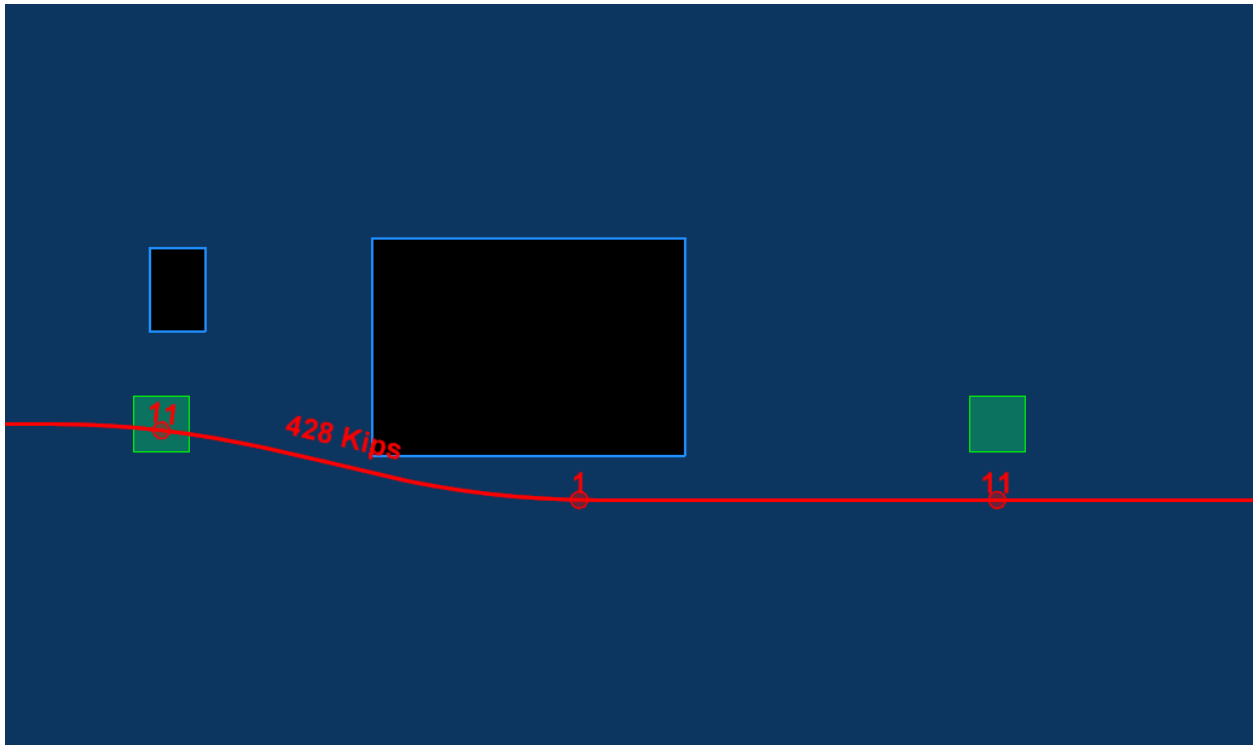Figure 1 – Banded Tendon Polyline Objects

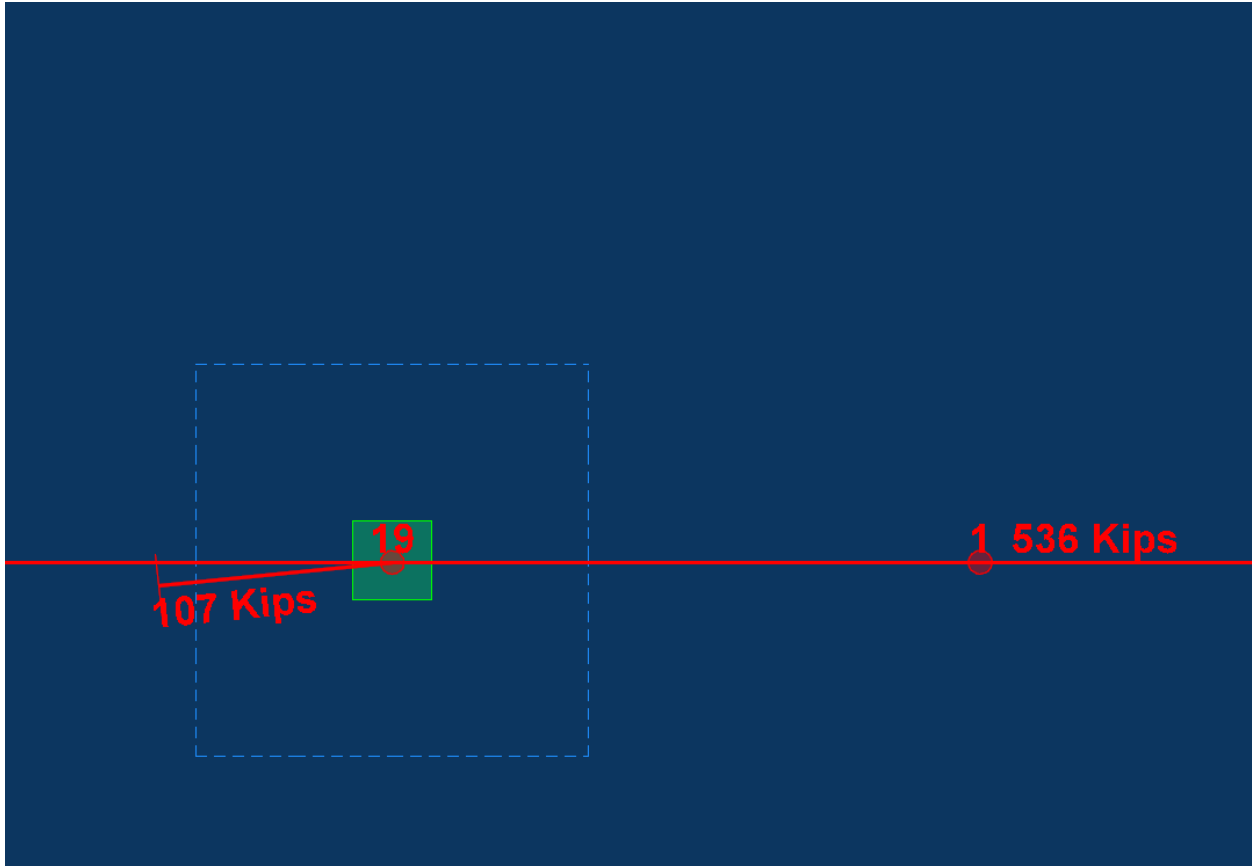Figure 2 – Tendon polyline filleting, profile elevation and force display

Figure 3 – Added tendon

Segment Banded Tendon Polylines Tool ( )

This tool segments all the banded tendon polylines where the drawn segmentation line crosses them. It can be useful when it is necessary to add force in an individual span that already contains a banded tendon polyline spanning across multiple spans. In this case the tendon can be segmented at the ends of the span and the force changed in the target span.

Distributed Tendon Quadrilateral Objects ( )

Description: A quadrilateral that represents an array of tendons at a fixed angle and transverse spacing. Adjacent or overlapping quadrilaterals that have the same angle, spacing, PT System, Inflection Point Ratio, and Harped properties will have a consistent array of generated tendons. Overlapping quadrilaterals that do not have these common properties will generate a warning.
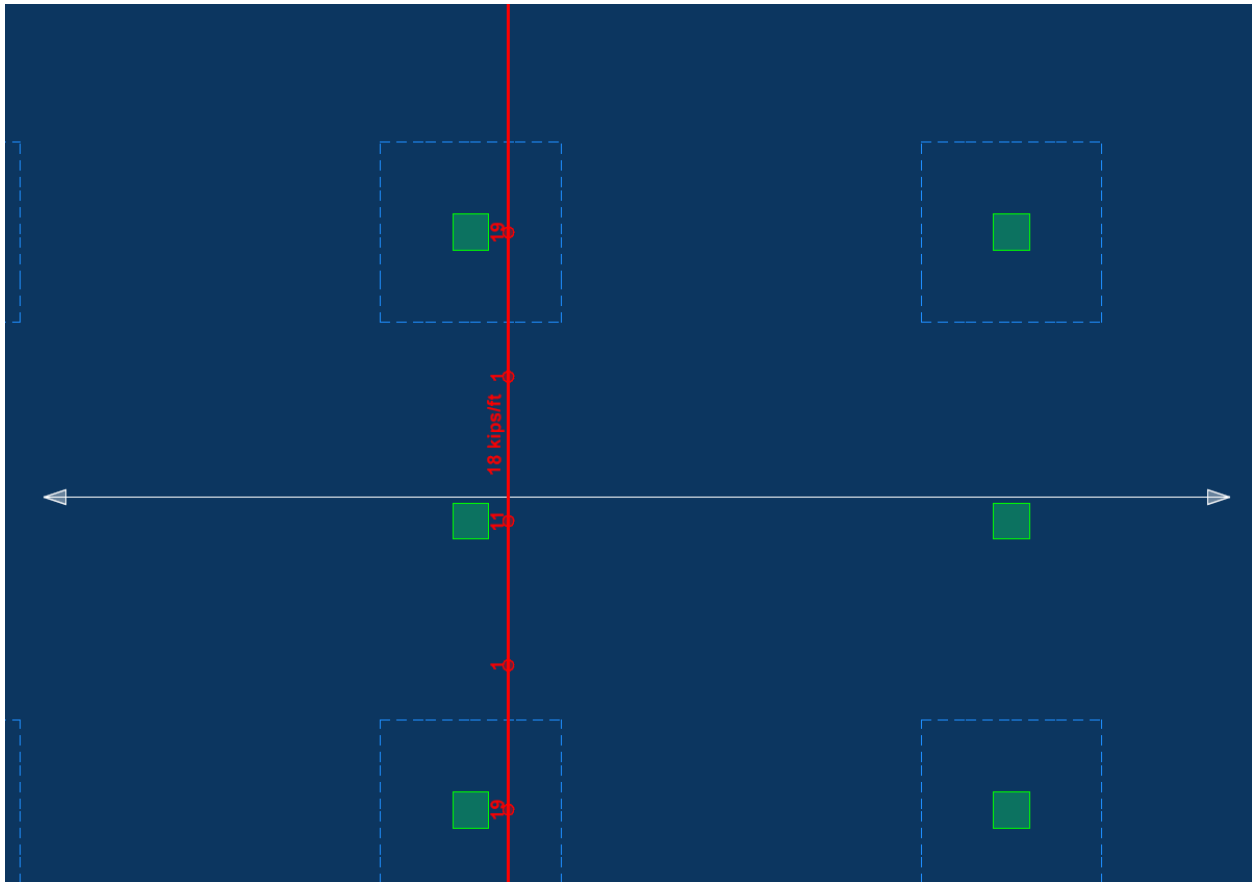
Figure 4 – Distributed Tendon Quadrilateral

Distributed Tendon Quadrilateral Properties

- Tendon Orientation angle – the angle of the generated tendons.
- Tendon Specification Type – "Force" or "Strands".
- Effective Force – Enabled if "Force" is selected, represents the force/width of the generated tendons.
- Number of Strands – Enabled if "Strands" is selected, represents the number of strands/width of the generated tendons (can be non-integral).
- Tendon Spacing – the transverse spacing of the generated tendons.
- PT System – The PT System to use with this specification object.
- Inflection Point Ratio – the I.P. ratio to use with this specification object.
- Harped - whether or not the generated tendons are to be harped.

"Presentation" tab for Distributed Tendon Quadrilateral properties

- Description – a user controlled format string. The codes for values that can be inserted into the string can be displayed by hovering the mouse over the text box.
- Symbol @ End 1 – "None", "Stressing End", "Dead End", or "Break" to specify the symbol that will be displayed at end 1. It does not affect the detailed tendons.

- Symbol @ End 2 – "None", "Stressing End", "Dead End", or "Break" to specify the symbol that will be displayed at end 2.   It does not affect the detailed tendons.
- Symbol @ Extent Ends – "Arrow" or "None", representing the symbol to display at the end of the extent lines.

Visual Display and Labeling of Objects

The presentation of the objects is meant to be suitable for exportation and use on a tendon design plan. For this purpose, generally the profile polylines will be turned off on the plan. The tendon polyline intersections with the profile polylines are displayed on the plan to provide profiling information for a design plan. For the distributed tendon quadrilaterals, some "additional" profile points are generated to describe the profiling information as much as possible in the entire quadrilateral region. These points can be controlled by different categories as shown in "Visible Objects". Geometrically complicated plans may need additional information provided manually after export to fully describe the profiling.
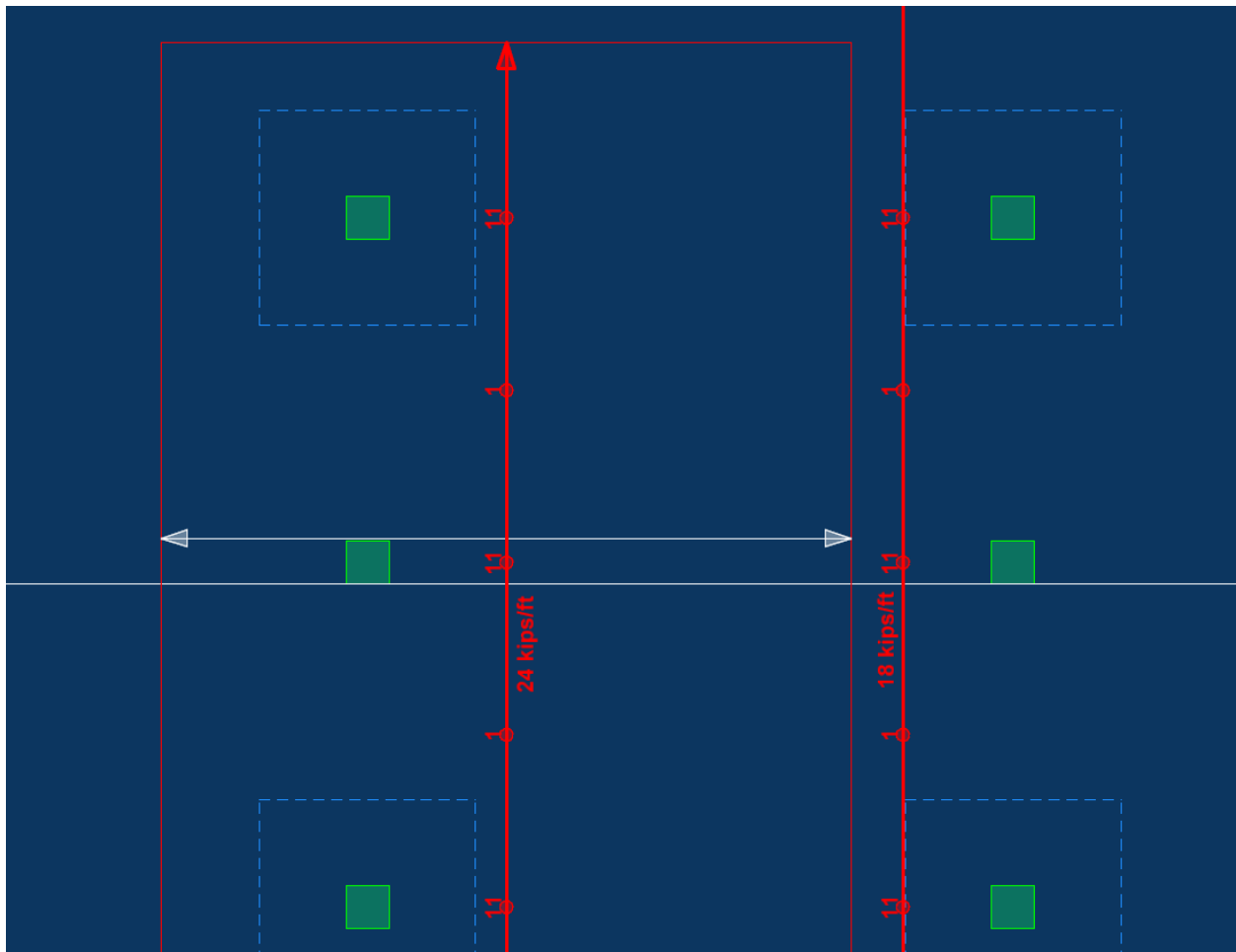

Figure 5 – Overlapping distributed tendon quadrilateral objects

Overlapping Distributed Tendon Area

Description: A shape that represents overlapping areas of distributed tendon quadrilaterals. They are created automatically by RAM Conce*pt* during the "generate tendons" operation. These objects are meant to be used in creating the plan display to be used for printing or exporting and are not used in the generation of tendons. This object's force properties represent the summation of the overlapping distributed tendon quadrilaterals that make it up. The tendon line and extents in this object can be edited by the user. The control points that make up the shape of the object can also be edited, but RAM Concept regenerates these shapes during each "generate tendons" command so any changes to the shape of the object will be lost the next time this command is executed. These objects can also be deleted and have separate display options in the Visible Objects Dialog.

Tendon Void ( )

Description: A polygon that represents a "void" in the generated tendons on the layer it is drawn. This applies to both banded tendon polylines and distributed tendon quadrilaterals. This object might be drawn in an area of the slab where the generated tendons would be very short and thus the user wants them omitted. This object could also be used to represent a stressing blockout, etc. This object has no editable properties.

Profile Polyline ( )

Description: A polyline that is meant to provide elevation reference information to any banded tendon polyline or distributed tendon quadrilateral object that crosses it. They are generally not meant to be displayed on the final tendon design plan, but rather used to automatically create profile elevation points on the banded tendon polyline and distributed tendon quadrilateral objects to convey profiling information. They provide a logical and easy to control means to control tendon profiles throughout the floor. These objects can be drawn manually, but RAM Concept also has tools to generate these lines automatically from previously defined span segments, since the location of these objects will normally coincide.
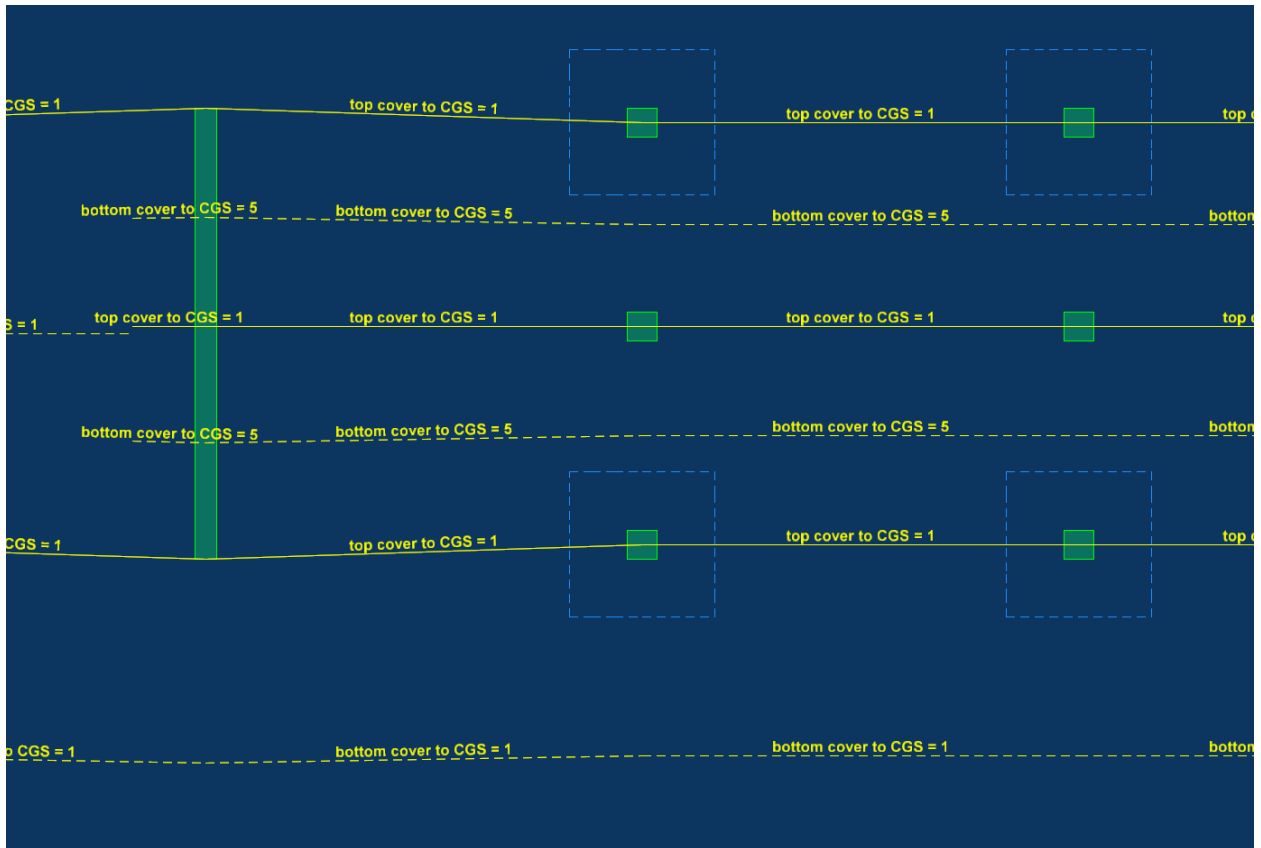
Figure 6 – Profile Polyline objects

Profile Polyline properties

- Elevation Reference – The location to reference the elevation from ("absolute", "above soffit", "above surface", "top cover", "bottom cover"). Note that the cover values are currently referenced to the CGS of the tendon.
- Elevation – the elevation value from the specified "elevation reference".
- Profile Location – "support" or "span". This property is used only to define the orientation of the half spans, and thus the location of the specified inflection point. See "generating tendons" for more information.

Visual Display and Labeling of Profile Polylines

- The details can be displayed on plan. The polylines themselves are shown as solid for "support" profile location and dashed for "span" profile locations.
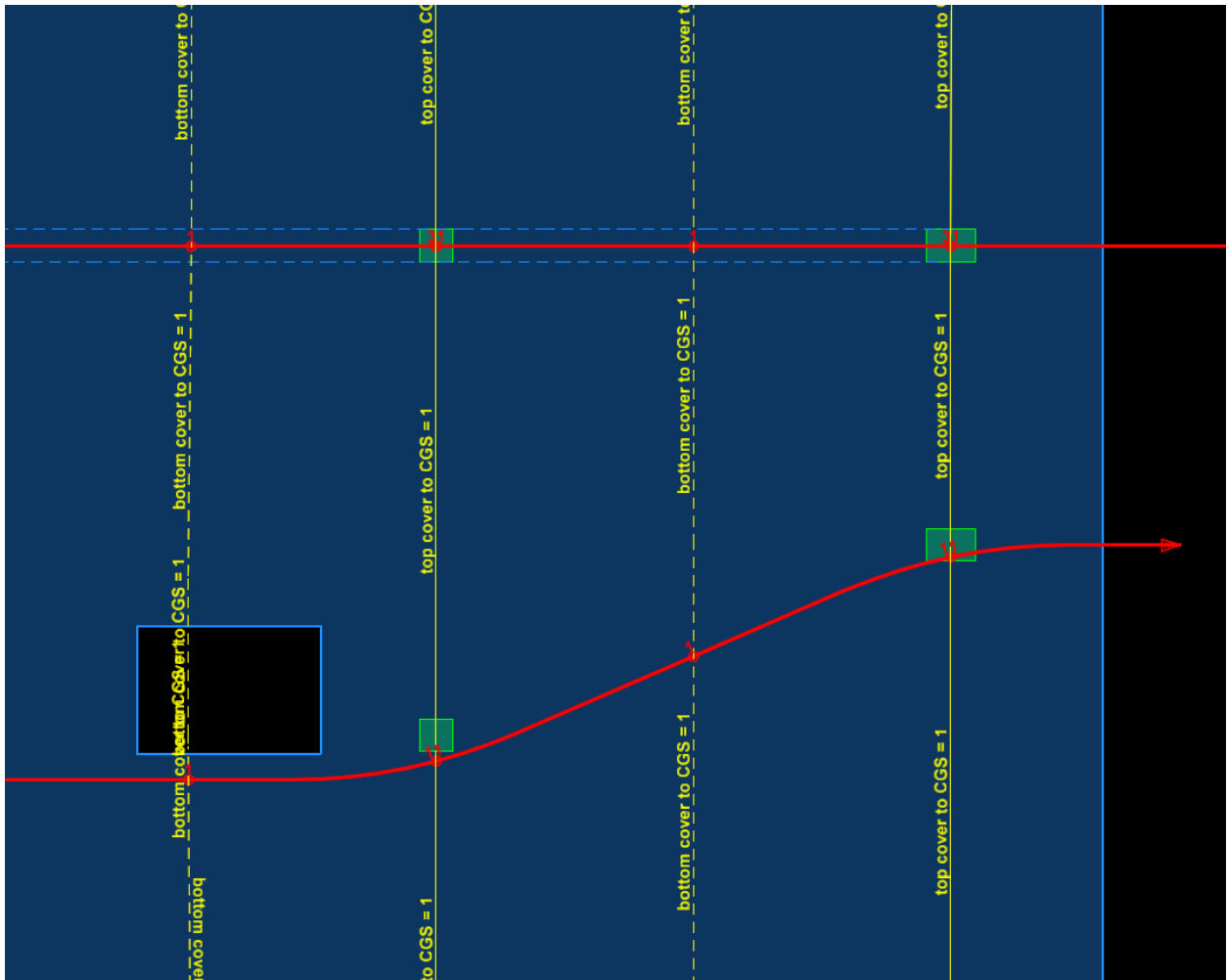
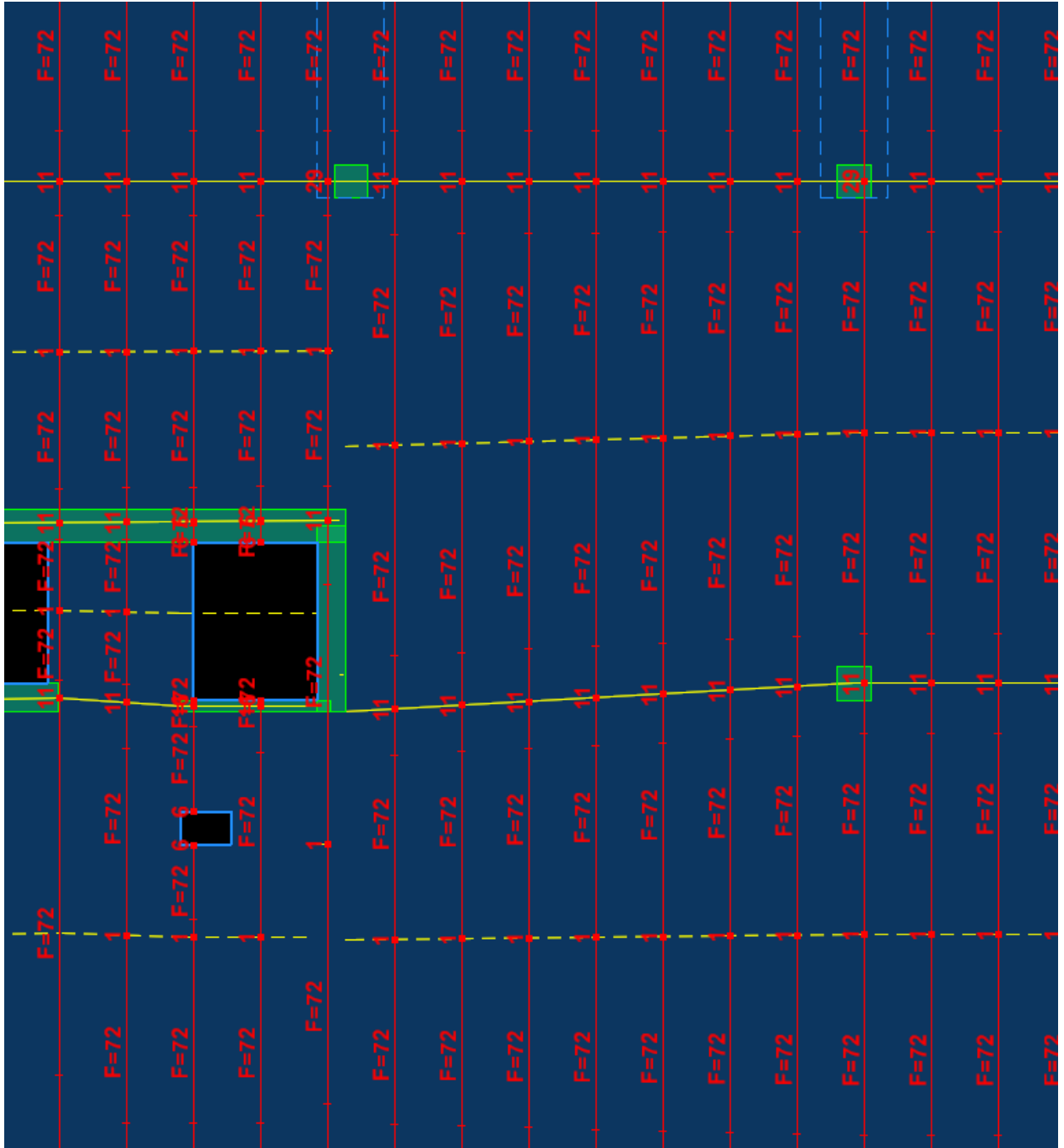Figure 7 – Relationship between banded tendon polyline objects and profile polyline objects

Figure 8 – Generated individual tendons (with profile polylines shown)

Generate Profile Polylines Tool ( )

Description: A tool that automatically generates profile polylines using already defined span segments.

First, the span set desired to be generated is selected. Since latitude tendons are typically oriented perpendicular to longitude spans, the opposing span set is used to find the profile polylines for a given span set (i.e. when generating longitude profile polylines the latitude span segments are used).

If the "Generate support polylines" check box is selected, then one support profile polyline with the specified properties will be generated at the location of each span segment on the opposing span set.

If the "Generate span polylines" check box is selected, span polylines with the specified properties will be generated from the already generated support polylines. The span orientation angle should be set to the orientation of the tendons spanning between the support polylines. If the tendons change angles throughout the floor then the "use medial axis" setting can be used which provides span polylines that are equidistant to perpendicular lines from the adjacent support polylines (in effect, the span orientation angle is the average of the perpendicular lines to the support polylines). When using this tool, span polylines are always generated at mid-span between support polylines.
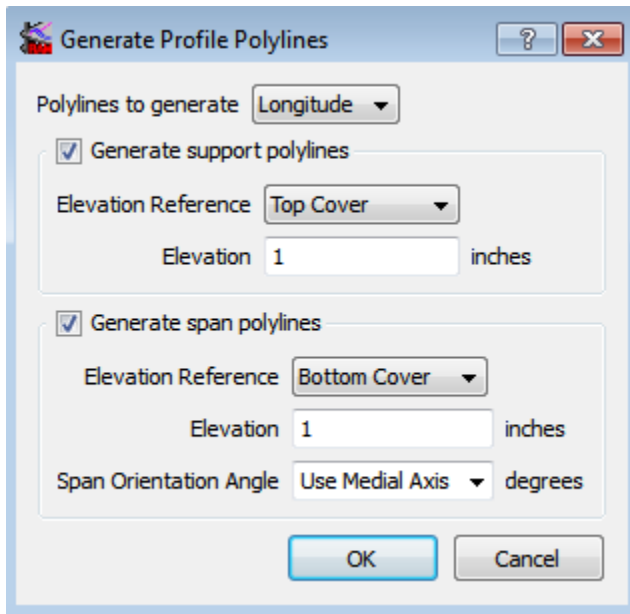

Figure 9 – Generate Profile Polylines Dialog

Generate Span Polylines Tool ( )

Description: A tool that automatically generates span profile polylines using already defined support profile polylines.

This tool operates on previously drawn/defined span profile polylines. By selecting any number of support profile polylines, span profile polylines with the specified properties can be generated between

them. See the discussion in the "Generate Profile Polylines" Tool for use of the Span Orientation Angle.
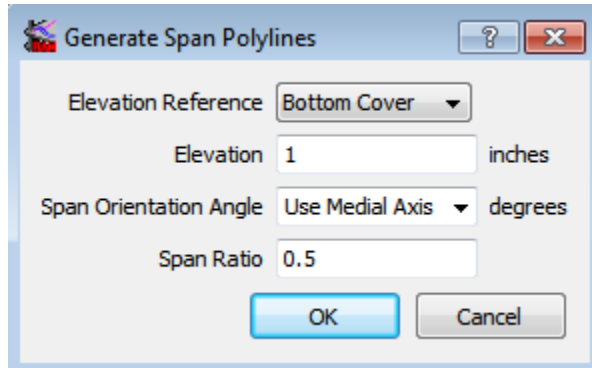This tool generates a span polyline at any ratio along the span as specified by the user.

Figure 10 – Generate Span Polylines Dialog

Generate Tendons Tool (�🮑)

Description: A tool that automatically generates RAM Concept individual tendons on the Generated
Tendon Layers from the Banded Tendon Polylines and Distributed Tendon Quadrilateral objects on the
Tendon Parameters Layer.

This tool can be used to generate and view the program generated tendons before running the analysis.
It is not necessary to execute this tool before running the analysis as any out of date tendons will be
regenerated during a "calc all".

Notes about generating tendons

Tendons are generated from banded tendon polylines without regard to the actual polyline orientation.
The tendon orientation is determined strictly by the profile polyline type defining the span at each end.
Locations at the end of a banded tendon polyline (where there is no intersecting profile polyline) or
where a banded tendon polyline intersects a slab edge are considered to be "slab edge" locations and
are profiled at mid-depth of the floor at that location.

Tendons generated from distributed tendon quadrilaterals that end within a span are profiled as if they
continue to the next profile polyline or slab edge location. This allows profile polylines with different
angles to be abutted within a span and represent a continuous array of tendons with a change in angle
at mid-span. Where distributed tendon quadrilaterals intersect slab edges, the tendons are considered
at a "slab edge" location and are profiled at mid-depth of the floor at that location.

Profiles at the end of a banded tendon polyline or at slab edges for banded tendon polylines or
distributed tendon quadrilaterals can be controlled by drawing a profile polyline near the end of the
tendon or near the slab edge location. From this profile polyline the generated tendon absolute
elevation will remain constant to the end of the tendon.

Generated tendon orientation is important mostly for proper location of the inflection point. Generated tendon orientation always follows the following conventions:

Support->Span

Support->Slab Edge

Slab Edge->Span

When the ends represent the same span location type (i.e., both supports) then the tendon is generated from the location of highest absolute elevation to location of lowest absolute elevation. If the elevations are the same then the orientation will be random (and not important).

New Properties in Existing Tendon Objects

The following new properties have been added to the existing tendon objects in RAM Concept:

- Elevation Reference at end 1 & 2 – The location to reference the elevation from ("absolute", "above soffit", "above surface", "top cover", "bottom cover"). Note that the cover values are currently referenced to the CGS of the tendon.
- Tendon End 1 & 2 Span Ratio – Represents the part of the "half-span" that this tendon represents. This allows a user to specify a part of a parabolic or reverse parabolic half-span profile. These properties should normally be 0 and 1 and changing them should be done with extreme caution.

"Check Only" option added to Calc Options

The option to perform a "check only" has been added to Calc Options.
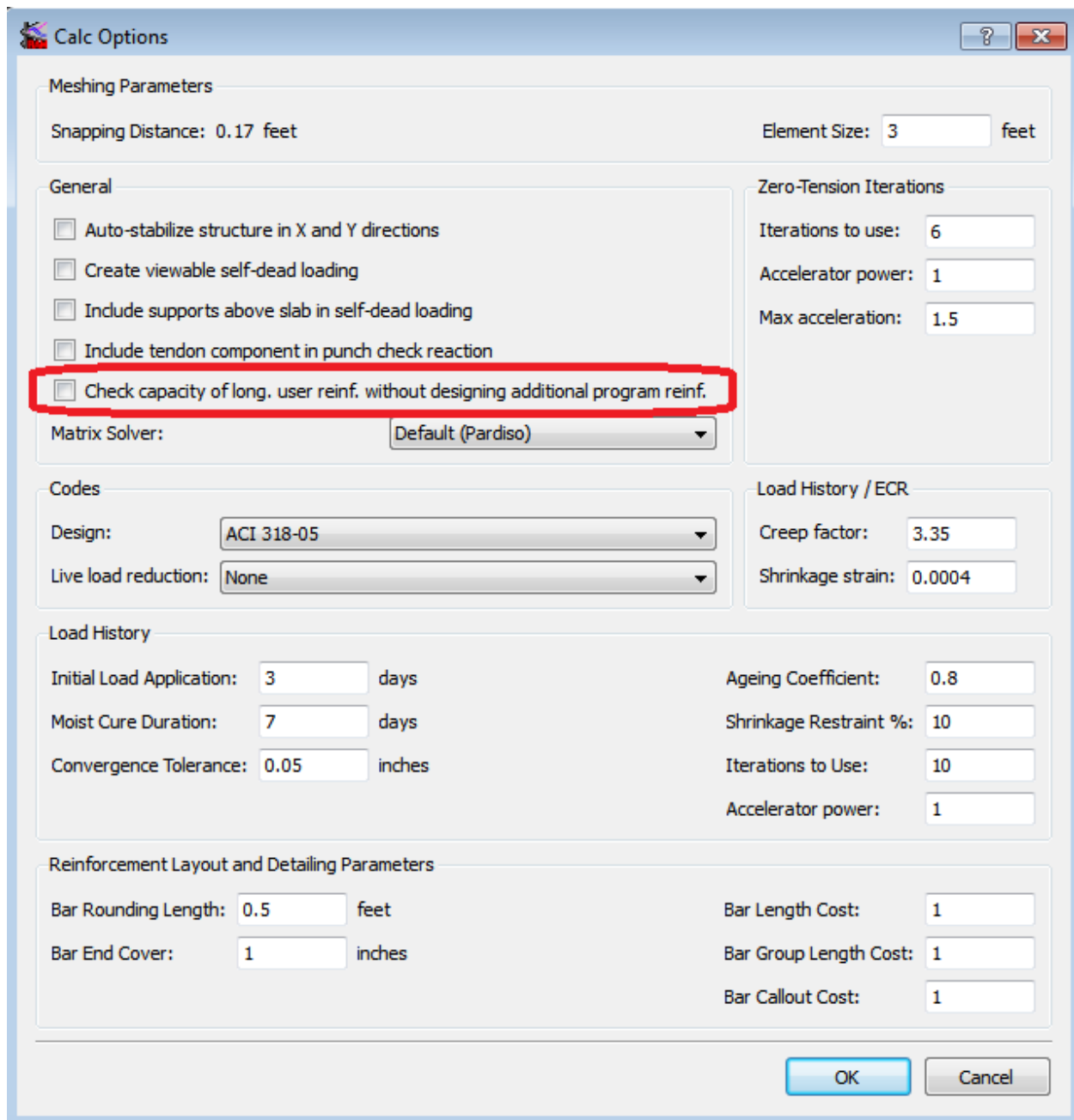
Figure 11 – Calc Options Dialog

This option will instruct Concept to perform a check of the existing defined longitudinal user reinforcement and post-tensioning and report any failed locations. Since RAM Conce*pt* currently does not have user defined transverse (shear) reinforcement, Concept always performs a transverse shear (and SSR for punching shear) design for the given longitudinal reinforcement. Ram Conce*pt* will not perform a design during the "calc all" and any program reinforcement will be deleted during the "calc all" when using this option.

Automatic Hook Tool on Reinforcement Layer ( )

This tool allows RAM Concept to automatically add the specified hook type to the current selection set of user reinforcement within the specified distance of the slab edge.
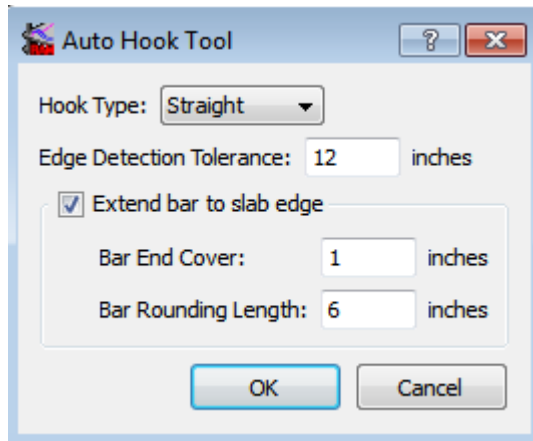

Figure 12 – Auto Hook Tool Dialog

The Edge Detection Tolerance controls how far out Concept looks from the end of a user bar to detect a slab edge. If the Perform Bar Extension check box is selected, RAM Concept will extend the end of the bar near the slab edge to the specified end cover, then lengthen the opposite end of the bar (if possible) to maintain the specified bar increment specified.

RAM Structural System Integration Enhancements

A number of enhancements to the RAM Structural System were made including:

- Upon export of Concept walls to RAM Structural System the "shear wall" parameter is used to determine the framing of the walls created in RAM Structural System ("gravity" for false, "lateral" for true). For export of Concept columns to RAM Structural System the "roller at far end" setting is used to determine the framing of the columns created in RAM Structural System ("gravity" for true, "lateral" for false).
- When transfer gravity forces are imported from RAM Structural System, all reactions are now imported from RAM Structural System regardless of whether or not they are supported by a member below. This allows easy equilibrium checks for the set of imported forces on the floor.
- For imported gravity wall reactions, the imported forces are now distributed over the wall length instead of split to the ends of the wall. The distributed loads are statically equivalent to the concentrated wall reaction they are created from.