RCDC (SACD) V11.04

Release Notes

RCDC V11.04.00 is herewith now available with the following new features and design capabilities. The newly introduced features are:

No	Module	Description
1	Beam	'Update Beam Design' functionality in the beam module with a new analysis file- All Design codes
2	Beam	Reading and 'Design of Beams at Foundation Level' without column modeled
3	Column	Different Reinforcement Grades for Main and Secondary reinforcement for Column module- All Design codes
4	Column	An additional option to calculate the Moment Capacity Reduction Factor (ϕ) for column design as per AS 3600:2018
5	Column	'Design Change' report for the 'Update Design' functionality in the column module
6	Column	An option to select the Strength Reduction Factor (ϕ) for shear design of special frames for ACI & NSCP code
7	Pile Cap	Pile-cap design for Columns with 'Tensile Axial' force- All Design codes
8	Tank Wall	Reading Tapered tank wall from STAAD physical modeler
9	General	Enhancements
10	General	Defects Resolved

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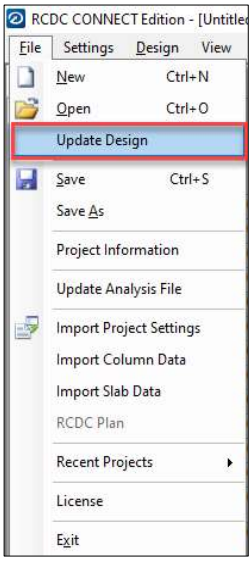
Beam	'Update Beam Design' functionality in the beam module with a new analysis file- All Design codes

The advantage of the 'Update Design' option is that users can check the existing design (which is based on an earlier analysis file) with the revised analysis file. If the existing design reinforcement is sufficient or more than the revised design reinforcement, then, the software will maintain the existing design. If the existing design is less than the required steel for the revised analysis, then, the software will show the updated design.

This feature handles changes in analysis such as changes in Beam location, beam size, loading, and so on. There is a set of rules implemented in the software to identify changes in the geometry. The software then performs the calculations needed to address these changes. The workflow for using this feature is as below –

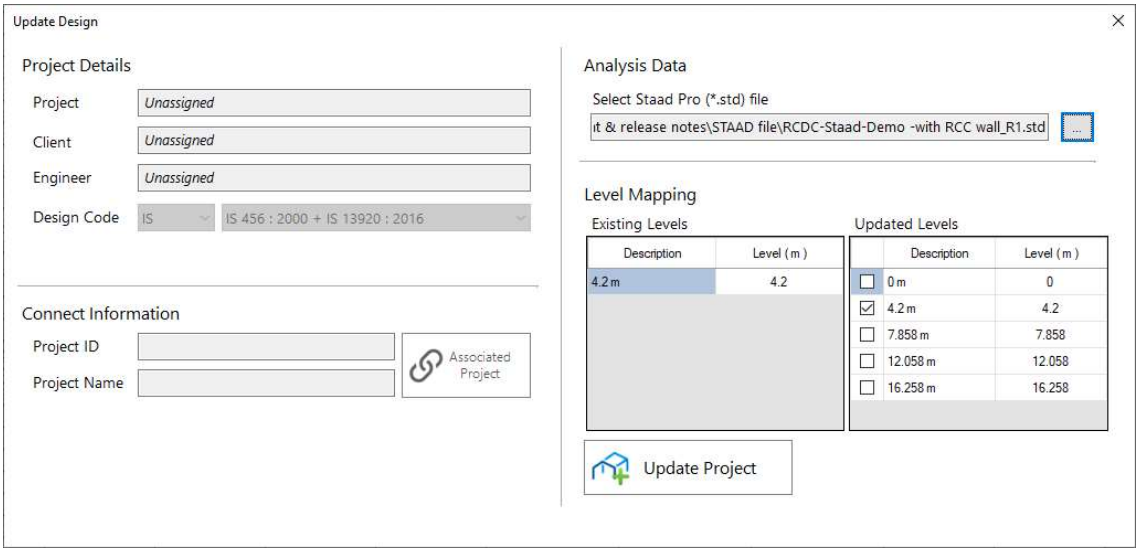
When an existing beam design file is opened, the following command is available in the File menu.



After opting to Update Design, RCDC will require the user to select the revised analysis file. Once the data from that file is read, a wizard will be available for making the choices/ changes related to:

1. Level Mapping
2. Preferred rebar spacing
3. Load Cases & Load Combinations

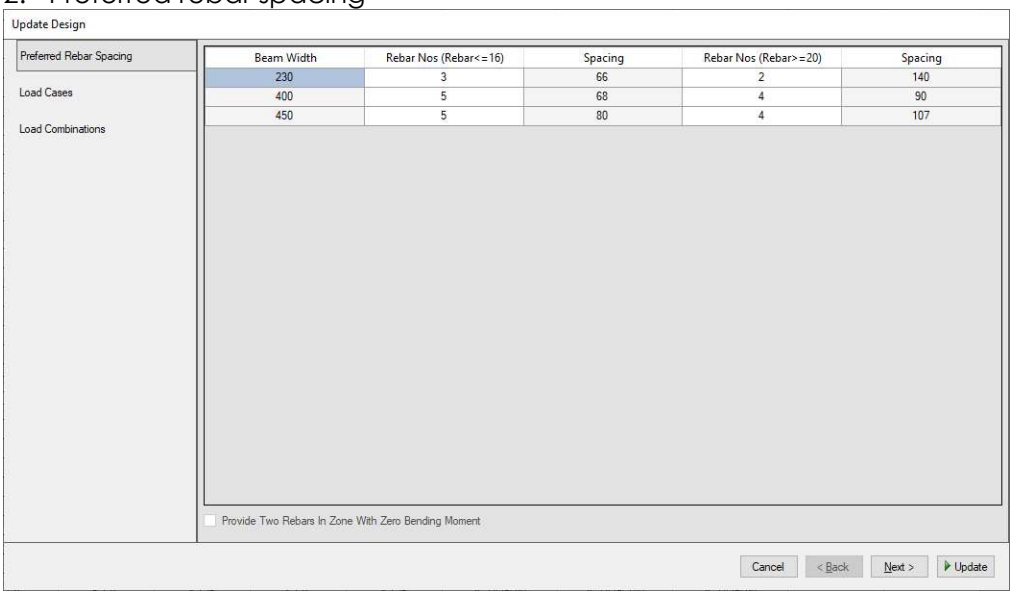
1. Level Mapping



If the existing level is the same as per the Y-coordinates present in the revised analysis file, by default, that level will be marked as selected. Users can change the level selection in the updated levels list. If in the old file, user has grouped the levels, RCDC will try to map and select the same levels if present in the revised analysis file.

Users can select any levels in the new analysis file irrespective of the actual level and the number of levels 'grouped' selected in the old file. If the old file contains one level (level grouping not done) then the user can select multiple levels in the new analysis file. RCDC will validate the geometry for the grouping of new levels selected.

2. Preferred rebar spacing



If any beams of width different than existing beam widths are available in the new analysis file, then, RCDC will update the above list of beam widths. Users will be able to change the rebar numbers for new widths only.

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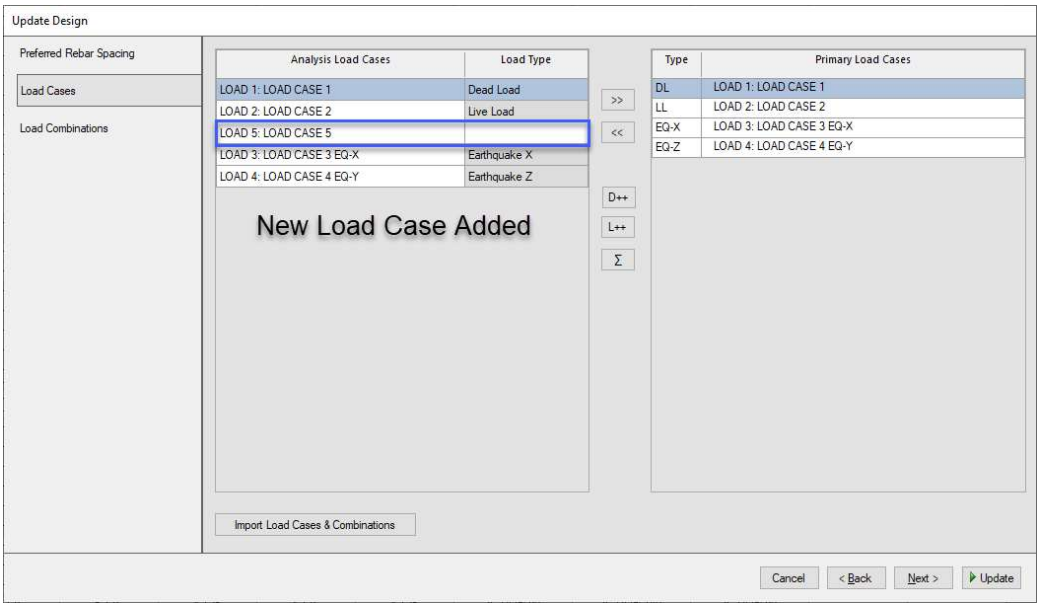
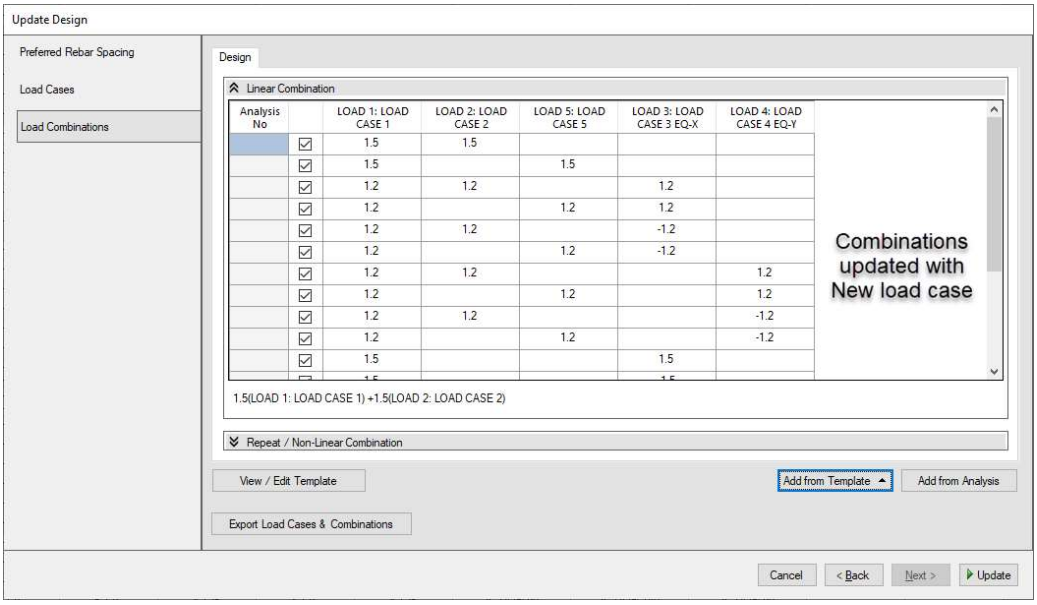
3. Load Cases & Load Combinations

The data from the revised analysis is read and if there are any changes in load cases in the revised analysis file compared to earlier, the user needs to set the type for the additional load cases and proceed.



Load combinations to be considered can also be modified based on the load cases considered.



The program then performs the calculations and produces updated design results. Users can now compare the existing design with the updated design. The Changed report is available after the update design is performed. This report will be auto saved in the same folder where the RCDC file is saved.

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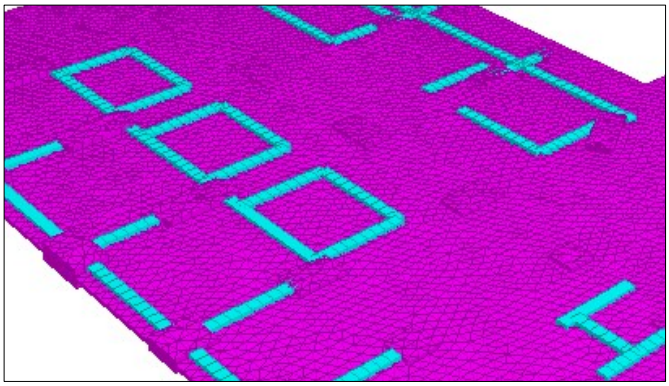
Please refer to the section "Beam – Update design-beam" of the program documentation for information regarding the rules used by the program to identify changes in the model.

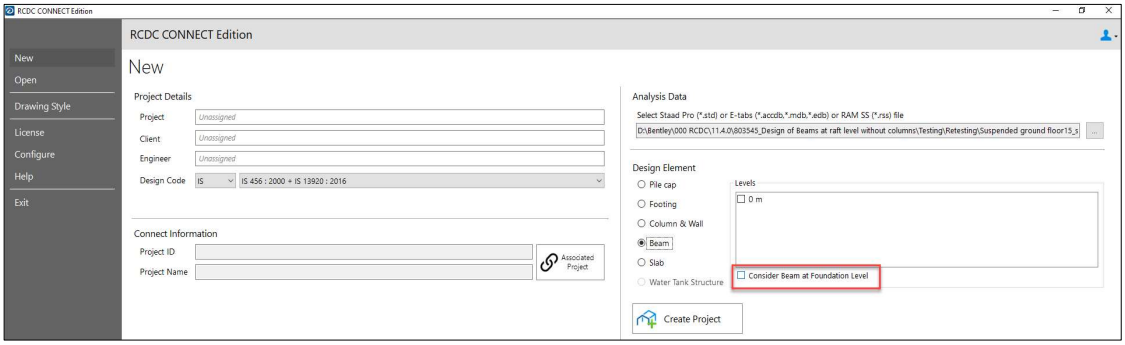
Beam — Reading and 'Design of Beams at Foundation Level' without column modeled

In the Beam module, SACD identifies the beam propagation (the full extent of a physical beam) by assembling collinear segments connected between columns. Hence, until now, if columns are not present at a given level, as in the case of a STAAD.Pro mat foundation modeled with finite elements, RCDC was unable to identify or read the data for those beams.



In the model shown in the above figure, the raft is modeled by connecting discrete individual foundations (footings or pile-caps). Beams are also modeled as connecting members between those individual foundations. Past versions of SACD were not able to identify these beams.

Starting with this version, SACD has been enhanced to read beams embedded in foundations modeled using finite elements in a STAAD.Pro model.



When the analysis file is read in RCDC and the beam module is selected, a new option named "*Consider beams at Foundation level*" will become available as highlighted in the above screenshot. The Y coordinate of that level is also displayed in the dialog box, and the user must select that to confirm that the beams are located at that level.

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The RCDC philosophy for beam design is based on the principle that beams span between columns. Accordingly, the beam identification algorithm looks for spans between columns.

Since, in a raft foundation, columns may not be present, but beams could be present. RCDC uses the following approach for beam identification in the case of embedded beams.

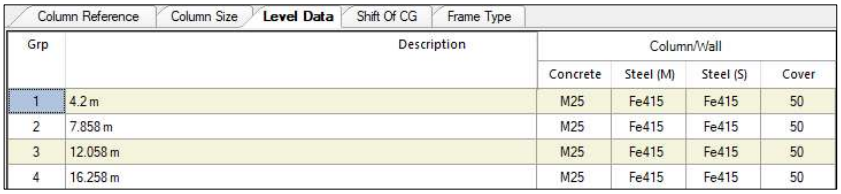
When this option is selected, SACD will search for beams that are at the foundation level. SACD will identify the columns based on the supports assigned to beams. If no support is present at the ends of the beam, then RCDC will assign a dummy column of size 600x600mm. Based on the support assigned in the analysis file, dummy columns are assigned to the end of the beam.

If support like *fixed*, *pinned*, and *fixed but* support exists at the ends of the beam, then a column of 600x600mm would be assigned at the same location. If foundation support like footing, Elastic mat, and Plate mat is assigned, then based on the beam end conditions, dummy columns are assigned to the end of the beam.

After reading the data for beams, further design processes and features are the same as those available for normal beams located on the floors of any superstructure model.

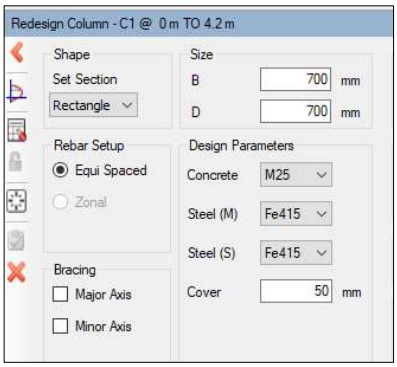
Column — Different Reinforcement Grades for Main and Secondary reinforcement for Column module- All Design codes

Different steel grades for Main and shear reinforcement can now be specified for the column design module. This functionality is enabled for all design codes available in RCDC.



Grp	Description	Column/Wall			
		Concrete	Steel (M)	Steel (S)	Cover
1	4.2 m	M25	Fe415	Fe415	50
2	7.858 m	M25	Fe415	Fe415	50
3	12.058 m	M25	Fe415	Fe415	50
4	16.258 m	M25	Fe415	Fe415	50

Further, new steel grades for main as well as shear reinforcement can be added to the program's library.The option of changing steel grade is also available on the input screens for redesign, and it can be set for an individual column.



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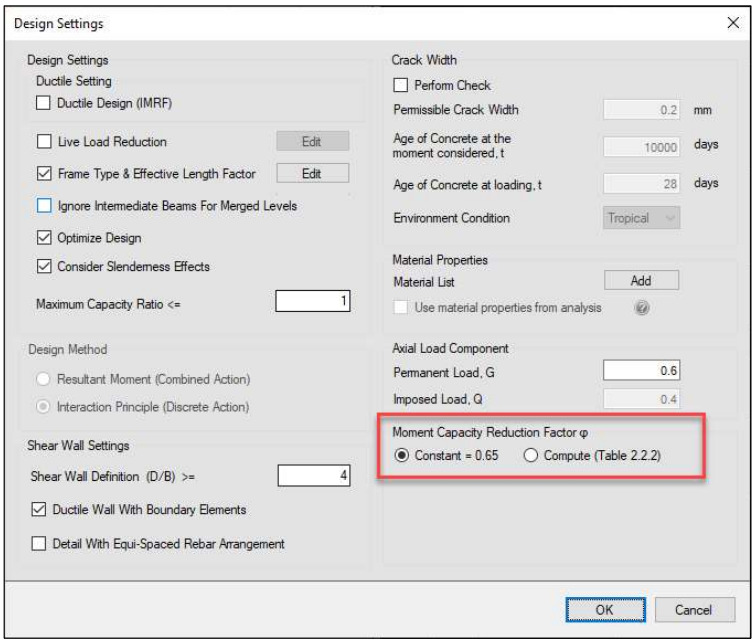
Column	An additional option to calculate the Moment Capacity Reduction Factor (ϕ) for column design as per AS 3600:2018

RCDC will now provide the user the option to calculate the value of the 'Moment Capacity Reduction Factor' (ϕ) on the design setting screen for column design as shown below,

a. ϕ = 0.65 (as constant)

b. ϕ as per table 2.2.2 of AS 3600:2018 – Amendment 2



Screenshots of the updated design calculation report for both the options are shown here for reference,

a. ϕ = 0.65 (as constant)

Moment Capacity Check		
	Along D	Along B
Pt Calculated (%)	2.96	
Reinforcement Provided	4-N32 + 14-N28	
Nu (N*) (kN)	4001.6	
Φ	0.65	0.65
ΦMu (kNm)	1090.5	719.52
ΦoN_{uo} (kN)	8136.38	
α_n	1.54	
Capacity Ratio	0.98	
	0.98 < 1	

b. ϕ as per table 2.2.2 of AS 3600:2018 – Amendment 2

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Moment Capacity Check		
	Along D	Along B
Pt Calculated (%)	1.1	
Reinforcement Provided	12-N20 + 8-N16	
Nu (N*) (kN)	701.21	
Φo	0.65	
Type	Non Slender	Non Slender
K_Φ	1	1
ku	0.17	0.17
kuo	0.55	0.55
Φ'	0.85	0.85
Nub (kN)	4245.78	4245.78
Φ	0.82	0.82
ΦMu (kNm)	755.06	755.06
ΦoN_{uo} (kN)	7103.05	
α_n	1	
Capacity Ratio	0.23	
	0.23 < 1	

Column 'Design Change' report for the 'Update Design' functionality in the column module

RCDC will show the 'Design Change' report after the update column design process is completed. Users can save this report to the desired location. By default, RCDC saves the changed report to the location where the RCDC file is saved.

This report will cover the following,

1. Level mapping of old and new analysis files
2. Details of entire column/wall added or removed
3. Details of column/wall added or missing at various levels
4. Details of geometry (location) and dimension changes (sizes) for the columns/walls
5. Details of reinforcement changed
6. Support type (Pinned or Fixed) for pedestal design.

A sample design change report is shown below,

UPDATE DESIGN REPORT

Entire Column/Wall Missing or New

Column/Wall No	Missing	New
	CG (m)	CG (m)
C11	X=46.08, Y=10.87	-
C20	X=49.06, Y=19.36	-

Column/Wall Missing or New at levels

Column/Wall No	Updated Level	Missing	New
		CG (m)	CG (m)
C11	4.2 m	X=46.08, Y=10.87	-
C11	7.858 m	X=46.08, Y=10.87	-
C20	4.2 m	X=49.06, Y=19.36	-
C20	7.858 m	X=49.06, Y=19.36	-

Column/Wall Geometry Changes

Column/Wall No	Updated Level	Column/Wall CG		Column/Wall orientation		Section Property		Frame Type	
		Old analysis file (m)	New analysis file (m)	Old analysis file (degree)	New analysis file (degree)	Old analysis file (mm)	New analysis file (mm)	Old analysis file	New analysis file
C17	4.2 m	-	-	-	-	600 X 900	650 X 950	-	-
C17	7.858 m	-	-	-	-	600 X 900	650 X 950	-	-
C17	12.058 m	-	-	-	-	600 X 900	650 X 950	-	-
C17	16.258 m	-	-	-	-	600 X 900	650 X 950	-	-
C26	4.2 m	-	-	-	-	600 X 900	650 X 950	-	-
C26	7.858 m	-	-	-	-	600 X 900	650 X 950	-	-
C26	12.058 m	-	-	-	-	600 X 900	650 X 950	-	-
C26	16.258 m	-	-	-	-	600 X 900	650 X 950	-	-

Column/Wall Reinforcement Changes

Column/Wall No	Updated Level	Main Reinforcement		Links		Ductile Links	
		Old	New	Old	New	Old	New
C9	16.258 m	14-T12	14-T16	-	-	-	-
C1-C12	4.2 m	22-T10 + 10-T8	22-T16 + 10-T8	T8 @ 150	T8 @ 125	-	-
C32	12.058 m	16-T16	16-T20	T8 @ 250	T8 @ 300	-	-

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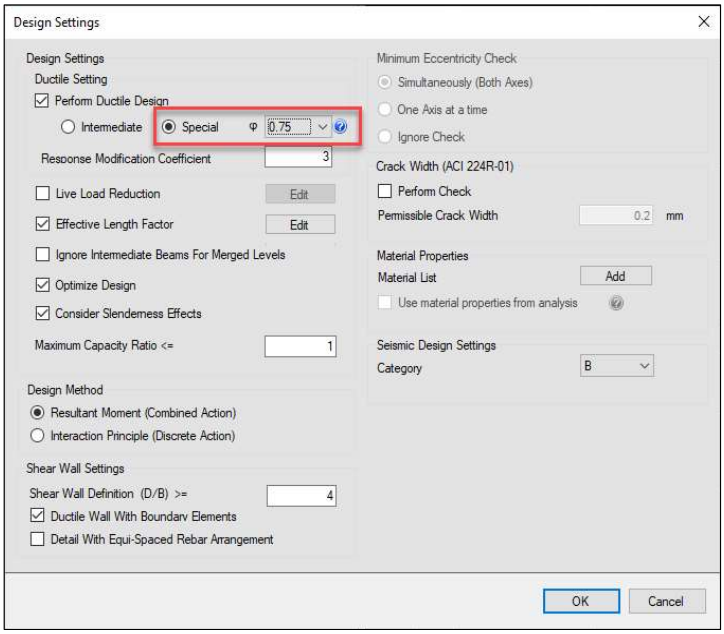
RCDC (SACD) V11.04

Column	An option to select the Strength Reduction Factor (ϕ) for shear design of special frames for ACI & NSCP codes

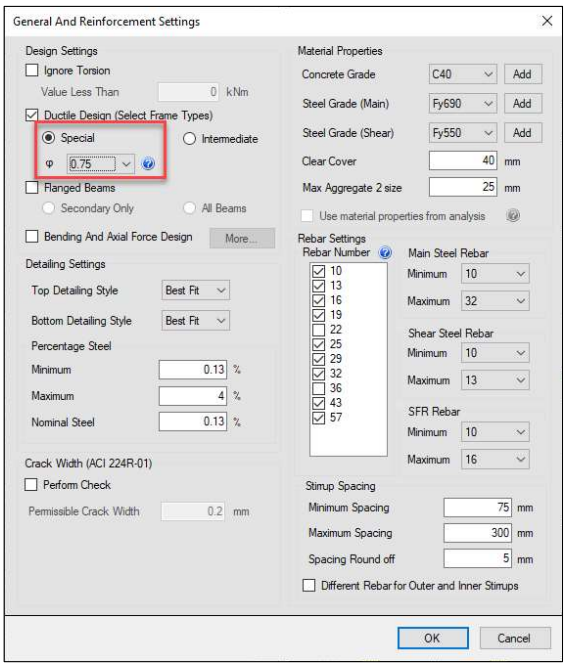
RCDC will now allow users to select strength factors for the shear design of columns and walls of special frames.

a. ϕ = 0.65
b. ϕ = 0.75



A similar facility is available for-beams of special frames.

a. ϕ = 0.65
b. ϕ = 0.75



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RCDC (SACD) V11.04

Pile Cap	Pile-cap design for Columns with 'Tensile Axial' force- All Design codes

If there is axial tension in the column, RCDC will now design the pile cap for axial tensile force in the piles. The top reinforcement in the pile cap will be based on the bending moment caused by the axial tension in the pile. The procedure for calculating the bending moment will be the same as that for the bending moment that produces tension at the bottom of the pile cap. It is calculated at the face of the column in each direction. The contribution from self-weight and soil weight above the pile cap is deducted from the axial tension force in the column to get the net axial tension in the pile cap

For design for shear, the shear force is calculated at the face of the column when the column axial force on the pile cap is tensile. Further calculations of the shear check are the same as the existing methods for shear design which are based on the rules of the selected design code.

Screenshots from design calculations report are shown below,

Top Reinforcement Along Column-D			
Critical Load Combination	:	[4] : (LOAD 2: LOAD CASE 2)	
Pcomb	=	-1200.48	kN
Ptotal	=	Pcomb + Pilecap Wt.	
	=	-1056.48	kN
Mx	=	-230.03	kNm
My	=	-290.04	kNm
Ppile	=	Max Load on pile	
	=	437.48	kN
Deff	=	940	mm
Beff	=	900	mm
DfCol	=	0.35	m
BMux	=	Ppile X DfCol	
	=	153.12	kNm
PtReq	=	0.2	%
AstReq (BM)	=	1925	sqmm/m
AstPrv	=	T16 @ 100 C/C	
	=	2010.6	sqmm/m

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Along Column-D (Tension Case)

Critical Load Combination	:	[4] : (LOAD 2: LOAD CASE 2)	
Pcomb	=	-1200.48	kN
Ptotal	=	Pcomb + Pilecap Wt.	
	=	-1056.48	kN
Mx	=	-230.03	kNm
My	=	-290.04	kNm
Ppile	=	Max Load on pile	
	=	-437.4766	kN
Location of critical section is at face of column			
Section Location from column center	=	400	mm

Data for Piles

Pile No	Load (kN)	% covered	Shear (kN)
P1	-90.76	100	-90.76
P2	-244.12	100	-244.12
P3	-284.12	100	-284.12
P4	-437.48	100	-437.48

Design Shear Force (Vu)	=	Max. of (Shear due to P1+P3, P2+P4)	
	=	681.59	kN
Deff	=	940	mm
Beff	=	2400	mm
Tv	=	Vu/(Beff x Deff)	
	=	0.302	N/sqmm
Tc	=	0.334	N/sqmm
Tv	<	Tc, Hence Shear Reinforcement is not required	

Pile capacity and sizing check report has been updated with new information as highlighted in the screenshot shown next.

Pilecap No	:	PC4	
Column No	:	C4	
Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Pile No	:	4	
Depth of founding layer	:	4	m
Density of Soil	=	18	kN/cum
Permissible SBC Increase for EQ	=	25	%
Permissible SBC Increase for Wind	=	25	%
Live Load Reduction	=	0	%
Pile Load Reduction Factor	=	0	%
Pile Over Loading Factor	=	10	%
Pile Group Overloading Factor	=	10	%
Permissible Load on Group of Piles	=	2860	kN
Pilecap Size (LXBXD)	:	2400 X 2400 X 1000	mm
Effective Self Weight	=	144.00	kN

Design Table (C4):

Load Combination	Analysis Forces			P total (kN)	Max. Compressive Load on One Pile (kN)	Max. Compressive Load on Group of Pile (kN)	Shear Load on Group of Pile (kN)	Max.Tensile Load on One Pile (kN)	Max.Tensile Load on Group of Pile (kN)	Permissible Shear Capacity (kN)	Pile Capacity (kN)	Pile Capacity Increase Factor (%)	Permissible Compressive Load on one Pile (kN)	Permissible Tensile Load on one Pile (kN)
	P (kN)	Mx (kNm)	My (kNm)											
1	1800.72	-268.04	375.05	1944.72	700.54	1944.72	131.3	-	1944.72	400	650	1.1	715	605
2	-1200.48	-230.03	-290.04	-1056.48	-	0	0	437.48	-1056.48	400	650	1.1	715	605

Tank Wall — Reading of data for a Tapered tank wall from the STAAD physical modeler

For tank walls modeled using STAAD.Pro's physical modeler, RCDC is now able to read the data for tapered type walls whose thickness varies along the height. Additionally, it will also identify the thickness reduction side.

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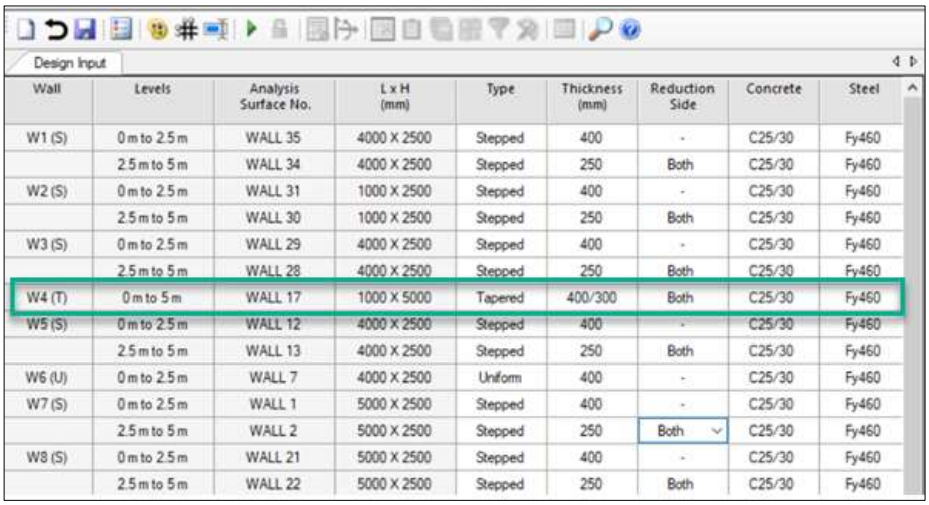

Design Input

Wall	Levels	Analysis Surface No.	L x H (mm)	Type	Thickness (mm)	Reduction Side	Concrete	Steel
W1 (S)	0 m to 2.5 m	WALL 35	4000 X 2500	Stepped	400	-	C25/30	Fy460
	2.5 m to 5 m	WALL 34	4000 X 2500	Stepped	250	Both	C25/30	Fy460
W2 (S)	0 m to 2.5 m	WALL 31	1000 X 2500	Stepped	400	-	C25/30	Fy460
	2.5 m to 5 m	WALL 30	1000 X 2500	Stepped	250	Both	C25/30	Fy460
W3 (S)	0 m to 2.5 m	WALL 29	4000 X 2500	Stepped	400	-	C25/30	Fy460
	2.5 m to 5 m	WALL 28	4000 X 2500	Stepped	250	Both	C25/30	Fy460
W4 (T)	0 m to 5 m	WALL 17	1000 X 5000	Tapered	400/300	Both	C25/30	Fy460
W5 (S)	0 m to 2.5 m	WALL 12	4000 X 2500	Stepped	400	-	C25/30	Fy460
	2.5 m to 5 m	WALL 13	4000 X 2500	Stepped	250	Both	C25/30	Fy460
W6 (U)	0 m to 2.5 m	WALL 7	4000 X 2500	Uniform	400	-	C25/30	Fy460
W7 (S)	0 m to 2.5 m	WALL 1	5000 X 2500	Stepped	400	-	C25/30	Fy460
	2.5 m to 5 m	WALL 2	5000 X 2500	Stepped	250	Both	C25/30	Fy460
W8 (S)	0 m to 2.5 m	WALL 21	5000 X 2500	Stepped	400	-	C25/30	Fy460
	2.5 m to 5 m	WALL 22	5000 X 2500	Stepped	250	Both	C25/30	Fy460

The option of changing the type from uniform to tapered or tapered to the uniform is available as per existing functionality.

General Enhancements

The following are the enhancements made in this release to existing features.

- **ADO ID – 850062 – Joint check calculation report enhancement for columns for design to the ACI codes when column levels are merged or/and columns are grouped.**

  A flexural joint check is performed for the ductile column along the major and minor directions of a column. The critical joint is identified based on the ratio of column and beam flexural capacity. If levels are merged or columns are grouped, then it is possible that the critical joint can be identified at a different level or different column based on the ratio of a column and beam flexural capacity.

  When column levels are merged or/and columns are grouped and a joint check is performed for the ductile column design, RCDC was not showing the correct critical level beam data in the joint check report. In a few cases, RCDC was showing the beam details of the level which is not critical in the design. However, the joint check design was performed at every level and the final design is performed as per the critical level.
  Now the details of a beam along the major and minor direction of a column at the critical level are presented in the joint check report.

- **ADO ID – 923411 – Story shear computation for story index is enhanced for parametric surface**

  The story shear computation for each story if the shear wall modeled as a parametric surface in the structure is enhanced. In earlier releases, the story shear values were wrongly computed for shear walls modeled as a parametric surface.

Now, the story shear along the major and minor directions of the parametric surface is computed appropriately.

Sway Calculation (Stability Index)

For Global-X Direction

Level	Load Combination	Storey Height (m)	Gravity Load P (kN)	Relative Displacements (mm)	Storey Shear (kN)	Stability Index (Q)	Sway Condition
	Analysis	A	B	C	D	B x C / (A x D)	
-2.7 m to 0 m	31	2.7	240068.36	0.67	4805.83	0.012	Non Sway
0 m to 3.9 m	31	3.9	212533.24	2.09	4623.32	0.025	Non Sway
3.9 m to 7.8 m	31	3.9	184732	2.82	4550.81	0.029	Non Sway
7.8 m to 11.7 m	31	3.9	157745.45	3.21	4308.65	0.03	Non Sway
11.7 m to 15.6 m	31	3.9	130833.82	3.36	3949.76	0.029	Non Sway
15.6 m to 19.5 m	31	3.9	101780.83	3.29	3410.64	0.025	Non Sway
19.5 m to 23.4 m	31	3.9	73852.95	3.1	2750.48	0.021	Non Sway
23.4 m to 31.2 m	16	3.9	25521.92	0.07	147.82	0.003	Non Sway
31.2 m to 35.1 m	16	3.9	3583.14	0.99	40.7	0.022	Non Sway

For Global-Y Direction

Level	Load Combination	Storey Height (m)	Gravity Load P (kN)	Relative Displacements (mm)	Storey Shear (kN)	Stability Index (Q)	Sway Condition
	Analysis	A	B	C	D	B x C / (A x D)	
-2.7 m to 0 m	31	2.7	240068.36	1.98	16003.48	0.011	Non Sway
0 m to 3.9 m	31	3.9	212533.24	6.82	15875.84	0.023	Non Sway
3.9 m to 7.8 m	31	3.9	184732	9.26	15450.15	0.028	Non Sway
7.8 m to 11.7 m	31	3.9	157745.45	10.3	14677.31	0.028	Non Sway
11.7 m to 15.6 m	31	3.9	130833.82	10.39	13495.99	0.026	Non Sway
15.6 m to 19.5 m	31	3.9	101780.83	9.73	11692.96	0.022	Non Sway
19.5 m to 23.4 m	31	3.9	73852.95	8.72	9470.78	0.017	Non Sway
23.4 m to 31.2 m	19	3.9	25521.93	1.07	522.94	0.013	Non Sway
31.2 m to 35.1 m	19	3.9	3583.16	0.47	91.76	0.005	Non Sway

- **ADO ID – 811322 – Detailing enhancement in shear if left and right shear zones merge due to small beam length**

  When left and right zones merge due to the small length of the beam, the correct diameter of longitudinal reinforcement from the overlaps zones is considered to calculate the spacing of the stirrups for the ductile beams of various design codes.

General Defects Resolved

Following is the list of Defects resolved in this release.

- **ADO ID - 863182 – Reinforcement quantity issue for sloped footing**
  When a grouped footing operation is performed for sloped footing, the quantity for the top reinforcement was not reported correctly. It was showing the correct top reinforcement quantity for individual sloped footings if the BOQ was generated before the grouping operations. This issue is now resolved, and correct reinforcement quantities are shown in the BOQ for individual and grouped sloped footings.

- **ADO ID - 891367 – Report presentation issue of Bending Moment in ACI slab design**
  RCDC was calculating and showing the area of reinforcement for the correct bending moment in the slab design per ACI 318M in all editions, however, there was a presentation error in showing the bending moment value. This error has been resolved now and the correct bending moment value is presented.
  A screenshot from the program's design calculation report where the bending moment value is now printed correctly is shown below.

	Short Span		Long Span	
	Side1	Side2	Side1	Side2
Beam				
B (mm)	550	400	550	550
D (mm)	650	500	650	650
Ib (mm^4) x10^6	12586.98	4166.67	12586.98	12586.98
Adjacent Slab				
Thk (mm)	-	-	-	200
Span (mm)	-	-	-	7000
Ib (mm^4) x10^6	1050	1050	2000	4333.33
αf lx, αf ly	11.99	3.97	6.29	2.9
αf	6.29			
Ln (mm)	2675		5450	
L2 (mm)	3275		1812.5	
Effective Width (mm)	1500		787.5	
	Ly/Lx		Lx/Ly	
	1.9		0.52	
Total BM (kNm)	61.63		141.59	
Bottom				
Moment Co-efficent	0.85		0.57	
Distributed Moment (kNm)	51.77		80.71	
Moment factor for CS	0.479		0.893	
CS Moment (kNm)	24.78		72.03	
MS Moment (kNm)	27		8.68	
Moment on Beam (kNm)	21.06		61.22	
Design Moment M1, M3 (kNm)	27		8.68	
Top				
Moment Co-efficent	0.16		0.7	
Distributed Moment (kNm)	9.86		99.11	
Moment factor for CS	0.479		0.893	
CS Moment (kNm)	4.72		88.46	
MS Moment (kNm)	5.14		10.65	
Moment on Beam (kNm)	4.01		75.19	
Design Moment M2, M4 (kNm)	5.14		10.65	

- **ADO ID - 891393– Issue of Generating design calculation report for ductile combined wall consist of Gravity column**

  When ductility check is switched on, and, the model contains combined walls, and, one or more gravity columns overlap(s) the combined wall(s), the design was performed correctly. However, there was a crash occurring during the generation of the design calculation report. This has been rectified.

  To elaborate, when a gravity column overlaps a ductile combined wall, the column should also be designed as ductile as they together form one entity. However, if the user wants to design the column as Gravity, then it is handled in generating a design calculation report.

- **ADO ID - 905528 – Issue of handling Gravity column design for Euro code from RAM SS**

  For columns that are defined as Gravity in RAM SS file and read into RCDC for design per the EURO code, a crash used to occur on auto design. This was because the EURO code does not have a concept of Gravity columns and this led to a crash in auto design in RCDC. This has now been rectified in the following manner. Gravity columns defined in the RAM SS file are treated as Non-Ductile columns for design

per the EURO code. The user still has the option to mark the columns as Ductile in RCDC and perform the design accordingly.

- **ADO ID - 861563 – Issue showing Beam group number in the longitudinal section**
  The option "Use Group Names in Outputs" from the RCDC style manager used to work only when a group consisted of multiple beams but not when the group consisted of a single beam. This has been solved now and whether the group consists of single or multiple beams, the group name will be displayed if the option is switched ON and beam names will be displayed when the option is switched OFF.