RCDC (SACD) V11.05

Release Notes

RCDC V11.05.00 is herewith now available with the following new features and design capabilities. The newly introduced features are:

No	Module	Description
1	Pile cap	'Update Pilecap Design' functionality in the Pilecap module with a new analysis file- All Design codes
2	Footing	The current footing design logic improved to accommodate axial force from columns that are tensile and when stability checks are performed
3	General	General improvements in various modules of the ACI 318-2011 code
4	General	Enhancements
5	General	Defects Resolved

RCDC (SACD) V11.05

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

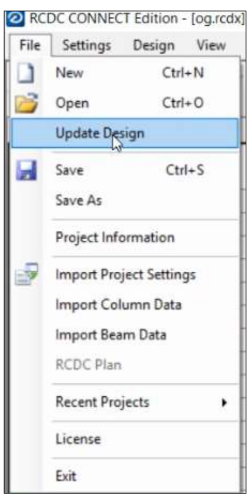
Update Design is a feature available in RCDC which will help users to check the adequacy of existing design against forces from the revised analysis. The change in the analysis file can be related to the geometry of the structure or members or it can be a change in Loading data.

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 column location, column size, column orientation, loading, and so on. There is a set of rules implemented in the software to identify changes in the superstructure data. The software then performs the calculations needed to address these changes. The workflow for using this feature is as below –

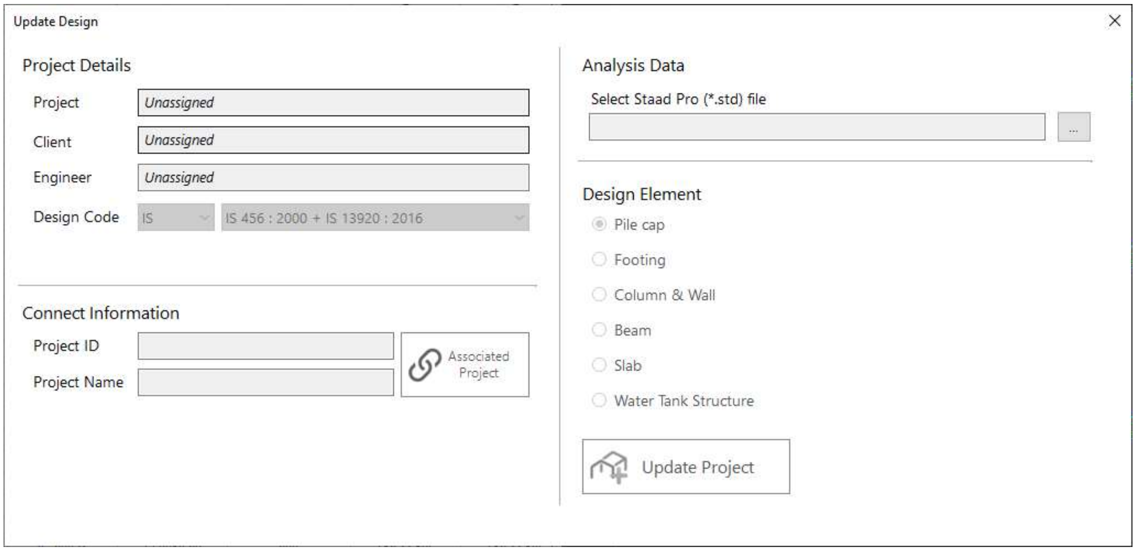
Following are the steps involved in using this feature:

Once the file is opened, under File Menu, Select the "Update Design" option.

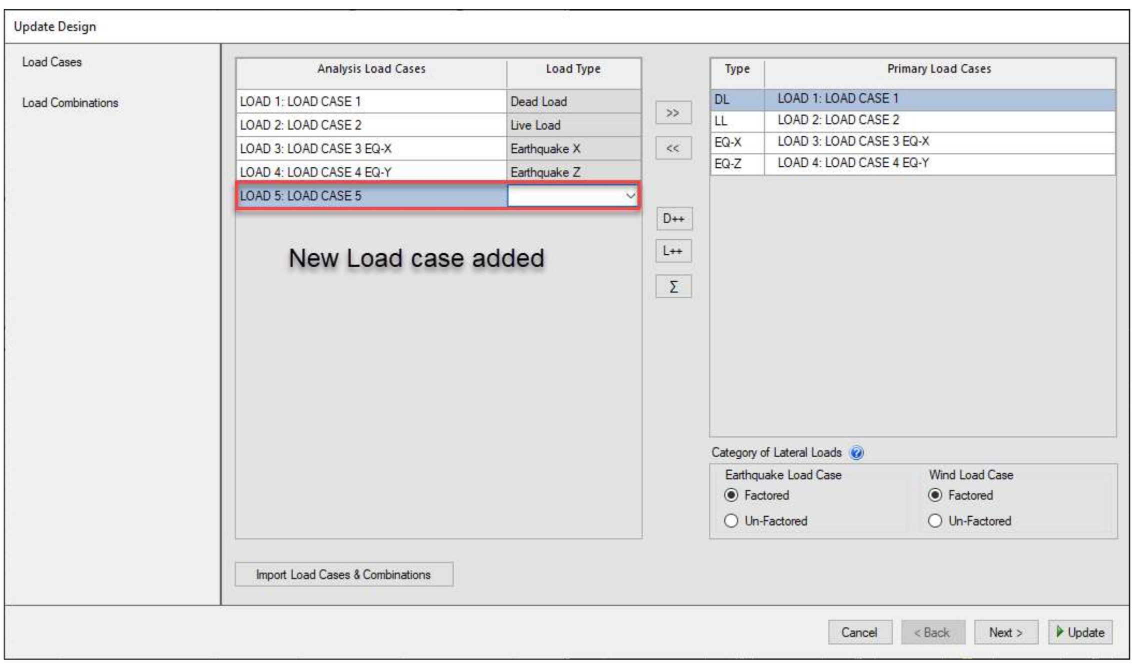


After opting to Update the Design, RCDC will ask to select the revised analysis file with the exception of the workflow of the pedestal design wherein the .rcdx file is used in the update which is explained in the later section.

RCDC (SACD) V11.05

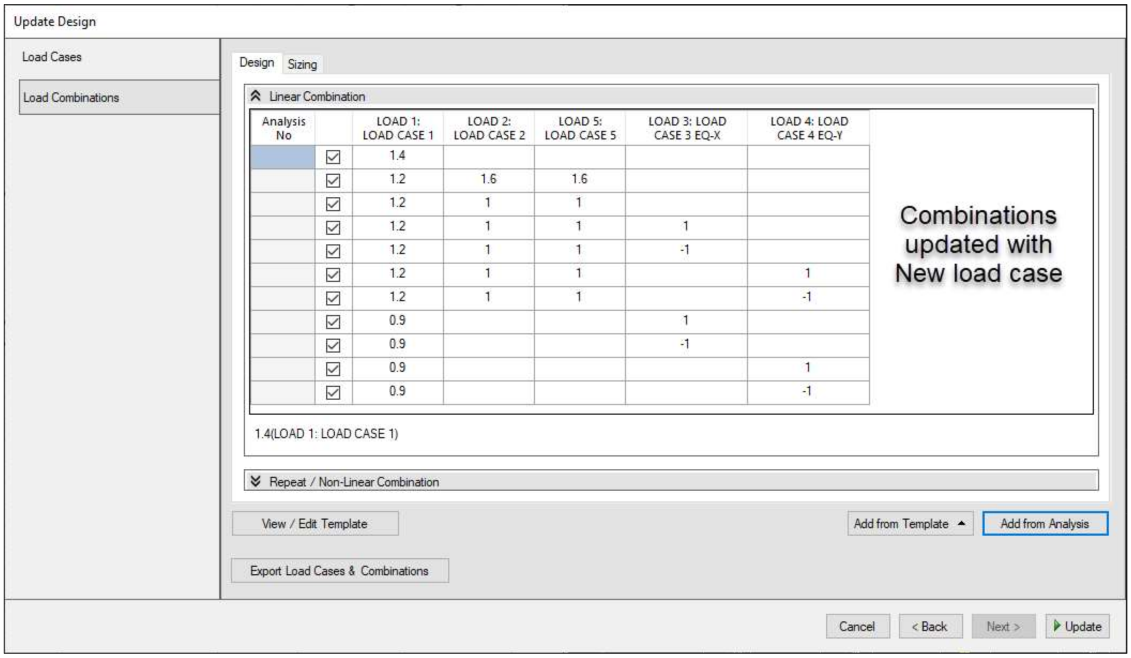


The data from the revised analysis is read and if there are any changes in load cases in the revised analysis file compared to earlier, the user needs to set the type for the additional load cases and proceed.



Additionally, if there are any changes in load cases, the user needs to redefine the set of load combinations for concrete design and sizing.

RCDC (SACD) V11.05



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.

RCDC is allowing users to design pedestals (columns) for the steel building where no RC columns are present in the analysis file. Through pedestal (columns) design, RCDC allows users to design pile caps.
RCDC is allowed to perform the Update design to the pile cap design if the pile cap design file is created through the pedestal (columns) design file.

As the existing pile cap design through the pedestal (columns) (.rcdx) file, RCDC will allow reading the new pedestal (columns) design (.rcdx) file only. If there are any changes done in the steel building file, then it is mandatory that the user update the pedestal (column) design file first and then use the same RCDC file for the update pile cap design. RCDC will auto-identify whether the pile cap design file is created through STAAD or RCDC file. Based on this file, RCDC will allow the user to select the corresponding file.

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

RCDC (SACD) V11.05

Footing	Pad footing sizing logic is enhanced if there are axial tensile forces exist in the column and stability checks are performed

In this version, PAD footing sizing logic has been improved in case footing size is critical due to axial tensile force and stability checks (sliding and overturning) are performed.

RCDC initially calculates plan dimensions based on the minimum and maximum soil pressure checks. After these checks, stability checks are performed. In case of footing size is governed by the stability checks, RCDC was increasing the depth to satisfy the stability checks. Increasing only the footing depth was not giving the optimized footing size.

Hence, the logic of satisfying footing size for stability check (sliding and overturning) is improved. Now, if the stability checks are critical in sizing checks, RCDC is increasing the plan dimensions which helps satisfy stability checks (sliding and overturning) with lesser footing concrete volume. Increasing the plan dimensions increases the downward load due to overburdened soil which helps satisfy sliding and overturning checks. In the case of a buoyancy check where increasing plan dimensions doesn't help, RCDC is using the earlier logic of increasing only footing depth to satisfy the buoyancy check

General	General improvements in various modules based on our renewed understanding of the ACI 318-2011 code

General improvements in various modules of the ACI 318-2011 code.
The following are General enhancements

1. Capping steel grades for flexural design as per Clause 9.4,10.9.3 and 21.1.5
2. Restricting value of Sqrt(f'c) to calculate shear capacity of section footing, pile-cap, and slab as per clause 11.1.2
3. Restricting value of Sqrt(f'c) to calculate development length for Beam, footing, pile-cap, and slab as per Clause 12.1.2

Column,

1. Additional shear for ordinary frame column in case of short column action as per Clause 21.2.3
2. Minimum area of shear links in beam-column joints as per Clause 11.10.2
3. Strength reduction factor for joint of special column joint for the shear check as per Clause 9.3.4
4. Spacing of links based on shear carried by links as per Clause 11.4.5.3
5. Criteria for minimum link diameter based on main reinforcement as per Clause 10.7.5.1
6. Minimum pt (transverse) and pl (longitudinal) in the wall as per Clause 14.3 and 11.9.8

Beam,

1. Criteria for maximum % reinforcement for special frames beams as per Clause 21.5.2.1

RCDC (SACD) V11.05

2. Spacing of shear stirrups as per Clause 11.4.5.3
3. Strength reduction factor for coupling beams as per Clause 11.10.2
4. Minimum reinforcement at any section of the bottom based on maximum bottom reinforcement as per Clause 12.11

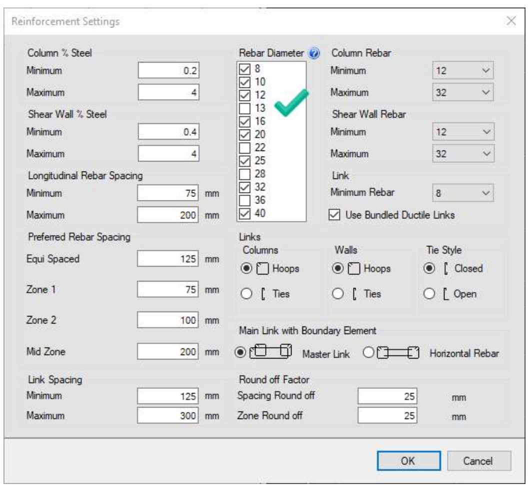
General Enhancements

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

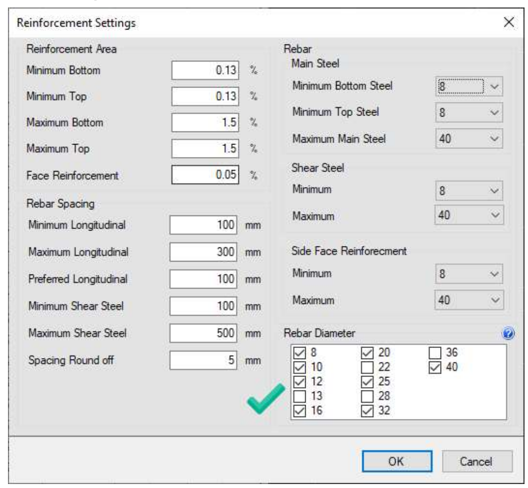
- **ADO ID – 577207 – 13mm rebar diameter added for the Euro code.**

  13mm rebar added to EN code for all modules. A screen of reinforcement settings of various modules is added here.

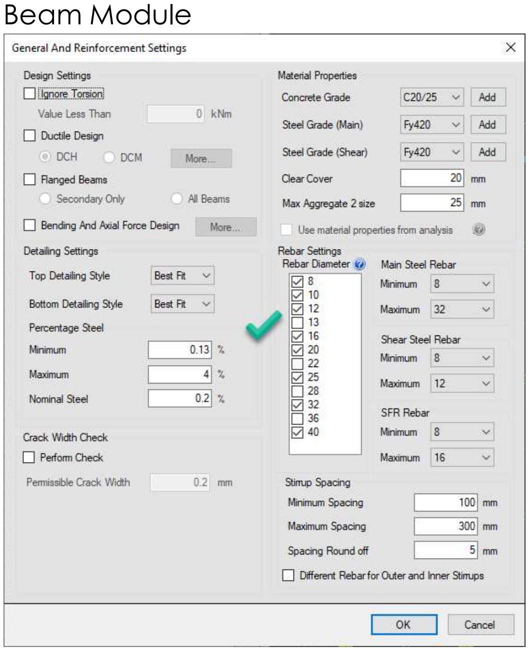
Column Module:



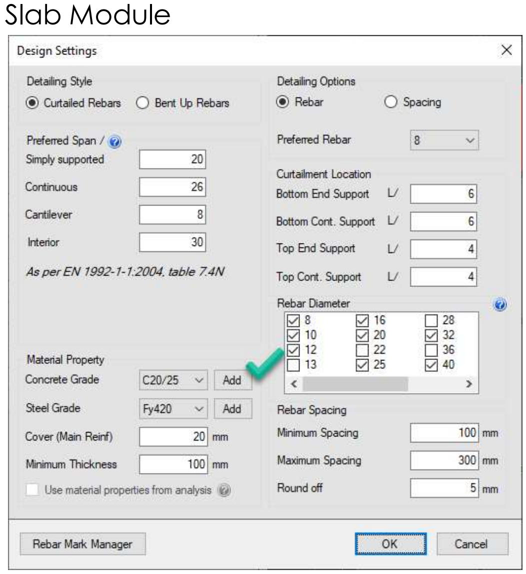
Footing/Pile cap Module:



Beam Module



Slab Module



RCDC (SACD) V11.05

- **ADO ID – 879482 – Cantilever beam to be ignored in the joint check of ductile column design.**

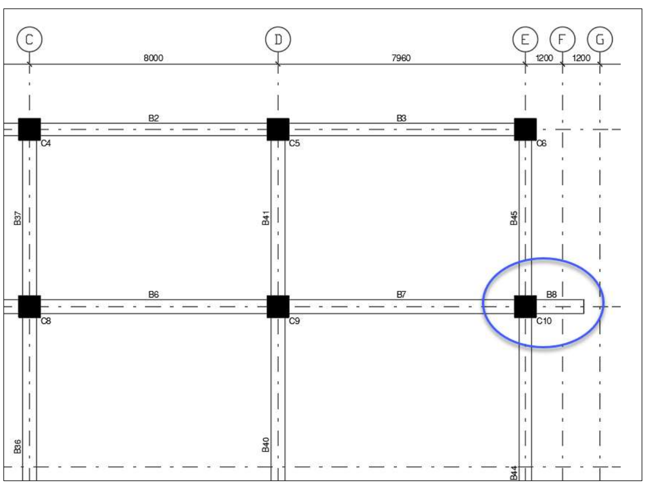
  If the beam is supported on the column at both ends, then it can be part of the lateral load-resisting frame. Column beam joint checks are mandatory for the ductile design for lateral loads. In the column beam joint check, the capacity of the column should be more than the beams resting on the column.

  In the earlier RCDC versions, if any beam is cantilevered from the column was also considered for the joint check. Cantilever beams are free at one end and supported on the column at another end, thus Cantilever beams do not participate in the lateral loads resisting frame action.

  In this version, cantilever beams are ignored in the column beam joint check. This is applicable to all design codes where a column beam joint check is performed for ductile design.

  Example: Column C10.

  Four beams resting on the column at 0,90,180 and 270 degrees with respect to the column axis. B8 is cantilevered and positioned at 0 degrees with respect to the column axis.



  B8 is ignored in the joint check of column C10 at that level.

Check At Beam-Column Joints:

1. Flexure Strength Of Joint:

Moment Capacity Calculations for Beam

Concrete Grade,fck	=	M25	N/sqmm
Steel Grade,fy	=	Fe415	N/sqmm

Beam Size	Beam angle w.r.t. column Ly	Moment Capacity for Top Reinforcement					Moment Capacity for Bottom Reinforcement					Resultant Moment			
(mm)	(deg)	Mu (kNm)	Tu (kNm)	Ast Req (sqmm)	Ast Pro (sqmm)	Mu Cap (kNm)	Mu (kNm)	Tu (kNm)	Ast Req (sqmm)	Ast Pro (sqmm)	Mu Cap (kNm)	Top @ D (kNm)	Top @ B (kNm)	Bot @ D (kNm)	Bot @ B (kNm)
400 x 800	90	166.64	3.29	861.69	904.8	239.59	0	3.29	861.69	904.8	239.59	0	239.59	0	239.59
450 x 800	180	313.85	7.09	1273.91	1344.6	352.13	0	7.09	969.4	1017.9	270.19	352.13	0	270.19	0
400 x 800	270	244.09	9.29	997.74	1017.9	267.15	0	9.29	861.69	904.8	239.77	0	267.15	0	239.77

Effective Moment for Beam

	Along D		Along B	
	Left	Right	Left	Right
Top (kNm)	352.13	-	267.15	239.59
Bottom (kNm)	270.19	-	239.77	239.59
Mnb (kNm)	MAX((Left Bottom + Right Top), (Left Top + Right Bottom))		MAX((Left Top + Right Bottom), (Right Top + Left Bottom))	
	352.13		506.74	

Check for Column Flexural Capacity

	Along D	Along B
Critical Load Combination Top	-	-
Pu Top (kN)	-	-
Mnc Top (kNm)	-	-
Critical Load Combination Bot	[6] : 1.5 (LOAD 1: LOAD CASE 1) +1.5 (LOAD 3: LOAD CASE 3 EQ-X)	[6] : 1.5 (LOAD 1: LOAD CASE 1) +1.5 (LOAD 3: LOAD CASE 3 EQ-X)
Pu Bot (kN)	425.12	425.12
Mnc Bottom (kNm)	731.52	731.52
Mnc (kNm)	731.52	731.52
	>= 1.4 x Mnb, Hence OK	>= 1.4 x Mnb, Hence OK

However, to identify the confinement of the column joint which depends on the beams resting on the column, cantilever beams are considered.

- **ADO ID – 452109 – Design calculation report enhancement in case of column design is critical in tensile force – ACI and NSCP codes**
  In the column design, a slenderness check is not required for the load combinations having axial tensile force. A slenderness check is required for the compressive loads. Thus, if the column design is critical for a load combination having axial tensile loads, the slenderness check is skipped in the design. However, in the earlier RCDC version, a message of skipped slenderness check was not displayed in the design calculation report.
  In this version, the message of slenderness check not performed for axial tension load is added if critical for load combination having axial tensile loads.

Check For Stability Index

Along D

Q = 0.01

0.01< 0.05, Column shall be designed as non-sway frame (Braced)

Along B

Q = 0.01

0.01< 0.05, Column shall be designed as non-sway frame (Braced)

Since Axial Force is Tensile, Slenderness check is not performed

Calculation of Design Moment

Direction	Manalysis	Msldr or Mc	Mdesign-final
	A	B	C
Major Axis Mux (top)	-1070.73	-	-1070.73
Major Axis Mux (bottom)	-271.08	-271.08	-271.08
Minor Axis Muy (top)	-825.06	-	-825.06
Minor Axis Muy (bottom)	175.38	-	175.38

Where

A = Moments from analysis

B = Moment due to slenderness effect

C = Final design Moment = Maximum of (Manalysis, Maximum of (Msldr or Mc))

Final Critical Design Forces

Critical Case - Axial Load & BiAxial Bending

Pu = -20.68 kN

Mux = -1070.73 kNm

Muy = -825.06 kNm

- **ADO ID – 965242 –Presentation of the term "column dimension (B X D)" is made consistent in all reports and outputs of the footing module**
  On the footing design screens and output, the size of the column is represented as B X D for a rectangular shape. There was a presentation issue on the screens and outputs like design calculation report and design summary. On a few screens, D x B was presented, and, on a few reports, B x D was presented. Also, for the circular and odd-shaped columns, the column shape was missing in a few reports.
  In the released version, the "B X D" presentation is made consistent for all types of columns in all screens and outputs. Sample snaps of screens and outputs are added below,
  Design Outputs:

RCDC (SACD) V11.05

Design

Grp. No.	Footing Mark	Column Mark	Footing Type	Material Property	Column Size (mm)	Footing Size (LxBxD) (mm)	Loss of contact (%)	Bottom @ L	Bottom @ B	
1	FC1	C1	Pad	M25 : Fe415	610 X 610	2150 x 2150 x 425	0	T10 @ 135	T10 @ 135	T
2	FC2	C2	Pad	M25 : Fe415	610 X 610	2650 x 2650 x 550	0	T10 @ 110	T12 @ 140	T
3	FC3	C3	Pad	M25 : Fe415	610 X 610	2600 x 2600 x 525	0	T10 @ 100	T12 @ 140	T
4	FC4	C4	Pad	M25 : Fe415	610 X 610	2700 x 2700 x 575	0	T10 @ 110	T12 @ 135	T
5	FC5	C5	Pad	M25 : Fe415	610 X 610	2700 x 2700 x 550	0	T10 @ 105	T12 @ 135	T
6	FC6	C6	Pad	M25 : Fe415	610 X 610	2100 x 2100 x 425	0	T10 @ 140	T10 @ 140	T
7	FC7	C7	Pad	M25 : Fe415	635 Dia	3450 x 3450 x 750	0	T16 @ 175	T16 @ 165	T
8	FC8	C8	Pad	M25 : Fe415	C 800 X 900	4850 x 4950 x 975	0	T16 @ 125	T16 @ 130	T
9	FC9	C9	Pad	M25 : Fe415	I 750 X 1000	4900 x 4650 x 950	0	T16 @ 130	T16 @ 130	T
10	FC10	C10	Pad	M25 : Fe415	L 750 X 750	5000 x 5000 x 975	0	T16 @ 125	T16 @ 120	T
11	FC11	C11	Pad	M25 : Fe415	T 750 X 900	4900 x 5050 x 1000	0	T16 @ 140	T16 @ 120	T
12	FC12	C12	Pad	M25 : Fe415	POLY 6 X 650	3900 x 3900 x 825	0	T12 @ 100	T16 @ 160	T
13	FC13	C13	Pad	M25 : Fe415	305 X 5335	11200 x 6200 x 775	0	T16 @ 105	T16 @ 105	T

Design Summary:

Design | Design Summary

Footing No: FC6
Column No: C6 (610 mm X 610 mm)
Footing Type: Pad
Concrete Grade: M25
Steel Grade: Fe415

Size (LxBxD)	Bot @ L	Bot @ B	Top @ L	Top @ B	Shear @ L	Shear @ B	SFR
2100x2100x425	16-T10 @ 140	16-T10 @ 140	8-T10 @ 300	8-T10 @ 300	-	-	-

Footing No: FC7
Column No: C7 (635 mm Dia)
Footing Type: Pad
Concrete Grade: M25
Steel Grade: Fe415

Size (LxBxD)	Bot @ L	Bot @ B	Top @ L	Top @ B	Shear @ L	Shear @ B	SFR
3450x3450x750	21-T16 @ 175	22-T16 @ 165	20-T10 @ 185	20-T10 @ 185	-	-	-

Footing No: FC8
Column No: C8 (C 800 mm X 900 mm)
Footing Type: Pad
Concrete Grade: M25
Steel Grade: Fe415

Size (LxBxD)	Bot @ L	Bot @ B	Top @ L	Top @ B	Shear @ L	Shear @ B	SFR
4850x4950x975	41-T16 @ 125	39-T16 @ 130	37-T10 @ 140	37-T10 @ 135	-	-	-

Footing No: FC9
Column No: C9 (I 750 mm X 1000 mm)
Footing Type: Pad
Concrete Grade: M25
Steel Grade: Fe415

Size (LxBxD)	Bot @ L	Bot @ B	Top @ L	Top @ B	Shear @ L	Shear @ B	SFR
4900x4650x950	37-T16 @ 130	39-T16 @ 130	34-T10 @ 145	36-T10 @ 140	-	-	-

Design Calculation report:

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC7	
Column No	:	C7	(635 mm Dia)
Analysis No	:	7	
Concrete Grade	:	M25	N/sqmm
Steel Grade	:	Fe415	N/sqmm
Clear Cover	:	40	mm
Df	:	4 M	
Dw	:	1 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	200	kN/sqm
Permissible SBC Increase for EQ	=	25	%
Permissible SBC Increase for Wind	=	25	%
Live Load Reduction	=	50	%
Permissible area of loss of contact	=	0	%
Design cross section by	:	Average pressure	

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	
Footing No	:	FC8	
Column No	:	C8	(C 800 mm X 900 mm)
Analysis No	:	8	
Concrete Grade	:	M25	N/sqmm
Steel Grade	:	Fe415	N/sqmm
Clear Cover	:	40	mm
Df	:	4 M	
Dw	:	1 M	
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	200	kN/sqm
Permissible SBC Increase for EQ	=	25	%
Permissible SBC Increase for Wind	=	25	%
Live Load Reduction	=	50	%
Permissible area of loss of contact	=	0	%
Design cross section by	:	Average pressure	

- **ADO ID – 961428 – Performance improved while auto-designing beams with Grouped levels and many Load Combs**
  In the earlier version for beam design, if the user groups the multiple levels and the analysis file has many load combinations, RCDC was taking more time to read as well as design the beams.
  In this release, the time has been reduced for reading and design without affecting the existing functionality of the reading and design part. So, for the multi-story structures having multiple levels grouped and having many load combinations, RCDC will be able to perform the design process fast as compared to earlier versions.

- **ADO ID – 962292 – Logic improvement in the shear design of the tank slab to satisfy the check**
  The logic of slab design for a shear check is improved in this version. For the slab shear design, % longitudinal reinforcement plays an important role. The higher the % longitudinal reinforcement higher would be the shear capacity of the section.

RCDC (SACD) V11.05

In the earlier version, RCDC was using the% longitudinal reinforcement required for the bending moment. In case if slab fails in the shear check using % longitudinal reinforcement required for the bending moment, it was showing failure. We can increase the shear capacity by increasing the % reinforcement to pass the design if other parameters are constant.

In this version, if the slab fails in shear for the % longitudinal reinforcement required for the bending moment then RCDC will try to increase the % longitudinal to satisfy the shear check. Refer to the snap from the design calculation report where the % reinforcement required for Bending moment and crack width is less but to satisfy shear check RCDC increases the longitudinal reinforcement.

Flexural Design

Description	Bottom		Top	
	Lx	Ly	Lx	Ly
Critical L/C - Analysis	1002	1002	1002	1002
Critical L/C - RCDC	2	2	2	2
Mu (kNm)	82.5703	107.4856	41.2805	58.4905
$Mu / (bd^2 x F_{ck})$	0.019	0.027	0.01	0.015
z (mm)	400.9	385.7	400.9	385.7
ρ (%)	0.1883	0.2631	0.0941	0.1432
A_s (sqmm) (A)	473.71	640.96	236.83	348.79
$A_{s,min\ (flex)}$ (sqmm) (B)	459.02	444.47	459.02	444.47
$A_{s,nominal}$ (sqmm) (Bn)	348.75	351	348.75	351
$A_{s,min}$ (user input) (sqmm) (B')	327.05	316.68	327.05	316.68
A_s(drying + Thermal) (sqmm) (C)	328.8	482.55	328.8	482.55
$A_{s,shear}$ (sqmm) (Bs)	2204.52	3420.6	2204.52	3420.6
$A_{s,reqd}$ (sqmm)	2204.52	3420.6	2204.52	3420.6
$A_{s,reqd}$ crackwidth (sqmm)	2251.03	3446.79	2251.03	3446.79
$A_{s,max}$ (sqmm)	6706.73	6750	6706.73	6750
$A_{s,prov}$ (sqmm)	2251.03	3446.79	2251.03	3446.79
Reinforcement Provided	T25 @ 130 C/C	T32 @ 140 C/C	T25 @ 130 C/C	T32 @ 140 C/C

Note: Calculation of As

$A_{s,reqd}$	=	Max{A,B,B',C,Bs} (for Mu > 0)		
$A_{s,reqd}$	=	Max{Bn,C,Bs} (for Mu = 0)		
Where,				
A	=	A_s	=	Tension reinforcement required for bending moment
B	=	As,min (flex)	=	Min area of flexural reinforcement
Bn	=	As,nominal	=	Nominal area of reinforcement
Bs	=	As,shear	=	Tension reinforcement required to satisfy shear design
C	=	As (drying + Thermal)	=	Ast required for drying shrinkage + thermal shrinkage

Shear Design

Description	Lx	Ly
Critical L/C - Analysis	1002	1002
Critical L/C - RCDC	2	2
PtPrv (%)	0.89	1.41
V_{Ed} (kN)	166.8151	190.5218
v_{Ed} (N/sqmm)	0.6631	0.7821
$v_{Rd,max}$ (N/sqmm)	3.5452	3.5452
$V_{Rd,max}$ (kN)	891.8895	863.6098
$v_{Rd,c}$ (N/sqmm)	0.6677	0.7841
$V_{Rd,c}$ (kN)	167.9803	191.0067

In case if % longitudinal reinforcement required for shear is more than the permissible % reinforcement specified by the user and design code, RCDC will show a shear failure.

General Defects Resolved

Following is the list of Defects resolved in this release.

- **ADO ID - 962942 – ACI and NSCP code Sway calculation issue - incorrect effective length factor calculated**

  Issue:

  The effective length factor of the column is based on the type of frame (Sway or Non-sway) and ψ factor which is the ratio of column stiffness to beam stiffness in a plane at one end of the column. The effective length factor calculated for factor ψ was wrong in the earlier version.

  Solution:

  Now the correct effective length factor is calculated for factor ψ.

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		ψ
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	940.39	No Beam	No Beam	-	-	1
Top	940.39	8000 x 450 x 800	8000 x 450 x 800	225.6	225.6	3.224

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Major Axis = 0.82

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes		Beam Stiffness		ψ
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6	
Bottom	940.39	No Beam	No Beam	-	-	1
Top	940.39	8900 x 450 x 800	5710 x 450 x 800	202.79	316.08	2.803

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Minor axis = 0.82

RCDC (SACD) V11.05

- **ADO ID - 965617 – ACI code beam design Shear + torsion design issue resolved in case of grouped beams**
  Issue:
  When beams are grouped in the plan, RCDC was showing all beams passed even if one of the beams failed in shear. When Beams are un-grouped, that beam was shown as failed in shear. Here, the result varied when beams are designed separately and grouped. The failure case due to the combined effect of shear and high torsion was not handled properly in the case of grouped beams. It was working properly for individual beam design.
  Solution:
  Now the correct results are available if the beams are designed with grouping or separately.

- **ADO ID – 992458 – Crash in generating design summary resolved for tank wall module**
  Issue:
  The software crashed while generating the design summary for the tank wall module. RCDC uses the section cuts to design the wall. Based on the section cut, length zones are created for vertical and shear reinforcement. If adjacent zones give the same reinforcement, RCDC auto-merges those zones.
  The issue occurred only for generating a design summary when shear zones were identified more than the vertical reinforcement zone in the design. If shear zones were less or equal to vertical reinforcement zones, then the design summary report was generated correctly. There was no issue with the design of the reinforcement and generating all other outputs.
  Solution:
  The issue has been resolved in this release. A design summary report is generated irrespective of zones created for vertical and shear reinforcement.