RCDC (SACD) V11.00

Release Notes

RCDC V11.00.00 is here with new features enhancing the design capabilities. The newly introduced features are:

No	Module	Description
1	General	Addition of AS 3600:2018 Code for Column, wall, Beam, Footing and Slab. Pile-cap module available as Tech Preview.
2	General	Addition of Belgium Annex for BS EN Code for all modules including Tanks Structures
3	General	Provision of BS EN Base / Custom Code for all modules including Tanks Structures
4	Tank Structures	Addition of Tank structures design module for Singapore annex (SS NA) and Malaysian Annex (MS NA) in Euro code
5	General	Addition of definition for Factored & Un-Factored Earthquake and Wind loading for ACI (as per ASCE) code
6	Column	Addition of Joint check for Ductile columns in Euro Code (all annexures)
6	Footing	Consideration of Ground-water table (Buoyancy) effect in SBC check in all types of footing
7	General	Enhancements
8	General	Defects Resolved

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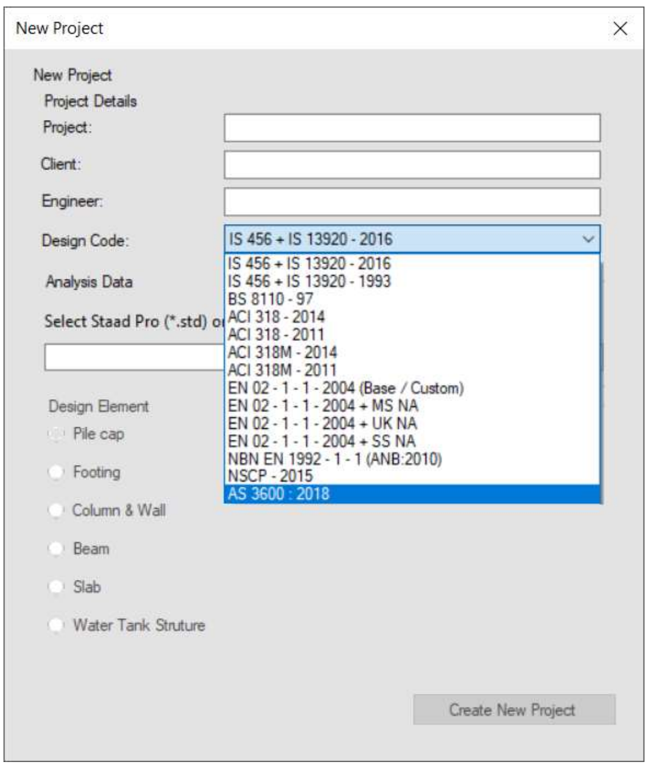
General	Addition of AS 3600:2018 Code for Column, wall, Beam, Footing and Slab. Pile-cap module to be available as 'tech-preview'.

AS 3600:2018 (Australian Standard – Concrete Structures) is added in RCDC. With this addition, all the structural elements can now be designed using AS 3600:2018. Pile-cap module is available as 'tech-preview'. For all other modules, all the functionalities are available.



General	Addition of Belgium Annex for BS EN Code for all modules

NBN EN 1992-1-1 (ANB: 2010) (Belgium annex) is added in RCDC. With this addition, all the structural elements can now be designed using Belgium Annex of BS EN code.

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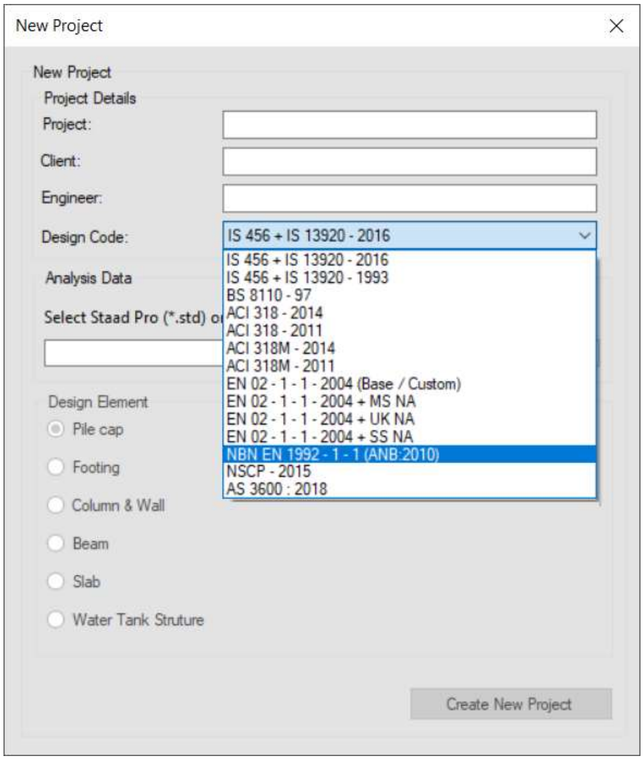

General — Addition of BS EN Base / Custom Code for all modules

If user selects the BS EN 02-1-1-2004 code (the base Eurocode), a new form for input has been introduced for the various constants defined in BS EN code. The design of all elements would be based on these constants. The default values are as per BS EN 1992-1-1-2004 code; however, user can change these factors to suit the local requirement. User also can update the title of the code. If user defines design annex name as "custom", then code title would be "*BS EN -1-1-2004 Custom*" and that would reflect in all the outputs. Modified values for these constants are added in project setting report for reference.

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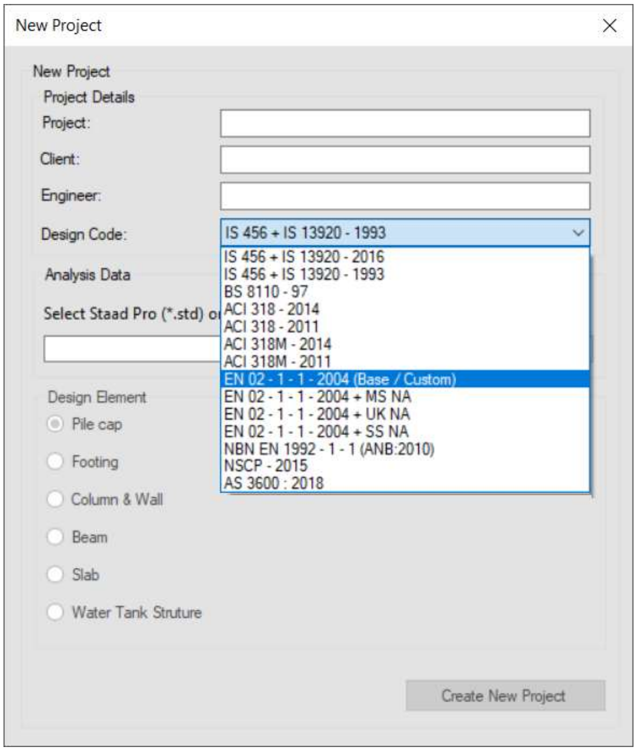

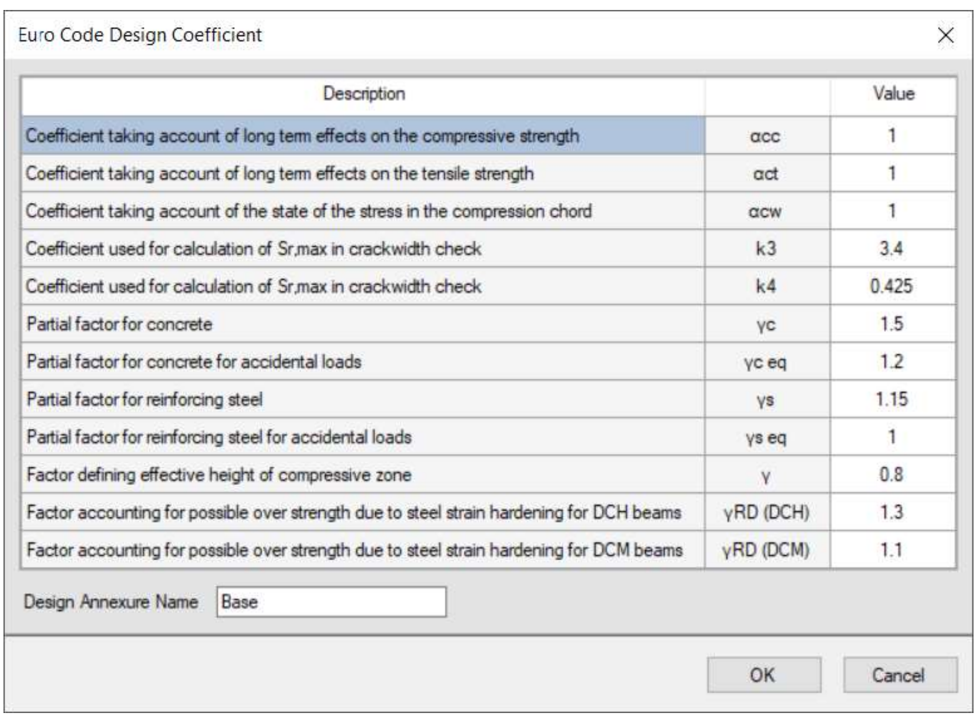
Euro Code Design Coefficient

Description		Value
Coefficient taking account of long term effects on the compressive strength	αcc	1
Coefficient taking account of long term effects on the tensile strength	αct	1
Coefficient taking account of the state of the stress in the compression chord	αcw	1
Coefficient used for calculation of Sr,max in crackwidth check	k3	3.4
Coefficient used for calculation of Sr,max in crackwidth check	k4	0.425
Partial factor for concrete	γc	1.5
Partial factor for concrete for accidental loads	γc eq	1.2
Partial factor for reinforcing steel	γs	1.15
Partial factor for reinforcing steel for accidental loads	γs eq	1
Factor defining effective height of compressive zone	γ	0.8
Factor accounting for possible over strength due to steel strain hardening for DCH beams	γRD (DCH)	1.3
Factor accounting for possible over strength due to steel strain hardening for DCM beams	γRD (DCM)	1.1

Design Annexure Name: Base

OK Cancel

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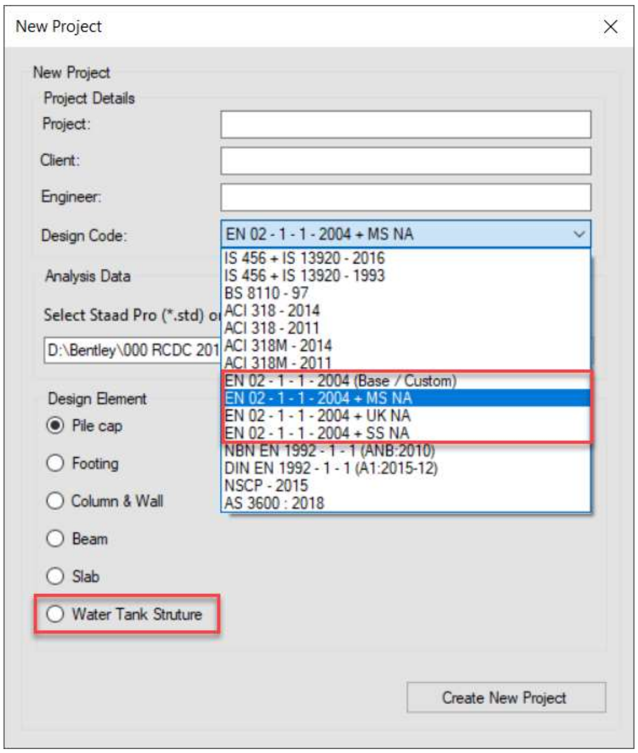
Tank Structures	**Addition of Tank structures design module for Base Eurocode, and for Singapore annex (SS NA) and Malaysian Annex (MS NA)**

Design of tank structures was available only for UK annex in V10 version. Design of tank structures is now available for the Base Euro code (BS EN 02-1-1-2004), Singapore annex (SS NA) and Malaysian Annex (MS NA).



General	**Addition of definition for Factored & Un-Factored Earthquake and Wind loading for ACI (as per ASCE) code**

As per ASCE code, user can define the lateral loads (Earthquake or Wind) as 'Factored or Un-factored' in the analysis. Based on this definition of lateral load, the load factors are different for design combinations. RCDC allows user to define type of load for EQ and Wind as factored or Un-factored. Accordingly, appropriate load factors are used to create load combinations. These definitions are essential only if user intends to work with 'the load combination template' from RCDC.

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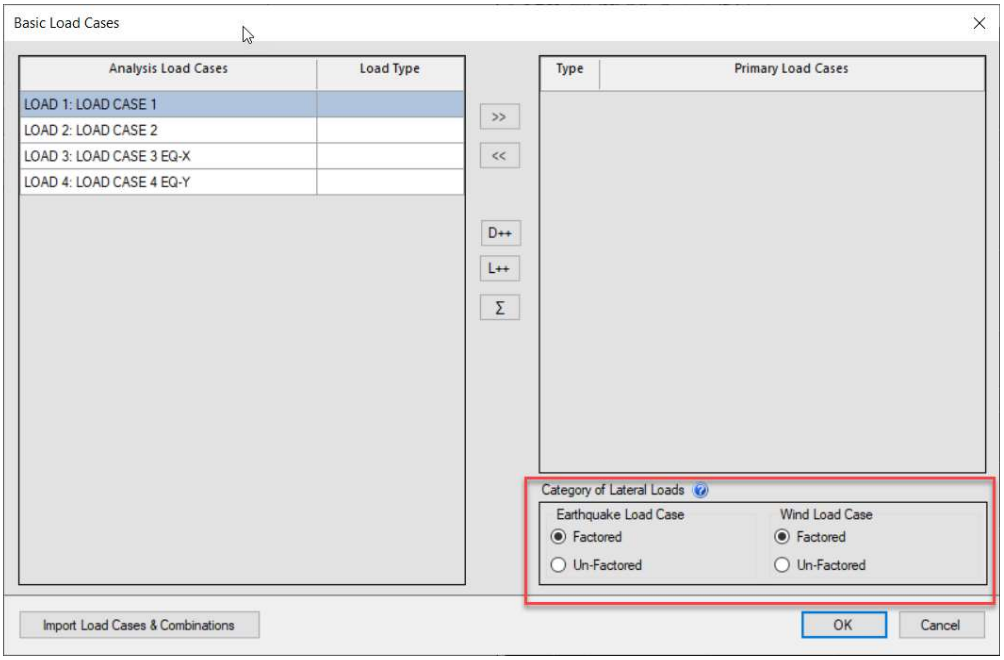

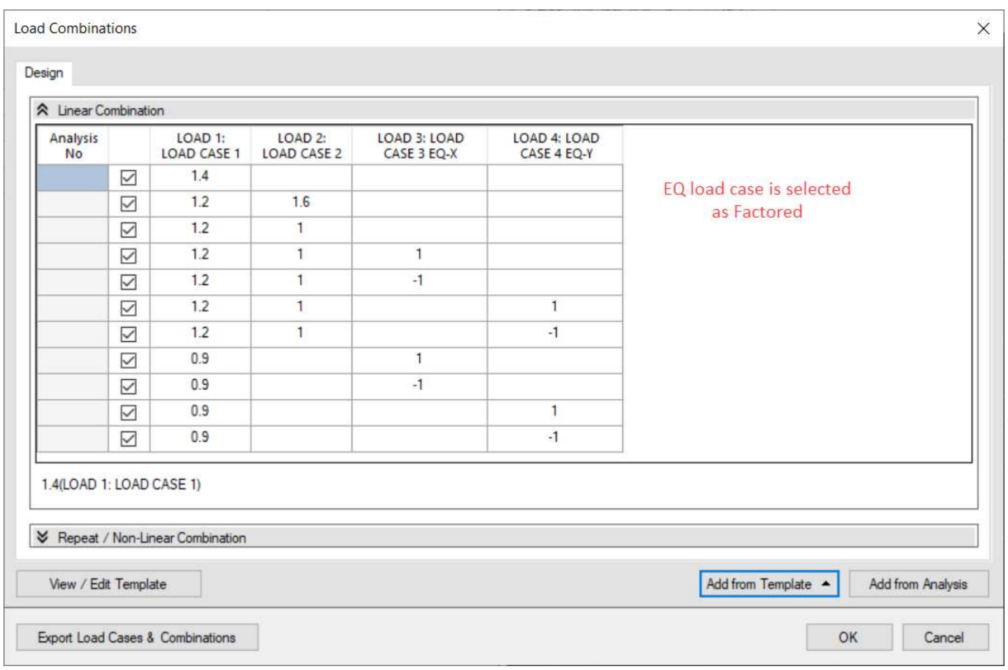

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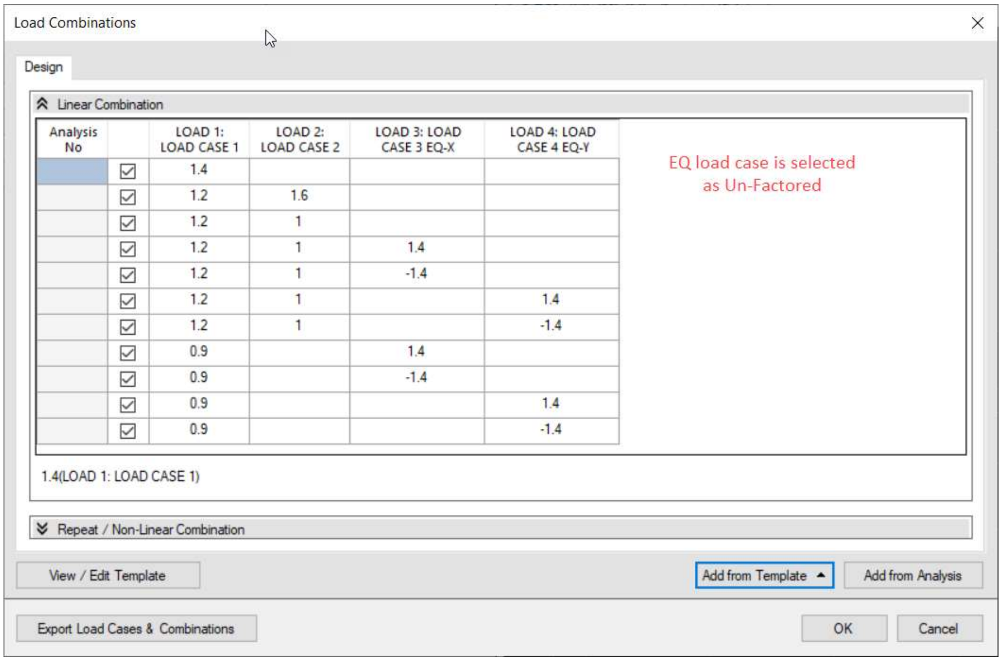


Column — Addition of Joint check for Ductile column in Euro Code

When columns is to be designed for seismic requirements (ductile detailing), 'Joint check' is an essential part of the same as per most design codes. In RCDC, this check is now performed as per BS EN 1998-1-2004 code as per equations 4.29, 5.22 & 5.23. It is mandatory check as per code thus when user selects the Ductile frame as Type High, joint check would be performed. Sample design calculation report are as follows,

General Data:

Column No.	:	C8
Joint at Level	:	4.2 m
Design Code	:	EN 02 - 1 - 1 - 2004 Base
Partial Factor for Concrete (γ_c)	:	1.5
Partial Factor for Concrete (γ_{cd})	:	1.2
Partial Factor for Reinforcement (γ_s)	:	1.15
Partial Factor for Reinforcement (γ_{sd})	:	1

	Column Below	Column Above
Member Number	701	711
Concrete Grade (fck) (Cylindrical)	C50/60	C50/60
Steel Grade (fyk)	Fy420	Fy420
Column Size (mm)	700 X 700	700 X 700

Check At Beam-Column Joints:

1. Flexure Strength Of Joint:

Moment Capacity Calculations for Beam

Concrete Grade,fck	=	C20/25	N/sqmm
Steel Grade,fy	=	Fy420	N/sqmm

Beam Size	Beam angle w.r.t.	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)
450 x 800	0	162.91	0.22	882.19	904.8	281.2	47.98	0.22	882.19	904.8	281.2	281.2	0	281.2	0
450 x 800	90	155.58	0.15	882.19	904.8	281.2	135.57	0.15	882.19	904.8	281.2	0	281.2	0	281.2
450 x 800	180	156.63	0.54	882.19	904.8	281.2	52.04	0.54	882.19	904.8	281.2	281.2	0	281.2	0
450 x 800	270	165.47	0.29	882.19	904.8	281.2	40.96	0.29	882.19	904.8	281.2	0	281.2	0	281.2

Effective Moment for Beam

	Along D		Along B	
	Left	Right	Left	Right
Top (kNm)	281.2	281.2	281.2	281.2
Bottom (kNm)	281.2	281.2	281.2	281.2
MRb (kNm)	MAX((Left Bottom + Right Top), (Left Top + Right Bottom))		MAX((Left Top + Right Bottom), (Right Top + Left Bottom))	
	562.41		562.41	

Check for Column Flexural Capacity		
	Along D	Along B
Critical Load Combination Top	[13] : (LOAD 1: LOAD CASE 1) -(LOAD 4: LOAD CASE 4 EQ-Y)	[13] : (LOAD 1: LOAD CASE 1) -(LOAD 4: LOAD CASE 4 EQ-Y)
Pu Top (kN)	1681.71	1681.71
MRc Top (kNm)	702.66	702.79
Critical Load Combination Bot	[13] : (LOAD 1: LOAD CASE 1) -(LOAD 4: LOAD CASE 4 EQ-Y)	[13] : (LOAD 1: LOAD CASE 1) -(LOAD 4: LOAD CASE 4 EQ-Y)
Pu Bot (kN)	1785.64	1785.64
MRc Bottom (kNm)	731.94	732.04
MRcd (kNm)	1434.6	1434.83
	>= 1.3 x MRb, Hence OK	>= 1.3 x MRb, Hence OK

Shear Strength of Joint:

η	=	0.6 x (1 - fck / 250)	
	=	0.48	
fcd	=	41.67	N/sqmm

For calculation of V_{jhd} cap along D

Location of the column	=	Internal	
Vd	=	1681.71	kN
Vd	=	Vd / (bc x hc x fcd)	
	=	0.08	N/sqmm
hjcdD	=	580	mm

Beams Along D					
Angle w.r.t Column Ly	Reference Location	Width	Depth	Ast Pro Top	Ast Pro Bot
(deg)		(mm)	(mm)	(sqmm)	(sqmm)
0	Right	450	800	904.8	904.8
180	Left	450	800	904.8	904.8

Shear Checks									
Conditions	AST-Total	V-Reinf	Vc	V_{jhd} (Shear Demand)	bc	hc	Aj	V_{jhd} cap	V_{jhd} < V_{jhd} cap
	(sqmm)	(kN)	(kN)	(kN)	(mm)	(mm)	(sqmm)	(kN)	
Right Top + Left Bottom	1809.6	912.04	562.41	349.63	700	700	490000	7390.52	OK
Left Top + Right Bottom	1809.6	912.04	562.41	349.63	700	700	490000	7390.52	OK

For calculation of V_{jhd} cap along B

Location of the column	=	Internal
Vd	=	1681.71 kN
Vd	=	Vd / (bc x hc x fcd)
	=	0.08 N/sqmm
hjcB	=	580 mm

Beams Along B					
Angle w.r.t Column Ly	Reference Location	Width	Depth	Ast Pro Top	Ast Pro Bot
(deg)		(mm)	(mm)	(sqmm)	(sqmm)
90	Right	450	800	904.8	904.8
270	Left	450	800	904.8	904.8

Shear Checks									
Conditions	AST-Total	V-Reinf	Vc	V_{jhd} (Shear Demand)	bc	hc	Aj	V_{jhd} cap	V_{jhd} < V_{jhd} cap
	(sqmm)	(kN)	(kN)	(kN)	(mm)	(mm)	(sqmm)	(kN)	
Right Top + Left Bottom	1809.6	912.04	562.41	349.63	700	700	490000	7390.52	OK
Left Top + Right Bottom	1809.6	912.04	562.41	349.63	700	700	490000	7390.52	OK

Footing — Consideration of Ground-water table (Buoyancy) effect in SBC check in all types of footing

Presently while performing minimum pressure check in footing design when water table is above the foundation level, RCDC doesn't consider the 'buoyancy' effect of ground-water. Now, effect of buoyancy due to water is now considered in the minimum pressure check. This is applicable to all types of footings. Please refer snapshot below for the same – Note that RCDC now calculates footing self-weight and soil weight in two conditions and uses them separately for maximum pressure check and minimum pressure check.

Footing Type	:	Pad	
Footing Size (L x B x D)	:	2550mm X 2550mm X 350mm	
Without considering Effect of Water Table			
Footing Self Wt., F1	=	56.9	kN
Soil Weight, S1	=	395.02	kN
Total Weight, W1	=	F1 + S1	
	=	451.92	kN
Considering Effect of Water Table			
Footing Self Wt., F2	=	34.14	kN
Soil Weight, S2	=	235.69	kN
Weight of Water (Submerged column), Wc	=	12.98	kN
Total Weight, W2	=	F2 + S2 - Wc	
	=	256.84	kN
Offset Along L (Loff)	=	925	mm
Offset Along B (Boff)	=	925	mm

Check For Maximum Soil Pressure:

Critical Load Combination	=	[9] : (LOAD 1: LOAD CASE 1) +0.75 (LOAD 2: LOAD CASE 2)	
Pcomb	=	1076.49	kN
P	=	Pcomb + W1	
P	=	1528.41	kN
Mx	=	-0.94	kNm
My	=	-92.76	kNm
P/A	=	235.05	kN/sqm
Mx/Zx	=	-0.34	kN/sqm
My/Zy	=	-33.56	kN/sqm
Maximum Soil Pressure	=	268.95	kN/sqm
Allowable Soil Pressure	=	(1 X 200) +	kN/sqm
	=	272	kN/sqm

Check For Minimum Soil Pressure:

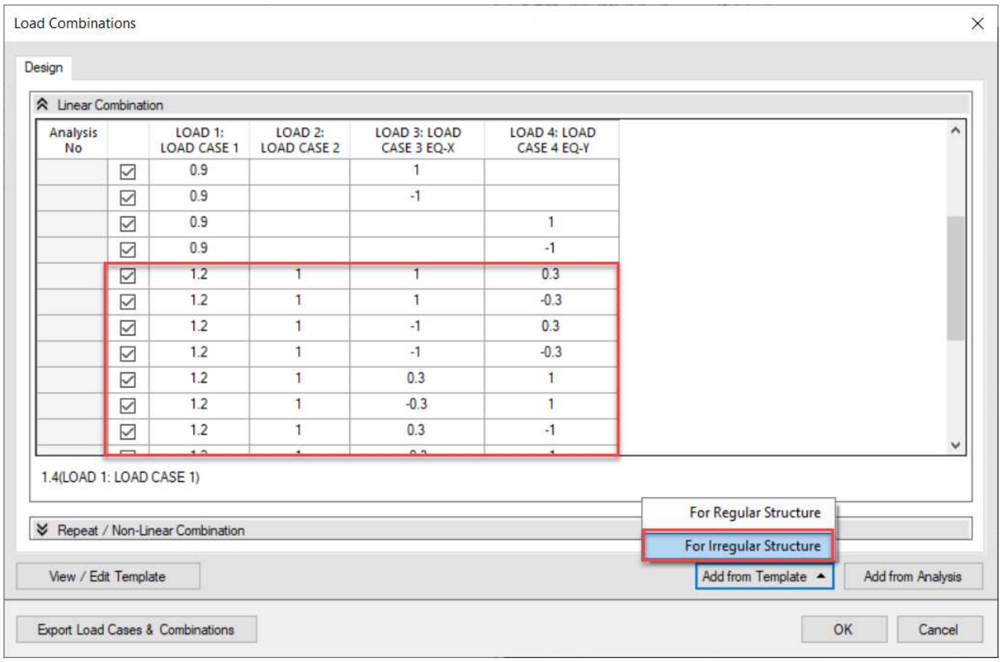
Critical Load Combination	=	[12] : 0.6 (LOAD 1: LOAD CASE 1) +0.7 (LOAD 4: LOAD CASE 4 EQ-Y)	
Pcomb	=	420.95	kN
P	=	Pcomb + W2 x 0.6	
P	=	575.06	kN
Mx	=	-7.13	kNm
My	=	109.89	kNm
P/A	=	88.44	kN/sqm
Mx/Zx	=	-2.58	kN/sqm
My/Zy	=	39.77	kN/sqm
Minimum Soil Pressure	=	46.09	kN/sqm
	>	0	

General Enhancements

Following are the Enhancements made in this release.

- **ADO ID – 467326 - Addition of irregular combinations for Eq loads in ACI code for all modules.**

  In earlier version of RCDC when user select the irregular load combinations for Earthquake load cases, RCDC used to show the same set of load combination as regular combination. Now we have added a new set of irregular load combinations as a standard template. This is available for column, beam, footing and pile-cap modules. So now onwards if user select the irregular combinations following set will be displayed as marked in Yellow colour.



List of load combinations are below,

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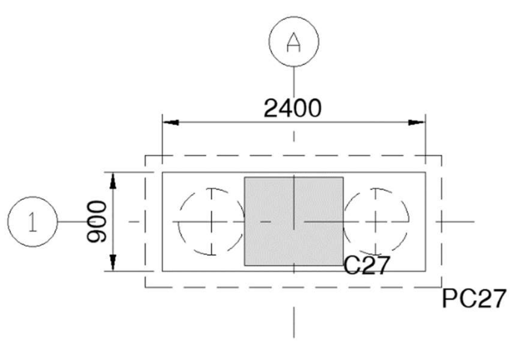
Analysis No	LOAD 1: LOAD CASE 1	LOAD 2: LOAD CASE 2	LOAD 3: LOAD CASE 3 EQ-X	LOAD 4: LOAD CASE 4 EQ-Y
1	1.4			
2	1.2	1.6		
3	1.2	1		
4	1.2	1	1	
5	1.2	1	-1	
6	1.2	1		1
7	1.2	1		-1
8	0.9		1	
9	0.9		-1	
10	0.9			1
11	0.9			-1
12	1.2	1	1	0.3
13	1.2	1	1	-0.3
14	1.2	1	-1	0.3
15	1.2	1	-1	-0.3
16	1.2	1	0.3	1
17	1.2	1	-0.3	1
18	1.2	1	0.3	-1
19	1.2	1	-0.3	-1
20	0.9		1	0.3
21	0.9		1	-0.3
22	0.9		-1	0.3
23	0.9		-1	-0.3
24	0.9		0.3	1
25	0.9		-0.3	1
26	0.9		0.3	-1
27	0.9		-0.3	-1

- **ADO ID – 522968_Column extent up to Pile-cap edge.**

In earlier version of RCDC, column dimensions are restricted up to the pile extent. If the column dimension was more than the pile extent, RCDC used to suggest next configuration or increasing the c/c distance between piles. As per requirements from client we have now modified the logic to qualify the column dimension with respect to pile-cap dimensions. Now, we are checking the column extent with respect to pile-cap extent instead of pile extent. Column width more than pile diameter is allowed. Accordingly, pile-cap section drawings are modified. This enhancement is applicable to all design codes.



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- **ADO ID – 545796 – Beam Propagation in Tank Structures.**
  In earlier version, for beam supported on tank wall, it was qualified as simply supported beam. In the general arrangement drawings and beam-layout, tank walls were not shown. This was somewhat misleading. The design of beam was performed as simply supported but beam elevation drawings were drawn with approximate size of column size.
  Now, tank walls are also identified as beam supports just like normal shear walls. Based on this, support conditions for beams are now identified as simply supported, cantilever or continuous. The drawings for beam elevation now provide correct information with walls identified as supports.

- **ADO ID – 466826 – Footing Pressure check report Updated.**
  Footing pressure check report has been updated to provide more clarity in various sizing conditions. The maximum and minimum pressure checks have been provided in a separate table, with due reference to effect of ground-water table.

  The 'Stability checks' like Sliding, Overturning and Buoyancy are presented in a separate table.

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Footing No	=	FC3	
Column No	=	C3	
Design Code	=	ACI 318M - 2014	
Depth of founding layer	=	4	m
Density of Soil	=	18	kN/cum
Soil Bearing Capacity	=	200	kN/sqm
Gross Bearing Capacity	=	272	kN/sqm
Permissible SBC Increase for EQ	=	0	%
Permissible SBC Increase for Wind	=	0	%
Live Load Reduction	=	0	%
Design cross section by	=	Average pressure	
Footing Type	:	Pad	
Footing Size (L X B X D)	:	2550mm X 2550mm X 350mm	
Area of Footing (Af)	=	L X B	
	=	6.5	sqm
Section Modulus, Zxx	=	B x L^2 / 6	
	=	2.76	cum
Section Modulus, Zyy	=	L x B^2 / 6	
	=	2.76	cum
Without considering Effect of Water Table			
Footing Self Wt., F1	=	56.9	kN
Soil Weight, S1	=	395.02	kN
Total Weight, W1	=	F1 + S1	
	=	451.92	kN
Considering Effect of Water Table			
Footing Self Wt., F2	=	34.14	kN
Soil Weight, S2	=	235.69	kN
Weight of Water (Submerged column), Wc	=	12.98	kN
Total Weight, W2	=	F2 + S2 - Wc	
	=	256.84	kN

Note:
P1 (for Max Pressure) = P + W1
P2 (for Min Pressure) = P + W2
Max Soil Pressure = P1/A + Abs(Mx/Zxx) + Abs(My/Zyy)
Min Soil Pressure = P2/A - Abs(Mx/Zxx) - Abs(My/Zyy)
Note1: For Eccentric Footings, Mx will be replaced by Mx + Mex & My + Mey.
Note2 : For Footings of Irregular Shaped Columns, Mx will be replaced by Mx + P x Exo & Mx + P x Eyo.

Soil Pressure Checks Table (C3):

L/C	Analysis Forces			Max. Soil Pressures (kN/sqm)	Min. Soil Pressures (kN/sqm)	SBC Increase (%)	Permissible Gross SBC (kN/sqm)	Loss of Contact (%)
	P (kN)	Mx (kNm)	My (kNm)					
1	888.67	-3.44	-6.32	209.7	172.63	0	272	0
2	1026.85	-5.17	-7.88	232.14	192.69	0	272	0
3	871.73	100.84	-6.17	242.28	134.84	0	272	0
4	905.61	-107.72	-6.48	250.09	137.45	0	272	0
5	776.42	-8.5	107.36	230.83	116.98	0	272	0
6	979.6	73.47	-7.38	249.4	160.89	0	272	0
7	1005.01	-82.95	-7.61	256.82	161.29	0	272	0
8	908.12	-8.54	77.78	240.39	147.92	0	272	0
9	1076.49	-0.94	-92.76	**268.95**	171.14	0	272	0
10	516.26	102.22	-3.64	159.4	64.79	0	272	0
11	550.14	-106.34	-3.95	166.21	68.4	0	272	0
12	420.95	-7.13	109.89	148.78	**46.09**	0	272	0
13	645.45	3	-117.48	184.56	79.36	0	272	0

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General **Defects Resolved**

Following are the list of Defects Resolved in this release.

- **ADO ID – 602826 - Error in generating design calculation for DL + WL or DL + EQ**
  Issue regarding generating design calculation report if primary Dead load + live load combination is not available in design is resolved. Now, even if the DL+LL load combination is not available then design calculation can be generated. This is applicable to all design codes available in RCDC.

- **ADO ID – 562497- Error in generating design calculation for some footings**
  When sliding check is performed in footing design, there was some issue generating design calculations report. Issue has been resolved now.

- **ADO ID – 553084- Error in generating detailed drawings for Combined walls**
  Unable to generate detailed drawings for specific geometry of combined wall as there was some issue displaying dimensions. The issue has been resolved now and detailed drawings can be generated.

- **ADO ID – 464391- Error identifying slab**
  When slab is modelled as plate element in STAAD, beams are auto divided into smaller length as per plate meshing. RCDC identified the slab as per beam surrounding it. The issue of identifying slab when there is smaller member length has now been resolved.

- **ADO ID – 648415- Euro Code Beam Design Critical combination presented is not critical as per max values of Shear + torsion values if beam qualify with minimum shear reinforcement.**
  There was an issue in presenting critical load combinations for design of beams for shear + torsion, if the design requirement is satisfied with minimum shear reinforcement for all load combinations. The design of Beam was correct, and all load combinations were considered. The correct load combinations were presented if the shear reinforcement required was more than the minimum requirement for any of the load combinations. The issue of reporting critical load combination, which causes maximum design shear force when design requirement is satisfied with minimum shear reinforcement is now resolved.