<u>aadspro</u> <u>Structural Engineering Software</u>

Analysis, autoscan design, detailing, scheduling and sequencing program or aadspro is a new generation design package which can be used for a number of applications in Civil Engineering. It is integrated with commonly used programs like STAAD.Pro and AutoCAD and ETABS.

The program consists of different modules which can perform the design of different parts of a structure. With this version we are introducing the reinforced concrete design of Doubly reinforced Beam, Slab, Column, Footing, T beam. All of the designs are as per limit state.

aadspro also has the option for designing all beams and slabs in a floor. By this the user gets automatic detailing of reinforcement.

This program is user friendly both for data and graphic input. Results can be viewed not only in Tabular form but also in a drawing format in AutoCAD. aadspro also gives option for saving to or importing from Excel.

Another important point in aadspro is that it thoroughly checks the code provisions like, minimum concrete cover, etc. and give message alerts if the values are exceeding the permissible limits as per Indian British and American codes.

CONTENTS

	Title			Page No
1	Creating Database	3	-	3
2	Settings	4	-	5
3	Model creator 3.1 Center line			
	scanning	6	-	9
	3.2 model creating	10		11
4	FOOTING			
	4.1 Footing Detailing	12		18
	4.2 Footing Design	19	-	28
5	PILE			
	5.1 Pile detailing	29		33
	5.2 Pile Scheduling	34		36
6	BEAM			
	6.1 Beam Detailing	37		44
	6.2 Beam Design	45		53
	6.3 Beam BBS	54	-	58
7	SLAB			
	7.1 Slab Detailing	59		66
	7.2 Slab Design	67	-	75
	7.3 Slab BBS	78	-	82
8	COLUMN			
	8.1 Column Detailing	83	-	88
	8.2 Column Design	89 102	-	102
	8.3 Column BBS	103	-	110

1. Creating Data base

aadspro using the output of STAAD Pro and ETABS as its input. In aadspro module such as Beam detailing ,Column detailing and Footing detailing, the output database of STAAD Pro and ETABS are used and in column detailing the STAAD Pro output file (anl file) is also used as input.

There are different procedure in creation of the database in STAAD Pro and ETABS.

Database Creation in STAAD Pro

User can create the Database file by selecting the menu Tools>SQL Query>Advanced Query in STAAD Pro. A database file (.mdb) is created with same name of the model is created in the same path of the model file. (See Fig: 1.1)

Creating STAAD Pro output file (anl) file

The anl file is automatically created in the same path of the model file after the analysis is performed. See STAAD Pro Manual for more information.

Database Creation in ETABS

Use File menu > Export > Save Input/output As Access Database File command to select the input/output data to be exported to a Microsoft Access database format.

堂S	TAAD	.Pro - BEA	W.std		
File	Edit	View Tools	Check Multiple Structures		
132h	<u></u>		Check Duplicate	▶ ♥ ◘ 중 ◘ □ ▲ 싊 ♡ ♡ 赨 ㅎ ㅋ ₽	* * * * * * * * *
			Orphan Nodes •	1.22	1.11
Ø	ø	666	Check for Warped Plates	▶ ▶ ♥ ♥ ★ @ ▲ \$> ♥ ● ● ♂ \$	Sector 10 10 10 10 10 10 10 10 10 10 10 10 10
	6		Check Zero Length Members	▼ ? ハジ外兵部時間間。	* ** 〒 69 開
معار	1		Check Overlapping Collinear Members		
Ro	Mo	deling P	Check Improperly Connected Plates	ponent Design Advanced Connection Design	Bridge Deck Advanced Slab
			Check Beam Plate Connectivity		
88	- <u>2</u> -	3	Check for Solids with Negative Volume (Jacobian)		
83	🕫 Setup	?	Check for Warped Solids		
			Redefine Incidence		
88	Geometry				
⊳ ≱	BWB		Calculator		
\geq	8		Unit Converter		
्रिमा	hH		HH Dimension Beams		
k#⊳	70		Display Node to Node Distance		
Ŀ\$⁄	General		😹 Remove Node Dimension		
-8-	6		Set Grid		
-	·		📥 Set Current Input Unit		
42	Ξ		All Set Current Display Unit		
⊳	s/Pri		*** Cut Section		
≙	Analysis/Print		Query		
-	- B		List Format		
	Í				
	5,		Create User Table		
	Design		Section Wizard		
	−I		Modify Section Database		
	-		Create New Group Ctrl+G		
10			A Insert Text	Simple Query	
			Create AVI File		
			2	Advanced Query	Load
	-		SQL Query	Customize Advanced Query Database	
		d.Pro Databa	Configure oser roois		Modeling M
14	sta	n) ©	User Tools		

Fig 1.1

aadspro

2. Settings

Click on the 'Tools' from main menu and select 'settings' from sub menu. (Fig 2.1)

	🛋 🐒 🦥 🍡 🕬	ш. 🙊 🤅) 🗸 🗧			aadspro 4
	<u>H</u> ome <u>S</u> lab <u>B</u>	eam <u>C</u> o	olumn Foundations	<u>T</u> ools <u>H</u> elp		
CG Finder	Pick Draw CG	Create Model	Draw Center Line	Pick Center Line Pick Column Pick Column	Calculator	
CG	CG Creating Options	Models	Model Cr	reating Options	Tools	



User can set the properties

aadspro Properties _ = X					
	2↓ 📼				
	Beam				
	Minimum % of Steel in Bear	0.2			
	Column				
	Column Naming Tag	С			
	Minimum % of Steel in Colu	0.8			
	Defaults				
	CheckSteelAsper	AsperCode			
	DesignCode	Indian			
	Mix of Concrete	25			
	ReinfoDiameterIndicator	#			
	Save Properties on Windo	True			
	Yield strength of Steel	415			
	Footing				
	Minimum Reinforcement Sp				
	Minimum Steel Percetage	0.12			
	Misc				
	Alternate Row Color in Gric				
	BackgroudImage	(none)			
	BackGroundImageLayout				
	ConnectedDwgFile	\\lx2-200-ti84cs\Advance\}			
	LicenceConfiguration	HardWareLock			
	VisualStyle	Office2007Silver			
Ξ	Slab				
Minimum % of Steel in Slab 0.2					
Alternate Row Color in Grid Set the Alternative row color for grids					

- Background Image
 By this property user can change the background image aadspro.
- Background Image Layout
 User can change the layout style of the current Background Image.

Column Naming Tag

Column Naming Tag to be used in detailing Process.

Check Steel As per

This property help the user to set the default steel percentage used in design process. In this user can use either as per Code option or User Defined option .The As per Code option will check the steel percentage as per the code provision given in standard code selected by the user. By User Defined option user can set the percentage manually. User can change the manual steel percentage setting for Beam, Slab, Column, Footing in their respective Minimum % of steel Properties.

Design Code

This property set the standard design code used in different design process. Aadspro gives provision to use Indian, British and American codes.

Fck Value

Set Current the mix of concrete used in design module of structural elements.

Reinfo Dia Indicator

By using this property user can customize the Diameter indication tag used in Detailing process.

- Connected Dwg File User can see which AutoCAD file is currently connected to aadspro.
- Alternate grid row Color
 Set the color of the alternate row of the grid used in aadspro.
- Visual Style

User can change the Visual Appearance of aadspro by changing the three option given (Office2007Black, Office2007Blue, Office2007Silver)

License Configuration

Sets how the software license is configured, aadspro uses three option in license configuration

1. Hard Ware Lock - License configured through a hardware lock supplied with aadspro software.

- 2. License File -License configured through a License file.
- 3. Web License License through web. User can login to aadspro with a aadspro account. User account can be created from <u>www.aadspro.com</u>

3. MODEL CREATOR

Model Creator is powerful tool for creating Staad Pro or ETABS model directly from AutoCAD. It minimizes the time and design procedure in model creation. It automatically detects the beam and column from AutoCAD and makes the model within minutes.

3.1 Center line scanning

This chapter provides a step-by-step procedure for the Centerline scanning of slabs. A layout of the structure is provided in AutoCAD as shown in the fig 3.1

- 'Fillet' the beam layout.
- All the beam lines & columns in the layout should be in a particular layer.
- All columns should be in polyline.
- All the beam lines should break inside at the column.
- Layout should be in cm.

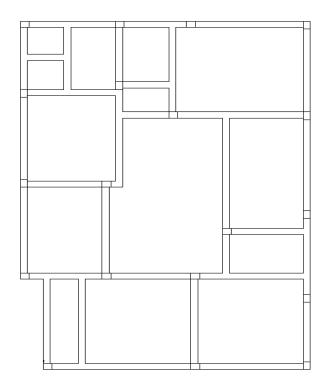
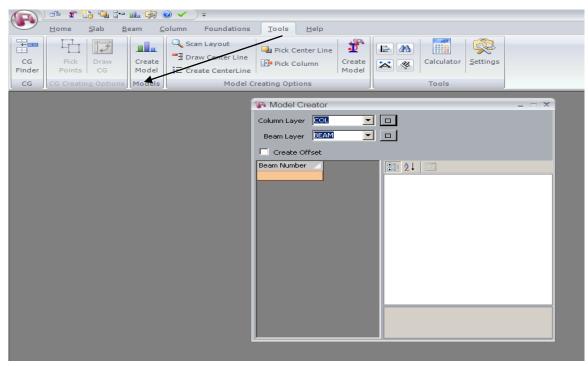


Fig.3.1



• Select 'Tools' from the Main menu and 'create model' from sub menu.(Fig 3.2)

Fig.3.2

 Before starting the Scanning process user must select Column and Beam layer from the layout drawing. User can either select the layer from the drop down list or select the layer directly from the AutoCAD drawing by clicking the button in right side of dropdown list. Create Offset option will make the offset correction in the created model.

🖗 Model Cre	eator	
Column Layer	COL	• •
Beam Layer	BEAM	•
🗌 Create Of	fset	

• Click on the Scan Layout from tool bar (Fig 3.3)

The Scan Layout option will help the user to scan AutoCAD layout drawing directly. The Columns drawn in the drawing must be in poly line and beams in line format and in a specified layer. By setting the Column and Beam Layer help the program to find out the beam and columns from drawing. Note that the Beam lines must break in every beam junction for better results. By Clicking this button aadspro prompt the user to select the desired layout area in AutoCAD to create the model. After the scanning process is over aadspro create the center of the layout in the drawing in specified layer.

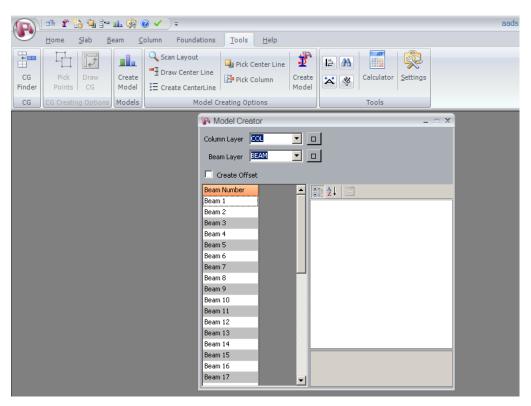


Fig 3.3

• Click on the Draw center line from tool bar

This option will help the user to create the lines in the AutoCAD. When using this option user must pick two point to draw a line. Aadspro will take the line drawn after clicking kept as a beam line in model. AutoCAD will prompt to pick two point until the user press the escape button or give any invalid input.

• Click on the Create center line from tool bar

This option will help the user to create the center line of two lines selected by the user in AutoCAD. When using this option user must select two lines to draw a center line. Aadspro will make a center line of selected line and take it as a beam line in model . AutoCAD will prompt to pick two lines until the user press the escape button or give any invalid input

• Result

Drawing obtained in AutoCAD (Fig 3.4)

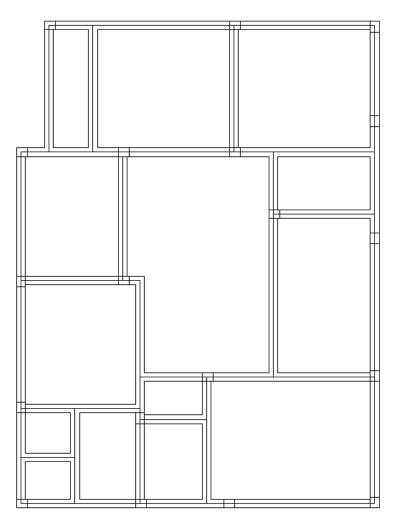


Fig 3.4

3.2 Creating model in STAAD

• Click on the **Pick Center Line** from tool bar (Fig 3.5)

This option will help the user to select a line as beam line that is already created in AutoCAD. If the user gives a layer (Beam Layer) in the time of selection, aadspro only take the line only in that layer otherwise aadspro takes all the lines in that selection area

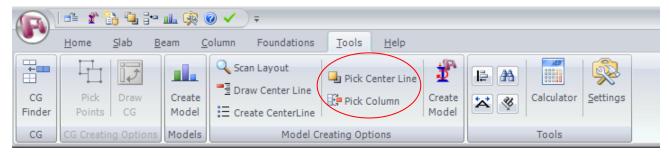


Fig 3.5

Click on the Pick Column from tool bar

This option will help the user to select the column in the layout drawing. User must give the Column Layer to detect the column and it must be in a poly line format.

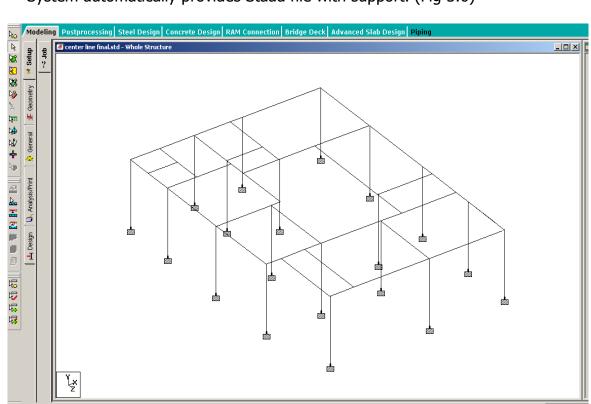
Click on the Create Model from tool bar

This option will produce the model after verifying all the center line created or selected by the user. When user click on this button aadspro prompt the user to save the file to any location that the user need.

At the time of saving, user can select the model type (STAAD Pro and ETABS). When user select a STAAD Pro model aadspro make the STAAD Pro file (.std) in the selected location and Open in STAAD Pro Application.

If the user select a ETAB Model aadspro create an e2k (*.e2k) file in the selected location. User can import this model file in ETABS application.

• Result



System automatically provides Staad file with support. (Fig 3.6)

Fig 3.6

4. FOOTING

4.1 Footing Detailing

This module helps the users to create the footing schedule and footing layout from STAAD Pro and ETABS database. User can import STAAD Pro and ETABS database file to create schedule and layout. aadspro will analysis and check all the foundation columns and extract the design parameters from the imported database. aadspro makes the design values by these parameters and the other inputs given through it, and group it with their width and design values .

This chapter provides a step-by-step tutorial for the layout of footings of a multistoried building.

- Description of structure
- <u>Steps involved in Staad</u>
- Steps involved in aadspro
- <u>Results</u>

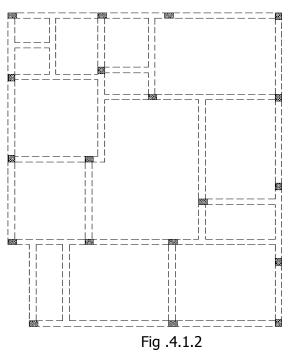
4.1.1 Description of structure

The structure is a double storied building. Plan of the building is shown in fig (4.1.1).



Fig 4.1.1

Layout in AutoCAD



A layout is provided in AutoCAD as shown in the fig 4.1.2.

4.1.2 Steps involved in Staad

Staad mdb file is required for the design of footing in aadspro, Creating Staad mdb file.

4.1.3 Steps involved in aadspro

Select 'Foundation' from the Main menu and 'Detailing' from the sub menu. (fig

4.1.3).





The detailing window helps the user to customize the detailing and design process. By setting these properties user can customize the detailing with variety of option.



1. Click on the Import Database from tool bar (fig4.1.4)

Fig 4.1.4

Import Database button allow the user to import the database file to the detailing system in aadspro. After selecting the database aadspro displays the details of the footing in the imported model (Axial Load, Moment in X direction, Moment in Y direction etc..) in the Footing details grid.

2. User can set data (fig4.1.5 & fig4.1.6)

m)> L	.X(m)<=	Depth	Dia
1	1.25	200	10
1.25	1.5	250	10
1.5	1.75	300	12
1.75	2	350	16
2	2.25	400	20
2.25	2.5	450	25

Fig	.4.	1.
-----	-----	----

	Level 0						
	LoadCombination	Envelope					
	Misc	сптеюре					
		A second a da					
	CheckSteelAsper	AsperCode					
	Fck	30					
	Fy	500					
	MinimumReinfoSpacing	300					
	MinimumSteel	0.12					
	ReinfoDiameterIndicator	#					
Ξ	Properties						
	Cover	40					
	Factor of safety provided	1.5					
	IncludeSpacinginGrouping	False 🔹					
	LX Rounding Factor	0.25					
	LY Rounding Factor	0.25					
	Minimum Depth	150					
	Minimum Edge Depth	150					
	Safe Bearing Capacity (Fa	100					
	Spacing Rounding Factor	50					



Depth & dia grid.

This grid helps the user to give the input for the footing depth and diameter to be used while the design process is going on through aadspro design module. aadspro find out the corresponding depth and diameter from this grid with comparing the lx value and it will be used in design process. User can edit these values if the user wants any changes in depth and diameter.

Properties

Level

Select the beam level to draw in cad.

• Load combination

The load combination property list out all the load combination in model. aadspro displays the Design Load Envelope at the time of importing the database. User can change these values by selecting any load combination from the list.

• Cover

The nominal cover use in design process.

- Factor of safety provided Set the factor of safety provided in the current design process
- Include spacing grouping Select whether spacing is to be used in footing grouping procedure.
- LX & LY Rounding Factor Group the footing by rounding the LX and LY value to reduce the number of footing groups.
- Minimum Depth
 Set the minimum depth of the footing
- Minimum Edge Depth Set the minimum edge depth of the footing
- Safe bearing capacity Safe bearing capacity of soil.
- Spacing Rounding factor
 Set the value of the rounding factor for spacing. It will helps in footing grouping to reduce the number of footing groups

3. Click on the Convert Data from tool bar (fig 4.1.7)

Convert data button design the imported foundation with the aadspro footing design module. Before going to the conversion user must set some parameters in depth setting grid and also in the property window.

The depth setting grid allow aadspro to take the depth of the footing in the design time with the footing size. In Property window user can set some parameter for the design process.

▲ * * * * * * * * *										aadspr	o 4					
Home	<u>S</u> lab <u>B</u> eam	<u>C</u> olumn	Foundations	Tools	<u>H</u> elp											
fx Design Detailing Footings	Layout Schedule Piles	e Impo Datab	_	Iraw in CAD	Draw Expo Schedule Repo	rt										
Footing Detailing (D:\DESKTOP\aadspro staad\str 2mdb)							x									
) Details		, langebieleran	alan n man]							SI No LX(m)> LX(m)	<= Depth	Dia	
		No 🖉	Axial Load(KN)	Moment in X	Dir(KNm) Mo	ment in Y Dir(KNm)	Col De	:pth (m)	Col WIdth(m)) X Y			1 1	1.25 2	50 10	
		45	409		39.44	1.21		0.5		0.5 7.01 8645		Π	2 1.25	1.5 2	50 10	
		46	465		2.2	1.97		0.5		0.5 5.01 9004			3 1.5	1.75 3	00 12	
		47	220		29.85	10.61		0.5		0.5 5972 8291			4 1.75		00 16	
		48	234		31.01	8.07		0.5		0.5 5972 9628			5 2		50 20	
		49	242		5.91	37.48		0.5		0.5 7.01 9628			6 2.25	2.5 4	0 25	
		50	367		0.07	2.67		0.5		0.5 7.99 8645			7			
		51 52	419 528		8.27 9.45	4.94		0.5		0.5 7.99 8291 0.5 5.01 8645				_	_	
		52	320		9,40	0.77		0,3		0.5 5.01 0045		•				
		<u> </u>	Detail (Distribute									_	🖯 Misc			▲
					Col WIdth (m)	Col Depth (m) Spa			Reinf Dia	Col Reinf Dia	No	4	CheckSteelAsper	AsperCode		-
		F3	2.00	2.00	0.5	0.5	300	300	16		0 45		Fck	30 500		
		F3	2.00	2.00	0.5	0.5	300	300	16		0 46		Fy MinimumReinfoSpacing	300		
		F2 F2	1.75	1.75 1.75	0.5	0.5	300 300	300 300	12 12		0 47 0 48		MinimumSteel	0.12		
		F2	1.75	1.75	0.5	0.5	300	300	12		0 49		ReinfoDiameterIndicator			
		F2	1.75	1.75	0.5	0.5	300	300	10		0 50		Properties			
		F3	2.00	2.00	0.5	0.5	300	300	16		0 51	T	Cover	40		
		, Group (Notaile									-	Factor of safety provide			
					calumbia (a)	Coll Death (a)		Durth D	utef pie	Col Reinf Dia	-		IncludeSpacinginGroupin LX Rounding Factor	g False 0.25		
		F1	Dim (A)(m) Dii 1.5	m (B)(m) 1.5	Col WIdth (m) 0.5	Col Depth (m) Spa	300 S	Depth F	Reinf Dia 10	COLKEINI DIA	0		LY Rounding Factor	0.25		
		F2	1.75	1.75	0.5	0.5	300	300	10	1			Minimum Depth	150		
		F3	2	2	0.5	0.5	300	300	16		0		Minimum Edge Depth	150		
67	Import D)ata			0.5	0.5	300	350	20		0		Safe Bearing Capacity (F			
22	- inporce												Spacing Rounding Factor	50		<u> </u>
9	Convert	Data	а		•								CheckSteelAsper			
۸.	Draw La	yout												_		
+	Draw Se	ctior	1				Fig	, 4.1	.7							
	Draw All Sections												g Detailin			n
	Draw Sc	hedu	ıle			draw La Auto Ca			Foo	ting S	Sect	io	n and scl	nedul	e in	

4.1.3 Results

1.Click on the Draw in Cad from tool bar (fig 4.1.8)

Draw in CAD button draws the footing layout in AutoCAD with designed footing size and give notation to each footing with their group name. User can select the level of beam to be draw in Auto CAD by selecting level in property window.

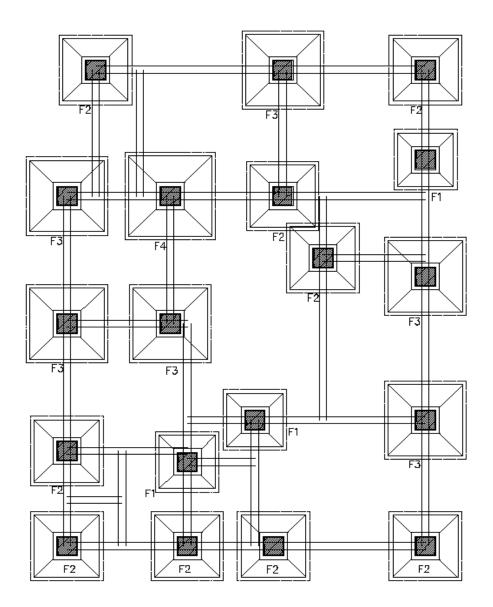


Fig 4.1.8

2. Click on the Draw Schedule from tool bar (fig 4.1.9)

Draw schedule draws a schedule in AutoCAD with footing name ,Dimension A, Dimension B, Dimension C and the Reinforcement details in a tabular format.

	$F \square \square]$	FING	SCHEI	DULE	
Name	A	В	С	Reinf A	Reinf B
F1	1.5	1.5	250	#10@30Dc/c	#10€300c/c
F2	1.75	1.75	300	#128300c/c	#120300c/c
F3	2	2	300	#16 0 300c/c	#16 0 300c/c
F4	2,25	2,25	350	#200300c/c	#208300c/c



3. Click on the Export report from tool bar

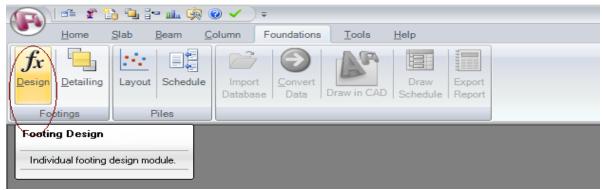
Export Report button export the details to excel format.

4.2 Footing Design

This module contains both Analysis and Design of a footing section as per limit state method.

4.2.1 Steps involved in aadspro

Open <u>aadspro</u>. Select 'Foundation' from the Main menu and 'Design' from drop down menu. (fig.4.2.1)





1. User can set data in footing design grid (fig 4.2.2)

(1) 1 ≤ 2 ≤ 1 ≤ 1 ≤ 2 ≤ 2 ≤ 2 ≤ 2 ≤ 2 ≤ 2 ≤		aadspro 4	
Home Slab Beam Column Foundations Tools Help			
Import Scan From Execute SetWeight Draw in CAD Print Export Cless Report Windo			
Home			
	🖗 Footing Design	_ = ×	
	Input Results		
	Load (Service) (KN) 200 Self Weight (Service) (KN) 201 Moment in x dn (Ntr) (KN-m) 00 Moment in y dn (Ntr) (KN-m) 0 Depth of footing (m) 0.75 Safe Bearing capacity (KN/m) 150 Peoting Dimensions 0 Dimension of footing (A) (m) 1.5 Pedestal Dimension (C) (m) 0.3 Pedestal Dimension (C) (m) 0.5 Other Dimensions 0 Width of the section (mm) 1000 Depth of the section (mm) 150 Min depth (mm) 150 Nominal Cover (mm) 50	Tensile Reinforcement 10 Diameter (mm) 10 Specing (mm) 5 Ir Recalculate Dimensions 0.00 0.00 0.00 0.00	

Fig.4.2.2

🖗 Footing Design	Load (service)
Input Results	Load acting on it.Self weight
Load (Service) (KN) 200 Self Weight (Service) (KN) 20 Moment in x dn (Mx) (KN-m) 0 Moment in y dn (My) (KN-m) 0	Self weight can calculate by <u>calc self weight</u> button from drop down menu by applying footing dimensions in footing design grid.
Depth of footing (m) 0.75 Safe Bearing capacity (KN/mm²) 150	 Moment in X & Y direction Depth of footing Safe bearing capacity of soil
Footing Dimensions Dimension of footing (A) (m) 1.5	 Dimension of footing A&B, Pedestal dimensions C&D
Other dimension (B) (m) 1.5 Pedestal Dimension (C) (m) 0.3 Pedestal Dimension (D) (m) 0.5	
Other Dimensions Width of the section (mm) 1000 Depth of the section (mm) 250	 F1 Width of section Program automatically calculates the width of
Min depth (mm) 150 Nominal Cover (mm) 50	 Depth of section Minimum depth Minimum depth is 150 mm
	 Nominal cover
Fig. 4.2.3	

4.2.2. Example for footing design (fig 4.2.4)

Consider the example given below and its solution by manual calculation. Explanations are also attached after solutions to see how the program arrives at results.

Example

A square column of size 400x400 and 2.75 metre effective length carries an axial load of 1500 kN including its weight. Design the square footing for the column. The service bearing capacity of the soil is 150 kN/m^2 . Use M25 concrete and Fe 415 steel.

Solution

Load on the column	=	1500 kN		
Weight of footing	=	150 kN		
Total load	=	1650 kN		
Area of footing	=	$\frac{1650}{150}$	=	11 m ²
\therefore Side of the footing	=	$\sqrt{11}$	=	3.3 m

∴ Provide 3.4m x 3.4m footing

Check for Maximum & Minimum soil pressure:

Moment about x direction, Mx	=	35 KNm		
Moment about y direction, My	=	25 KNm		
Z	=	L ³ /6		
	=	$3.4^3/6 = 6.$	55 m ³	
P/A	=	$\frac{1500}{3.4x3.4}$		
	=	129.76 KN/	′m²	
Mx/Z	=	35/6.55	=	5.34KN/m ²
My/Z	=	25/6.55	=	3.8 KN/m ²

aadspro

Maximum soil pressure	=	$\frac{P}{A} + \frac{Mx}{Z} + \frac{My}{Z}$
	=	129.76+5.34+3.8
	=	138.9 KN/m ^{2 <} 150 KN/m ²
Minimum soil pressure	=	$\frac{P}{A} - \frac{Mx}{Z} - \frac{My}{Z}$
	=	129.76-5.34-3.8
	=	120.6 KN/m ² > 0

Hence safe for Maximum and Minimum soil pressure.

Net upward pressure intensity	=	$\frac{1500}{3.4 \times 3.4}$
	=	129.76 KN/m ²
Pu	=	1.5 x 129.76
	=	194.64 KN/m ²

Depth of the footing

The critical section for bending moment is taken corresponding to the column face.

Projection beyond the column face	=	(3.4-0.4)/2	=	1.5m	
B.M. at the critical section, M_u	=	1.5×129.76×1.50)0×-	$\frac{1.500}{2}$	
	=	218.97kNm			
B.M. at the critical section, M_u	=	218.97x3.4	=	744.50KN/m	
The cross sectional shape of footing, resisting this BM is trapezoidal.					

The trapezoidal section may be considered as the equivalent rectangular section of width,

b =
$$b_w + (B - b_w)/8$$

			=	0.4 + (3.4 - 0)	.4)/8	
			=	<u>0.775m</u>		
R	=	0.138 fck	=	0.138 x 25		
d	=	$\sqrt{rac{M_u}{Rb}}$	$=\sqrt{\frac{1}{0}}$	744.50×10^{6} $138x25 \times 775$	=	527.68mm
			= 53	0mm		

Assume a clear cover of 50 mm and dia.of bars 10mm,

D = 530 + 50 + 5 = 585 mm

Provide overall depth, D = 900mm (for shear consideration)

d = 900-50-5 = 845 mm

		aadspro 4
Home Slab Beam Column Foundations Tools Help		
Import Database AutoCAD	se	
Home		
	🖗 Footing Design	_ = X
	Input Results	
	Load (Service) (KN) 1500 Self Weight (Service) (KN) 125.1 Moment in x dn (Mtx) (KN-m) 35 Moment in x dn (Mtx) (KN-m) 25 Depth of footing (m) 0.75 Safe Bearing capacity (KN/mm²) 150 Footing Omenations 0 Dimension of footing (A) (m) 3.4 Other dimension (B) (m) 3.4 Pedestal Dimension C() (m) 0.4 Pedestal Dimensions 775 Depth of the section (mm) 775 Depth of the section (mm) 150 Min depth (mm) 150	Tensile Reinforcement Diameter (mm) 10 Spacing (mm) 90 Recalculate Dimensions 131.42 142.106 139.053 149.739

Fig 4.2.4

Calculation for Reinforcement;

$$0.87f_{y}A_{st}d\left(1-\frac{A_{st}f_{y}}{bdf_{ck}}\right) = M_{u}$$

$$0.87x415xA_{st}x845\left(1-\frac{A_{st}415}{775x845x25}\right) = 218.97x10^{6}$$

$$305087.25A_{st} - 7.733A_{st}^{2} - 218.97x10^{6} = 0$$

$$A_{st} = 731.28mm^{2}$$
Percentage of reinforcement, Pt
$$= 100\left(\frac{A_{st}}{bd}\right)$$

$$= 100\left(\frac{731.28}{775x845}\right)$$

$$= 0.11\%$$

Hence provide A_{st} 731.28 mm²

Check for shear stresses

(i) Critical section for one-way shear

The critical section for one-way shear is at a distance equal to the effective depth from the column face.

Min depth of footing at edge = 0.2D = 0.2x900 = 180mm

Provide 180mm>150mm minimum specified in IS 456-2000, Cl: 34.1.2

Overall depth at critical section, D' =
$$900 - \left(\left(\frac{900 - 180}{1500} \right) x 845 \right)$$

= 495mm
Effective depth at critical section, d' = 495-50-5 = 440mm

Width of footing at critical section, b'	=	b+2d
	=	775+ (2 x 845) = 2465mm
Shear force at the critical section, V_{u}	=	1.5 x 129.76x (1.500 -0.845)
	=	127.48 kN
$\tau_v = \frac{V_u}{b' \times d'}$	=	$\frac{127.48 \times 10^3}{2465 \times 440}$
	=	0.12 N/mm ²
τ_c for pt = 0.11%		= 0.29 N/mm ²

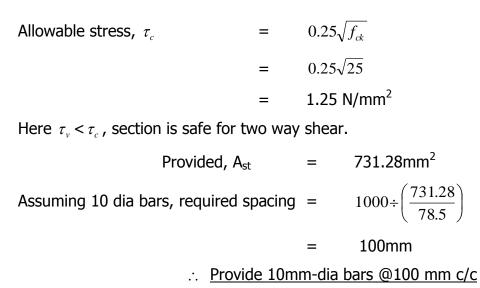
Here $\tau_v < \tau_c$, hence the section is safe for one way shear.

(ii) Critical section for punching shear

Critical section for punching shear is all-round the column at a distance $\frac{d}{2} = \frac{845}{2} = 423$ mm from the column face.

Critical Perimeter, b' = 4(400 + 845) = 4 x 1245 $= 900 - \left(\left(\frac{900 - 180}{1500} \right) x 423 \right)$ Overall depth at critical section, D' 696.96mm = Effective depth at critical section, d' = 697-55 642mm = = 1.5 x 129.76x (3.4² - 1.245²) Shear force at the critical section, V_{u} 1948.34 kN = $\frac{F_u}{4b_0d}$ Punching shear stress, τ_v = 1948.34×10^{3} = 4×1245×642 0.61 N/mm² =

aadspro



4.2.2. Results

1. Click on the Execute from tool bar (fig 4.2.5)

n 🔁 📲 📲 🔤 📖 🙊 🔍 🗸		aadspro 4
Home Slab Ream Column Foundations Tools Help		
Import Database AutoCAD		
4) -	Footing Design	- = x
	input Results	
	Self Weight (Service) (KN) 125.1 Moment in x dn (Mx) (KN-m) 35	

Make it use for a required one by changing the dimensions either by typing or by clicking on the buttons. Corresponding changes are seen in the attached figure and each time it calculates and shows the corner stresses in the figure.

2. Click on the Results from footing design grid (fig 4.2.6)

🎙 Footing Design						
Input Results						
		_				
Footing area required (Sq. m)	10.83					
Dimension Proposed (m)	3.25					
Reqd Spacing (mm)	96.3					
- Steel Details		_				
Ultimate moment (KN-m)	243.668					
Total Area Of Steel required (Ast)	815.96					
% Reinforcement						
Area of steel Provided(AAst) (mm²)	873.016					
Punching Shear		_				
Punching shear area (mm²)	3361500					
Punching shear stress (At d/2 from column) (Mpa)	0.572					
Allowable shear stress at this section (Mpa)	1.25					
Shear		_				
Allowable shear stress (At d from column) (Mpa)	0.546					
Capacity of section in shear(Vc) (KN)	190.352					
Forces		_				
Factored Moment (KN-m)	243.668					
Factored Shear (KN)	129,956					
			_			Ì

Fig.4.2.6

Comparison of results

1. Factored values of moment and shear

	Values by program	Values by manual
	Values by program	calculation
Moment	243.668 KNm	218.97KNm
Shear	129.956KN	127.48KN

Here almost all values are exactly same as that of manual calculation.

2. Program also gives details like,

A _{st} required	= 815.96 mm ²
A _{st} provided	= 873.016 mm ²

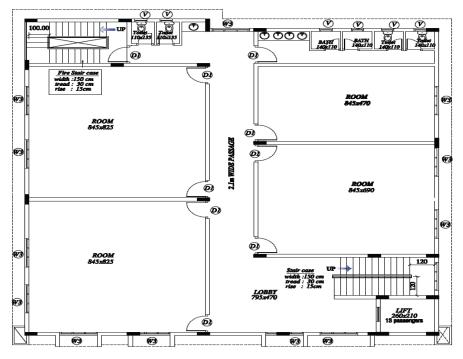
Spacing of 10 dia bars = 90 mm c/c

5. PILE

5.1 Pile Detailing

5.1.1 Description of the building

The structure is a triple storied building; in which pile is to be designed (fig 5.1.1). plan of the building is shown in figure .



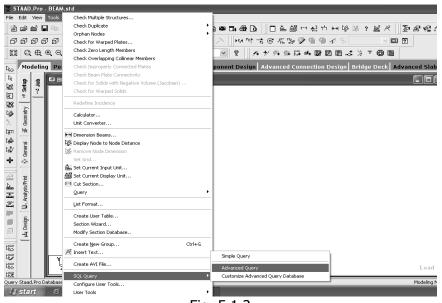


5.1.2 Steps involved in Staad

Staad mdb file is required for the design of pile in aadspro,

Creating Staad mdb file

- Open the Staad file and analyze it.
- Select Tools >SQL Query>Advanced Query for STAAD Pro version 2006 & higher (fig.5.1.2).





• Steps involved in aadspro

Open aadspro. (AutoCAD will be open automatically)

Select Foundation from main menu.

• Click on the Layout from tool bar (fig5.1.3)

	r 🛅	ч 📴 止 🧔	🕡 🗸) 🗧							aadspro	4							
<u>H</u> ome	<u>s</u>	lab <u>B</u> eam	Column Foun	dations <u>T</u> ools	<u>H</u> elp													
fx Design Detail		Layout Schedule	Import C	onvert Data Draw in CA	Draw E	Export Report												
	P C	reate Pile Layou	t												: Other Costs			
	NO _	Axial Load	Diameter	Nos	Pile ID	Х	Y	Z		Capcity and Cost Details ID Diameter Capacity Reinfo C Concrete Driving Cost Other Costs								
										iameter 40		S50	Concrete L 753	riving Cost 500				
									2	45	2000	890	1200	500				
									3	50	2500	1271	1700	500				
																í.		

Fig 5.1.3

The layout window helps the user to customize the detailing and design process. By setting these properties user can customize the detailing with variety of option.

• Click on the Import Database from tool bar (fig 5.1.4)

Import Database button allow the user to import the database file to the detailing system in aadspro .After selecting the database aadspro displays the details of the Pile in the imported model (Axial Load, Moment in X direction, Moment in Y direction etc..) in the Pile details grid.

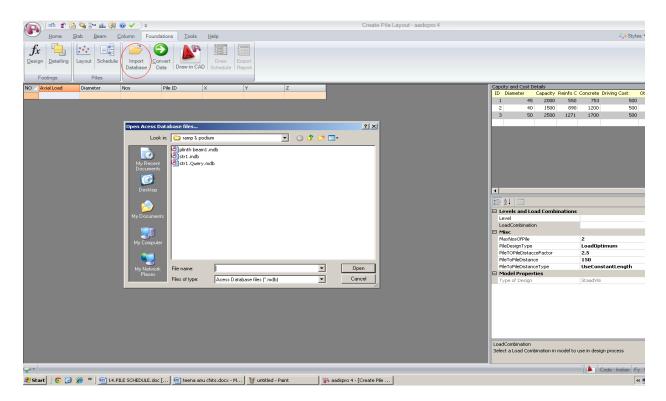


Fig 5.1.4

User can set

- Diameters of piles
- Corresponding capacities of pile from soil report
- Level (i.e. the plinth beam level in staad pro.)
- Load combination (Maximum ie envelope)
- Maximum number of pile
- Pile design type
- Pile to pile distance factor
- Pile to pile distance
- Click on the Convert Data from tool bar (fig 5.1.5)

Convert data button design the imported Pile with the aadspro pile design module. Before going to the conversion user must set some parameters in depth setting grid and also in the property window. The depth setting grid allows aadspro to take the depth of the Pile in the design time with the pile size.

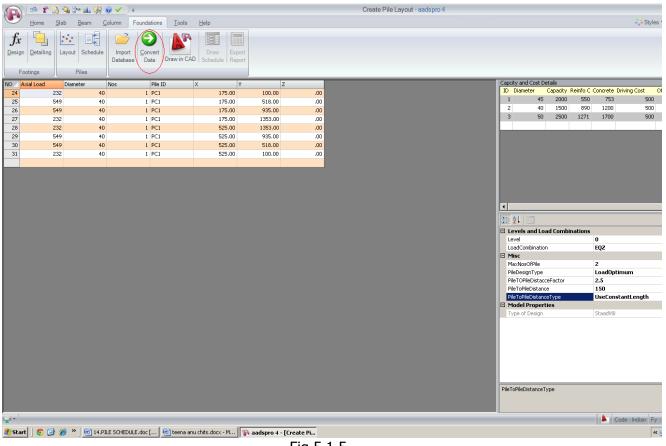


Fig 5.1.5

5.1.3 Results

• Click on the Draw in Cad from tool bar (Fig 5.1.6)

Draw in CAD button draws the Pile layout in AutoCAD with designed Pile size and give notation to each Pile with their group name.

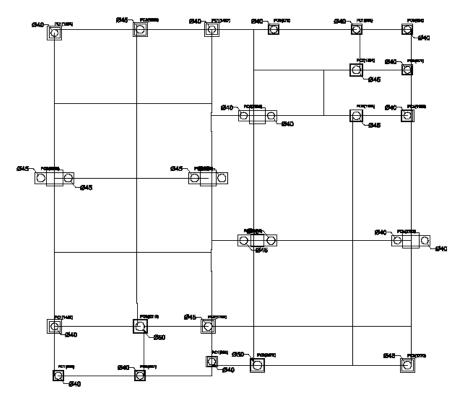


Fig 5.1.6

• User can add piles directly to staad file by Right click- Add pile to staad pro model (Fig 5.1.7)

	🖆 🐒 🎦 🛱 Home Slab	<mark>L 3™ ILL (≩) (⊘)</mark> Beam Colur		Help		Create P	ile Layout - aadspro 4		🐝 St
fx	Detailing Lay	out Schedule	Import atabase	Draw Export					, u
	- /	iameter No:	; Pile ID	X Y	Z			Capcity and Cost Details	
500	1204	40	1 PC1	99803.00	-115763.00	.00			fo C Concrete Driving Cost
501	1688	45	1 PC2	100273.00	-115743.01	.00		1 40 1500	550 753 5
502	805	40	1 PC1	101463.00	-115743.01	.00			890 1200 5
503	803	40	1 PC1	100668.00	-117631.99	.00		3 50 2500 1	.271 1700 5
504	2219	50	1 PC3	100273.00	-117431.99	.00			
505	657	40	1 PC1	100273.00	-117712.00	.00			
606	569	40	1 PC1	99823.00	-117712.00	.00			
07	2075	50	1 PC3	100918.00	-117652.00	.00			
608	1770	45	1 PC2	101743.00	-117652.00	.00			
09	1729	45	1 PC2	100648.00	-117431.99	.00			
510	1452	40	1 PC1	99803.00	-117431.99	.00			
511	2702	40	2 PC4	101763.00	-116943.01	.00			
512	3540	45	2 PC5	100918.00	-116943.01	.00			
513	3239	45	2 P 5	Add Piles to Staad.	Pro Model	.00		•	
514	3200	45	2 PC5	77000.00	110000.00	1994			
515	2706	40	2 PC4	100918.00	-116233.00	.00			
516	1156	40	1 PC1	101743.00	-116233.00	.00		Levels and Load Combinat	
517	1905	45	1 PC2	101463.00	-116233.00	.00		Level	0
18	821	40	1 PC1	101743.00	-115973.00	.00		LoadCombination	EQZ
519	1504	45	1 PC2	101463.00	-115973.00	.00		Misc	3
520	634	40	1 PC1	101743.00	-115743.01	.00		MaxNosOfPile DisDesimTures	3 CostOptimum
i21	1427	40	1 PC1	100668.00	-115743.01	.00		PileDesignType PileTOPileDistacceFactor	2.5
522	872	40	1 PC1	101008.00	-115743.01	.00		PileToPileDistance	150
								PileToPileDistanceType	UseConstantLength
								Model Properties	



aadspro

5.2 Pile Schedule

1. Click on the **Schedule** from tool bar (Fig 5.2.1)

	aadspro 4
Home Stab Beam Column Foundations Tools Help	
fr image: constraint of the second seco	
🚱 Pile Layout	_ = ×
Pile Details	
ID Dia (m) Cover Main Bar D Main Bar N Tie Dia Tie Sp	pacin: Steel Area Name
	Bar Number Increment 2
	E Diameters used in Design Int32[] Array
	Maximum Number of Bars 10
	Minimum % of Steel in Pile: 0.4
	Minimum Number of Bars 4 Stirrup Diameter 8
	B Misc
	Show Forces in Layout False
	E Model Properties
	Type of Design StaadV8i
	🖯 Styles
	Layer of Beams SRC_BEAM
Pile Groups	Pile Group Details
Pile Groups	Layer of Reinforcements SRC_REINFO
	Ber Number Increment Number of bar to be incremented in Design Process



2. Click on the Import Database from tool bar

Import Database button allow the user to import the database file to the detailing system in aadspro.

User can set

- Bar number increment
- Diameter used in design
- Maximum number of bar
- Minimum percentage steel in pile
- Minimum number of bar
- Stirrup diameter

- A | == 👔 🛅 🖳 📴 💷 👰 🕥 🗸 aadspro 4 Home Slab Beam Column Foundations Tools Help fx 🕒 🔛 📑 📂 🌍 AP Import Convert Data Draw Export Database Data Draw in CAD Schedule Report Design Detailing Layout Schedule Footings Pile Pile Layout [D:\DESKTOP\aadspro\staad\pile\SEMS _2.mdb] - 0 X Pile Details ₿. <u>A</u>l I aadspro Design Propertie Bar Number Increment 2 Main Bar D Main Bar N Tie Dia Tie Spacing Steel Area Name ID Dia (m) Cover 534 0.4 Diameters used in Design Int32[] Array
 Maximum Number of Bars 20 536 0.4 538 0.45 540 542 544 0.45 Minimum % of Steel in Pile: 0.4 Minimum Number of Bars 6 0.45 🗿 🛛 Import Data 0.45 Stirrup Diameter 8 Convert Data 546 0.45 Show Forces in Layout False 548 0.45 Design-using aadspro- Model Properties 550 552 0.4 Type of Design StaadV8i 0.4 Design all using aadspro 🗄 Styles 554 0.4 Warnings Layer of Beams SRC_BEAM ⚠ 555 0.45 Layer of Pile SRC_PILE
 Layer of Reinforcements SRC_REINFO Pile Groups Details \pm Draw Layout 4 Draw Section Show Force Details Show Design Output Values Minimum Number of Bars Minimum No of bar used in Design Process
- 3. By Right click **Design all using aadspro** from the bar (Fig 5.2.2)

Fig 5.2.2

It will produce pile details, pile groups and pile group details. (Fig 5.2.3)

Pile Detai											2↓ 🖻	
ID 🖉	Dia (m)	Cover	Main Bar D	Main Bar N	Tie Dia	Tie Spacing	Steel Area	Name				F
7	0.5	40	12	8	8	192					aadspro Design Prope	rties
8	0.8	40	20	8	8	300	.50				Bar Number Increment	2
9	0.8	40	20	8	8	300	.50			Ð	Diameters used in Design	Int32[] Array
10	0.8	40	20	8	8	300	.50				Maximum Number of Bars	20
11	0.0	40	20	10	8	300					Minimum % of Steel in Pile	0.4
13	0.7	40	16	8	8	256					Minimum Number of Bars	6
14	0.9	40	20	10	8	300					Stirrup Diameter	8
15	0.9	40	20	10	8	300	.49	P5			Misc	0
16	0.9	40	20	10	8	300	.49	P5				- 1
17	0.7	40	16	8	8	256					Show Forces in Layout	False
18	0.7	40	16	8	8	256					Model Properties	
19	0.5	40		8	8	192					Type of Design	StaadV8i
20	0.7	40	16	10	8	256 192					Styles	
92	0.5	40	12	8	8	192	.46				Layer of Beams	SRC_BEAM
93	0.8	40	20	8	8	300	.40				Layer of Pile	SRC_PILE
											Layer of Reinforcements	SRC_REINFO
Pile Group	ns								le Group Details			
			_	_	_	_	_	_		1		
	2010111401110											
	2											
з Г	23						Co	lumn Grou				
4 I	°4						_					
5 I	95						0	olumn grou	converting data			
										M	nimum Number of Bars	
										M	nimum No of bar used in De	esign Process

Fig 5.2.3

4. Results

Click on the **Draw Schedule** from tool bar (Fig 5.2.4)

Draw schedule button draws the pile schedule in AutoCAD with designed pile number, reinforcement, tie, and pile section with diameter and percentage steel.

NO:	PILE NO:	REINF	TIES	COL SECTION
1	P1	8- #12	#8-192	Dia 500 Steel Area 0.469
2	P2	8- #16	#8-256	Dia 700 Steel Area 0.425
3	P3	10- #16	#8-256	Dia 700 Steel Area 0.52
4	P4	8- #20	#8-300	
				Dia 800 Steel Area 0.5%
5	P5	10- #20	#8-300	Die 900 Steel Aree 0.49%



6. BEAM

6.1 Beam Detailing

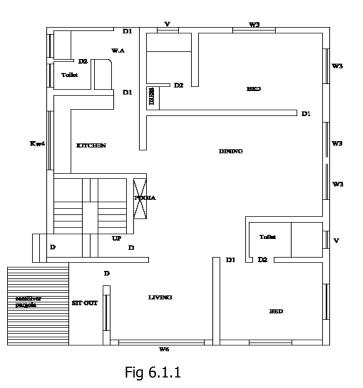
aadspro beam detailing system is a simple and powerful tool for creating beam detailing drawing with minimum user effort. It reduces the time for creating detailing drawing in AutoCAD. A simple user interface helps these activity more simple and accurate. All the standard code checking is done through this system.

This chapter provides a step-by-step tutorial for the detailing of a beam of a multistoried building.

- 6.1.1 Description of structure
- 6.1.2 Steps involved in staad
- 6.1.3 Steps involved in aadspro
- 6.1.4 Results

6.1.1 Description of the structure

The structure is a double storied building; in which the beam is to be designed. Plan of the building is shown in fig (6.1.1).



6.1.2 Steps involved in Staad

Staad mdb file is required for the design of beam in aadspro, Create a Staad mdb file

6.1.3 Steps involved in aadspro

Open aadspro. (AutoCAD will be open automatically) Select 'Beam' from main menu.

• Click on the **Using STAAD. Pro'** from tool bar (fig1.3.1)

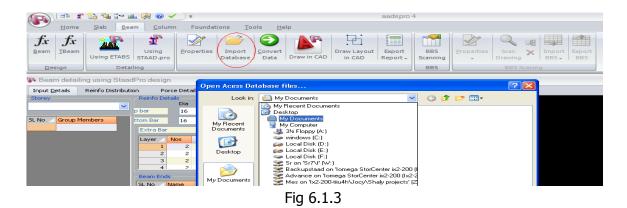


Fig 6.1.2

• Click on the **Import Database** from tool bar (fig 6.1.3)

Import Database button allow the user to import the database file to the detailing system in aadspro.

Import the staad mdb. File, .After selecting the database file aadspro check the input file and display the Level/Stories in Storey list box



• User can set (Fig 6.1.4)

This window helps the user to customize the detailing and design process. By setting these properties user can customize the detailing with variety of option.

(A) = 1	ч 🐤 🏦 👰 🙆 🕻	/ =		aad	spro 4		_ @ X
<u>H</u> ome <u>S</u> la	ab <u>B</u> eam <u>C</u> olun	n Foundations <u>T</u> oo	s <u>H</u> elp				👶 Styles 🔻
fx fx Beam TBeam	ng ETABS	Properties Import Database	Convert Data	Draw Layout Exp in CAD Repo	ort BBS	Properties Can X Imp Drawing	port Export
<u>D</u> esign	Detailing				BBS	BBS Scaning	
🚯 Beam detailing us	ing StaadPro design	[\\lx2-200-tiiu4h\advanc	SURENDRA NATH	STAAD\str 3mdb)]		_ = X
Input <u>D</u> etails Reinfo		te Details					
Storey	Reinfo Det	ails Dia Nos					
	p bar	16 2					
0	ttom Bar	16 2					
-3 0 3 6 9	Extra Bar						
9	Beams Det						
	ID	Sup Width(Lel Sup Width(el Sup Width(Rig Sup Wid	ith(Ric Length I	Depth Widtl	h Cum: Length	
				_			

Fig 6.1.4

- Reinforcement Details Number and dia of bar for
- Top bar
- Bottom bar
- Extra bars
- Story select the suitable story at the beam level.

• Set Properties (Fig 6.1.5, 6.1.6)

Beam Detailing Properties	s .	- = X	Beam
			Beam Name Color
			Beam Name Layer
🗆 Beam			Beam outline color
Beam Name Color	0, 255, 255		Beam outline Layer \rangle As per project layout
Beam Name Layer	SRC_BEAM		Beam Naming Tag
Beam Outline Color	255, 255, 255		Beam Text height
Beam Outline Layer	SRC_BEAM_Outline		Beam Text Style
BeamNamingTag	В	\succ	
BeamTextHeight	300	\succ	Column
BeamTextStyle	SRC_NEW_BEAMTEXT	\succ	Column Color
🗆 Column		\succ	Column Cut Color`
Column Color	255, 255, 255	\succ	Column Cut Layer
Column Cut Color	255, 255, 255		Column Layer
Column Cut Layer	SRC_CUT		
Column Layer	SRC_COL		Cross section
Cross Section			Cross section scale factor
CrossSectionScaleFactor	2		Beam cross section scaling factor
DrawCrossSection	CrossSectionNone		Draw cross section
TypeofCrossSection	CrossSectionLeader		Cross section none - No cross section.
🗆 Detailing Style			Cross section support - Cross section is created in
Detailing Style	aadsproDefault		two support point of a beam.
Dimension			Cross section mid - Cross section is created in the
Dimension Line Color	📃 Cyan		midpoint of a beam.
Dimension Text Color	📃 Cyan		Type of cross section
Dimension Text Layer	SRC_Dim		Cross Section Leader: Cross section is created
DimensionStyle	Standard		with multi leader.
DimensionTextHeight	100		Cross Section Simple: Cross section is created with
DimensionTextStyle	SRC_NEW_DIM		simple number notations.
🗆 Leader			
Leader Text Color	0, 255, 255		DETAILING STYLE
Leader Text Layer	SRC_LEADER		Aadspro Defaults
LeaderTextHeight	120		Default value can change from main menu-tools-
LeaderTextStyle	SRC_NEW_LEADER	_	settings – addspro properties.
CrossSectionScaleFactor			Style1
Beam Cross Section Scaling Fa	actor		Style2 Can select suitable style.
			Style3
			Custom
Fig	6.1.5		User can change style.
i ig i	0.1.0		
	٦		

- LEADER
 - Leader text color Leader text layer Leader text height

,

as per project layout

DIMENSION

Dimension line color Dimension text color Dimension text layer Dimension style Dimension text height Dimension text style

as per project layout

Load combination

Set a load combination in model to use in design process.

MISC

Aggregate Spacing - Set the spacing need to accommodate the aggregate used.

Cover in design – Cover to be used in design process of beam.

Cover in drawing - Cover to shown in the detailing drawing for better viewing.

Development length factor -Development Length factor given to reinforcement.

Extra bar length factor - Length calculating factor for extra bars based on the beam span length i.e., an extra length is calculated and added to the current reinforcement length with the given factor.

Gap Between beam groups -Distance between two beam section.

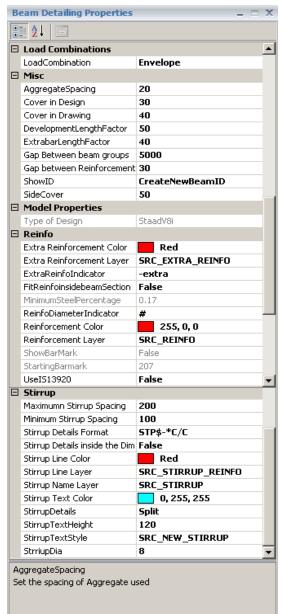
Gap Between reinforcement - Gap provided in between reinforcement bars.

Show ID –

ShowBeaminModel ShowBeaminModel CreateNewBeamID

sets Which type of Beam number is shown in drawing

Show Beam in Model: Displays the id of the beam in STAAD Pro or ETABS model



Create New Beam ID: Create new id starting from 1. Side cover– Side cover of beam.

MODEL PROPERTIES – Type of data base loaded in beam detailing.

E.g.: Staad V8i

Staad 2004

REINFO

Extra reinforcement color, Layer and indicator can change as per project Fit reinfo inside beam section -

True – reinforcement cut inside with the beam section.

False – reinforcement up to the development length.

Reinfo Diameter indicator - Set the reinforcement diameter indication tag.

Reinforcement color As per project layout

Reinforcement layer

Use IS13920 - Use IS-13920 Standard in beam detailing.

STIRRUP

Maximum & Minimum stirrup spacing

Maximum & minimum stirrup spacing to be given in detailing.

Stirrup Detail format

In the given format `\$' legend replaces the diameter of the stirrup bar and `*' legend replaces the spacing of stirrup.

Stirrup details inside dimension

True – Stirrup details come inside the dimension.

False – stirrup detail come outside the dimension.

Stirrup line color, line layer, text color, text height, text style can change as per project.

Stirrup details – How stirrup details shown in detailing

Grouped – Stirrup details shown as maximum group

Split - Stirrup details shown as splited form.

• Click on the **convert data** from tool bar (Fig 6.1.7)

Convert data button design the beam with the aadspro beam design module. Before going to the conversion user must set input details and also in the property window.

Convert data button converts all the data in selected level and imported to the detailing system. In this process aadspro check all the beam and columns in that level and make the continuity details of the beam and make them into groups.

In detailing using STAAD Pro database aadspro make the reinforcement details with the forces and moments values from the database and used in detailing. aadspro calculate steel details for each section in beam. But in the case of ETABS database aadspro take the steel details directly from the database itself.

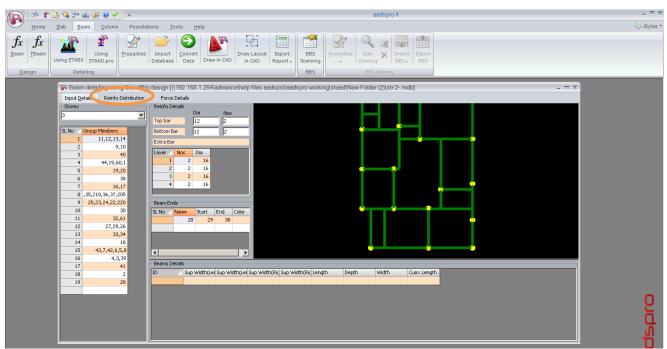


Fig 6.1.7

Reinfo Distribution:

The Reinfo Distribution window helps user to customize the steel distribution of the selected beam group. By selecting any beam group aadspro displays the details of the steel area in each station location. In Reinfo Distribution aadspro displays the steel details of the top, bottom and stirrup details of the selected beam



Force Details:

Force details list all the positive and negative moments, Torsion and shear details to grid in tabular format. This is used for creating design reports.

6.1.4 Results

• Click on the **Draw in Cad** from tool bar (Fig 6.1.8)

Draw in CAD button draws all beam groups listed in the grid just right side of the beam detailing window to AutoCAD. Before drawing to the AutoCAD user can edit the Reinforcement detail for any changes needed. Make sure that Beam Properties must be set before going to draw. User can draw a single beam group by right click the grid and selecting the 'Draw section menu'.

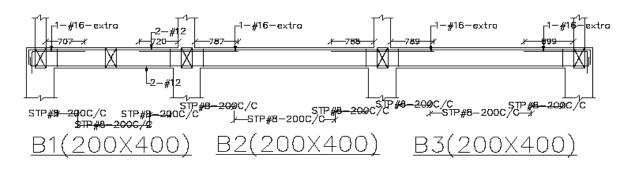
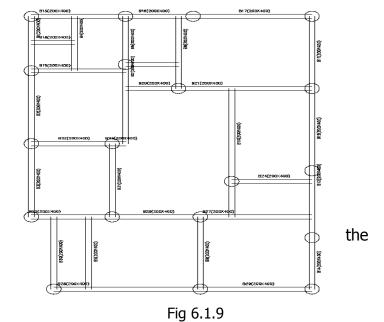


Fig 6.1.8

 Click on the 'Draw layout in cad' from tool bar (Fig 6.1.9)

This button creates a layout of beam with the beam name in AutoCAD

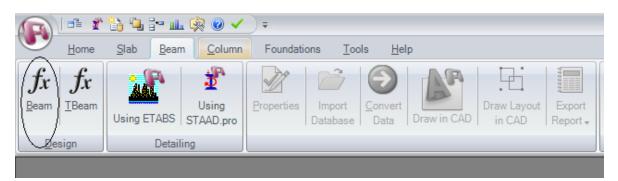
- Click on the 'Export Report' from tool bar.
- Export Report button export details to excel format.



6.2 Beam Design

This module contains Design of a beam section as per limit state method.

- 1.1 Steps involved in aadspro
- Open aadspro. Select 'beam' from the Main menu and 'Design' from drop down menu. (fig.6.2.1).





• User can set data in beam design grid (fig 6.2.2)

n 🔁 📲 🕌 🖫 🗁 💵 🦗 🕢 🗸	
Home Slab Beam Column Foundations Tools	Help
Import Database Scan From AutoCAD Execute Execute Import Draw in CAD Import Print Import Export Report Import Close Window	v
Home	
Dimensions Width (section) (mm) 200 Depth (section) (mm) 450 Nominal Cover (mm) 30 Forces Moment (KN-m) 105 Torsion (KN-m) 0 Shear (KN) 150 Stirrup Details Shear Diameter (mm) 8 No of legs for stirrups 2 Compressive Reinforcement Diameter (mm) 12 No of bars provided 2 Tensile Reinforcement Diameter (mm) 12	Steel For moments Eff. Depth 0.00 mm (Mu) 0.00 KN-m (Mulim) 0.00 KN-m (Mulim) 0.00 KN-m Comp.steel (Ast1) 0.00 mm ² % Reinf 0.00 mm ² % Reinf 0.00 mm ² Provided(Ast) 0.00 mm ² Shear Allowable shear stress of section(vc) 0.00 Mpa Capacity of section in shear(Vc) 0.00 KN Shear resisted by additional Reinforcement 0.00 KN Area of shear reinforcement required 0.00 mm ² /mm Maximum spacing allowed 0.00 mm ²

Fig 6.2.2

🖗 Beam Section Des	sign	
Dimensions Width (section) (mm) Depth (section) (mm) Nominal Cover (mm)	200 450 30	Stee
Forces Moment (KN-m) Torsion (KN-m) Shear (KN)	105 0 150	Comp
Stirrup Details Shear Diameter (mm) No of legs for stirrups	8	Shea
Compressive Reinforce Diameter (mm) No of bars provided	ment	-
Tensile Reinforcement Diam	neter (mm)	16

- In Beam Section Design plate, input the dimensions and clear cover by typing new values in the boxes.
- Similarly input the factored values of moment, shear and torsion.
- Input the reinforcement and clear cover by typing new values in the boxes.
- Program calculates the actual shear stress of the section and compares this with the allowable capacity. Minimum shear reinforcement or additional shear reinforcement, if required any, will also be provided.

Consider the examples given below and its solutions by manual calculation. Explanations are also attached after solutions to see how the programme arrives at results.

Example 1

Determine the reinforcement required for a rectangular beam section with the following data.

Width: 200mm

Depth: 500mm

Factored B.M: 310kNm

Factored torsional moment: 10 kNm

Factored shear force : 150 kN

Use M25 grade concrete and Fe 415 steel.

Solution

Overall depth = 500 mm

Assuming 25 mm dia. bars of two layers at a clear cover of 30 mm and 10mm dais stirrups,

Vertical distance between longitudinal bar is 20mm.

Effective cover, d' 30 + 5 + 25 + 20 + (25/2)= 92.5mm = Effective depth, d 500 - 92.5 = 407.5 mm = X_{umax}/d 0.48 (As per Cl: 38.1 of IS 456-2000) = X_{umax} 0.48 x 407.5 = 195.6 mm =

Longitudinal reinforcement

Equivalent bending moment, M _{e1}	=	$M_u + M_t$
Where, M _t	=	$T_{u}\left[\frac{1+\frac{D}{b}}{1.7}\right]$
		$\left[1+\frac{500}{2}\right]$

Mt

 $= 10 \times 10^{6} \left[\frac{1 + \frac{500}{200}}{1.7} \right]$

= 20.59 kNm

Since $M_u > M_t$, calculate M_{e1} as per IS 456-2000 Cl: 41.4.2., otherwise calculate M_{e2} as per IS 456-2000 Cl : 41.4.2.1.

 $\therefore M_{e1} = 310+20.59$ = 330.59 kNm aadspro

Limiting moment of resistance, M	1 _{ulim}	=	0.36(x _{umax} /d)(1-0.42x _{umax} /d)bd ² f _{ck}
		=	0.138 f _{ck} bd ² (for fy415)
		=	0.138 x 25 x 200 x 407.5 ²
		=	114.58 KNm
Percentage of steel at limiting			
Condition, p _{tlim}		=	$41.4(f_{ck}/f_y)(x_{umax}/d)$
		=	41.4 x (25/415) 0.48
		=	1.197%
Area of steel at limiting condition	, A _{stlim}	=	(p _{tlim} bd)/100
		=	1.197 x 200 x 407.5/100
		=	975.64mm ²
Calculation for tensile steel			
Additional moment, M_{u2}	=	M _{e1} -M	1 _{ulim}
	=	330.5	59 – 114.58
	=	216.0	1 KNm
Area of additional steel, Ast_2	=	M _{u2} /((0.87fy(d-d'))
	=	216.0	01 x 10^6 / (0.87 x 415(407.5-92.5))
	=	1899.	.305 mm ²
Total tensile steel, A _{st}	=	A _{stlim} +	-A _{st2}
	=	975.6	4 +1899.305
	=	2874.	95 mm ²

No of bar required	=	Ast / (Area of bar used)
	=	2874.95 / (490.625)
	=	5.85 nos
Hence provide 6 bars of 25 n	nm dia in te	ension side ($A_{st} = 2943 \text{ mm}^2$)
Calculation for compression s	steel	
Stress in concrete, f_{cc}		= 0.446f _{ck}
	=	0.446 x 25
	=	11.15N/mm ²
Stress in compression steel, f	sc =	700(1-(d'/x _{umax}))
	=	700(1-(92.5/ 195.6))
	=	368.967 N/ mm ²
Here, d'/d	=	92.5 / 407.5
	=	0.22
Maximum value of f _{sc} (f	or fy 415)	= 353 N/mm^2 (from SP 16, Table F)
Note: For fy 250 steel the m	aximum va	alue of f _{sc} is 0.87fy
Area of compression steel, A	_{sc} =	$M_{u2}/((f_{sc}-f_{cc})(d-d'))$
	=	(216.01 x 10^6)/ ((353-11.15) x (407.5-92.5))
	=	2003.63 mm ²
No. of bar required in comp. side =		A _{sc} / (Area of bar used)
	=	2003.63 / (490.625)
	=	4.08no.s
Hence provide 4 bars of 25m	m dia.(A _{sc}	_c = 2003.63 mm ²)

Check for maximum and minimum area of steel:

Minimum area of steel required, A_{sm}	nin	=	$\frac{0.85bd}{fy}$
		=	$\frac{0.85x200x407.5}{415}$
		=	166.93 mm ² < A_{st} provided
Maximum area of steel required, A_m	ıax	=	0.04bD
		=	0.04 <i>x</i> 200 <i>x</i> 500
		=	4000.00 mm ² > A_{st} provided
Transverse reinforcement			
Equivalent shear, V_e =	=	V_u -	$+1.6\frac{T_u}{b}$
=			$150 \times 10^3 + 1.6x \frac{10 \times 10^6}{200}$
=			230 kN
Equivalent shear stress, τ_{ve} =			$rac{V_e}{bd}$
=		$\frac{230\times}{200\times4}$	
=		2.8 N/	$mm^2 < \tau_{c, max}$

(for M25 $\tau_{c, max}$ = 3.1 N/mm²)

Shear is safe. Hence revision not required.

% Steel provided, p_t = $100 \times \frac{A_{st}}{bd}$ = $100 \times \frac{2943}{200 \times 407.5}$ = 3.61% τ_c , From table 19 of IS 456: 2000 for pt = 3.61%,

$$=$$
 0.92 N/ mm²

Since $\tau_c < \tau_{ve}$, transverse shear reinforcement is essential.

As per IS 456-2000, Cl: 41.4.3., The area of two legged stirrups should satisfy the equation,

$$A_{sv} = \frac{T_u . S_v}{b_1 . d_1 \langle 0.87f_y \rangle} + \frac{V_u . S_v}{2.5 d_1 \langle 0.87f_y \rangle}$$
$$A_{sv} = \frac{10 \times 10^6 . S_v}{115 \times 415 \times \langle 0.87^* 415 \rangle} + \frac{150 \times 10^3 . S_v}{2.5 \times 415 \times \langle 0.87^* 415 \rangle}$$

Assuming 10 dia stirrups,

2 x 78.54	=	$0.58 \ S_v + 0.4 \ S_v$
Sv	=	160 mm

Also, area of transverse reinforcement should satisfy the following condition,

$$A_{sv} = \frac{\langle \tau_{ve} - \tau_c \rangle b.S_v}{0.87 f_y}$$

$$2 \times 78.54 = \frac{\langle 2.8 - 0.92 \rangle 200.S_v}{0.87 \times 415}$$

$$S_v = 150.83 \text{ mm}$$

Choosing the minimum, provide 10 dia stirrups @ 150mm c/c.

As per IS 456-2000, Cl: 26.5.1.7, this spacing should not exceed the least of the following,

i) $x_1 = 200-(2x30)+10 = 150$ mm

ii) $\frac{x_1 + y_1}{4} = \frac{150 + 450}{4} = 150$ mm

iii) $y_1 = 500-(2x30)+10 = 450$ mm

Hence provide 10mm dia 2 legged stirrups @ 150 mm c/c.

Now let us see how the program arrives at results.

- 1. First enter the Characteristic values of concrete and steel. Here this values are f_{ck} = 25 and f_y = 415.
- 2. Enter the dimensions of the beam section. Given width = 200 and overall depth = 500. Assuming25mm dia bars and 10mm dia stirrups at a clear cover of 30mm, effective depth = 407.5mm. The programme automatically calculates the effective depth with respect to the area of tensile reinforcement (provided) and this is displayed just above the message boxes.
- 3. Here, select 25mm dia bars as compressive reinforcement, 25 mm dia bars as tensile reinforcement and 10mm dia stirrups as shear reinforcement.
- 4. Enter the values of moment = 310 kNm, Torsion = 10 kNm and Shear force = 150KN.
- 5. Cross sectional details of the beam is neatly shown in the diagram attached to the design plate.

<u>H</u> ome <u>S</u> lab <u>B</u> ean	n <u>C</u> olumn Foundations	<u>T</u> ools	Help
Import Scan From AutoCAD	Draw in CAD Print Export	Close Window	
	Beam Section Design	_	_ = x
	Dimensions Width (section) (mm) Depth (section) (mm) Nominal Cover (mm) Forces Moment (KN-m) Torsion (KN-m) Shear (KN) Shear (KN)	200 500 30 310 10 150	Steel For moments Eff. Depth 407.5 (Mu) 331 KN-m (Mulim) 114.579 KN-m Comp.steel (Ast1) 1846.496 % Reinf 3.614 Tensile (Ast) 2652.349 Provided(Ast) 2946.429 Shear Allowable shear stress of section(vc) Allowable shear stress of section(vc) 1.023 Capacity of section in shear(Vc) 83.403
	No of legs for stirrups Compressive Reinforcement Diameter (mm) No of bars provided Tensile Reinforcement	2 25 4	Shear resisted by additional Reinforcement 146.597 KN Area of shear reinforcement required 0.996 mm²/mm Maximum spacing allowed 140 mm Provide a spacing of 140 mm with 10 mm Bars
	Diameter (n	nm)	25 Required nos 5.403 No of bars provided 6

Now let us see how the program arrives at results.

1. Program automatically calculates the moment and shear. A comparison with manual calculation is shown below.

	Values from	Values by manual
	Program	Calculation
Effective depth	407.5mm	407.5mm
Mulim	114.58kNm	114.58kNm
Area of tensile reinforcement	2946.429mm ²	2874.95mm ²
Spacing of stirrups	140 mm	150 mm

Here almost all values are exactly same as that of manual calculation.

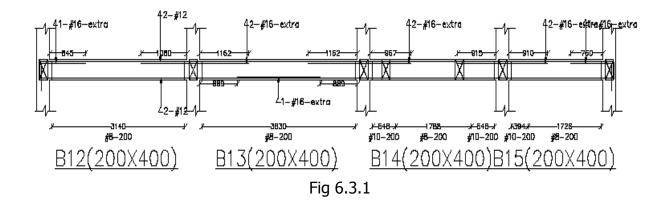
6.3 BBS (Bar Bending Schedule) of -BEAM

This chapter provides a method for getting the bar bending schedule of existing beams. This can be used to change the existing bar bending schedule of beams.

6.3.1 In AutoCAD

Beam detail is provided in AutoCAD as shown in the fig 6.3.1

• Stirrup details should be in #8-220 formats, the entire leader should touch the line. Beam naming tag should be there.



6.3.2 In aadspro

Select 'Beam' from the Main menu and 'Beam BBS Scan' from drop down menu. Beam BBS Scan window will be displayed as below (Fig 6.3.2)



Fig 6.3.2

aadspro

6.3.3 Click on the **properties** from tool bar (fig 6.3.3)

_	2↓ □		_
-	Defaults		-
	Add Laping Length	False	
	Add One Extra Bar	True	
	Bar Details Type	ShowBarmakandDetails	
	BarMark Text Color	Cyan	
	BBS Options	Split	
	Beam Naming Tag	В	
	Bend Length	100	
	Development Length Factor	50	
	Drawing Type	Beam	
	Export To	AutoCAD	
	IS 13920 Used	False	
	Margin to Leader	10	
	Min Column Size	250	
	Reinforcement Tag	#	
	Starting BarMark	500	
	Top Bar Single	False	
	Wall Height	3.5	
Ξ	Junction bar Extension		
	At Junctions	400	
	At No Junctions	50	_
Ξ	Misc		
	FyValue	415	
Ξ	Reinfo		
	Dimension Layer	SRC_DIM	
	Reinforcement Layer	SRC_REINFO	
Ξ	Stirrup		
	Bottom Cover	30	
	Clear Cover	40	
	Constant Inner width	300	
	Hook Length	40	
	Stirrup Dimensions	Inner	
	Stirrup Tolerance	50	
	Top Cover	30	
	Type of Inner With	Constant	

Fig 6.3.3

Misc

- Fy value Set fy value
- ➤ Reinfo
- Reinforcement layer

Layer of reinforcement drawn in Auto Cad

- ➤ Stirrup
- Bottom cover given in beams
- Clear cover
- Constant inner width

- > Default
- Add lapping length

Set true for adding a development length to the total length with the bar of length greater than 12m.

BBS Option

Bar bending schedule can 'Grouped' or 'split' type

- Beam Naming Tag Beam naming tag used in drawing
- Development length factor
- Development length factor used
 Export to

Bar bending exporting option, 3 options are there

- 1. Auto Cad
- 2. Simple Excel
- 3. Excel with picture.
- IS 13920 Used

Set true for if IS 13920 is used.

Margin to Leader

Setting the tolerance of the leader position with the reinforcement line in drawing

Min column size

Minimum size of the column:

Reinforcement Tag

Reinforcement tag used in drawing

• Starting Bar mark:

Starting bar mark to be set for bar bending schedule

- Constant width for inner stirrups in 4 Legged stirrups
- Hook length
- Hook length multiplier
- Stirrup dimensions
- Calculate the stirrup dimension with inner or outer
- Stirrup tolerance
- Minimum stirrup tolerance in mm
- Top cover
- Top cover given in beams
- Type of inner width
- Sets the width type of inner stirrups in 4 Legged stirrups
- Constant- will set the value in inner stirrup constant width property.
- As per width- will give the 1/3 value of the width after reducing the clear cover of the beam.
- Click on the **Scan drawing** from tool bar (fig 6.3.4)

The scan Beam Drawing button help the users to select the beam area from layout drawing in AutoCAD. Before scanning the layout the drawing must formatted to suit with aadspro scanning process.

A	1 💼 🦹	👌 强 im i	11 🖗	@ 	-								Bear	m BBS	Scan	Utility - a	aadsp
\cup	<u>H</u> ome	<u>S</u> lab <u>B</u> e	am 🤇	olumn	Foundations	<u>T</u> ools	<u>H</u> elp							_			
fx Bear		Using ETABS	Us			mport <u>C</u> onv atabase Dat		Draw Layou in CAD	t Export	rt	BBS canning	Pro	perties	Scar Drawin	n	Import BBS +	Exp BB
[<u>D</u> esign	Det	ailing								BBS			BBS	Scanir	ng	
EBS Details Weight Details																	
ID	Bar Mark	Bar Type	Size	Mem No	Bar No	Total Bars	Total Length	Shape Code	A	В	С	D	E	F R	5		
B12	500	#	8		1 52	52	1025	8B	325	0	0	0	105	0			
B14	501	#	10		1 11	11	1050	8B	320	0	0	0	100	0			
	502	#	12		l 2	2	14225	38	13590	340	340	0	0	0			
	503	#	16		1 1	1	1550	37	1045	530	0	0	0	0			
	504	#	16		1 2	2	2550	20	2545	0	0	0	0	0			
	505	#	16		1 2	2	2450	20	2430	0	0	0	0	0			
	506	#	16		1 2	2			2125	0	0	0	0	0			
	507	#	16		1 1	1	1475		960	530	0	0	0	0			
	508	#	16		1 1	1	1975		1955	0	0	0	0	0			
	509	#	12		1 2	2	14225	38	13530	370	370	0	0	0			
_																	

Fig. 6.3.4

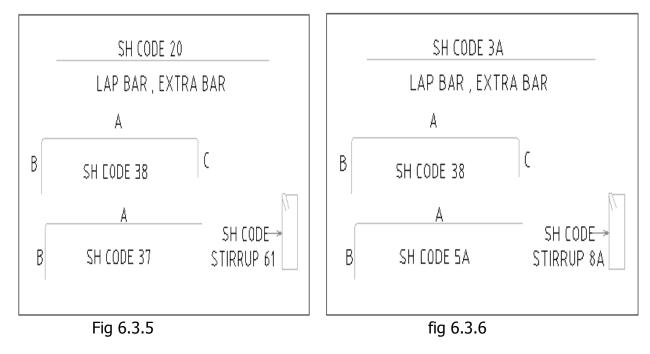
Here,

- Bar mark = Bark mark given in Result (500,501 etc as shown in Fig
 6.3.4)
- # = Type of bar.
- Size = Bar dia size
- Member No = No of repetitions of the member.
- Bar No = No of bars of same length and dia.
- Tot Bars (Total Bars) = Member No x Bar No
- Len(Bar)mm = Length of bar in mm
- Shape code = Shape code depends on the code selected, British, Indian & American.
- A, B, C etc = Representations in shape code.

SHAPE CODES

As per British code

As per Indian code



1.3 Results

- Bar Bending Schedule (Fig 6.3.7 & Fig 6.3.8) is obtained for the drawing in AutoCAD
- Here 1-#16-503 means 1 number 16 mm dia bar and 503 represents bar no for BBS.
- 2L-17-#8-500-200 means 2 legged 17numbers of 8 mm dia stirrups @ 200 mm spacing and 500 represents bar number for BBS.

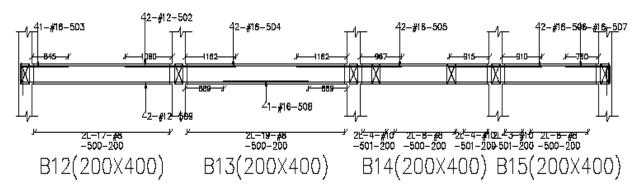


Fig	6.	3.	7
-----	----	----	---

B	Bar Bending Schedule															
10	Bor Mork	Sor Type	Sizz	Mern No	Bor Nol	iotol 88a	ebol Lerbij	ibpe Cor	IE A	8	с	D	E	F	R	s
812	500	¥	в	1	52	52	1025	88	325	a	o	o	105	o		
814	501	ŧ	10	n	11	11	1050	88	320	a	D	σ	100	۵		
	502	¥	12	1	2	2	14225	38	13590	340	340	0	٥	٥		13590
	503	¥	16	1	1	1	1550	37	1045	530	o	o	٥	o		<u>الاسمال</u>
	5D4	¥	16	1	2	2	2550	20	2545	a	D	a	٥	٥		<u>12545</u>
	505	¥	16	1	2	2	2450	20	2430	Ð	o	o	٥	o		<u>1 2430 1</u>
	506	ŧ	16	1	2	2	2125	20	2125	a	D	٥	٥	o		<u>1</u> 21251
	507	Ŧ	16	1	۱	1	1475	37	960	53D	D	a	٥	۵		- <u></u>
	508	#	16	1	1	1	1975	2D	1955	0	o	o	٥	o		1 <u>1855-1</u>
	508	ŧ	12	1	2	2	14225	38	13530	370	370	٥	٥	٥		1-13530-1 370-370-

7. SLAB

7.1 Slab Detailing

This chapter provides a step-by-step tutorial for the detailing of a slab of a multi-storied building.

- 7.1.1 Description of structure
- 7.1.2 Steps involved in auto cad
- 7.1.3 Steps involved in aadspro
- 7.1.4 Results

7.1.1 Description of the structure

The structure is a double storied building; in which the first floor slab is to be designed. Plan of the building is shown in fig. (7.1.1).

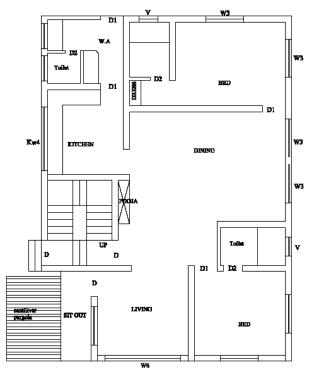


Fig. 7.1.1

aadspro

7.1.2 Steps involved in auto cad

A layout of the slab is provided in AutoCAD as shown in the fig 7.1.2.

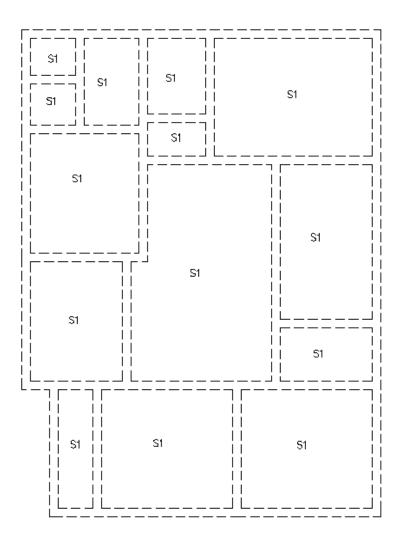
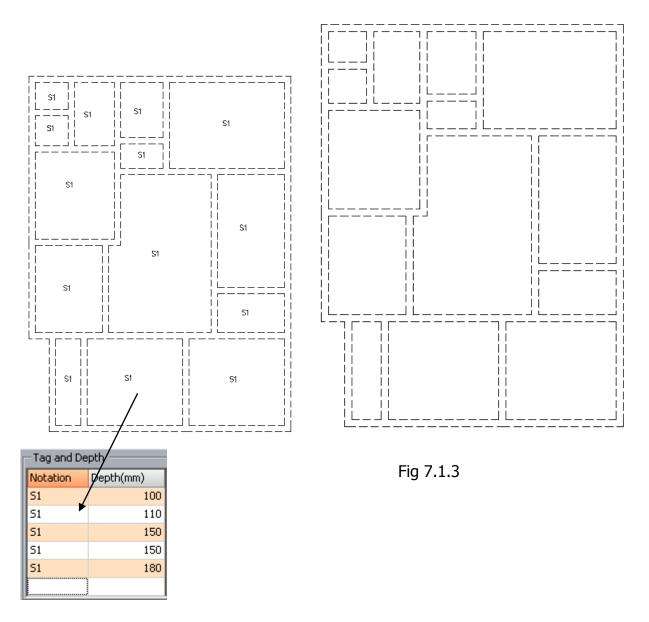


Fig.7.1.2

Make two layouts as shown in fig. 7.1.3



Layout should be filleted, the Z coordinate must be 0, give any slab name like 'S1' in each slab of one layout, one layout for bottom bar reinforcement and other for top bar reinforcement.

7.1.3 Steps involved in aadspro

Click on the **slab detailing** from tool bar (Fig 7.1.4)

Slab detailing module is powerful tool for generating slab detailing drawing to AutoCAD. In this module aadspro automatically detects the slab area and edge conditions by selecting the layout area in AutoCAD.

This tool helps to minimize the drafting and design time .The simple user interfaces help the users to make the activity more easy and understandable. User can give their own parameters, detailing strategies and detailing style in this process.

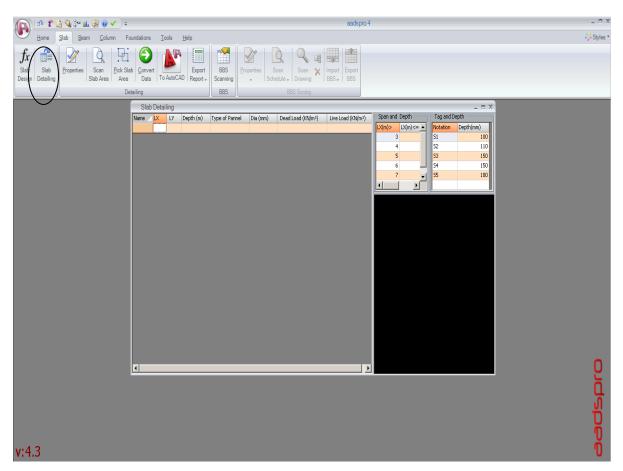


Fig 7.1.4

The layout window helps the user to customize the detailing and design process. By setting these properties user can customize the detailing with variety of option.

• Click on the **properties** from tool bar (Fig 7.1.5)

The property window help the user to customize the detailing and design process. By setting these properties user can customize the detailing with variety of option .User can change the visual appearance of drawing and also the design parameters

> Bottom bar

Color & Layer of Bottom bars lines drawn in auto cad in detailing process.

• Bottom continuous or discontinuous bar edge length multiplication factor

This property help aadspro to draw the line in the Bottom bar continuous or discontinuous edge. This length is calculated by multiplying the span length with the given factor

eg: if the span length is 3.5 meter and the factor is 0.17 the continuous bar edge length will be 3.5x0.17 = 0.6 m

For discontinuous bar edge length will be 3.5x0.12=0.42m

> Bottom bar Dimension

Layer & color of the Bottom bars dimension lines drawn in auto cad in detailing process.

Defaults

Default value can change from main menu-toolssettings- aadspro properties.

> Miscellaneous

- Beam width
- Default diameter > As per project layout
- Dimension style -
- Drawing unit
- Live load (factored Kn/m²)
- Minimum spacing
- Detailing type
- Select suitable detailing type from drop menu

Slab Detailing Properties _ = X								
•	Ż↓ 🖻							
-	Bottom Bar	_						
	BottomBarColor	Red						
	BottomBarLayer	SRC_SLAB_BOTBAR						
	BottomContinuousBarEdgeLe	0.17						
	BottomDiscontinuousBarEdge	0.12						
-	Bottom Bar Dimension							
	BottomBarDimensionLayer	SRC_SLAB_BOTBAR_DIM						
	BottomBarDimensionLayerCo	Red						
-	Defaults							
	CheckSteelAsper	AsperCode						
	DesignCode	Indian						
	FckValue	25						
	FyValue	415						
-	Misc							
	BeamWidth	200						
	DefaultDiameter	8						
	DetailingType	BardetailsinsidetheDrawing						
	DimensionStyle	Found 1						
	DrawingUnit	Millimeter						
	LiveLoad	3						
	MinSpacing	200						
	ShowLbendAsCircle	True						
	UseSlabDepth	AsperSpan						
-	Top Bar							
	AlternateBarLengthPercenta	60						
	LBendLength	1000						
	TopBarColor	Red 📃						
	TopBarLayer	SRC SLAB TOPBAR						
Pe	ternateBarLengthPercentage ercentage of Length(Top Cont e alternate bar in Top bar det	inuous Edge Bar) to be given to :ailing						

Fig 7.1.5

- Show bend As circle
 Set 'True' to show L bend as a circle
 Set 'False' to show L bend as a L shape
- Use slab depth 1. AsperUserDefinedLX
 This option helps the user to select the depth of slab with the span
 LX. The show how user can set the depth of slab. In this user can
 enter the depth value that they need to various LX value.

 For e.g. When a slab has a LX of 3.5 the system will check these
 entered values and find the desired depths from the given list. Here
 aadspro take 120 as depth
- 2.As per User Defined Tag

This option help the user to select the depth of slab with the given notation in AutoCAD At the scanning time. The fig. (b) Show how user can set the depth of slab . In this user can Enter the depth value that they need in various notations. In the scanning process time aadspro

assign these depths to the scanned slab area

3.As per span

In this option aadspro assigns a depth to each slab by checking each slab spans and assign a depth with standard code provisions.

> Top Bar

- Alternate Bar length percentage
 Percentage of length (top continuous edge bar) to be given to the alternate bar in top bar
- detailing.
- L Bend Length

Set the length of the bending bar in the discontinuous edge of the slab

Top bar color & Layer

Color & Layer of Top bars lines drawn in auto cad in detailing process.

• Top continuous or discontinuous bar edge length multiplication factor

This property help aadspro to draw the line in the Top bar continuous or discontinuous edge. This length is calculated by multiplying the span length with the given factor

eg: if the span length is 3.5 meter and the factor is 0.3 the continuous bar edge length will be 3.5x0.3 = 1.05 m

For discontinuous bar edge length will be 3.5x0.2=0.7m

> Top Bar Dimension

Layer & color of the Top bars dimension lines drawn in auto cad in detailing process.

• Click on the **Scan slab area** from tool bar (fig 7.1.6)

The scan Slab button help the users to select the slab area from layout drawing in AutoCAD. Before scanning the layout the drawing must formatted to suit with aadspro scanning process. Users must note the below listed conditions before scanning.

1. The Appropriate notation (eg :S1,S2,S3 etc..) to be placed inside the layout to find out the slab area

2. The enclosing beam lines must be filleted properly to find out the slab area.

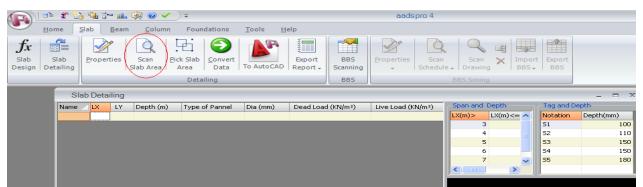


Fig 7.1.6

1.3.3 Click on the **Convert data** from tool bar (fig 7.1.7)

The convert data button in aadspro analyzes all the created slab areas and makes their continuity details and assign edge conditions of each slab area.

			• <u>nila</u> (÷				aadspro 4			
fx Slab	Home Sla Slab Detailing	Propert		Scan Pick	Foundations		Export Report -	BBS Scanning	Properties Scan Schedule	Scan 🗙 Im	port Export BS - BBS	
					Detailing			BBS				
	Slab	Detai	ling									_ = ×
	Name	LX		Depth (m)	Type of Pannel	Dia (mm)	Dead Load	d (KN/m²)	Live Load (KN/m²)	Span and Depth	Tag and D	
	Slab - 1	2720	4510		OneLongEdgeDi			6	2.1	LX(m)> LX(m)<=		Depth(mm)
	Slab - 2	1700	2720		OneShortEdgeC			6	2.	3	51	100
	Slab - 3	3500	3800		TwoAdjecentEd			6.75	2.	4	52 53	110
	Slab - 4 Slab - 5	3500 1160	3800		OneLongEdgeDi TwoAdjecentEd			6.75	2.'	6	53	150
	Slab - 6	2740	3550		OneLongEdgeDi			6	2.		V 55	180
	Slab - 7	4068	6250		InteriorPannel			6.75	2.	< >	<u> </u>	
	Slab - 8	1340	1440		OneShortEdgeC			6	2.			
	Slab - 9	1250	1440	0.11	TwoAdjecentEd	ge: 8		6	2.			
	Slab - 10		2630		OneShortEdgeC			6	2.			
	Slab - 11		4548		TwoAdjecentEd			6.75	2.'			
	Slab - 12				InteriorPannel_:			6	2.'			
	Slab - 13		2320		OneShortEdgeC			6	2.'			
	Slab - 14	3200	3530	0.12	OneLongEdgeDi	sO 8		6.38	2.			
v:4. 3	3	_	_			1111	_					

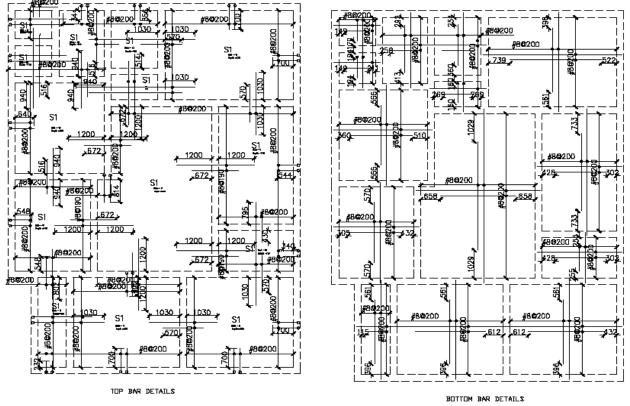
Fig 7.1.7

aadspro

7.1.4 Results

Click on the 'To Auto Cad' from tool bar •

The Draw in AutoCAD button will prompt the user to pick two points in AutoCAD to draw the bottom and top detailing of slabs with the current converted data.





Click on the Schedule from ٠

tool bar

Draw schedule button draws the slab schedule in AutoCAD with designed pile number.

1	#8 AT 200 C/C	11	#8 AT 200 C/C
2	#8 A⊤ 200 C/C	12	#8 AT 200 C/C
3	#8 AT 200 C/C	13	#8 AT 200 C/C
4	#8 AT 200 C/C	14	#8 AT 200 C/C
5	#8 AT 200 C/C	15	#8 AT 190 C/C
6	#8 AT 200 C/C	16	#8 AT 190 C/C
7	#8 AT 200 C/C	17	#8 AT 200 C/C
8	#8 AT 200 C/C	18	#8 AT 200 C/C
9	#8 AT 200 C/C	19	#8 AT 200 C/C
10	#8 AT 200 C/C	20	#8 AT 200 C/C

7.2 Slab Design

7.2.1 Two way slab design

This module contains both Analysis and Design of a slab section as per limit state method.

7.2.1.1. Steps involved in aadspro

Open aadspro. Select 'slab' from the Main menu and 'Design' from drop down menu. (Fig 7.2.1)

A	💼 🐒 🔐	f 🛅 强 📴 💵 🙊 🎯 🖌 🗧								
	Home	<u>Slab</u> <u>B</u> eam <u>C</u> olumn Foundations <u>T</u> ools <u>H</u> elp								
fx Slab Design	Slab Detailing	Properties Scan Slab Area Dick Slab Convert Data To AutoCAD Export	BBS Scanning	Properties Scan Schedule Trawing BS-						
\square		Detailing	BBS	BBS Scning						

Fig 7.2.1

• User can set data in slab design grid (fig7.2.2)

👝 i 🖆 🖺 🖫 🗁 💵 🙊 🔍 🗸		aadsp	ro 4
Home Slab Beam Column Foundations Tools He	lp		
Import Scan From AutoCAD Execute Draw in CAD Draw in CAD			
Home			
Steel F (%) Steel F (%) Steel F (%) Requ	antilever 🔘 Circular Fixed	Factored Load (KN/m²) 9,75 Fx (continuous)(KN) 14.89 Fx (Discontinuous)(KN) 0.00 F (y axis) (KN) 11.26 Mx (support) (KN-m) 6.138 Mx (midspan) (KN-m) 4.705 My (support) (KN-m) 3.822 My (midspan) (KN-m) 2.867 Forces C Calculate Moment (KN-m) 14.89 Tensile Reinforcement Required Spacing (mm) 0.00 Spacing Provided (mm) 0.00 Shear Strength of the section(vc) (Mpa) 0.00 Capacity of section(Vc) (KN) 0.00	Le X
	Fig 7.2.2		

> Type

Select type of slab

Slab depth

Constant:-

This option help the user to fix the depth.

As per span:-

In this option aadspro assigns a depth to each slab by checking each slab spans and assign a depth with standard codel provisions.

> Deflection

Select deflection whichever required. The corresponding deflection will be shown in deflection box.

- Width of support(cm)
- \triangleright
- > Lx(short side)(m) (effective span shorter direction)
- > Ly(m) (effective span longer direction
- Width(mm)
- Depth of slab
- > Cover
- > Diameter
- Load Load detail can set as per project on 'Loads' grid
- Material properties, f_{ck} & f_y is a default value, can be change by clicking Tools-Settings-addspro properties.

Program thoroughly checks the code provisions like max. Diameter of tensile reinforcement, maximum spacing of reinforcement in longitudinal and transverse directions, minimum concrete cover, etc. and gives message alerts if the values are exceeding the limits as per IS: 456 – 2000.

Following illustrations give more idea about the performance of the program.

Consider the example below and its solution by manual calculation.

Example 1

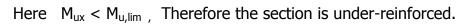
Design a slab over a room 6 m x 4.5m. The slab has a bearing of 150 mm all round at the edges on supporting masonry walls. The corners of the slab are held down. The live load on the slab is 3000 N/ m^2 . Use M 15 concrete and Fe 415 steel.

Solution

Distance between the c/c of bearings						
in the shorter direction	=	4.5+.15				
	=	4.65 m				
C/c distance in the longer direction		= 6+.015				
	=	6.15 m				
Assume over all depth as 1/30 of span	=	$\left(\frac{1}{30}\right)x4.65$				
=	155m	ım				
Provide dept	า	= 160 mm				
Provide a slab of depth160mm with 10 mm dia. bars and clear cover of 25mm						
Effective depth (shorter direction)	=	160 - 25 - 5 mm				
	=	130 mm				
Effective depth (longer direction)	=	160 - 25 - 5 - 10				
	=	120mm				
Clear span + eff. depth in shorter direction		= 4.5 + 0.130 = 4.63				
Clear span + eff. depth in the longer direction	=	6.0 + 0.120 = 6.120				
\therefore Effective span (Shorter of the two)						
In the shorter direction, I_x	=	<u>4.63m</u>				
In the longer direction, I_y	=	<u>6.12m</u>				
Span ratio, ly /l _x	=	6.12/4.63 = 1.32 Say 1.30				
Referring to Table 26 of I.S. 456-2000,						

Four edges discontinuous condition and span ratio 1.3, we get

$\alpha_{x} = 0.079$ and	α _γ =	0.056			
Load Calculation					
Self weight of the slab (160mm)	=	0.16	× 25	=	4.00 KN/m ²
Wt of finishes (20 mm)	=	0.02	× 25	=	0.50 KN/m ²
Live Load (given)					= 3.00 KN/m ²
Total Load				=	7.5KN/m ²
With a partial safety factor of 1.5	,				
Total factored load	=	7.5 ×	1.5	=	11.25 N/m ²
Consider a 1 meter wide strip of s	slab,				
Factored short span moment, M_{ux}	¢	=	$\alpha_{x} w l_{y}$	2 x	
		=	0.079	x11.25x	:4.63 ²
		=	19.05	KNm	
Factored long span moment, $\ensuremath{M_{uy}}$		=	$\alpha_{y}wl_{z}$	2 x	
		=	0.056	x11.25x	:4.63 ²
		=	13.51	KNm	
M _{u, lim}		=	0.138	f _{ck} bd ²	2
		=	0.138	x15x100	$200x130^2$
		=	34.98	KNm	



Steel for short span							
	$\frac{M_{ux}}{bd^2}$	=	$\frac{19.05x10^6}{1000x130^2}$				
		=	1.13				
Percentage of steel		=	$50\left[\frac{\sqrt{1-\frac{4.6}{f_{ck}}x\frac{M_{ux}}{bd^2}}}{\frac{f_y}{f_{ck}}}\right]$				
		=	$50\left[\frac{1-\sqrt{1-\frac{4.6}{15}x1.13}}{\frac{415}{15}}\right]$				
		=	0.35%				
Minimum percentage c	f steel		= 0.12% < 0.35%				
Area of steel, A _{st}		=	$\frac{0.35}{100} \times 1000 \times 130$				
		=	455.00 mm ²				
Spacing of 10 mm diar	neter bars	=	$\frac{78.5 \times 1000}{455.00}$				
		=	172.53mm				

<u>Therefore provide 10mm ϕ bars @ 170 mm c/c.</u>

Steel for long span

	$\frac{M_{uy}}{bd^2}$	=	$\frac{13.51x10^6}{1000x120^2}$
		=	0.94
Percentage of steel		=	$50\left[\frac{1-\sqrt{1-\frac{4.6}{f_{ck}}\times\frac{M_{uy}}{bd^2}}}{\frac{f_y}{f_{ck}}}\right]$
		=	$50 \left[\frac{1 - \sqrt{1 - \frac{4.6}{15} \times 0.94}}{\frac{415}{15}} \right]$
		=	0.283%
A _{st}		=	$\frac{0.283}{100}$ × 1000 × 120
		=	339.6 mm ²
Spacing of 10 mm diameter bars	S	=	$\frac{78.54 \times 1000}{339.6}$
		=	231.27mm
Therefore provide 10 mm dia h	ara @ 220mm	ala	

Therefore provide 10 mm dia. bars @ 230mm c/c

1 5		
	🖗 Slab Design	- = X
	-Туре	
	Slab Circular- Simple	Factored Load (KN/m²) 11.25
	C Cantilever C Circular Fixed	Fx (continuous)(KN) 0.00
	Slab Depth Deflection	Fx (Discontinuous)(KN) 21.61
Loads	Constant Short Term	F (y axis) (KN) 17.19
Dead Load Depth of Slab(mm) 160	C As per Span C Long Term	C Mx (support) (KN-m) 0.000
Wt of Slab (KN/m²)	Width of Support (cm) 15	Mx (midspan) (KN-m) 19.228
Depth of Finishes (mm) 20 Wt of Finishes 1 (KN/m²) 0.5	Lx(Shorter side)(m) 4.63	C My (support) (KN-m) 0.000
Wt Finishes2 (KN/m²))	Ly(m) 6.12	O My (midspan) (KN-m) 13.505
Vit Finishes3 (KN/m²)) 0	Width (mm) 1000	
Factor of Safety 1.5	Depth (mm) 160	-Forces
Factored Dead Load (KN/m2) 6.75	Cover (mm) 25	Calculate
Concentrated Load Con. Load (KN)	Diameter (mm) 10	Moment (KN-m)/m 19.228 Shear (KN)/m 0.00 Deflection 26.74 +
x (m) 0.30	Load 11.25	(All values are as per meter width only)
)Siddle of contact (m)	Steel For Moments	Tensile Reinforcement
0.30	Eff. Depth (mm) 130	Required Spacing (mm) 173.192
Effective width (m) 0.88 Factored Con. Load (KN/m ²) 0	Mu lim (KN-m) 34.983	Spacing Provided (mm) 170 Continuous
	(% Reinforcement) 0.355	-Shear DisContinuous
Live Load (KN/m²)	Required Ast (mm ²) 453,6659	Strength of the section(vc)(Mpa) 0,399
Factor of Safety 1,5	Provided Ast (mm²) 461.999	Capacity of section(Vc) (KN) 63.808
Factored Live Load (KN/m²) 4.5		
Total (KN/m²) 11.25		

Now let us see how the program arrives at results (Fig 7.2.3)



Now let us see how the program arrives at results.

2. Program automatically calculates the moment and shear. A comparison with manual calculation is shown below.

	Values from	Values by manual
	Program	Calculation
Effective depth	130mm	130mm
Factored load	11.25kN/m ²	11.25kN/m ²
M _{ux}	19.228kNm	19.05kNm
M _{uy}	13.51kNm	13.51kNm
Steel for short span	10mm @170mm c/c	10mm @170mm c/c
Steel for long span	10mm @250mm c/c	10mm @230mm c/c

Here almost all values are exactly same as that of manual calculation.

7.2.2 cantilever slab design

User can set data in slab design grid (fig 7.2.4)

▲ 🖉 📲 📲 🖿 🏛 🖗 🗸 🗧		aadspro 4	
Home Slab Beam Column Foundations Tool	s <u>H</u> elp		
Import Jatabase AutoCAD Execute Draw in CAD Print Export Clos	e		
Home			
	🖗 Slab Design		- = ×
	Type C Slab Cantilever Circular - Simple Cantilever Circular Fixed Slab Depth Constant As per Span Width of Support (cm) Lx(Shorter side)(m) Cover (mm) Cover (mm) Diameter (mm) Load 9.75 +	Dilear (Krywin 14,89	effection 15 + es are as per meter width only)
	Steel For Moments Eff. Depth (mm) 0.00 Mu lim (KN-m) 0.00 (% Reinforcement) 0.00 Required Ast (mm²) 0.00 Provided Ast (mm²) 0.00	Tensile Reinforcement 0.00 Required Spacing (mm) 0.00 Spacing Provided (mm) 0.00 Shear Strength of the section(vc)(Mpa) 0.00 Capacity of section(vC) (KN) 0.00 0.00	Continuous DisContinuous

Fig 7.2.4

Example 2:

Design a cantilever slab to carry a live load of 2500 N/m^2 . The overhang of the slab is 1.25 m. Use M 15 concrete and Fe 415 steel.

Solution

Provide a slab of depth 100mm with 8 mm dia. bars and clear cover of 15mm

h			=	100-1	5-4 mm
			=	81 mr	n
on					
the slab (100mm)	=	0.10	× 25	=	2.50 KN/m ²
(20 mm)	=	0.02	× 25	=	0.50 KN/m ²
(given)				=	2.50 KN/m ²
	on the slab (100mm) (20 mm)	on the slab (100mm) = (20 mm) =	on the slab (100mm) = 0.10 (20 mm) = 0.02	on the slab (100mm) = 0.10×25 (20 mm) = 0.02×25	= 81 mm on the slab (100mm) = 0.10 × 25 = (20 mm) = 0.02 × 25 =

Total Load		=	5.50 KN/m ²
With a partial safety factor of 1.	5,		
Total factored load	=	5.50 × 1.5 =	8.25 N/m ²
Consider a 1 metre wide strip of	slab,		
Max Bending Moment , M _{ux}	=	$\frac{wl^2}{2}$	
	=	$\frac{8.25\times1.25^2}{2}$	
	=	<u>6.445 KNm</u>	
Mu limit	=	0.138 x fck x b x	d ²
	=	<u>13.58 KNm</u>	

(M < Mu limit)

M bd²

Steel for Max Bending Moment

$$= \frac{6.445 \times 1000}{1000 \times (81)^2}$$

= 0.98
$$= 50 \left[\frac{\sqrt{1 - \frac{4.6}{f_{ck}} \times \frac{M_{ux}}{bd^2}}}{\frac{f_y}{f_{ck}}} \right]$$

$$= 50 \left[\frac{1 - \sqrt{1 - \frac{4.6}{15} \times 0.98}}{\frac{415}{15}} \right]$$

= 0.296%

Percentage of steel

Minimum percentage of steel

= 0.12 %< 0.296%

Area of steel, A _{st}	=	$\frac{0.296}{100}$ x1000x81		
	=	239.760 mm ²		
Spacing of 8 mm diameter bars	=	$\frac{50.24 \times 1000}{239.76}$	=	209.54mm

Therefore provide 8 mm ϕ bars @ 200 mm c/c.

Now let us see how the program arrives at results. (Fig 7.2.5)

👝 🗉 🗶 🛅 🖫 🖿 💷 🛞 🖌 🔪	Ŧ		aadspro 4
Home Slab Beam Column	Foundations <u>T</u> ools <u>H</u> elp		
Import Database AutoCAD	Print Export Close Report Window		
	🖗 Slab Design		_ = X
	Туре ———	Deflection FX (bikindoos)(N) 10,31 © Short Term FX (Discontinuous)(KN) 0,00 © Long Term FX (Discontinuous)(KN) 5,16 20 Mx (support) (KN-m) 6,445 20 Mx (midspan) (KN-m) 1,611 1.25 My (support) (KN-m) 3,223 1.25 My (support) (KN-m) 3,223 1000 My (support) (KN-m) 0,806 1000 Forces ✓ Calculate Moment (KN-m)/m 6,445 Shear (KN)/m 10,31 3 13.58127 Shear Spacing Provided (mm) 3.31 Shear Strength of the section(vc)(Mpa)	Deflection 0.75 + (All values are as per meter width only)

Fig 7.2.5

1. Program automatically calculates the moment and shear. A comparison with manual calculation is shown below.

	Values from	Values by manual
	Program	Calculation
Effective depth	81mm	81mm
Factored load	8.25kN/m ²	8.25kN/m ²
М	6.445kNm	6.445kNm
Steel for Max BM	8mm @200mm c/c	8mm @200mm c/c

Here all values are exactly same as that of manual calculation.

7.3. BBS (Bar Bending Schedule) of -SLAB

This chapter provides a method for getting bar bending schedule of existing slabs. This can be used to change the existing bar bending schedule of slabs.

7.3.1 In AutoCAD

Slab detail is provided in AutoCAD as shown in the Fig 7.3.1

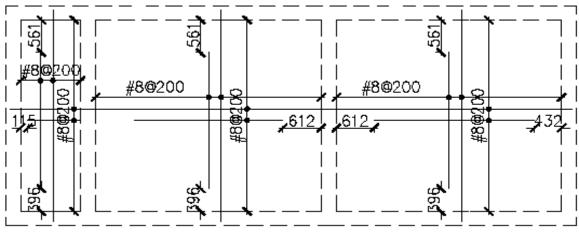


Fig 7.3.1

- There should not be any layer called 'Templayer'.
- The Z coordinate must be zero.

7.3.2 In aadspro

Select 'Slab' from the Main menu and 'Slab BBS Scan' from drop down menu Fig

7.3.2

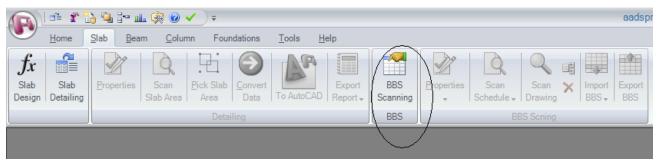


Fig 7.3.2

• Click on the **properties** from tool bar (fig 7.3.3)

-	Defaults		
	Add Laping Length	False	Γ
	Add One Extra Bar	True	
	Bar Details Type	BarmarkOnly	
	BarMark Text Color	Cyan .	
	BBS Options	Split	
	Beam Naming Tag	В	
	Bend Length	100	
	Development Length Factor	50	
	Drawing Type	Slab	
	Export To	AutoCAD	
	IS 13920 Used	False	
	Margin to Leader	10	
	Min Column Size	250	
	Reinforcement Tag	#	
	Starting BarMark	1	
	Top Bar Single	False	
	Wall Height	3.5	
Ξ	Junction bar Extension		
	At Junctions	400	
	At No Junctions	50	
Ξ	Misc		
	FyValue	415	
Ξ	Reinfo		
	Dimension Layer	HATCH	
	Reinforcement Layer	SRC_SLAB_BOTBAR	
Ξ	Stirrup		
_	Bottom Cover	30	•



> Default

•

- Add laping length Set true for adding a development length to the total length with the bar of length greater than 12m.
- Bar details type
 How bar details are shown after the scanning process.
- BarMark text color Set suitable color for bar mark text.
- Bend length
 - Length of L bend in slab detailing
 - Export to Bar bending exporting option, 3
 - options are there
 - 1.Auto Cad
 - 2.Simple Excel
 - 3.Excel with picture.
 - Reinforcement Tag Reinforcement tag used in drawing
- Starting Barmark Starting bar mark to be set for bar bending schedule.
- Top Bar single Set true for Top bar single in slab detailing drawing (only for top bar)
- Misc
 - Fy value
 - Set fy value
- Reinforcement
- Dimension layer- As per the project
- Reinforcement layer- As per the project

• Click on the **Scan drawing** from tool bar (fig 7.3.4)

The scan Slab Drawing button help the users to select the slab area from layout drawing in AutoCAD. Before scanning the layout the drawing must formatted to suit with aadspro scanning process.

<i>fx</i> _{Slab}		12									/						
Design	Slab Detailing	<u>P</u> roperties	Sca Slab /				Export D Report -	BBS Scanning	operties		Scar edue	+ D	Scan		Im		Export BBS
				[Detailing			BBS			_/	BBS	Scning	9			
BBS Details Weight Details								/	_	-	-						
			Size	Mem No	Bar No	Total Bars	Total Length	Shape Code	A 1000			D		F	R	S	
1 2 2		# #	8	1	9	9	1300		1300 745	0 100	0	0	0	0			
3 3		, #	8	1	9	9	2400		2380	0	0	0	0	0			
+ 4		#	8	1	16	16	3950		3940	0	0	0	0	0			
5 5		#	8	1	9	9	2575		2560	0	0	0	0	0			
6	,	¢	8	1	23	23	2350	20	2345	0	0	0	0	0			
7 7	\$	¢	8	1	21	21	3650	20	3640	0	0	0	0	0			

Fig 7.3.4

- Here,
 - Bar mark = Bark mark given in Result (1,2 etc as shown in Fig 5)
 - T = Type of steel.
 - Size = Bar dia size
 - Mem No = No of repetitions of the member.
 - Bar No = No of bars of same length and dia.
 - Tot Bars (Total Bars) = Member No x Bar No
 - Len(Bar)mm = Length of bar in mm
 - Shape code = Shape code depends on the code selected, British, Indian & American.
 - A, B, C etc = Representations in shape code.

SHAPE CODES

As per British code

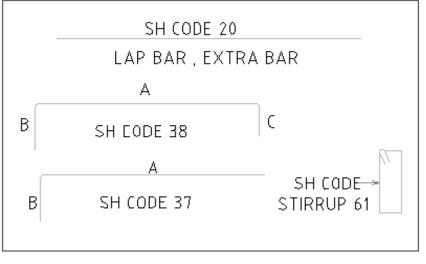


Fig 7.3.5<u>(</u>a)

As per Indian code

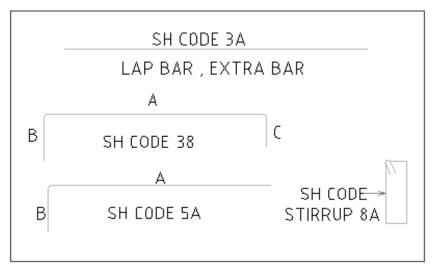


Fig 7.3.5(b)

7.3.3 Results

Bar Bending Schedule is obtained in AutoCAD (Fig 7.3.6 and Fig 7.3.7).

• 1, 2, 3 etc represents bar number for BBS.

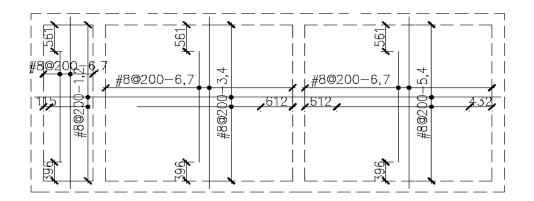


Fig 7.3.6

ID	Bor Mark	Bar Type	Size	Mem No	Bar Nol	iotal Baie	tai Lengi	lippe Cox	le A	в	с	D	E	F	R	S
1	1	ŧ	в	1	9	g	130D	20	1300	D	D	D	D	o		- <u>+</u> 1 300 <u></u> +
2	2	ŧ	в	1	в	8	850	37	745	100	٥	o	D	o		- <u>1</u> 745
3	з	ŧ	в	1	9	8	2400	20	2380	D	Б	D	D	o		<u>1 2380 1</u>
4	4	ŧ	в	1	16	16	3950	20	3940	D	D	D	D	D		<u>⁺<u></u>3940-<u></u>ť</u>
5	5	ŧ	в	1	9	g	2575	20	2560	D	٥	D	D	D		1 <u></u>
Б	Б	#	в	1	23	23	2350	20	2345	D	٥	٥	٥	٥		<u>1 2345 1</u>
7	7	ŧ	в	1	21	21	3650	20	3640	٥	ß	٥	٥	٥		<u>ı'</u> 364D <u>1</u> '

Bar Bending Schedule

Fig 7.3.7

8. COLUMN

8.1 column detailing

This chapter provides a step-by-step tutorial for the detailing of a column of a multistoried building.

- 8.1.1 Description of structure
- 8.1.2 Steps involved in Staad
- 8.1.3 Steps involved in aadspro
- 8.1.4 Results

8.1.1 Description of the problem

The structure is a double storied building; in which the column is to be designed. Plan of the building is shown in fig. (8.1.1).

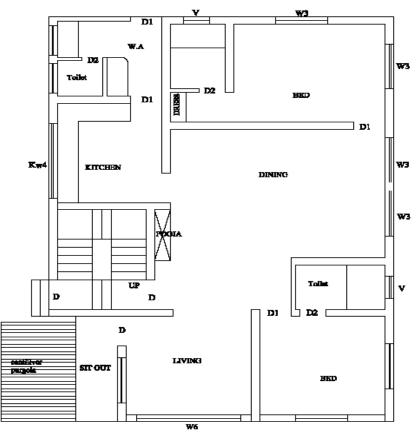


Fig.8.1.1

8.1.2 Steps involved in Staad

Staad mdb file is required for the design of column in aadspro,

Creating Staad mdb file

- Open the Staad file and analyze it.
- Select Tools >SQL Query>Advanced Query for STAAD Pro version 2006 & higher (fig.8.1.2).

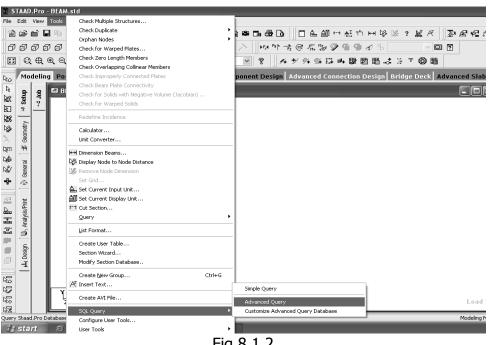


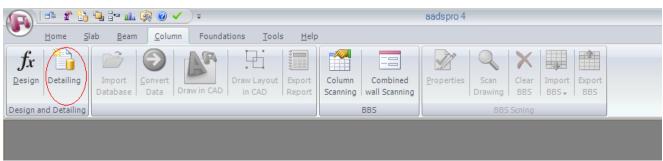
Fig.8.1.2

8.1.3 Steps involved in aadspro

Open aadspro. (AutoCAD will be open automatically)

Select 'Column' from main menu.

• Click on the 'Detailing' from tool bar (fig 8.1.3)





• User can set **properties** (fig 8.1.4)

This window helps the user to customize the detailing and design process. By setting these properties user can customize the detailing with variety of option.

User can set ₿₽₽₽ **Reinforcement Details** 🖂 aadspro Design Properties Bar Number Increment 2 王 Diameters used in Design Int32[] Array AADSPRO DESIGN PROPERTIES Maximum Number of Bars 10 Minimum % of Steel in Column Minimum Number of Bars 4 Bar number Increment • Stirrup Diameter 8 Model Properties Number of bar to be incremented in Type of Design StaadV8i design process. 🗆 Styles Diameters used in design • Layer of Beams SRC_BEAM Layer of Columns SRC_COL Set reinforcement used in design Layer of Reinforcements SRC_REINFO Maximum number of bars Maximum number of bars used in design process. Minimum % of steel in column • It's a default value, Default value can menu-toolschange from main settings- aadspro properties. Stirrup diameter Layer of Reinforcements Diameter of stirrup used. Layer of Reinforcement drawn AutoCAD Drawing STYLES Fig 8.1.4 \geq Layer of beams • Layer of column As per project layout • Layer of reinforcement

• Click on the Import Database from tool bar (fig 8.1.5)

Open Database button allow the user to import the database file to the detailing system in aadspro .After selecting the database file aadspro check the input file and display the Level/Stories (Fig 8.1.6) in that file and prompt the user to select the desired Level/Storey.

Click Import button in the Storey window to import the data. aadspro automatically check for the STAAD Pro output file, if the selected database file is an output of STAAD Pro model.

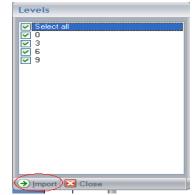


Fig 8.1.6

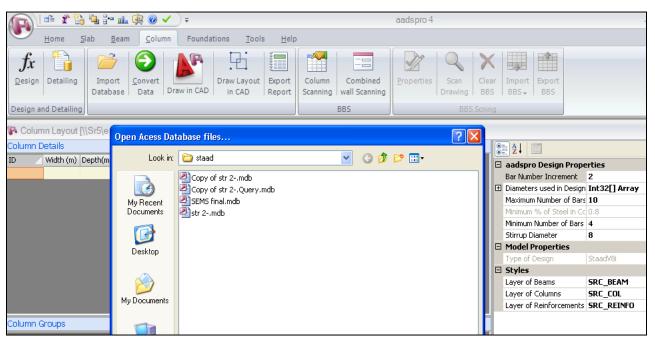


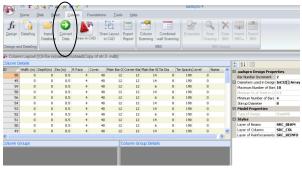
Fig 8.1.5

• Click on the Convert data from tool bar (fig 8.1.6)

The Convert data button converts the imported data into a grouped format and listed in the Column Group Grid. The Properties (Fig 8.1.6) of each column group can be viewed

in the property list in the right side of the window. User can edit this property for further changes.

Aadspro will check the entire column for any invalid data, if it found any invalid data column it will be marked with red color. User can view the error message by right clicking (Fig 8.1.5) the grid and selecting the Warnings menu





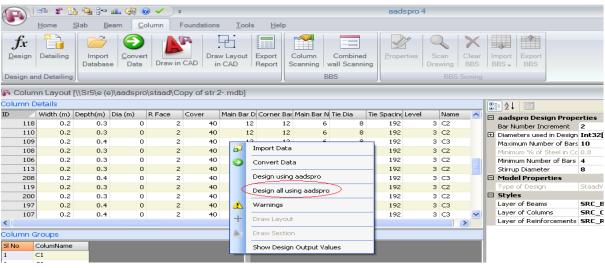


Fig 8.1.7

8.1.4 Results

• Click on the 'To Auto Cad' from tool bar

This button will draw the column schedule in AutoCAD. In this aadspro create a schedule with column name, reinforcement details, tie details and cross sectional drawing. The cross section of single column group is created by right clicking the column group name and select Draw Section menu (Fig 8.1.8)



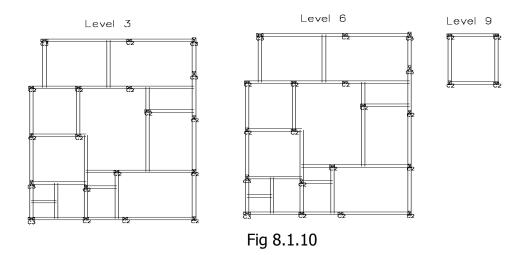


ND:	COL NO:	REINF	TIES	COL SECTION
2	C2	6- #12	#8-192	300X200
Э	СЗ	6- #12	#8-192	400X200



• Click on the 'Draw layout in CAD' from tool bar

This button creates a layout of column in each floor selected while importing .aadspro prompt the user in AutoCAD to pick a point to draw the layout. (Fig 8.1.10)



• Click on the 'Export Report' from tool bar

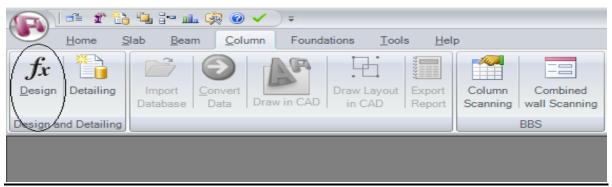
This button exports the design out to excel or text file the design result can viewed by right clicking the Column details grid and selecting the Show **Design Output Values**.

8.2 Column design

This module contains Design of a column section as per limit state method.

8.2.1 Steps involved in aadspro

Open aadspro. Select 'column' from the Main menu and 'Design' from drop down menu (Fig 8.2.1)





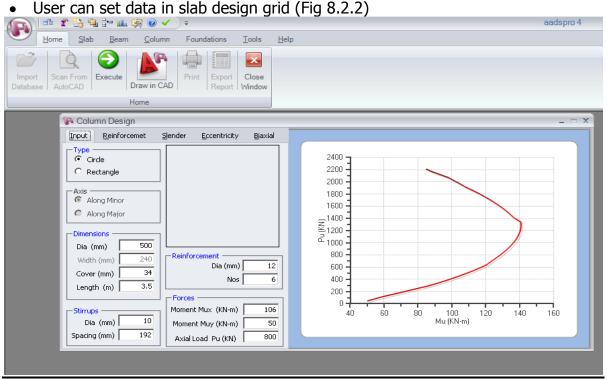


Fig 8.2.2

- Options are given for circular columns and rectangular columns. And also select the axis.
- Material properties, f_{ck} & f_y is a default value, can be change by clicking Tools-Settings-addspro properties.
- Dimensions and clear cover can be entered by typing new values
- Nos. and diameter of the bars can also change.
- Values of axial force, moment about x-direction and y-direction, etc. can be entered by typing new values. These values can be transferred to the corresponding design plate also.
- Analysis can be done by pressing the 'analysis' button. Interaction diagram is
 plotted in the design plate with M_u in x- axis and P_u in y-axis. Circle shown in the
 diagram represents the load and moment. In the analysis mode we can make this
 circle close to the curve either by changing the reinforcement or by changing the
 dimensions.

Consider the examples given below and its solutions by manual calculation.

Explanations are also attached after solutions to see how the program arrives at results.

Example1

Determine the reinforcement required for a rectangular column subjected to biaxial bending with the following data.

Width, b	=	400mm
Depth, D	=	600mm
Length of column, l	=	3000mm
Factored load on column, P _u :	=	1600KN
Factored moment acting parallel		
to larger dimension, M_{ux}	=	120KNm
Factored moment acting nerallal		

Factored moment acting parallel

to shorter dimension, M_{uv} 90KNm = Use M25 grade concrete and Fe 415 steel.

Calculation for minimum eccentricity;

a) Eccentricity in longer direction, $e_x =$

$$\left(\frac{l}{500}\right) + \left(\frac{D}{30}\right)$$
$$\left(\frac{3000}{500}\right) + \left(\frac{600}{30}\right)$$

26mm

=

=

=

=

=

b) Eccentricity in shorter direction, e_v

$$= \left(\frac{l}{500}\right) + \left(\frac{b}{30}\right)$$

$$\left(\frac{3000}{500}\right) + \left(\frac{400}{30}\right)$$

19.33mm

=

c) Minimum eccentricity limit, 20mm =

Minimum eccentricity, e_{min}

Moment due to minimum eccentricity, Max

Moment due to minimum eccentricity, May

 $P_u e_x$ = 1600x0.026 = 41.60KNm P_ue_v = 1600x0.0193 =

26mm (as per IS 456-2000, Cl: 25.4)

30.88KNm =

Moments due to eccentricity are less than the value of initial moments. Then design moments are,

Mux 120KNm = M_{uy} 90KNm =

Calculation for longitudinal reinforcement:

Reinforcement is distributed equally on two sides,

Assume, percentage of reinforcement, p = p/f_{ck} =			0.84% 0.034
Dia of reinforcement, =			16mm
Uniaxial moment capacity	of the section	about	x-x axis;
Effective cover to the colu	mn, d' d'/D P _u /f _{ck} bD	= = = =	40+8 =48mm 48/600 0.08 1600x10^3/(25x400x600) 0.267
Using SP 16, chart 32,	$M_u/f_{ck}bD^2$ M_{ux1}	= = =	0.09 0.09 <i>x</i> 25 <i>x</i> 400 <i>x</i> 600 ² 325KNm
Uniaxial moment capacity	of the section	about	y-y axis;
	d'/b P _u /f _{ck} bD	= = =	48/400 0.12 1600x10^3/(25x400x600) 0.267
Using SP 16, chart 33,	M _u /f _{ck} Db ² M _{uy1}	= = =	0.07 0.07 <i>x</i> 25 <i>x</i> 600 <i>x</i> 400 ² 168KNm
Calculation of P _{uz} ;			
Using SP 16, chart 63,	Puz/Ag Puz	= = =	13.5N/mm ² 13.5x400x600 3240KN
	Pu/ Puz M _{ux} /M _{ux1} M _{uy} /M _{uy1}	= = = =	1600/3240 0.49 120/325 0.37 90/168 0.54

For	check;
	000

⊢or ci	neck;				
	, a _n	=	1.48 (with respect	to Pu/	Puz)
(M _u	$(M_{ux1})^{an} + (M_{uy}/M_{uy1})^{an}$	=	$0.37^{(1.48)} + 0.54^{(1.48)}$		
	e the section is safe. Provide 10no.s of 16mmDia bars.	=	0.63 < 1.0 (as per	Cl:39.6	5,IS456:2000)
Calcu	lation for Transverse reinforcemer	nt:			
As pe follow	r IS 456-2000, Cl : 26.5.3.2.(c).(2 <i>i</i> ing:), the c	liameter of tie shall	not les	s than the
a) b)	¹ ⁄4 of the main Dia 5mm	=	1/4x16 5mm	=	4mm
As pe	r IS 456-2000, Cl : 26.5.3.2.(c).(1), the p	pitch of ties shall not	excee	d the following:
a)	Least dimension of column	=	400mm		

a)	Least dimension of column =	400mm	
b)	16 of smallest dia of minimum bar	= 16x16	5
	=	256mm	
c)	300mm		

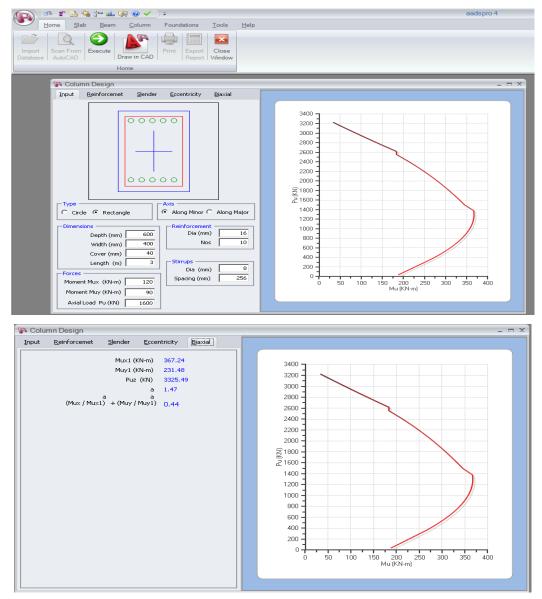
Hence the lateral ties of 8mm diameter at a spacing of 200mm c/c shall be provided as transverse reinforcement.

Now let us see how program arrives at results.

- 1. First choose Rectangle type column.
- 2. Select analysis to calculate the reinforcement detail of column.
- 3. Enter the characteristic values of concrete and steel. Here these values are f_{ck} = 25 and f_y = 415.
- 4. Enter the dimensions of the column. Width = 400mm, Depth = 600mm, Cover = 40mm Length = 3m.

- 5. Diameter of the longitudinal reinforcement can be selected by clicking on the up and down buttons. Here, select 10 no.s of 16mm dia bars as longitudinal reinforcement.
- 6. Enter the values of moment, $M_{ux} = 120$ kNm, $M_{uy} = 90$ kNm and axial load = 1600 kN.

Now let us see how the program arrives at results.



A comparison with manual calculation is shown below.

	Values from	Values by manual
	Program	Calculation
Moment capacity Mux1	367.24Kn-m	325 Kn-m
Moment capacity Muy1	231.48Kn-m	168 Kn-m
Load capacity Puz	3325 KN	3240 KN

Example 2

Determine the reinforcement required for a rectangular slender column subjected to biaxial bending with the following data.

Width, b		=	300m	m
Depth, D		=	400m	m
Length of column, I		=	7000r	nm
Factored load on co	lumn, P _u	=	1500ł	٢N
Factored moment a	cting parallel			
to larger dim	ension, M _{ux}	=	40KN	m
Factored moment a	cting parallel			
to shorter dir	mension, M _{uy}	=	30KN	m
Use M25 grade cond	crete and Fe 415 ste	eel.		
Effective length for	bending parallel to			
	larger dimension, l	ex	=	6000mm
Effective length for bending parallel to				
	shorter dimension,	I_{ey}	=	5000mm
Slenderness ratio, l _e	_{ix} /D		=	6000/400

	=	15 > 12
Slenderness ratio, I _{ey} /b	=	5000/300
	=	16.7 > 12

The column is slender about both the axis.

Calculation for moments due to slender:

As per Cl: 39.7.1, of IS 456-2000 Additional moments are calculated by the following:

Additional moments, M _{ax}		=	$\left(\frac{P_u}{2000}D\right)\left(\frac{l_{ex}}{D}\right)^2$
		=	$\left(\frac{1500x400}{2000}\right)15^2$
		=	67.5KNm
Additional moments, M _{ay}		=	$\left(\frac{P_u b}{2000}\right) \left(\frac{l_{ey}}{b}\right)^2$
		=	$\left(\frac{1500x300}{2000}\right)\!\!16.7^2$
		=	62.75KNm
Calculation for reduction f	factors:		
Reinforcement is distribut Assume, percentage of re	inforcement,		
Dia of reinforcement,			= 20mm
Using SP 16, chart 63,	P _{uz} /Ag P _{uz}	= =	20.5N/mm ² 20.5 <i>x</i> 300 <i>x</i> 400

		=	2460KN
About x-x axis;			
Effective cover to the colu	ımn, d'	=	40+10=50mm
	d'/D	=	50/400
		=	0.12
From Table 60 of SP16,	k ₁	=	0.20
	k ₂	=	0.07
	P _{bx}	=	$\left(k_1 + k_2 \frac{p}{f_{ck}}\right) f_{ck} bD$
		=	(0.07x0.12) $(25x300x400)$
		=	625.2KN

Reduction factor, k_x (As perCl: 39.7.1.1, IS 456-2000)

		=	$\left(\frac{P_{uz}-P_{u}}{P_{uz}-P_{bx}}\right)$
		=	$\left(\frac{2460-1500}{2460-625.2}\right)$
		=	0.52
About y-y axis;			
	d'/b	=	50/300
		=	0.16
From Table 60 of SP16,	k ₁	=	0.19
	k ₂	=	0.04
	P _{by}	=	$\left(k_1 + k_2 \frac{p}{f_{ck}}\right) f_{ck} bD$

	=	(0.19 + (0.04x0.12))x25x300x400
	=	584.4KN
Reduction factor, k_y	=	$\left(\frac{P_{uz} - P_u}{P_{uz} - P_{by}}\right)$
	=	$\left(\frac{2460-1500}{2460-584.4}\right)$
	=	0.51
Modified moments, M _{ax}	=	M _{ax} k _x
	=	67.5 x 0.52
	=	35.1KNm
Modified moments, M _{ay}	=	$M_{ay}k_y$
	=	62.75 x 0.51
	=	32KNm
Calculation for minimum eccentricity;		
As per Cl: 25.4, IS 456-2000		
a) Eccentricity in longer direction, e_x	=	$\left(\frac{l}{500}\right) + \left(\frac{D}{30}\right)$
	=	$\left(\frac{7000}{500}\right) + \left(\frac{400}{30}\right)$
	=	27.33mm

b) Eccentricity in shorter direction, $e_y =$

$$\left(\frac{l}{500}\right) + \left(\frac{b}{30}\right)$$

$$\left(\frac{7000}{500}\right) + \left(\frac{300}{30}\right)$$

=

	=	24mm
c) Minimum eccentricity limit,	=	20mm
Moment due to minimum eccentricity, I	M _{ax} = = =	$P_u e_x$ 1500x0.027 40.50KNm > 40KNm (initial moment)
Moment due to minimum eccentricity, I	M _{ay} = =	= $P_u e_y$ 1500x0.024 36.00KNm > 30KNm (initial moment)

Then, Total moments for which the column is to be designed are:

M _{ux}	=	40.5 + 35.1
	=	75.6KNm
M_{uy}	=	36+32
	=	68.0KNm

Calculation for longitudinal reinforcement:

Reinforcement is distributed equally on two si	des,
Assume, percentage of reinforcement, p =	3%
p/f _{ck} =	0.12

Uniaxial moment capacity of the section about x-x axis;

	d'/D	=	0.125
	P _u /f _{ck} bD	=	$1500x10^3 / (25x300x400)$
		=	0.50
Using SP 16, chart 33,	$M_u/f_{ck}bD^2$	=	0.13
Using SF 10, chart 55,	M _{ux1}	=	$0.13x25x300x400^2$
		=	156KNm

Uniaxial moment capacity of the section about y-y axis;

d′/b	=	0.16
P _u /f _{ck} bD	=	0.5
M _u /f _{ck} Db ²	=	0.12
M _{uy1}	=	$0.12x25x400x300^2$
	=	108KNm
	P _u /f _{ck} bD M _u /f _{ck} Db ²	$P_u/f_{ck}bD = M_u/f_{ck}Db^2 = M_{uy1} = $

For check;	Puz Pu/ Puz M _{ux} /M _{ux1} M _{uy} /M _{uy1}	= = = = =	2460KN 1500/2460 0.61 75.6/156 0.48 68/108 0.63
	a _n	=	1.32(with respect to Pu/ Puz)
$(M_{ux}/M_{ux1})^{an} + (M_{uy}/M_{uy1})^{an}$) ^{an}	=	$0.48^{(1.32)} + 0.63^{(1.32)}$
Hence the section is safe.	2000	=))	0.923 < 1.0 (as per Cl: 39.6, IS456-

Then Provide 12no.s of 20mmDia bars.

Calculation for Transverse reinforcement:

As per IS 456-2000, Cl : 26.5.3.2.(c).(2), the diameter of tie shall not less than the following:

a)	1/4 of the main Dia	=	1/4x20	=	5mm
b)	5mm	=	5mm		

As per IS 456-2000, Cl : 26.5.3.2.(c).(1), the pitch of ties shall not exceed the following:

a)	Least dimension of column	=	300mm
b)	16 of smallest dia of minimum bar	=	16x20
		=	320mm

d) 300mm

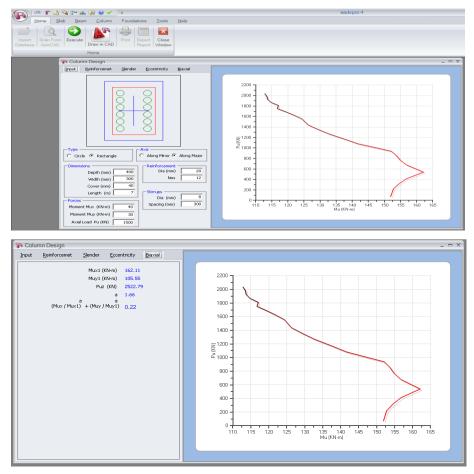
Hence the lateral ties of 8mm diameter at a spacing of 200mm c/c shall be provided as transverse reinforcement.

Now let us see how program arrives at results.

1. First choose Rectangle type column.

- 2. Select analysis to calculate the reinforcement detail for column.
- 3. Enter the characteristic values of concrete and steel. Here these values are f_{ck} = 25 and f_y = 415.
- 4. Enter the dimensions of the column. Width = 300mm, Depth = 400mm, Cover = 40mm Length = 7m.
- 5. Diameter of the longitudinal reinforcement can be selected by clicking on the up and down buttons. Here, select 12 no.s of 20mm dia bars as longitudinal reinforcement.
- 6. Enter the values of moment, $M_{ux} = 40$ kNm, $M_{uy} = 30$ kNm and axial load = 1500 kN.

Now let us see how the program arrives at results.



A comparison with manual calculation is shown below.

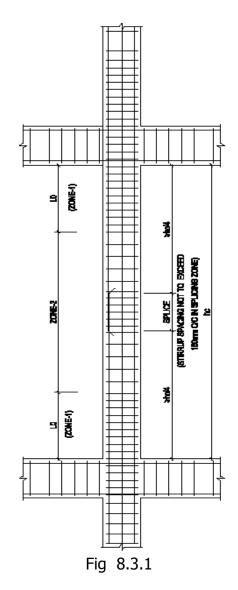
	Values from	Values by manual
	Program	Calculation
Moment capacity Mux1	162.11 Kn-m	156 Kn-m
Moment capacity Muy1	105.55 Kn-m	108 Kn-m
Load capacity Puz	2522.79 KN	2460 KN

8.3 BBS (Bar Bending Schedule) SCAN-COLUMN

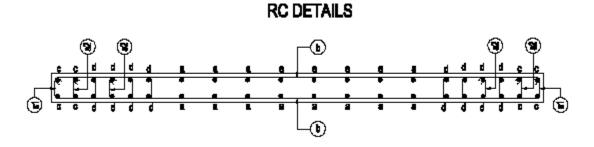
This chapter provides a method for getting the bar bending schedule of existing columns. This can be used to change the existing bar bending schedule of columns.

8.3.1 In AutoCAD

Column detail is provided in AutoCAD as shown in the fig 8.3.1, classify the columns in different zone.



- Make the reinforced concrete details for each zones (Fig 8.3.2)
- All layers of bars should be in same layer.





• Make the reinforced concrete details in a table format for each zones also the longitudinal and distribution bar details.(Fig 8.3.3).

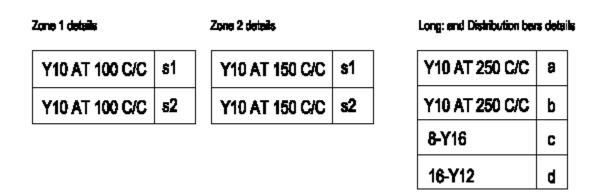


Fig 8.3.3

8.3.2 In aadspro

Select 'Column' from the Main menu

• Click on the 'Column Scanning' from tool bar (fig1.2.1)

🖳 🛙 🖆 📲 📴 🖷 👰 🕲 🗸 🗧 aadsp					
Home Slab Beam Column Foundations Tools Hel	p				
fx Import Convert Draw in CAD Draw Layout Export	Column Scanning wall Scanning	Properties Scan Drawing BBS BS + BBS	rt		
Design and Detailing	BBS	BBS Scning			

Fig 1.2.1

• User can set properties (fig1.2.2)

Scanning wall Scanning Drawing BBS BBS BBS	
BBS BBS	BBS BBS - BBS
	Scning
BBS Scanning Properties - [Column	ı] _ ⊟ X
2000 200 200	
	
	rmakandDetails
Beam Naming Tag B	
Bend Length 100	
Development Length Factor 50	
Drawing Type Column	
	ND
IS 13920 Used False	
Margin to Leader 10	
Min Column Size 250	
-	
	M.
	··
-	
Clear Cover 40	
Constant Inner width 300	
Hook Length 40	
	•
	Defaults Add Laping Length True Bar Details Type ShowBa BarMark Text Color Cog BBS Options Groupe Beam Naming Tag B Bend Length 100 Development Length Factor S0 Drawing Type Column Export To AutoCf IS 13920 Used False Margin to Leader 10 Min Column Size 250 Reinforcement Tag Y Starting BarMark 200 Top Bar Single False Wall Height 3.5 Misc FyValue 415 Reinfo Dimension Layer SRC_DI Reinforcement Layer BAR Stirrup Bottom Cover 40 Constant Inner width 300

Fig 1.2.2

- BBS option

This option is to confirm that how should be the BBS report displayed . It means the type of BBS report. It can be grouped or split.

- Development length factor Development length factor
- Export to
- To which software you want to export the bbs report. There are three options
 - 1. Auto Cad
 - 2. Simple Excel
 - 3. Excel with picture
- Margin to leader

Setting the tolerance of the leader position with the margin

- Reinforcement Tag.

Reinforcement tag provided in drawing.

- Starting bar mark

Bar mark means the id of the reinforcement to represent it in the drawing to separate each bar from one other . Starting letter of this id need to be set here

- Reinforcement Layer

Set the Layer of reinforcement in which the whole reinforce bars are arranged. And it is to verify that all reinforcement lines are assigned to this layer

1.2.3- Click on the 'Scan Drawing' from tool bar.

All steps coming in auto cad command line.

- Step 1: Select Zone 1 Lateral ties details schedules.
- Step 2: Select Zone 2 Lateral ties details schedules.
- Step 3: Select longitudinal details schedules.
- Step 4: Enter the height of Zone 1.
- Step 5: Enter the height of Zone 2. (Fig.a)

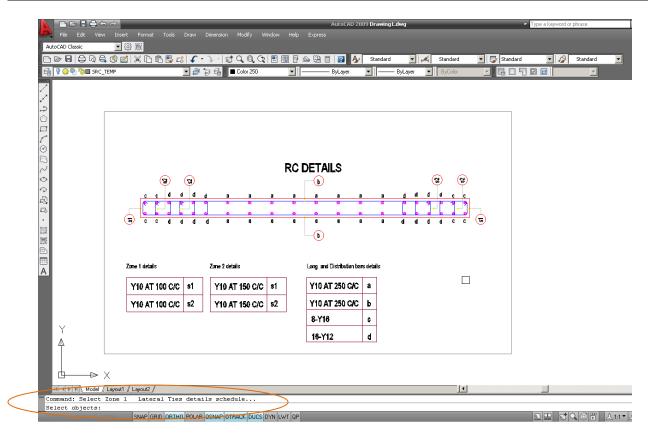


Fig.a

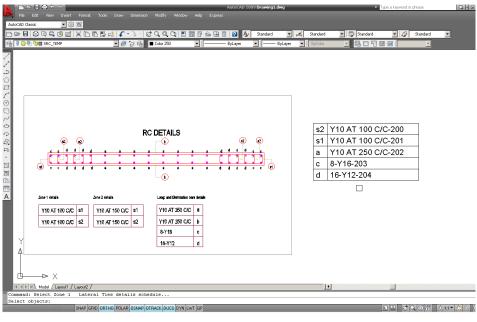
Step 6: Then the aadspro reinforcement details table is coming, close the table.(Fig b)

Design and Detailing	Column Foundations Iools Hele Convert Draw in CAD Draw Layout Report Data	Column Scanning Combined wall Scanning BBS	Colum Properties Clear Properties Clear Properties BBS BBS BBS BBS BBS BBS BBS BBS BBS BB	ort Export
Beinforder (Basilian States)	Lateral Ties Longitudinal Reinfo Details Longitudinal Reinfo Details Provided BAR ID DESCRIPTION a Y10 AT 250 c/C b Y10 AT 250 c/C c 8-Y16 d 16-Y12 33 40 16-Y12	5 4.5 5 5 5 6.5 0 8 2 10 13		



Step 7: Select the object.

Step 8: Select a point to draw schedule. (Fig: c)



(Fig.c)

After that bar bending schedules and weight details obtained from the aadspro (Fig.d)

i 🕯 🐒 强 📴 💷 🥘 🥥 🗸) 🕫 Column BBS Scan Utility - aadspro 4 P Home Slab Beam Column Foundations Tools Help $\overline{\mathbf{O}}$ 📝 🔍 🗙 🜉 🏥 fx 🛅 Column Properties Scan Clear Import Export Drawing BBS BBS + BBS Design Detailing Scanning wall Scanni Design and Detailing BBS BBS Scning BBS Details Weight Details
 Total Length
 Shape Code

 0
 800
 88

 0
 1950
 88

 A
 B
 C
 D
 E
 F
 R

 155
 0
 0
 0
 140
 0

 725
 0
 0
 0
 140
 0

 2400
 0
 0
 0
 0
 0
 Bar Mark Bar Type Size Mem No Bar No Total Bars F R S 200 Y 10 1 80 80 10 1 40 40 201 202 Y 10 1 22 22 2400 20 2400 0 0 0 0 0 203 Y 16 8 8 2400 20 204 Y 12 16 16 2400 20 2400 0 0 0 0 0 Fig .d

1.2.4- Click on the 'Export BBS' from tool bar (fig1.2.4), It give bar bending schedule.

Bar Mark	Ваг Турв	Size	Merri Na	Bor No	lotal Bair	tal Len§j	libpe Cod	la A	в	С	D	E	F	R	s	
200	Y	10	1	80	BD	8030	68	155	o	o	D	14D	a			
201	Y	10	1	40	40	1950	88	725	o	o	D	140	Ø			1-725-1 140 ¹
202	Y	10	1	22	22	2400	20	2400	٥	D	D	¢	a			<u>1 2400 1</u>
203	Y	16	1	8	8	2400	20	2400	٥	Ċ	Ď	0	٥			<u>1 2400 1</u>
204	Y	12	1	16	16	2400	20	2400	o	o	٥	0	٥			<u>1′──2400</u> ──1′

Bar Bending Schedule

Fig 1.2.4

- Here,
 - Bar mark = Bark mark given in Result (200,201 etc as shown in Fig 1.2.4)
 - Y = Type of steel.
 - Size = Bar dia size
 - Mem No = No of repetitions of the member.
 - Bar No = No of bars of same length and dia.
 - Tot Bars (Total Bars) = Mem No x Bar No
 - Len(Bar)mm = Length of bar in mm
 - Shape code = Shape code depends on the code selected, British, Indian & American.
 - A, B, C etc = Representations in shape code.

SHAPE CODES

As per Indian code

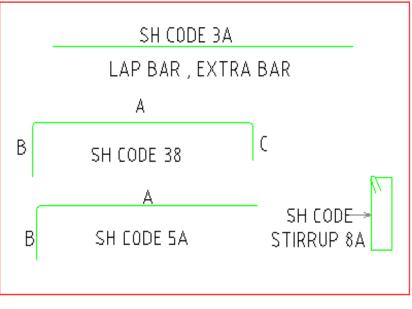


Fig 4(b)

As per British code

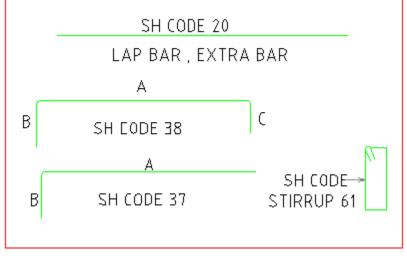


Fig 4(a)