iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** XI **Month of publication:** November 2018

DOI: http://doi.org/10.22214/ijraset.2018.11095

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue XI, Nov 2018- Available at www.ijraset.com

Automated Excel Sheets for Various RC Elements

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Abstract: In this paper EXCEL spreadsheet software has used in analyzing and calculating rebar's of different RC elements like beams, columns and slabs. Five different types of EXCEL spreadsheet like simply supported beam, cantilever beam, short column and long column, one way and two-way slab has calculated in this project work. Different characteristics conditions like effective span, nominal cover, and effective length of compression members has applied in our study. Apart from the inclusion of various characteristics properties, different checks have assigned to the RC elements. Reference has been taken from RCC code IS 456:2000.
Keywords: MS Excel, IS 456:2000, Analysis, Design, Beam, Column, Slab.

I. INTRODUCTION

This study shows that, with the help of MICROSOFT excel we can create a program or a software, which can calculated reinforcement bars and distribution, bars only by given dimensions and assigning properties of the reinforced elements. For the study, a huge amount of documented data is required.

It will recorded by going through different papers and extracting the values from the same. Reinforced concrete (RC) (known as reinforced cement concrete or RCC) is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength or ductility.Excel sheets are are design sheets with in-built cell-based structure and the simple boundary that is easy to use, for the first time users also. It helps in analysis as well as design of civil engineering structures, which effectively utilizes MS EXCEL environment.

It has mainly used in teaching civil engineering concepts and providing useful applications. It focuses on concepts related to construction management and structural engineering varying from a simple cost estimating problem, structural design and analysis to advanced applications.

Typical civil engineering problems has used to present the programming concepts. Excel has used to enhance the concept and efficiency of structural analysis and design when design sheet is used.

II. OBJECTIVE

A. To develop a computerized programme to reduce paper work and time.
B. This increases the efficiency and reduction in workload.
C. To use structural engineering concepts in design sheets.
D. To enhance the concept and efficiency of structural analysis and design when design sheet is used.

III. CODING

MICROSOFT EXCEL is a spreadsheet developed for Windows, Android and IOS. It features calculation, tabular forms, pivot tables. It is a very widely applied spreadsheet for these type of functions, especially since 1993.

There are three activities must be performed to achieve that goal.

A. Coding of the RC elements using MICROSOFT EXCEL..
B. The calculations to decide the explanatory.
C. Result has checked in the OUTPUT.

IS 456:2000 RCC code is used in this paper as reference to various characteristic properties of reinforced elements like effective span, nominal cover, effective length of compression members, exposure conditions, etc.

IV. METHODOLOGY

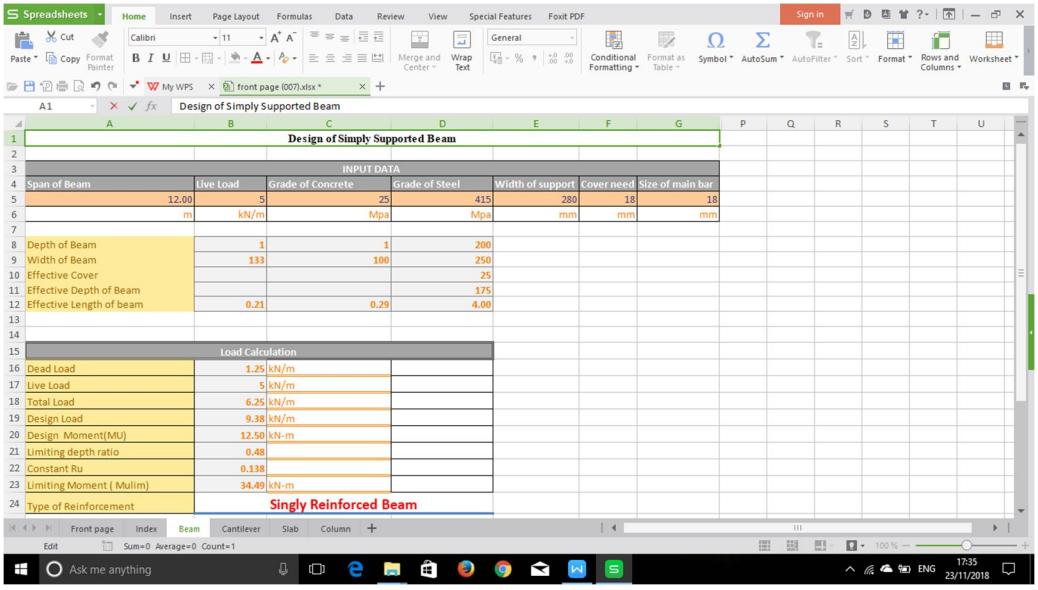
For the study, a large amount of documented data is required and RCC code IS 456:2000 is taken as a reference for different characteristic properties like effective cover, effective span, effective length of compression members, nominal cover and exposure conditions, etc.

The study shows automated calculation of rebar for following RC elements:

MS EXCEL is extensively used in calculating the rebars of the above mentioned RC elements.

A. Beams

The procedure of the method for calculation of rebars of both simply supported as well as cantilever beam can be precised as follows: 1.)given span of beam, grade of concrete, live load, grade of steel, width of support, cover need and size of main rebars 2.) to check if the simply supported beam is singly or doubly using Mu< Mu_{lim} then it is singly else doubly reinforced beam 3.) determine area of steel by using clause G.1.1-b (annex G) for singly reinforced bean and clause G.1.2 for doubly reinforced beam 4.) calculation of rebars using formula ($AST_{calculated}/ast_{one\ bar}$).



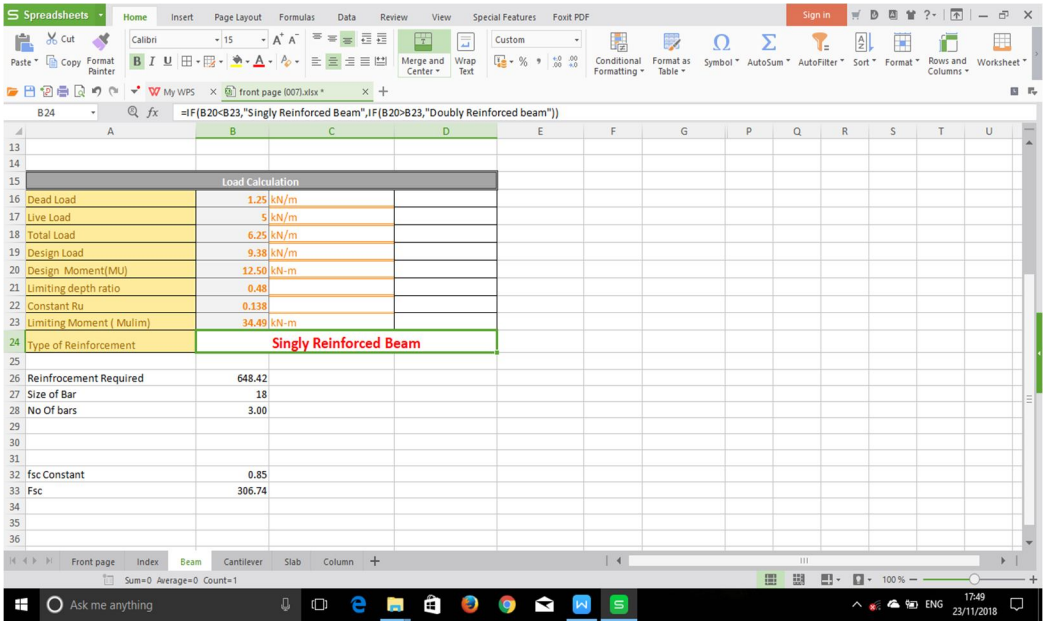
Design of Simply Supported Beam

INPUT DATA						
Span of Beam	Live Load	Grade of Concrete	Grade of Steel	Width of support	Cover need	Size of main bar
12.00	5	25	415	280	18	18
m	kN/m	Mpa	Mpa	mm	mm	mm

Depth of Beam	1	1	200
Width of Beam	133	100	250
Effective Cover			25
Effective Depth of Beam			175
Effective Length of beam	0.21	0.29	4.00

Load Calculation		
Dead Load	1.25	kN/m
Live Load	5	kN/m
Total Load	6.25	kN/m
Design Load	9.38	kN/m
Design Moment(MU)	12.50	kN-m
Limiting depth ratio	0.48	
Constant Ru	0.138	
Limiting Moment (Mulim)	34.49	kN-m
Type of Reinforcement	Singly Reinforced Beam	

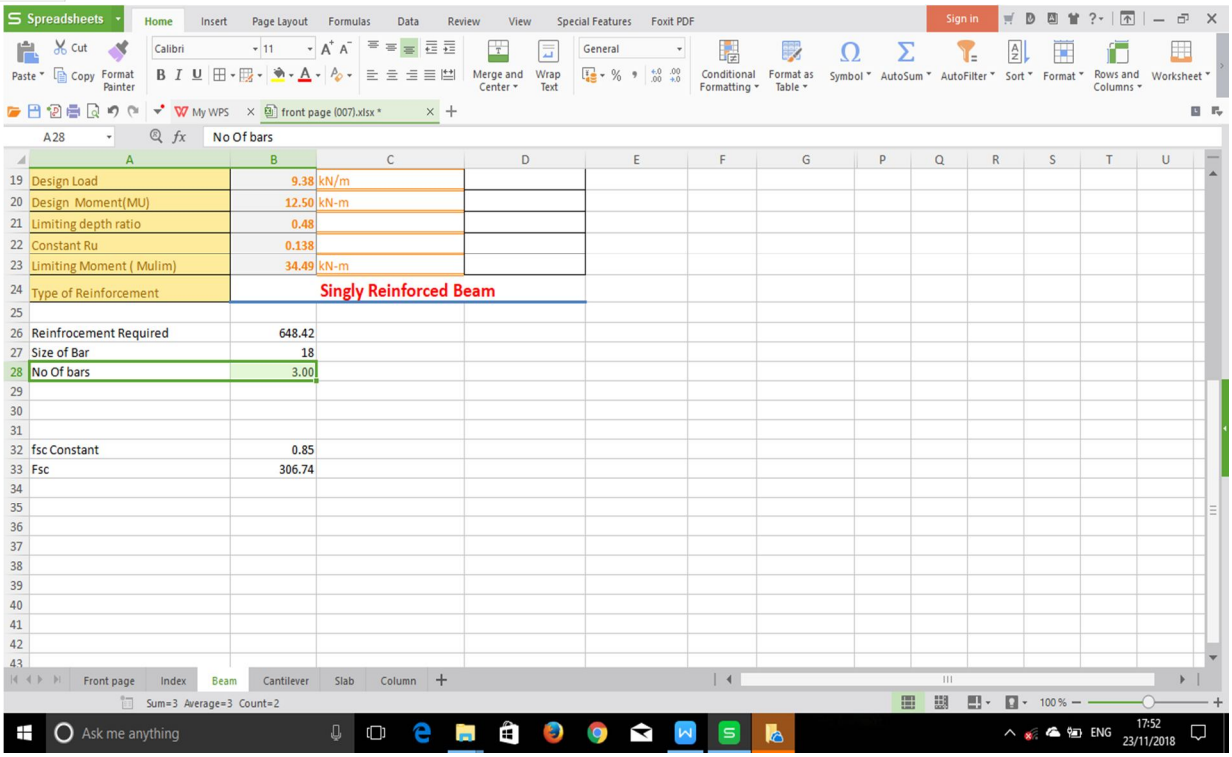
Fig1.1 input data



=IF(B20<B23,"Singly Reinforced Beam",IF(B20>B23,"Doubly Reinforced beam"))

Load Calculation		
Dead Load	1.25	kN/m
Live Load	5	kN/m
Total Load	6.25	kN/m
Design Load	9.38	kN/m
Design Moment(MU)	12.50	kN-m
Limiting depth ratio	0.48	
Constant Ru	0.138	
Limiting Moment (Mulim)	34.49	kN-m
Type of Reinforcement	Singly Reinforced Beam	
Reinfrocement Required	648.42	
Size of Bar	18	
No Of bars	3.00	
fsc Constant	0.85	
Fsc	306.74	

Fig1.2 checks for singly and doubly reinforced



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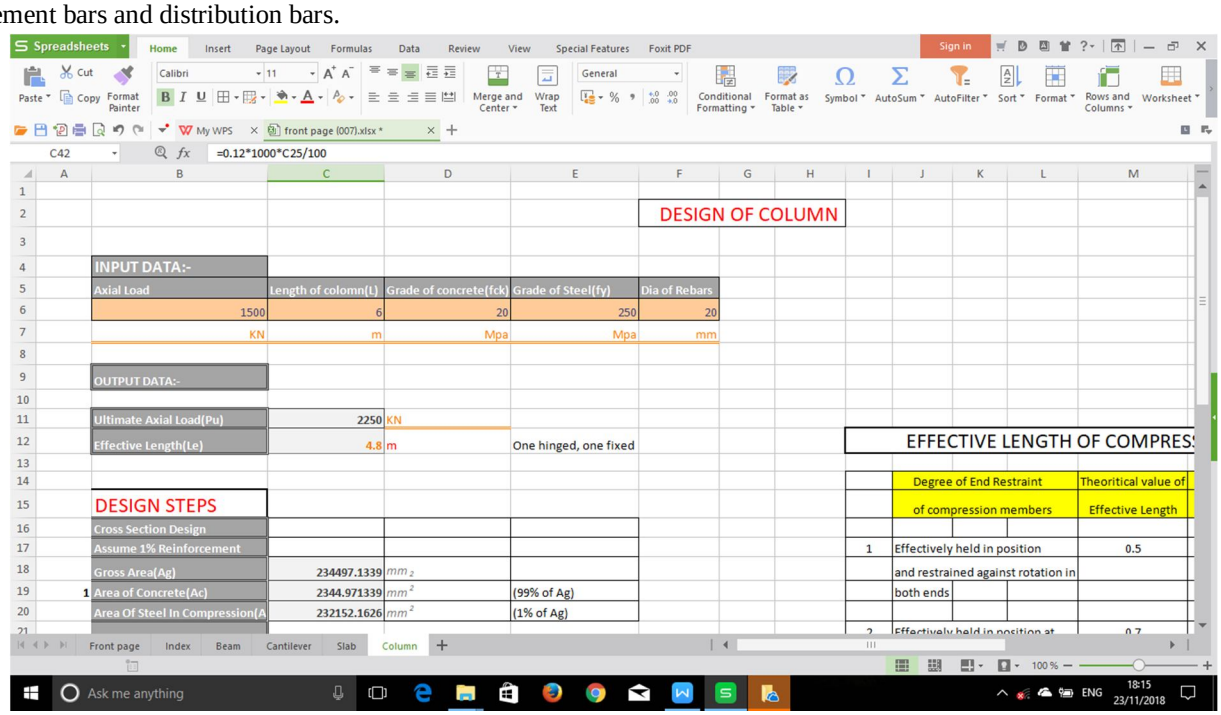
Type of Reinforcement	Singly Reinforced Beam	
Reinfrocement Required	648.42	
Size of Bar	18	
No Of bars	3.00	
fsc Constant	0.85	
Fsc	306.74	

Fig1.3 no. Of rebars

B. Columns

The procedure of the method for calculation of rebar's of column for both shorter and longer span is précised as follows: 1.)given data axial load(P), length of column(L), grade of concrete(fck), grade of steel(fy), dia of rebar's 2.) check effective length of compression members using table 28 of IS 456:2000. 3.)determine whether short column or long column using clause 25, 3.)verify that the eccentricities are not less than the corresponding minimum eccentricities as per clause clause 39.2, 4.) calculation of reinforcement bars and distribution bars.



DESIGN OF COLUMN

INPUT DATA:-				
Axial Load	Length of colomn(L)	Grade of concrete(fck)	Grade of Steel(fy)	Dia of Rebars
1500	6	20	250	20
KN	m	Mpa	Mpa	mm

OUTPUT DATA:-			
Ultimate Axial Load(Pu)	2250	KN	
Effective Length(Le)	4.8	m	One hinged, one fixed

DESIGN STEPS			
Cross Section Design			
Assume 1% Reinforcement			
Gross Area(Ag)	234497.1339	mm^2	
1 Area of Concrete(Ac)	2344.971339	mm^2	(99% of Ag)
Area Of Steel In Compression(A	232152.1626	mm^2	(1% of Ag)

EFFECTIVE LENGTH OF COMPRES

	Degree of End Restraint of compression members	Theoritical value of Effective Length
1	Effectively held in position and restrained against rotation in both ends	0.5
2	Effectively held in position at	0.7

Fig2.1input data

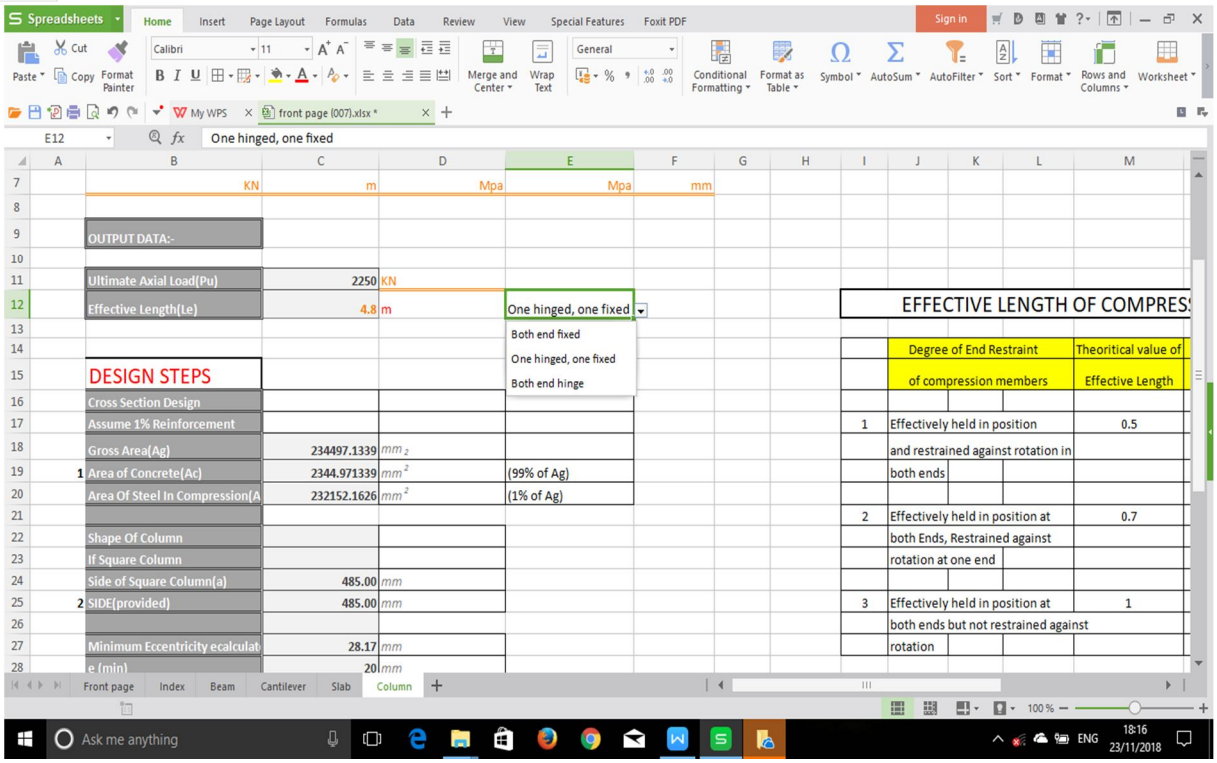


Fig2.2 different end conditions

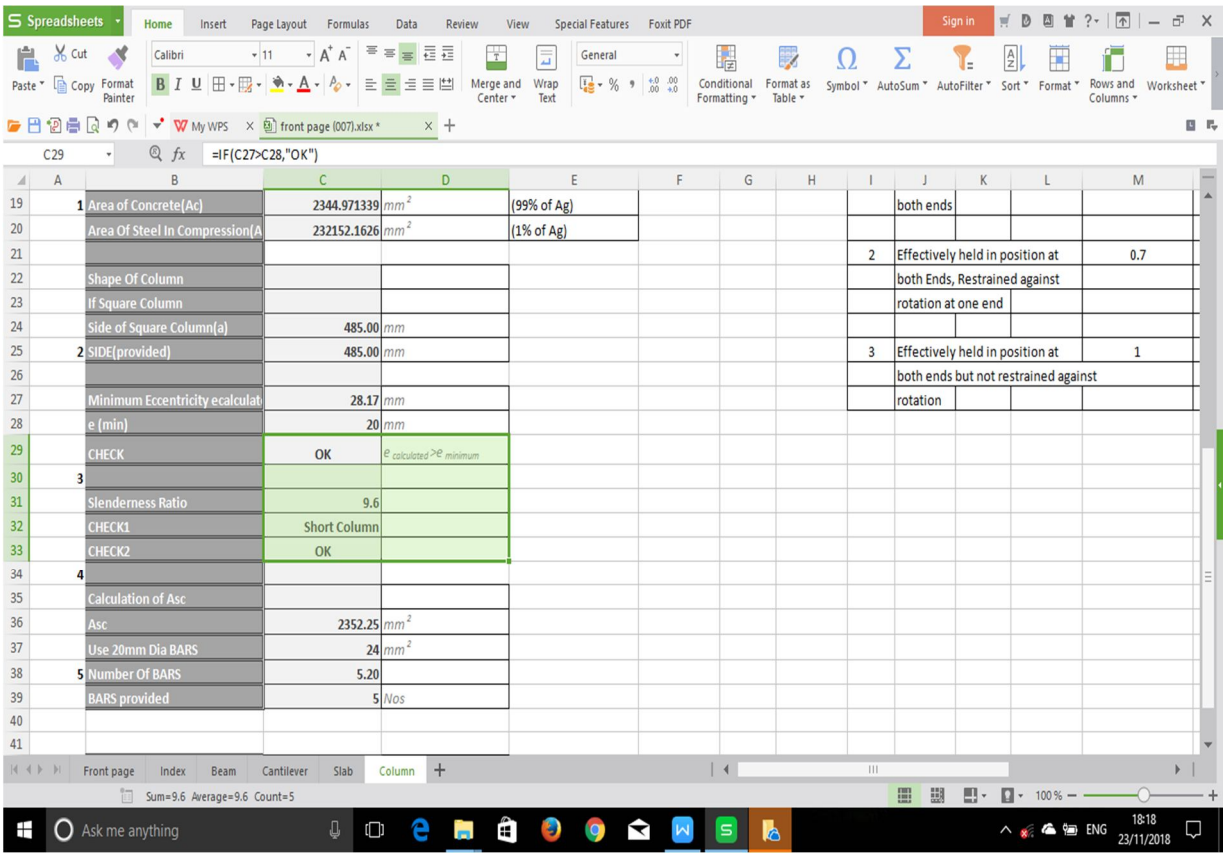
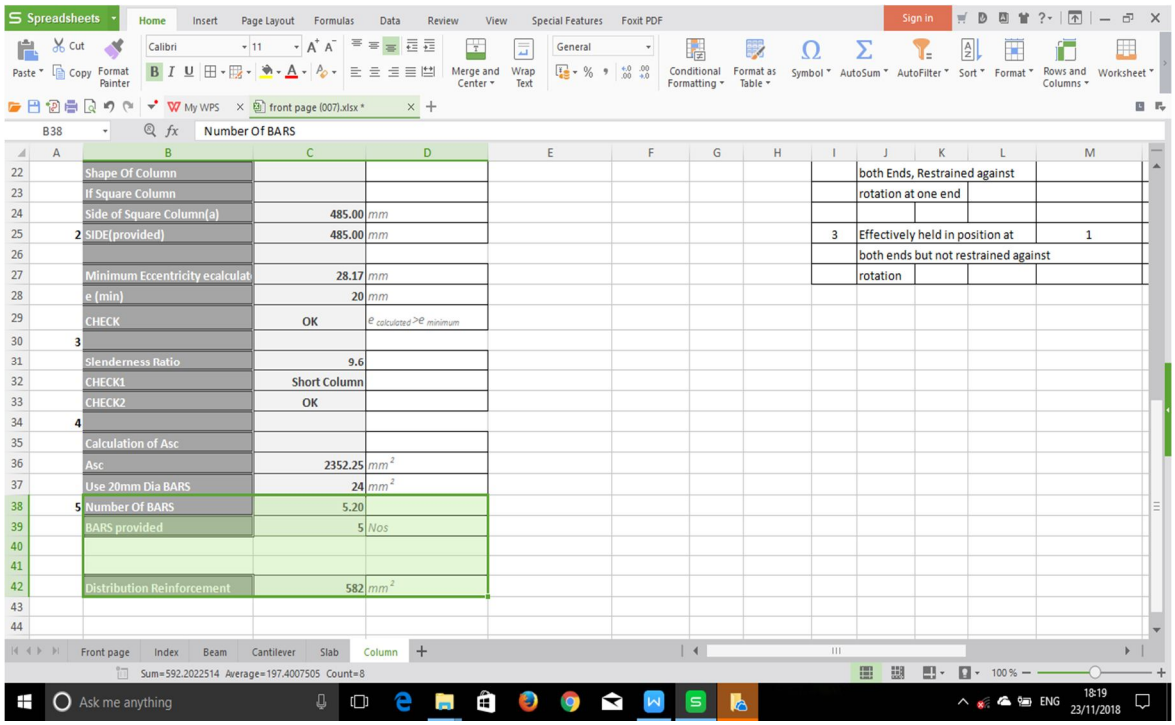


Fig 2.3 checks for short and long column



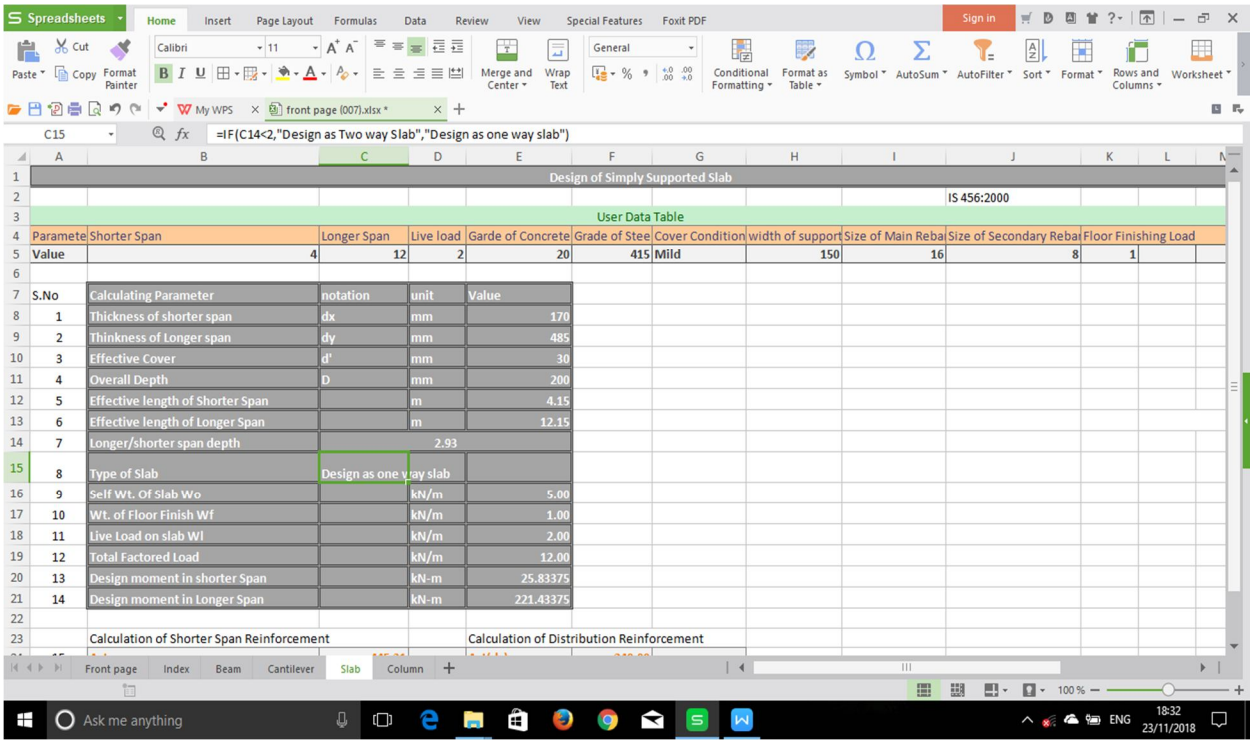
22	Shape Of Column		
23	If Square Column		
24	Side of Square Column(a)	485.00	mm
25	2 SIDE(provided)	485.00	mm
26			
27	Minimum Eccentricity ecalculat	28.17	mm
28	e (min)	20	mm
29	CHECK	OK	$e_{calculated} > e_{minimum}$
30	3		
31	Slenderness Ratio	9.6	
32	CHECK1	Short Column	
33	CHECK2	OK	
34	4		
35	Calculation of Asc		
36	Asc	2352.25	mm^2
37	Use 20mm Dia BARS	24	mm^2
38	5 Number Of BARS	5.20	
39	BARS provided	5	Nos
40			
41			
42	Distribution Reinforcement	582	mm^2
43			
44			

	both Ends, Restrained against	
	rotation at one end	
3	Effectively held in position at	1
	both ends but not restrained against	
	rotation	

Fig 2.4 calculation of rebars and distribution reinforcement

C. Slabs

The third case demonstrates the automated calculation of rebars of two-way slab using designsheets. The design steps mainly includes: 1) given data like shorter span, longer span, live load, grade of concrete and steel, cover condition, width of support, size of primary and secondary rebars, floor finishing(=1KN/m2). 2) finding thickness of slab 3)finding effective span 4) check for one way and two way slab using clause as per IS 456:2000 5) calculation of shorter and longer span reinforcements.



Design of Simply Supported Slab

IS 456:2000

User Data Table

Paramete	Shorter Span	Longer Span	Live load	Garde of Concrete	Grade of Stee	Cover Condition	width of support	Size of Main Rebai	Size of Secondary Rebai	Floor Finishing Load
Value	4	12	2	20	415	Mild	150	16	8	1

S.No	Calculating Parameter	notation	unit	Value
1	Thickness of shorter span	dx	mm	170
2	Thinkness of Longer span	dy	mm	485
3	Effective Cover	d'	mm	30
4	Overall Depth	D	mm	200
5	Effective length of Shorter Span		m	4.15
6	Effective length of Longer Span		m	12.15
7	Longer/shorter span depth		2.93	
8	Type of Slab	Design as one way slab		
9	Self Wt. Of Slab Wo		kN/m	5.00
10	Wt. of Floor Finish Wf		kN/m	1.00
11	Live Load on slab Wl		kN/m	2.00
12	Total Factored Load		kN/m	12.00
13	Design moment in shorter Span		kN-m	25.83375
14	Design moment in Longer Span		kN-m	221.43375

Calculation of Shorter Span Reinforcement

Calculation of Distribution Reinforcement

Fig 3.1 input data in user data table

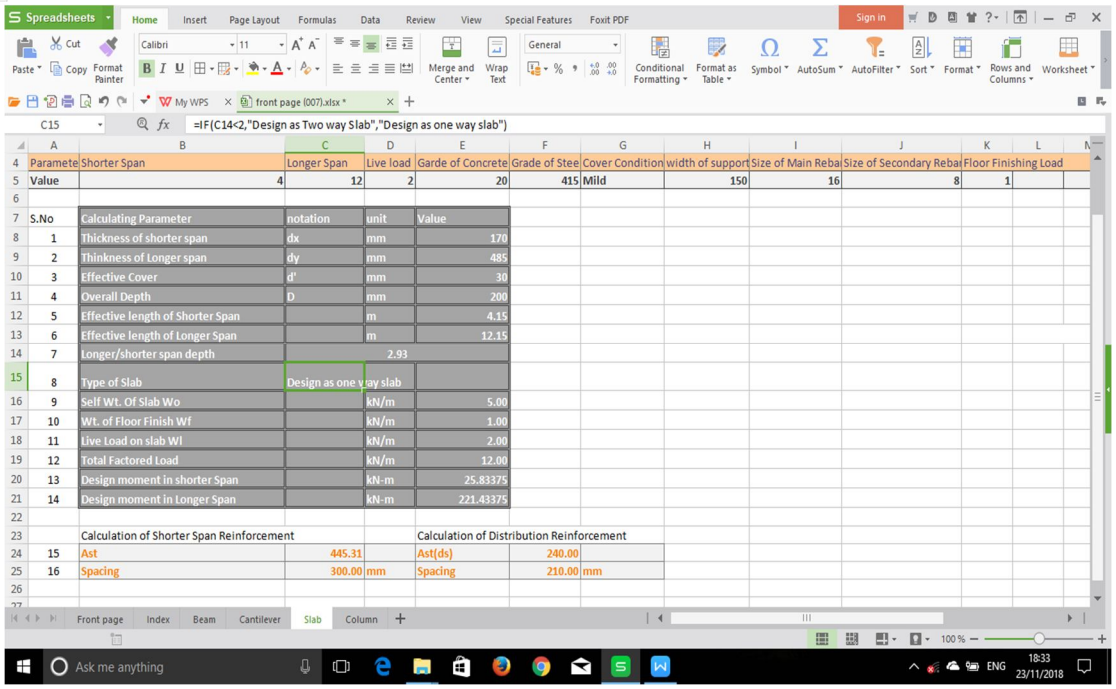


Fig 3.2 check for type of slab

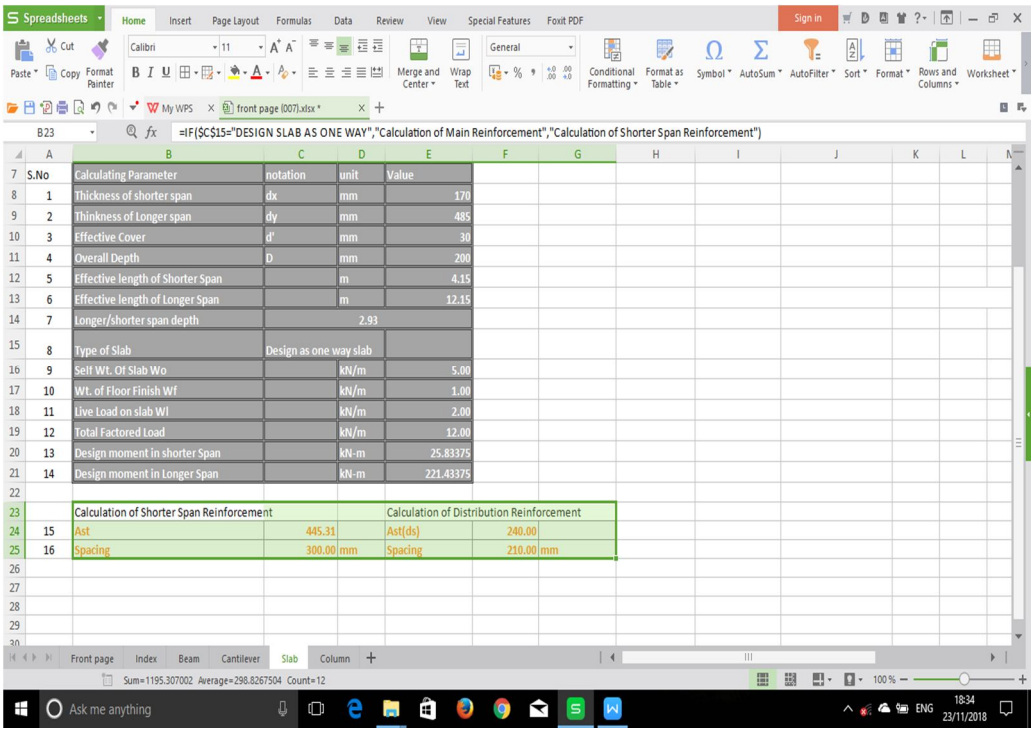


Fig 3.3 calculation of shorter and longer span reinforcements

V. CONCLUSION

MS-EXCEL sheet is a very helpful tool for calculation of rebars of various RC elements such as beams, columns, slabs. These excel sheets can be used in conjunction with the analytical softwares like STAAD and ETABS for the design of reinforced concrete elements. These are efficient and help in quick design of buildings and other structures on various projects. While standard software like STAADPRO were used in the frame analysis but self created excel sheets for design of columns, beams and slabs.

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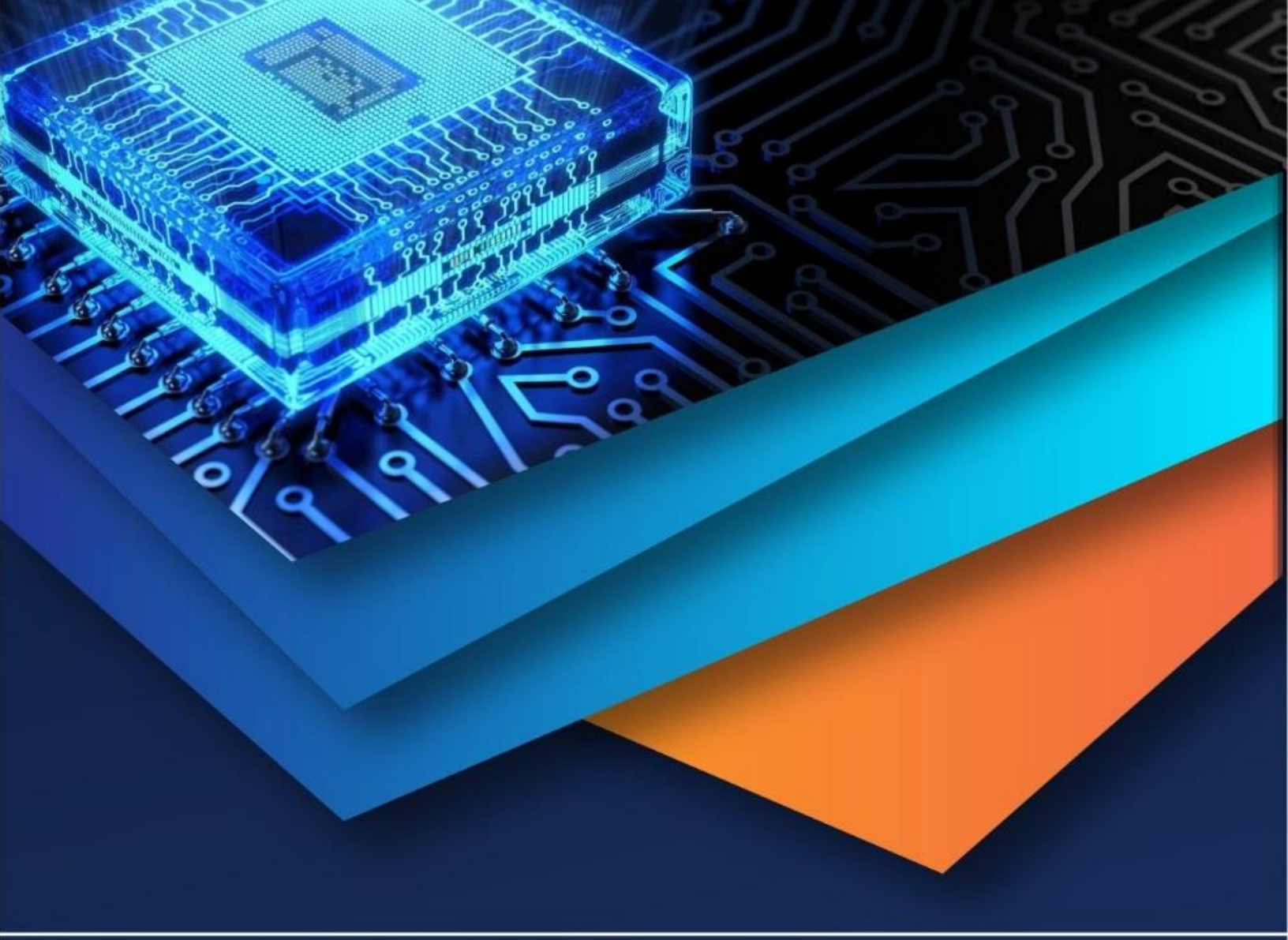

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