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Comparative Study of Analysis and Design Of RC Frame

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***Abstract*— This paper aims towards the comparative study of analysis and design of (G+2). The design process of structural planning and design requires not only imagination and conceptual thinking but also sound knowledge of structural engineering besides the practical aspects. It is important to first obtain the plan of a particular building i.e. position of particulars rooms The position of columns, size of beams, and depth of slab are provided on the basis of structural requirement. Manual analysis of frames in selected plan is carried out by Kani's method and EXCEL sheet are prepared for analysis by Kani's Method also SAP2000-software is used for the study and end moments of different span are validated with it. Paper shows the comparative analysis of end moments of frame by manual excel and SAP 2000.The design parameters such as slab, beam, column, footing is done. The moments and design obtained in this study is useful for engineers to understand the design procedure and utility of software for more complicated structure. At the end the results are compared and it is found that the analysis done by manual, excel and SAP are nearly same which gives validation of manual results with software result.**

***Index Terms*—Kani's Method, SAP-2000**

I. INTRODUCTION

Building construction is the engineering deals with the construction of building such as residential, public & commercial building. A Multi-Stored is a building that has multiple floors above ground. Multi-storey buildings aim to increase the floor area of the building without increasing the area of the land the building is built on, hence saving land and, money.

An example of R.C frame for 3-STOREY building is taken up. The analysis is made using Kani's method as it is less time consuming and easy for analysis of frame more than two span .The building subjected to vertical loads. The vertical load consists of dead load of structural components such as beams, columns, slabs etc and live load thus building is designed for dead load and live load as per IS 456-2000. The building is subjected to self -weight dead load, live load as per IS 875 (part 1, part2) 1987.

The current codal practice of design of RC building is based on limit state design philosophy. The design of structure involves many considerations among which are four major objectives that must be satisfied.

1. The structure must meet the performance requirement(utility)
2. The structure must carry loads safely. (safety)
3. The structure should be economical in material construction and cost. (economy)
4. The structure should have a good appearance. (Aesthetics).

STRUCTURAL ANALYSIS

A structure refers to a body or system of connected parts used to support a load. Important examples related to civil engineering include buildings, bridges, and towers **etc. Structural analysis** is the determination of the effects of loads on physical structures and their component.

The analysis of structure usually involves determination of various quantities such as shear forces bending moments as caused by given loading condition. There are various methods for analysis of structure as follows:

- Kani's Method
- Moment Distribution Method.
- Strain Energy Method
- Slope Deflection Method

KANI'S METHOD – This method was first developed by Prof. Gasper Kani of Germany in the year of 1947. This method may be considered as a further simplification of Moment Distribution Method. This is an indirect extension of slope deflection method. It is efficient method due to simplicity of moment distribution method. The frame analysis is carried out by this method as it is less time consuming and gives analytical approximate results. Operations are simple as it is carried out in a specific direction.

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STRUCTURAL DESIGN

The complete design of structure is outlined in the following stages:-

1. Planning of a building.
2. Investigating the loads.
3. Analysis for bending moments and shear force.
4. Design of different building elements.
5. Drawing and detailing.

These five stages are interrelated and may be sub-divided and modified. In many cases they must be carried out more or less simultaneously

METHODOLOGY ADOPTED

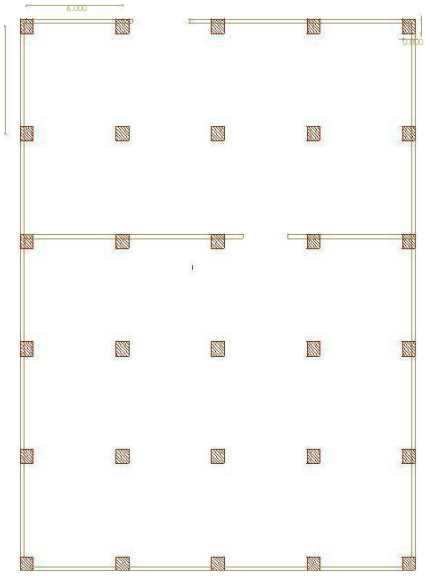
1. Planning of the building is done.
2. Frames in x and y direction is analyzed for bending moments using Kani's method for vertical loading.
3. Excel sheet is prepared for different frames.
4. SAP analysis has been performed for all frames.
5. Results are validated.

OBJECTIVE OF PROJECT

1. To study analysis of building using KANI'S Method.
2. To study analysis of building using SAP-2000.
3. To study design of different elements involve in a building.

2.1 SPECIFICATION OF BUILDING		
SR. NO	PARTICULARS	SIZE
1.	Type of building	Library Building
2.	Floor To Floor Height	4MT
3.	Bearing capacity of soil	= 200KN/m^3
4.	External Wall Thickness	230 mm
5.	Internal Wall Capacity	115mm
6.	Size of Column	0.8 X 0.8m
7	Size of Beam	0.6 X0.9m
2.2 ASSUMED LOAD		
1.	Live Load	4 KN/m^2
2.	Floor Finish	1 KN/M^2
2.3 ASSUMED MATERIAL		
1.	Concrete	M_{20}
2.	Steel	FE_{415}(HYSD)
3.	Unit Weight of Concrete	24 KN/M^3

2.4 LOADING CALCULATIONS FOR (GF+ FF):-		
1.	LIVE LOAD	= 4 KN/M^2
2.	DEAD LOAD	0.15X24X1=3.75 KN/M^2
3.	FLOOR FINISH	1 KN/M^2
4.	TOTAL LOAD	8.75 KN/M^2
5.	LOAD ON MEMBER (BEAM)	= (25 X 0.15 X 6 X 6)/4 = 33.75KN/M^2
6.	LOAD PER METER LENGTH OF BEAM	=33.75/6 =5.63KN/M^2
7.	DEAD LOAD OF BEAM	0.6 X 0.9 X 25= 13.5 KN/M^2
8.	BRICK WALL LOAD	4X 0.23 X 19=17.48KN/M^2
9.	TOTAL LOAD	36.61KN/M^2
10.	ULTIMATE LOAD	54.92KN/M^2
11.	PARAPET WALL LOAD	1.567 KN/M^2
12.	DEAD LOAD	13.5 KN/M^2
13.	TOTAL LOAD	20.70KN/M^2



POSITION OF COLUMN AND FRAME

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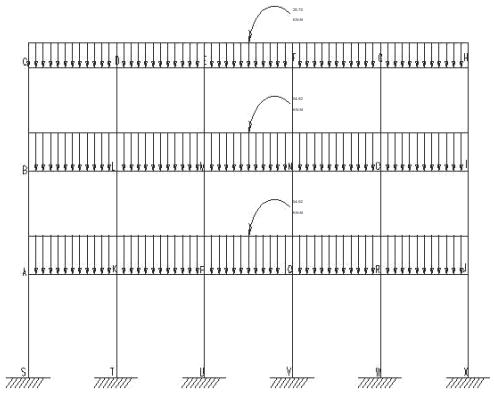
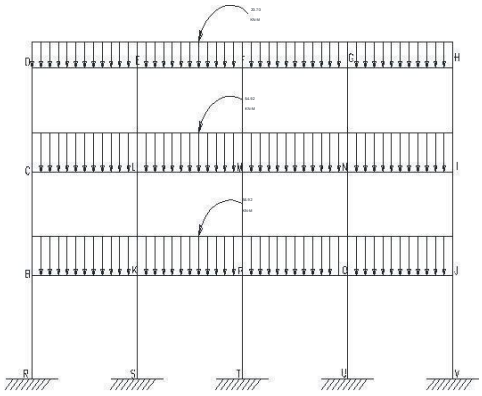


Y FRAME



X FRAME

RESULTS

FINAL END MOMENTS IN KN-M

X-X FRAME			
JOINT	MEMBER	MANUAL (EXCEL)	SAP
B	BK	-120.93	-121.23
	BC	67.85	67.92
	BA	54.51	53.31
C	CL	-127.88	-128.04
	CD	59.31	60.48
	CB	65.03	67.56
D	DC	-54.44	-54.74
	DE	56.19	54.74
E	EF	-54.17	-58.61
	ED	58.44	56.34
	EL	-2.12	2.27
F	FM	3.01	-3.08
	FG	-63.13	-63.74
	FE	63.08	63.74
G	GF	58.01	58.61
	GH	-56.66	-56.33
	GN	2.09	2.27
H	HG	54.23	54.78
	HI	-46.03	-54.74
I	IH	-59.16	60.49
	IJ	-65.57	-67.54
	IN	127.11	-128.02
J	JI	-52.69	-53.31
	JO	119.01	121.23
	JT	-52.97	-53.31
K	KP	-146.28	-147.88
	KQ	-0.45	-0.15
	KB	1.65	2.62
	KL	-144.67	-145.41
L	LE	-0.95	-0.85
	LM	-141.55	-142.85
	LK	-0.81	-0.71
	LC	141.14	-142.71
M	ML	143.79	145.29
	MF	1.02	1.1
	MP	-7.01	-7.75
	MN	-144.03	-145.29
N	NM	141.37	142.86
	NG	0.98	0.85
	NO	0.71	0.71
	NI	-142.34	-142.72
O	OP	145.46	-145.86
	ON	-2.72	-2.62
	OJ	-147.39	-147.88
	OS	0.39	-0.16
P	PO	-144.85	-144.09
	PR	4.01	4.66
	PM	6.03	6.42
	PK	142.06	-144.09
	AB	26.06	-26.27
	QK	-0.28	-0.96
	RP	-5.05	5.45
	SO	0.14	0.96
	TJ	-26.04	26.27

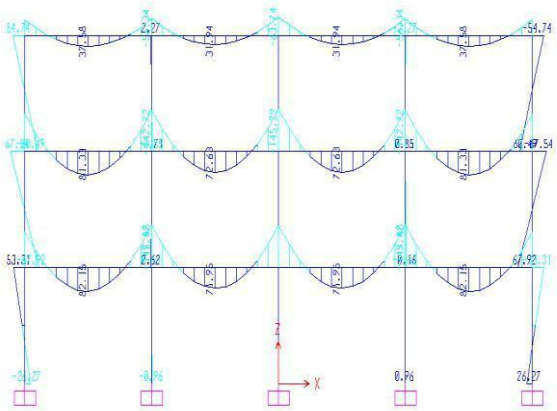
Y-Y FRAME			
JOINT	MEMBER	MANUAL (EXCEL)	SAP
A	AS	52.95	53.85
	AK	-120.97	-121.25
	AB	-66.8	-67.40
B	BL	-127.38	-127.40
	BC	59.31	60.02
	BA	65.03	67.38
C	CD	-55.44	-54.21
	CB	53.19	54.21
D	DC	48.34	-56.91

	DL	-1.93	1.49
	DE	-57.13	-58.30
E	ED	-19.98	20.82
	EM	0.68	-1.60
	EF	-62.22	-63.79
F	FE	61.59	-62.19
	FG	-61.86	-63.79
	FN	0.55	1.60
G	GH	-55.95	-56.81
	GF	-57.48	-58.30
	GO	-1.06	-1.49
H	HG	45.88	-54.21
	HI	-46.11	54.21
I	IO	126.87	-127.4
	IH	-59.3	60.02
	IJ	-64.16	-67.37
J	JI	66.66	67.40
	JX	-52.37	-53.85
	JR	120.14	-121.2
K	KL	2.21	3.27
	KA	-145.03	-147.8
	KT	-1.05	0.75
	KP	-144.91	-145.3
L	LD	-0.77	-0.09
	LB	147.1	-143.2
	LK	-1.49	-1.1
	LM	-142.57	-142.2
M	ML	145.76	-145.8
	MN	-140.02	-144.2
	ME	1.09	1.18
	MP	-0.64	-0.43
N	NM	-140.32	-144.2
	NO	-144.92	-145.8
	NF	-1.03	-1.18
	NQ	-0.76	0.43
O	ON	141.8	-142.2
	OG	0.93	0.09
	OI	-144.86	-143.2
	OR	1.55	1.1
P	PU	0.98	0.84
	PK	147.87	-144.2
	PM	1.51	0.63
	PQ	-139.28	-144.4
Q	QR	-137.12	-144.2
	QP	140.09	-144.4
	QN	-0.84	-0.63
	QV	-1.02	-0.84
R	RO	-1.46	-3.27
	RW	-0.64	-0.75

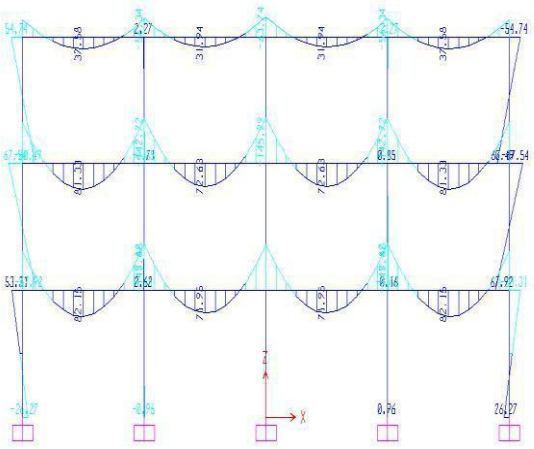
	RQ	-146.6	-145.3
	RJ	-146.89	-147.8
	WR	3.55	1.55
	SA	-25.97	-26.8
	TK	-0.31	-1.55
	UP	-0.22	-0.77
	VQ	-0.59	0.77
	XJ	25.98	26.8

RESULT OF SAP-2000

FRAME X-X



FRAME Y-Y

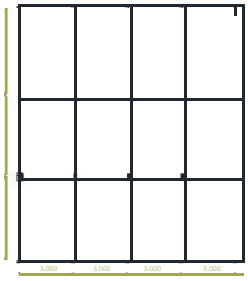


DESIGN OF RC FRAME

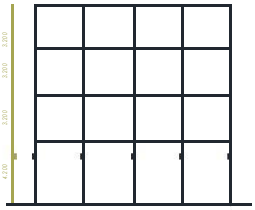
Based on the structural analysis and grouping of the member of the frame, it is decided to design slab, beam, column and footing. The limit state method is used for the design of all elements of the structure.

The following are the reinforcement details for the design of RC frame structure for slab beam column and footing.

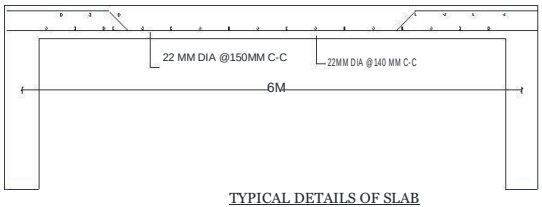
PLAN OF RC FRAME



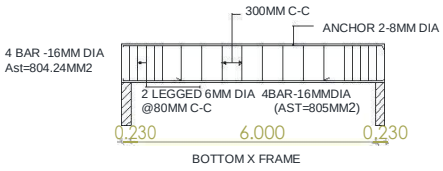
PLAN



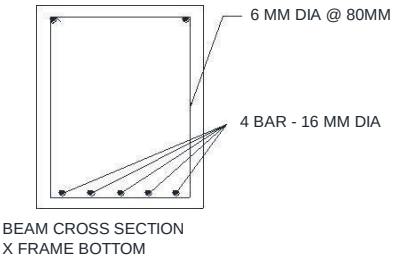
REINFORCEMENT DETAILS FOR SLAB



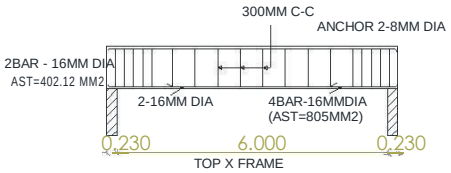
TYPICAL DETAILS OF SLAB

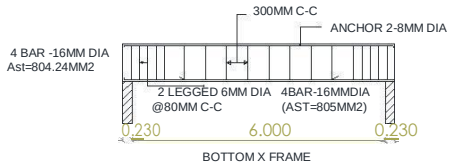


REINFORCEMENT DETAILS OF BEAM

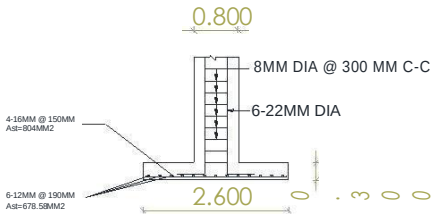


BEAM CROSS SECTION
X FRAME BOTTOM





REINFORCEMENT DETAILS OF COLUMN AND FOOTING



CONCLUSION

1. KANI's method has the capability to analyze any frame section as compared to other methods.
2. Frame structures are rarely symmetric and subjected to side way, hence KANI's method is best and much simpler than other methods like moment distribution and slope deflection method.
3. By comparing the final moments obtained from manual analysis, SAP analysis and EXCEL analysis are nearly same. So the calculations done manually and by sap and excel are correct and hence we conclude that SAP software is beneficial for analysis of frames of building
4. The design details for preliminary design and optimization have been briefly summarized and methodology of design shown.
5. In manual and software design the area of different elements of the building is same.

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