ANALYSIS OF AXIALLY LOADED REINFORCED CONCRETE JACKETED COLUMNS USING NISA

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***Abstract*: An RC Jacketed column mainly includes about retrofitting of existing columns which are low performed due to bad exposure conditions in its lifetime. So such columns selected randomly and retrofitted. Here in the present paper purely software based analysis has been made by typical conditions assumed before modelling. So based on such data an analysis programme carried out and before that columns are analysed manually and those values will be refered after analysis. This will show a RC Jacketed columns have been modelled and also theoretically can be shown. The main objective of the present paper concentrated on axial strength under compression of slender columns having typical height and by using one of the manual methods choosed mainly based on the journal alongside in the literature review and have been done and same section also by using the NISA software.**

***Keywords*: Axial Load, NISA IV, Confined Strength, Unconfined Strength, Strength Gain Factor.**

I. INTRODUCTION

1.1 GENERAL

The durability of RC member is its ability to serve its intended purposes for a sufficiently long period of time, even expose to adverse environment condition,and heavy loading condition it may vulnerable so one of techniques here to follow is to go for RC Jacketing for columns. The existing columns may wrapped with Reinforcement over which will be finely covered with the concrete material. However, since a suitable strengthening technique depends on many factors such as the type of construction and the professional environment, what is suitable for one country may not be suitable for another country. Thus, while we can draw benefit from the experiences of many other countries, we must evolve methodologies suitable to our own conditions. Considering the severe seismic risk that many parts of our country are prone to,experience on seismic strengthening needs to be accumulated by carefully documenting individual case histories. Since cost is a very important consideration. So better strength enhancement achieved from RC Jacketing.

1.2 TYPES AND REPAIR AND STRENGTHENING METHODS OF DAMAGED RC COLUMN / COLUMN RETROFIT METHOD

Jacketing from claiming a major aspect or the whole member: in this method, those harmed section will be as a rule temporarily upheld Throughout those intercession. At whatever deteriorated cement will be evacuated and the steel support may be revealed toward suitable puts. Surface preparation methods, in roughening of the existing cement surface What's more evacuating tainting materials for example, dirt, dust alternately oil, take after. Extra support bars need aid welded onto those existing support bars, Welding may be carried whichever through middle of the road bars or through bend-down bars.

- **JACKETING BASED ON MATERIALS:**

a. RC JACKET
b. STEEL JACKET
c. COMPOSITE FIBER JACKET
d. FIBER GLASS JACKET
e. SPECIAL FABRIC

1.3 REINFORCED CONCRETE JACKETING

Jacketing may be a standout amongst the practically every now and again utilized systems will fortify strengthened solid (RC) columns. RC jacketing comprises for included cement with longitudinal Furthermore transverse support around the existing columns. Furthermore sturdiness of the unique section is also improved, as opposed of the erosion and shoot insurance needs from claiming other strategies the place steel will be uncovered or the place epoxy resins need aid utilized are expanded.

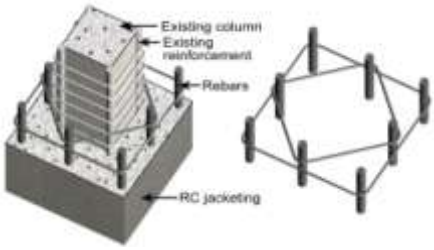


Fig A:RC column strengthened by RC jacketing

1.4 FUNDAMENTAL STRUCTURAL BEHAVIOUR OF RC JACKETING

Reinforced concrete columns are repaired or strengthened by introducing a new *re*inforced concrete layer surrounding the existing column. The method is known as jacketing.*For* this restoration method, An noteworthy expand from claiming quality or pliability might a chance to be attained. This technobabble is not best used to accomplish these objectives, as well as with right the generally conduct of the structure.

II. OBJECTIVES OF THE PRESENT STUDY

RC jacketing., this is very economical and also does not require highly skilled labours when compare to other techniques. For this purpose RC jacketing has been used for strengthening of RC slender columns element subjected to $P_{u\ (axial\ load)}$

- To find the design compressive strength component in axial compression for both original and jacketed column by theoretically.
- To analysis the axially loaded columns using NISA.
- To compare the theoretical and software results by graphical representation.\

Original column dimension (mm)	Jacketed column dimension (mm)	Longitudinal steel provided	
		Original column	Jacketed column
300X300	450X450	8#20	8#16
			4#16+8#12
			12#12
	500X500		16#25
			12#25
			12#12

Table 1: Details of the original and jacketed RC columns:

III. METHODOLOGY

3.1 Procedure Various approaches of disparate convolutions have been advanced for the structural seismic analysis. The current study E-TABS software is used for the analysis which the various analyzing methods are involved.
The methods used for the analysis are:

- Selection of columns and size.
- Computing the confined compressive strength of existing column and jacketed column using theoretical analysis and software analysis.
- Comparing the old compression column to jacketed column.
- Comparing the values of NISA software values with that of theoretical values.

3.1.1 THEORETICAL ANALYSIS OF AXIALLY LOADED JACKETED RC COLUMNS

The technique in view of Sheik and Uzumeri's model's has been utilized for the hypothetical examination of jacketed RC segment subjected to axial load. The fundamental motivation behind this investigation is to develop the outline bends for jacketed RC sections subjected to axial load.

Table 2: DESCRIPTION OF GEOMETRICAL AND MATERIAL PROPERTIES USED

Original column dimensions(mm)	300x300
Column height (m)	3
Jacket thickness (mm)	75, 100
Original column concrete	
Modulus about Elasticity(MPa).	22360
Poisson's proportion.	0.15
Jacketing concrete	
Modulus about Elasticity(MPa)	25000
Poisson's proportion	0.15
Longitudinal support.(V^{le} bars)	
Modulus about Elasticity(MPa)	200000
Poisson's proportion	0.3
Stirrups	
Modulus about Elasticity(MPa)	200000
Poisson's proportion	0.3

3.1.2 FINITE ANALYTICAL METHOD

The FE component investigation (FEA) or limited component technique (FEM) includes arrangement of building issues utilizing PCs. Building structures that have complex geometry and burdens, are either extremely hard to dissect or have no hypothetical arrangement.

Based on the steps model have been prepared

- Pre-processing or modeling the structure
- Analysis
- Post-Processing

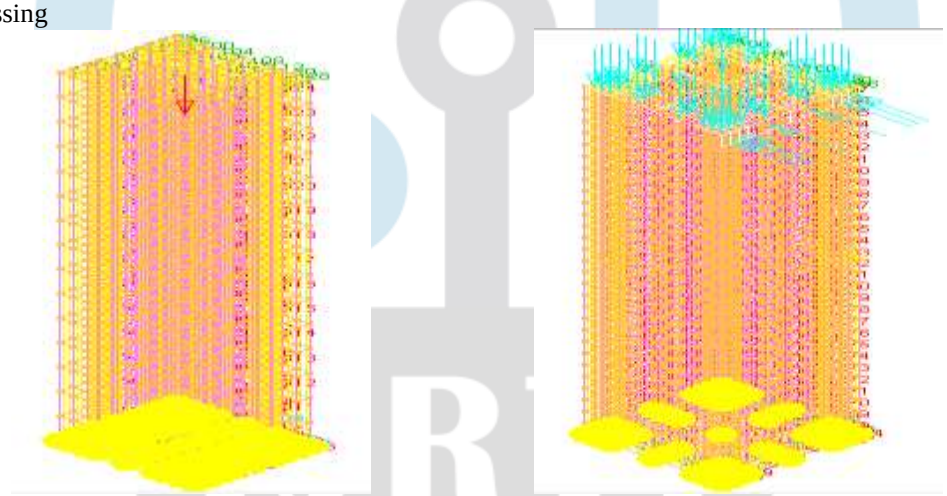


Fig B: Modeling of jacketed RC columns

IV RESULTS AND DISCUSSIONS

4.1 THEORETICAL ANALYSIS

The original column section chosen has been theoretically analysed and even jacketed columns analysed manually for axial load. The obtained results has been tabulated below for both original and stabilized columns. These manual analysis is based on the Sheikh andUzumeri,S model. The Strength gain factor (K) for the R.C. jacketed section was hypothetically ascertained utilizing the strategy in view of Sheik and Uzumeri's model [2]. At that point, they contrasted the hypothetical outcomes and the exploratory outcomes done by the Aksan. Both the trial and hypothetical work was completed by them is just for the square segment segments. In the hypothetical investigation they have said that, this proposed model can likewise be utilized for the examination of square segment area.

Column Section	Spacing	Confined concrete strength (fcc) in MPa values

		C_1	C_2	C_3	C_4	C_5	C_6
300×300	100	41.15	41.15	41.15	41.15	41.15	41.15
300×300	150	40.94	40.94	40.94	40.94	40.94	40.94
300×300	200	40.70	40.70	40.70	40.70	40.70	40.70
300×300	250	40.41	40.41	40.41	40.41	40.41	40.41
300×300	300	40.05	40.05	40.05	40.05	40.05	40.05

Table 3: Confined concrete strength (fcc) from theoretical analysis with columns having different spacing of inner and outer stirrups in longitudinal direction

4.2 FINITE ELEMENT ANALYSIS RESULTS AND DISCUSSIONS

(at Free end) **(At bottom)**

Fig C: Plan view of normal stress distribution in the jacketed RC column

4.2.1 Comparison of theoretical and NISA element results

Table 4: Confined concrete strength (fcc) from theoretical analysis with columns having different spacing of inner and outer stirrups in longitudinal direction

Column Section	Spacing	C1		% error	C2		% error
		Theoretical fci=20MPa fco=25MPa	FEM fci=20MPa fco=25MPa		Theoretical fci=20MPa fco=25MPa	FEM fci=20MPa fco=25MPa	
300×300	100	41.15	42.36	2.94	41.15	36.63	-10.98
300×300	150	40.94	40.85	-0.29	40.94	37.30	-8.89
300×300	200	40.70	38.82	-4.62	40.70	36.62	-10.02
300×300	250	40.41	35.89	1.09	40.41	34.53	-14.55
300×300	300	40.05	31.22	-11.1	40.05	30.97	-22.67

Column Section	Spacing	C3		% error	C4		% error
		Theoretical fci=20MPa fco=25MPa	FEM fci=20MPa fco=25MPa		Theoretical fci=20MPa fco=25MPa	FEM fci=20MPa fco=25MPa	
300×300	100	41.15	35.70	-13.24	41.15	35.70	-13.24
300×300	150	40.94	39.92	-2.49	40.94	36.54	-10.74
300×300	200	40.70	37.85	-7.00	40.70	35.57	-12.60
300×300	250	40.41	34.87	-13.70	40.41	33.86	-16.20
300×300	300	40.05	30.19	-24.61	40.05	30.66	-24.12

Column Section	Spacing	C5		% error	C6		% error
		Theoretical fci=20MPa	FEM fci=20MPa		Theoretical fci=20MPa	FEM fci=20MPa	

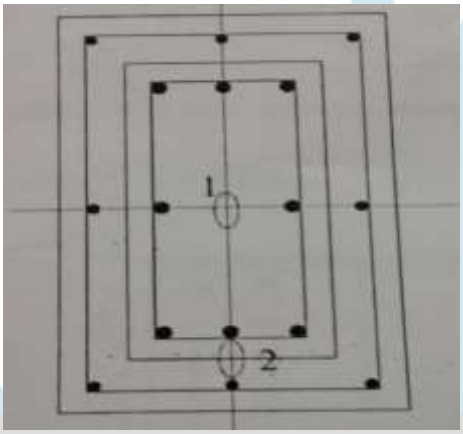
		fco=25MPa	fco=25MPa		fco=25MPa	fco=25MPa	
300×300	100	41.15	41.68	1.28	41.15	35.49	-13.75
300×300	150	40.94	40.84	-0.24	40.94	36.37	-11.16
300×300	200	40.70	39.53	-2.87	40.70	35.34	-13.16
300×300	250	40.41	37.46	-7.30	40.41	33.62	-16.80
300×300	300	40.05	34.05	-14.98	40.05	30.72	-23.29

4.2.2 Discussions

The theoretical results obtained from the analysis of jacketed column of varying concrete strength have been considered. It can be observed from the table 4.3 that the results of theoretical and finite element analysis are approximately matching with some percentage of errors. The comparative errors are -0.24% to-24.61 % and 1.09% to 2.94% the column jacketed with 25MPa concrete strength with respect to theoretical analysis.

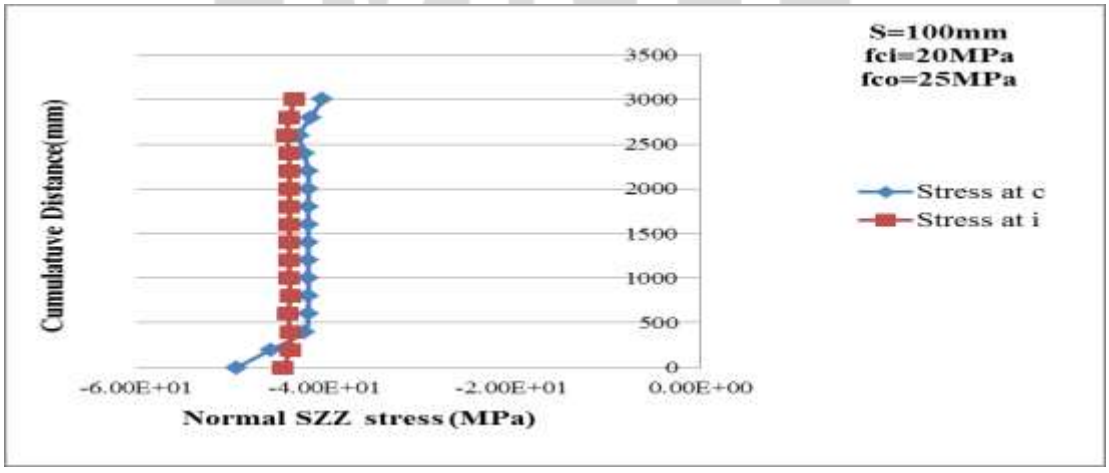
4.2.3 Variation of the normal stresses in jacketed RC columns

In order to know the behavior of jacketed RC columns under the applied confined load in NISA the normal stress SZZ has been extracted at the points as shown in the figure 4.4. The stress at the point 1 is at the centre core and stress at point is at the interface of the older and new concrete and stress at point 2 is at core center (x-axis).



1-Normal stress SZZ at the core Centre
2-Normal stress SZZ at the interface between the old and new column

Fig D: C/S OF JACKETED COLUMN



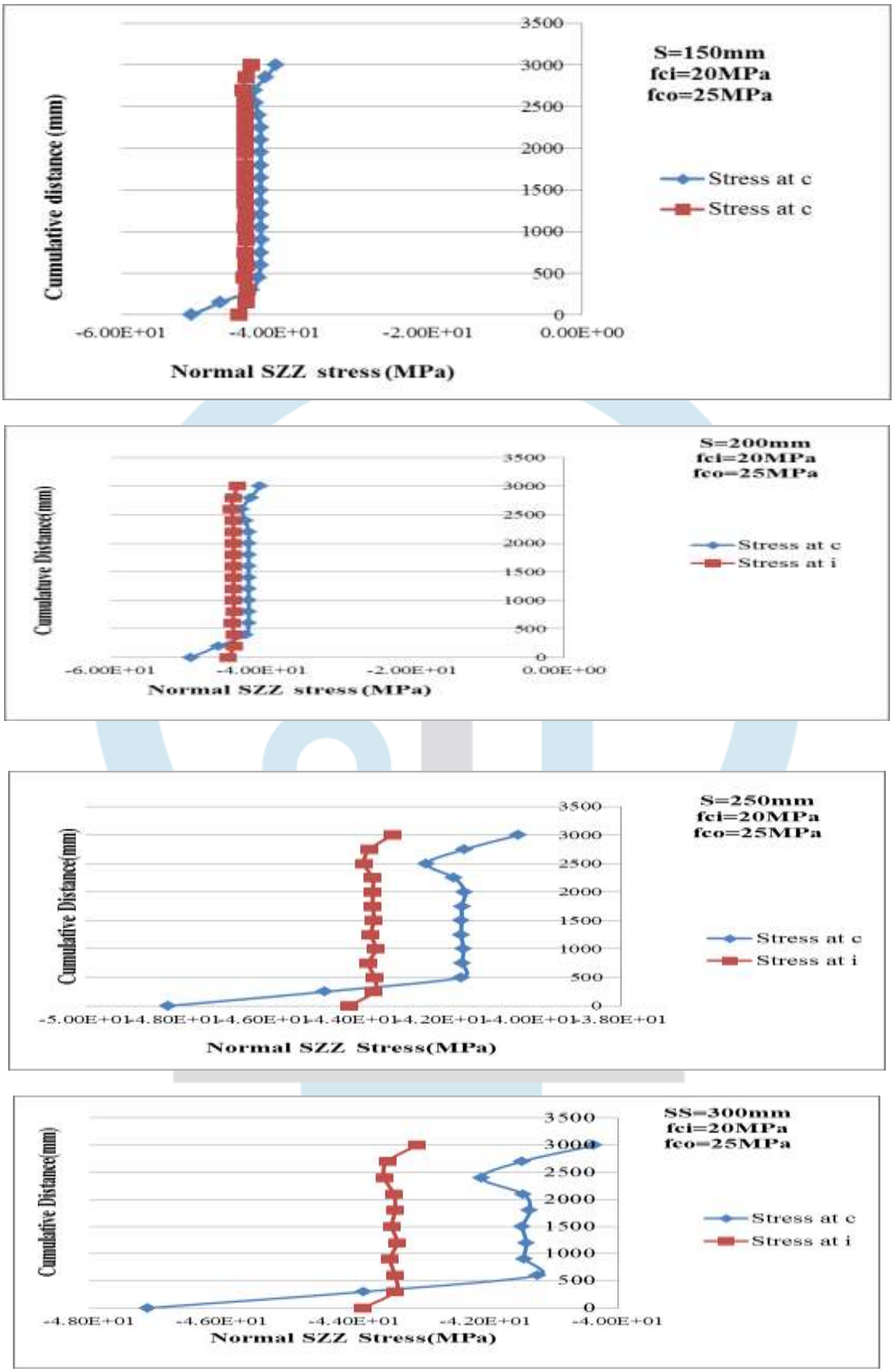


Fig D: The variation of normal stresses in the central core of column and interface of the jacket and original column along direction parallel to applied load for (300x300)mm column section with 75mm jacket(C1 Column).

NOTE: Similarly, rest of the sections can be done.

V. CONCLUSION

The existing work is concerned with the theoretical study of jacketed columns based on the Sheikh and Uzumeri's model and also F E analysis carried out for jacketed RC columns with a commercially available finite element analysis package NISA/DISPLAY-IV. Based on the theoretical and finite element analysis study carried out, the following conclusions have been drawn.

1. The jacketed column with 100mm and fco=25MPa with longitudinal bars (16#25mm),increases about 61% in it'strength which is maximum.
2. The jacketed column with 75mm and fco=25MPa with longitudinal bars of dia (12#12mm),increases about 38% in it'strength which is minimum.
3. It can be observed that for the same dimension in the original column with decreasing the spacing of stirrups, K decreases with increased concrete strength in the original column.
4. It is concluded that the theoretical results are comparable with finite element results with are -0.24% to-24.61 % and 1.09% to 2.94% percentage of errors.

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