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Retrofitting of an Existing Residential Structure

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Abstract

Retrofitting of any given structure is done to improve its strength and performance. In most scenarios, retrofitting is done to improve seismic resilience and performance, however in this investigation retrofitting techniques are utilized to increase the structural strength. In order to encompass the additional load parameters, instead of complete reconstruction, retrofitting solutions are to be adopted, which reduces cost, labor and is very energy and environment conscious. The said structure was modeled using the E-Tabs software, with appropriate load parameters. Furthermore, the altered load parameters for the data center would likewise be examined to understand the extent of failure and would help in indicating the appropriate retrofitting solution to ameliorate the situation. This project is cutting edge in the sense that a sustainable approach in the construction industry is sought to, looking at the need for energy efficiency.

Keywords: Retrofitting, Seismic Resilience, Energy Efficiency.

Introduction

Throughout the time, the construction industry promotes sustainable strategies and practices that are environmentally friendly. Although all of them need the right infrastructure to live in, renovation and change are increasingly necessary. In addition, any place's civil infrastructure should be modified in accordance with the requirements of that time. There are a few issues with the same problem, and this document identifies one and suggests an alternative approach to circumventing the problem.

If a structure is to be transformed from one function to another, likewise changing a building site for a commercial facility, the most common way is demolishing and reconstructing. This approach causes a lot of pollution and produces a lot of waste. An alternative approach and the objective of this paper is to use retrofitting solutions to change structural functionality. Several research works on this topic present the impact of usage of such retrofitting techniques on the reduction of greenhouse gas emissions of various energy conservation measures implemented in building stocks. Certain studies provide specific strategies for the evaluation of the effects on residential case studies and various energy efficiency strategies.

Analysis 1 (10 – Story residential building)

All the data which was applied on the software were taken from the field investigation and design document from the consultant. Data taken directly is the dimension of each structural element. The other data such as the grade of concrete and grade of steel is taken from the design document. The building structure was modeled and analyzed by using the ETABS program. The structure was carried out for analysis where data of strips forces and failure modes was obtained based on which the behavior of the structure due to gravity loads was identified.

Data of Existing Structure

A 10-storey residential building is taken for the study. The structure is composed of a moment resisting RC frame with a flat plate of 250 mm thickness. The structure members are made of reinforced concrete structure. The floor height of the building is 4m. There are in total 9 columns. The strips are further divided into column and middle strips. The proposed structure is said to have a core wall comprising 6 lifts and a staircase where a shear wall of thickness 300mm is provided and the dimensions of beam used in the core region is 600mmx450mm and the flat plate used in the core region is of thickness 200mm. Beam and column sections were designed as frame elements.

The building is examined for gravity loads, considering all the design load combinations specified in the IS: 456 standard codes. The RC frame structure was analyzed according to IS: 456 standard codes. The suitable live and dead loads were taken from IS: 875 (Part-I). The compressive strength of concrete is taken as 25 MPa; the yield strength of steel reinforcement bars is 500 MPa for both longitudinal and transverse reinforcement, respectively. In fig 1 Anchorage details and Footing details are provided.

Load Bearing Capacity of the Existing Structure

From the results of structural analysis, the cross-section capacity of the structural elements such as bending and shear for beams, shear for columns and strip moments were obtained. From the results, the ability of structural elements to withstand the combination of loads can be determined as no failure modes were identified on columns and slabs.

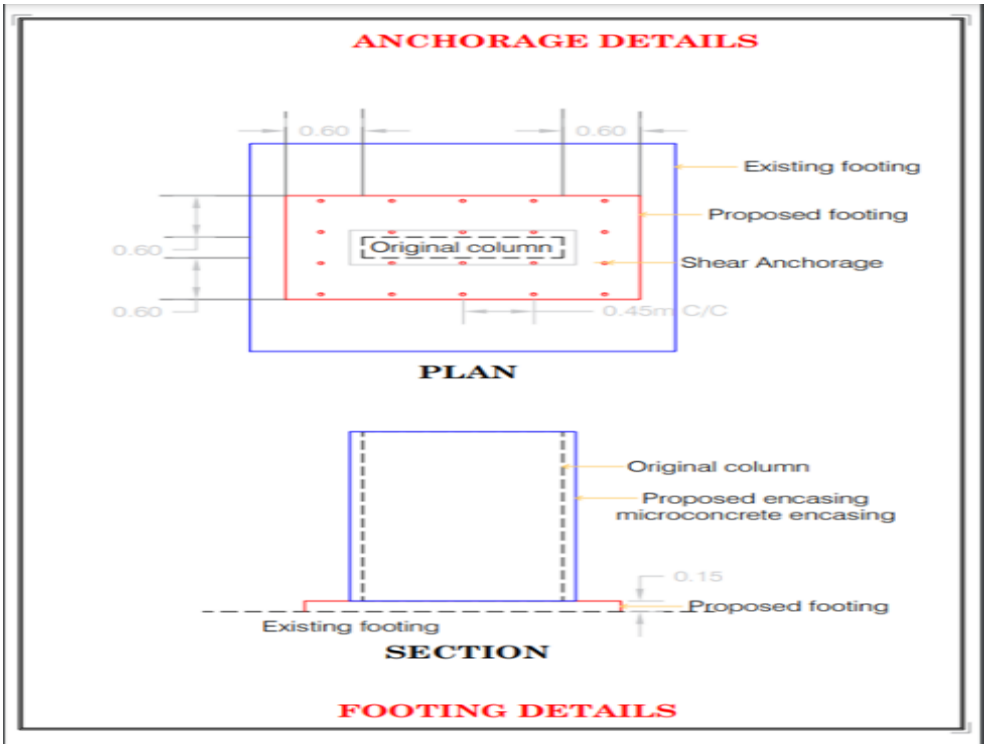

Fig. 1

Micro Concrete

"MAGNIGROUT" has been carefully developed to optimum performance, even in the toughest applications along with unparalleled ease of application. It provides long life expectancy and maintains the rigid equipment to foundation connections which is necessary to meet demanding installation

requirements. "MAGNIGROUT" complies and exceeds the guidelines provided in ASTM C 1107/ C1107M and EN 1504-3 Class R4.

Advantages

- Very high compressive and flexural strength at very short time.
- Longer pot life ensuring negligible wastage.
- Non-shrink grout with controlled positive expansion ensures proper load transfer and durability of structure.
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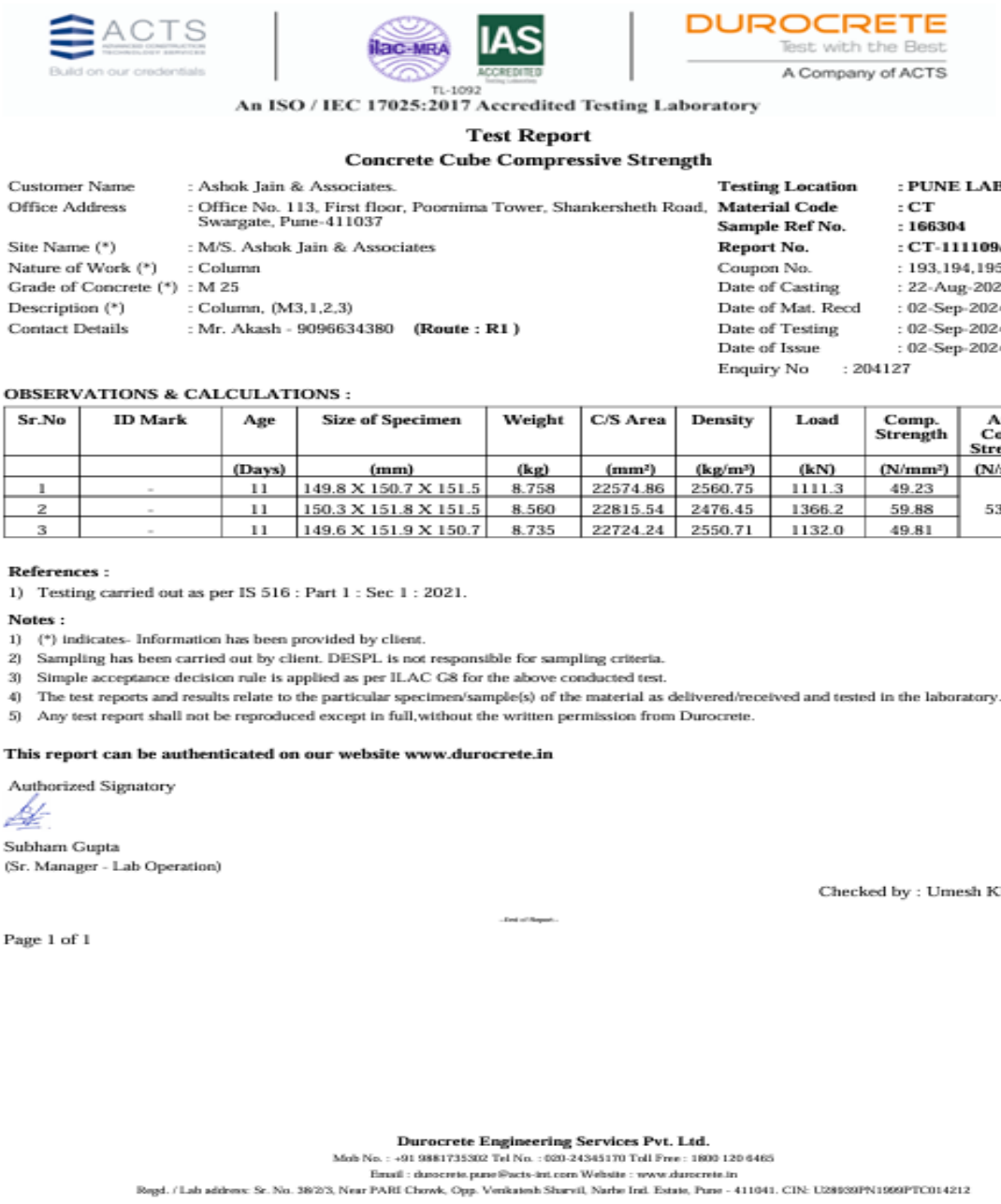
- Free of chlorides and additives, that may lead to corrosion.
- High drill resistance property.
- Self-compacting.
- Product variants available in both Flow-able and Normal Trowel-able consistency.

Properties Table

Parameter		Unit	Values	
			Normal	Flowable
Bulk density		Kg/L	1.35~1.45	1.30~1.40
Fresh wet density		Kg/ L	2.2~2.3	2.1~2.3
Water demand normal		%	15~16	16~17
Pot life		Minutes	60	60
Flexural Strength @ 28 days		N/mm^2	13~14	15~17
Splitting Tensile Strength @ 28 days		N/mm^2	8.5	8.0-8.5
Linear coefficient of Thermal Expansion		$mm/mm/^0C$	8-9 X 10^{-6}	8-9 X 10^{-6}
Modulus of Elasticity @28 days		GPa	53~55	53~55
Compressive Strength	@ 01 Day	N/mm^2	40~45	40~45
	@ 03 Days		55~65	55~65
	@ 07 Days		70~80	70~80
	@ 28 Days		Up to 100	Up to 100
Flexural Strength	@ 01 Day	N/mm^2	4~5	3~4
	@ 07 Days		7~8	7~8
	@ 14 Days		9~11	9~10
	@ 28 Days		13~14	13~14
Pull off bond Strength	@ 07 Days	N/mm^2	17~18	16~18
	@ 28 Days		22~24	20~24
Tensile Strength	@ 28 Days	N/mm^2	6.5~8.5	6.5~8.5
Packaging		MAGNIGROUT is available in 40 Kg BOPP laminated packaging.		

Fig. 2

Concrete Cube Compressive Strength Test



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Test Report

Concrete Cube Compressive Strength

Customer Name	: Ashok Jain & Associates.	**Testing Location**	**: PUNE LAB**
Office Address	: Office No. 113, First floor, Poornima Tower, Shankersheth Road, Swargate, Pune-411037	**Material Code**	**: CT**
		Sample Ref No.	**: 166304**
Site Name (*)	: M/S. Ashok Jain & Associates	**Report No.**	**: CT-111109/2-1**
Nature of Work (*)	: Column	Coupon No.	: 193,194,195,
Grade of Concrete (*)	: M 25	Date of Casting	: 22-Aug-2024
Description (*)	: Column, (M3,1,2,3)	Date of Mat. Recd	: 02-Sep-2024
Contact Details	: Mr. Akash - 9096634380 **(Route : R1)**	Date of Testing	: 02-Sep-2024
		Date of Issue	: 02-Sep-2024
		Enquiry No	: 204127

OBSERVATIONS & CALCULATIONS :

Sr.No	ID Mark	Age	Size of Specimen	Weight	C/S Area	Density	Load	Comp. Strength	Avg. Comp Strength
		(Days)	(mm)	(kg)	(mm²)	(kg/m³)	(kN)	(N/mm²)	(N/mm²)
1	-	11	149.8 X 150.7 X 151.5	8.758	22574.86	2560.75	1111.3	49.23	53.00
2	-	11	150.3 X 151.8 X 151.5	8.560	22815.54	2476.45	1366.2	59.88	
3	-	11	149.6 X 151.9 X 150.7	8.735	22724.24	2550.71	1132.0	49.81	

References :

1) Testing carried out as per IS 516 : Part 1 : Sec 1 : 2021.

Notes :

1) (*) indicates- Information has been provided by client.
2) Sampling has been carried out by client. DESPL is not responsible for sampling criteria.
3) Simple acceptance decision rule is applied as per ILAC G8 for the above conducted test.
4) The test reports and results relate to the particular specimen/sample(s) of the material as delivered/received and tested in the laboratory.
5) Any test report shall not be reproduced except in full,without the written permission from Durocrete.

This report can be authenticated on our website www.durocrete.in

Authorized Signatory

Subham Gupta
(Sr. Manager - Lab Operation)

Checked by : Umesh Khillare

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Fig. 3

Dimensions of Column

Column name	Original Dimension	Encasing	Final Dimension	Steel Area (mm^2)
C4 & C6	1000x500	100	1200x700	2980
C8	1050x300	100	1250x500	2680
C9 & C11	1350x300	100	1550x500	3280

C12 & C13 (Chipping)	1500x300	100	1620x420	3580
C14 & C15 (Chipping)	1050x300	100	1170x360	2120

Details of Column 4 and 6

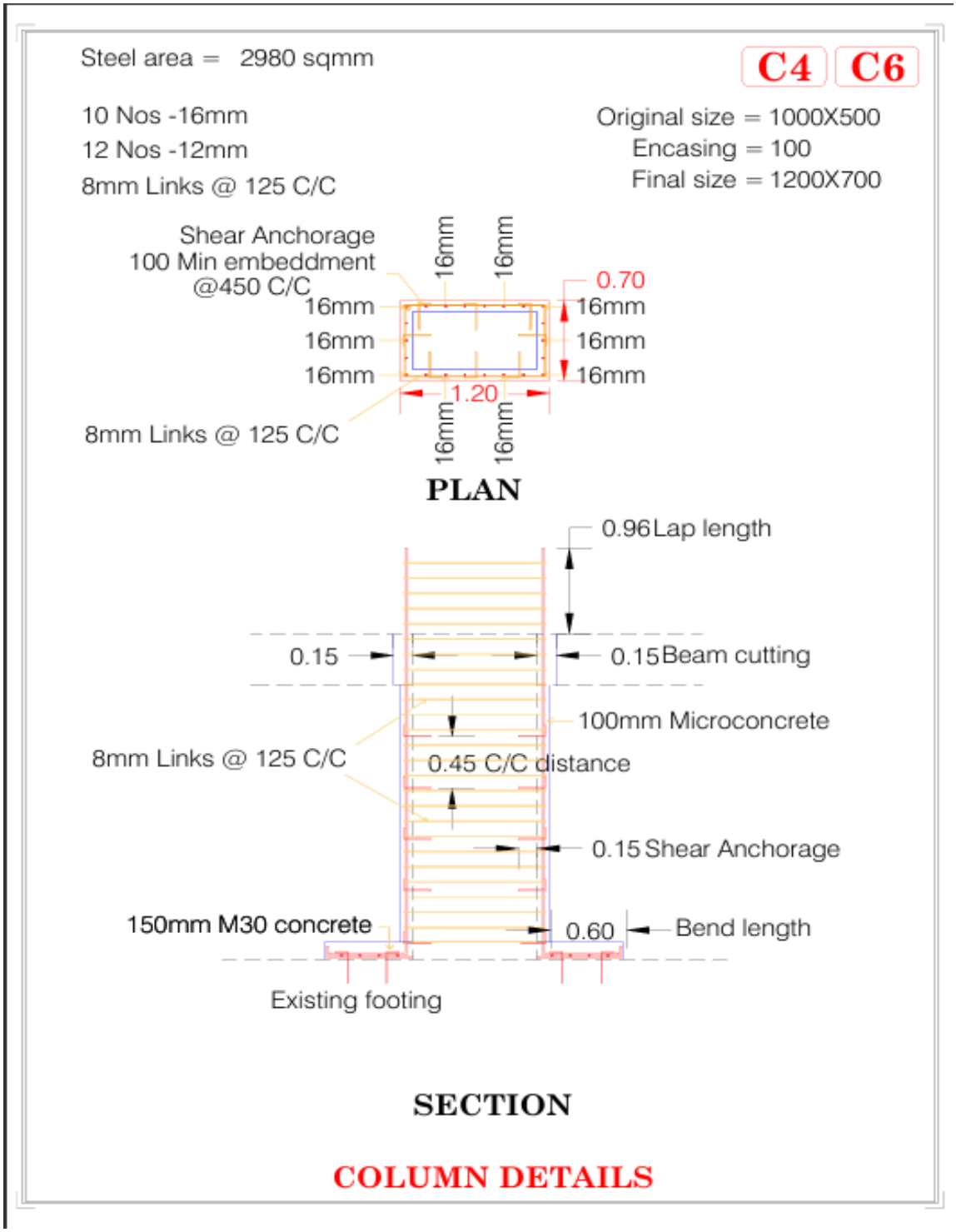

Fig. 4

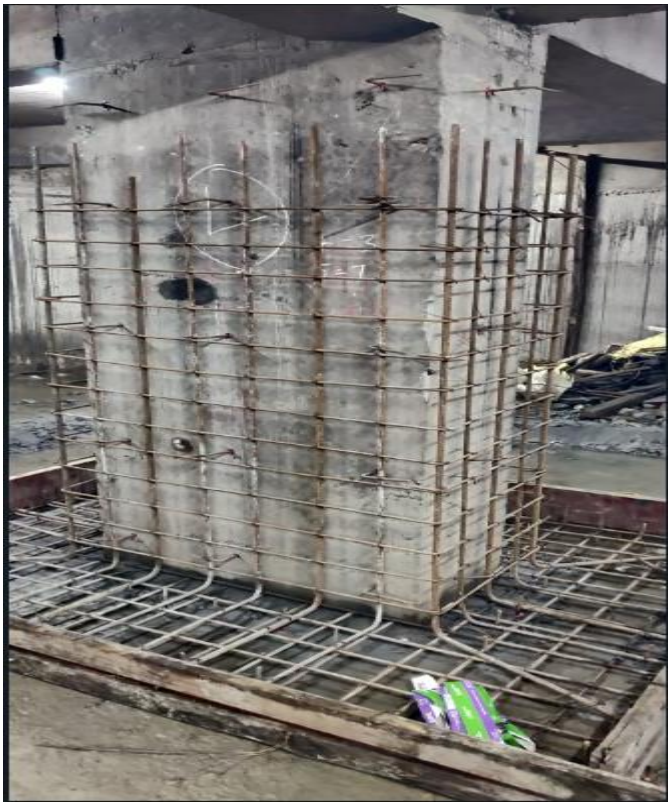

Fig. 5 (Column 4)

Fig. 6 (Column 6)

Details of Column 8

Fig. 7

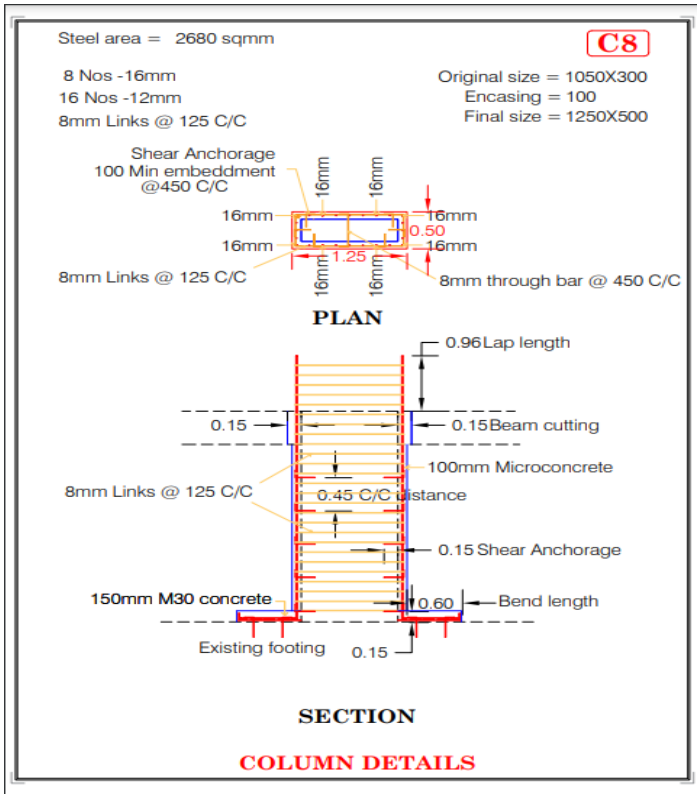

Fig. 8 (Column 8)

Details of Column 9 and 11

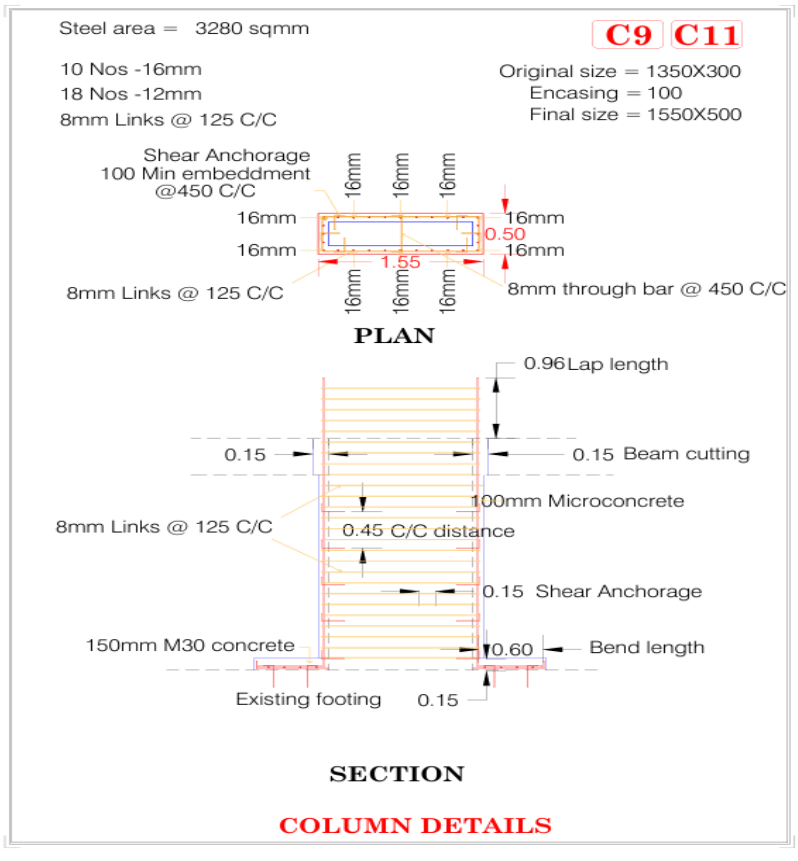

Fig. 9

Fig. 10 (Column 11)

Details of Column 12 and 13

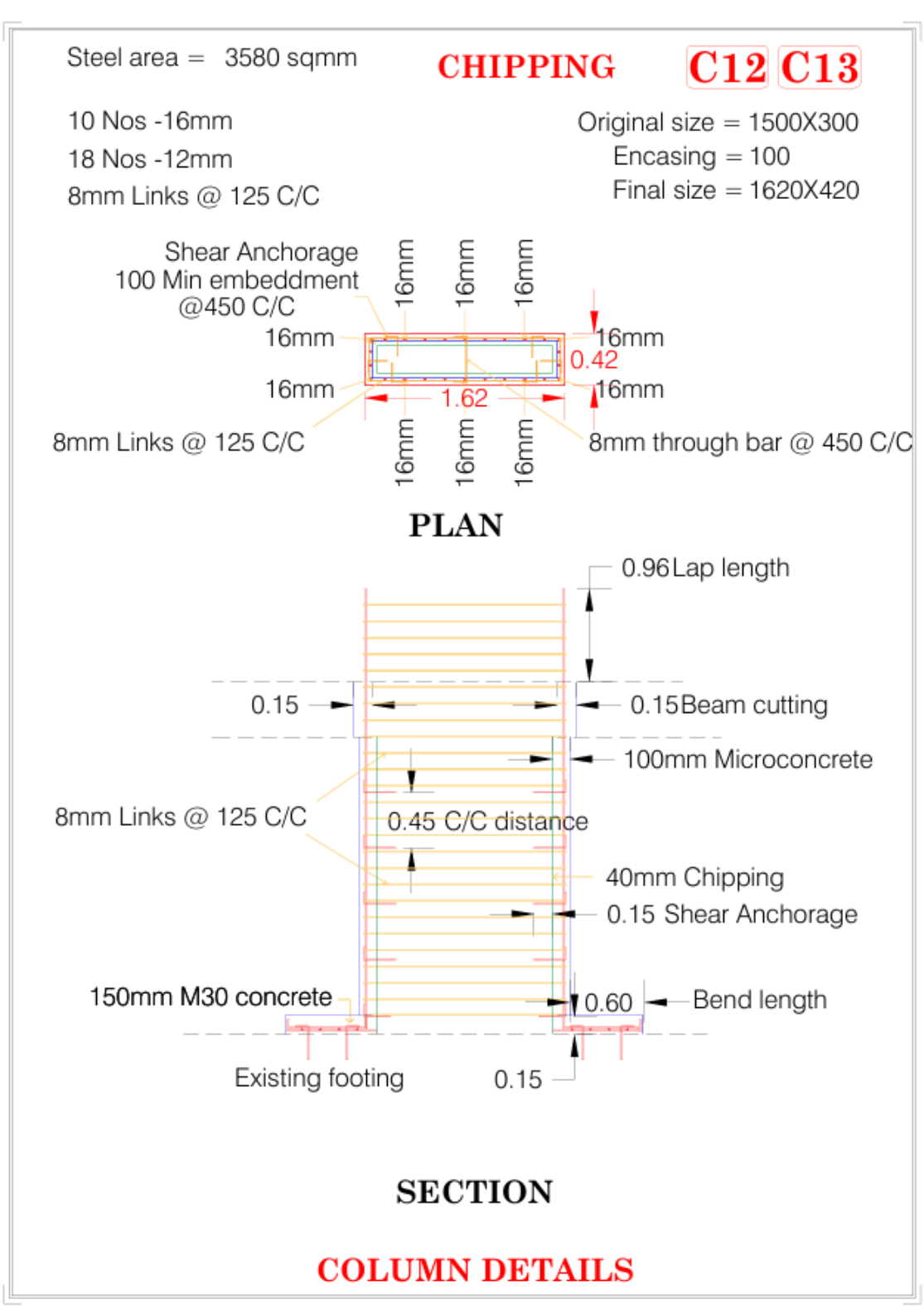

Fig. 11

Fig. 12 (Column 12)

Fig. 13 (Column 13)

Details of Column 14 and 15

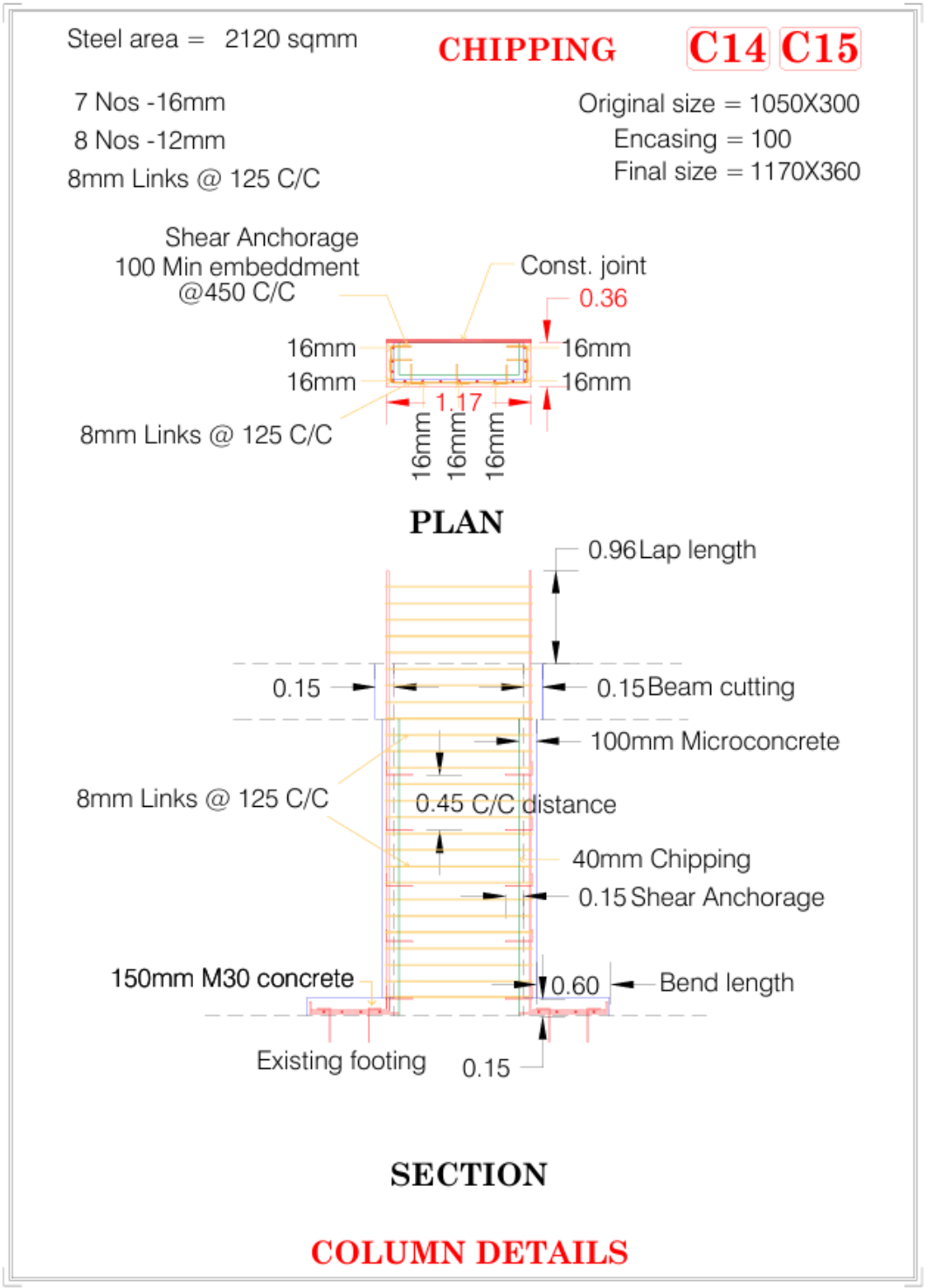

Fig. 14

Fig. 15 (Column 14)

Fig. 16 (Column 15)

Results

Retrofitting is extremely environmentally friendly and energy efficient. There is a great amount of CO2 emission reduction and water conservation in this method. It reduces the usage of natural resources and also ameliorates the effect the construction industry has over climate change. With reduced time for construction, the labor force is reduced to a great extent. The structure also increases its durability when it has been retrofitted, thereby increasing its life, and also has seismic enhancement properties which would help the structure in calamities such as earthquakes. The strength of the structure has increased by 3 times.

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