

Original Article

Digital Rebar Detailing and Bar Bending Schedule Generation For RCC Columns Using Rebar CAD Software

Pandiyarajan.k¹, Mr. S. Keasavan²¹UG Student / Department of Civil Engineering / P.S.R. Engineering College / Sivakasi, Tamilnadu, India – 626140.²Assistant Professor / Department of Civil Engineering / P.S.R. Engineering College / Sivakasi, Tamilnadu, India – 626140.

Abstract: Reinforced Concrete (RCC) columns are essential vertical load-bearing elements in modern construction. Accurate detailing of reinforcement is critical to ensure structural safety, reduce steel wastage, and optimize construction schedules. Traditional manual methods of reinforcement detailing are labour-intensive, error-prone, and time-consuming, particularly for high-rise buildings with dense reinforcement layouts. This study presents the application of digital rebar detailing using Rebar CAD software for RCC columns, incorporating real-time construction practices from Saudi construction projects. The methodology involves creating precise 3D models, placing longitudinal and shear reinforcements, and automatically generating Bar Bending Schedules (BBS) that include cutting lengths, bending angles, and total steel weight. Implementation of this approach reduces human errors, improves visualization of reinforcement congestion, streamlines procurement and fabrication, and enhances site execution efficiency. The study demonstrates that digital detailing can lead to significant savings in steel material, reduce rework, and improve overall project quality, making it a vital tool for modern construction practices.

Keywords: RCC Column, Digital Rebar Detailing, RCC Columns, Bar Bending Schedule (BBS), Rebar CAD Software, 3D Modeling, and Reinforcement Optimization.

I. INTRODUCTION

RCC columns are critical vertical load-bearing elements in buildings, transferring loads from slabs and beams to the foundation. Accurate reinforcement detailing is essential for structural safety, material optimization, and timely project execution. Traditional manual methods are time-consuming, error-prone, and often lead to steel wastage, especially in high-rise or complex structures.

Digital rebar detailing using Rebar CAD software provides a modern solution by creating precise 3D models of columns and automatically generating Bar Bending Schedules (BBS) with cutting lengths, bending angles, and total steel weight. This approach allows engineers to visualize reinforcement congestion, detect clashes, and ensure compliance with design codes (ACI 318 / Saudi Building Code).

By integrating real-time construction data from Saudi projects, digital detailing reduces human errors, optimizes steel usage, streamlines procurement and fabrication, and improves construction efficiency. It also supports better resource management, faster approval of shop drawings, and cost-effective project execution, bridging the gap between design and practical site implementation.

II. MATERIAL AND METHODS

A. BUILDING INFORMATION MODELING (BIM)



Building Information Modeling (BIM) is a digital representation of a building's physical and functional characteristics. For RCC columns, BIM enables:

- ❖ 3D visualization of structural elements and reinforcement layout.
- ❖ Coordination between structural, architectural, and MEP models to avoid clashes.

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- ❖ Data integration with Rebar CAD software for accurate reinforcement detailing.
- ❖ Documentation and reporting, including quantities, schedules, and fabrication drawings.

BIM ensures that all stakeholders have a single source of truth, improving accuracy and efficiency in modern construction projects.

B. REBAR CAD SOFTWARE



Rebar CAD software is specialized for reinforcement detailing and Bar Bending Schedule (BBS) generation. Key features include:

- ❖ 3D modelling of RCC columns with longitudinal bars, ties, hooks, and laps.
- ❖ Automatic BBS generation, including cutting lengths, bending angles, steel weight, and quantity.
- ❖ Clash detection and reinforcement congestion analysis.
- ❖ Compliance with design codes such as ACI 318 and Saudi Building Code.
- ❖ Integration with BIM models to streamline detailing and fabrication processes.

Rebar CAD ensures accuracy, efficiency, and cost-effectiveness, making it indispensable in large-scale Saudi construction projects.

C. METHODOLOGY

1. Selection of RCC column from real-time project
2. Collection of structural drawings and design data as per ACI 318
3. Identification of column dimensions and reinforcement requirements
4. Input of reinforcement details in RebarCAD
5. Digital modeling and placement of longitudinal bars and stirrups
6. Automatic preparation of Bar Bending Schedule (BBS)
7. Verification of BBS with structural drawings and site requirements
8. Final output issued for site execution and fabrication.

III. RESULTS AND DISCUSSION

A. Detailed Structural Analysis in Column

Detailed structural analysis of RCC columns is essential to ensure load-bearing capacity, stability, and reinforcement adequacy. For this study, digital rebar detailing using Rebar CAD software was employed to perform an in-depth analysis of columns in a high-rise construction project.

a) Longitudinal Elevation

The longitudinal elevation of Column C-25 & C-26 (as shown in Figure 3) provides a clear view of the reinforcement layout along the full height of the column. This elevation is essential for understanding the placement and detailing of vertical bars in relation to the applied loads and structural requirements.

- ❖ **Column Heights:** Two typical columns are considered: Column C-09 (height 6500mm)
- ❖ **Kicker:** A 75mm kicker is provided at the base of each column to ensure proper alignment from the footing to the column start.
- ❖ **Column Starter:** Vertical bars extend from the footing as starters, connecting to the lower portion of the column.
- ❖ **Lap Lengths:** Lap splices are provided where necessary to maintain tension continuity, especially near critical points where columns connect with beams or slabs.
- ❖ **Development Lengths:** Bars are anchored into the footing and slab using calculated development lengths as per ACI 318 / Saudi Building Code, ensuring full load transfer.
- ❖ **Slab Connection:** At the top, columns are designed to connect with the slab reinforcement, ensuring structural integration between vertical and horizontal members.

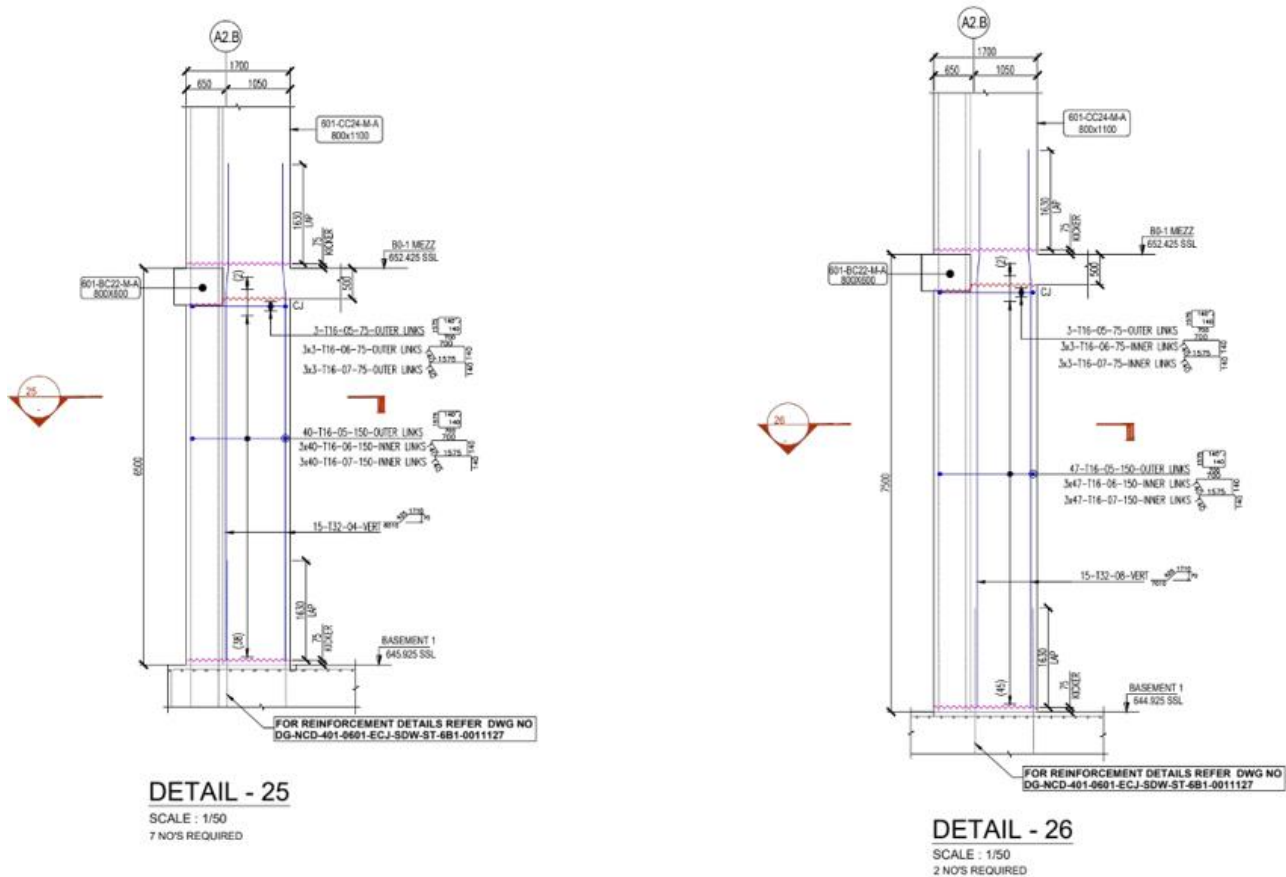


Figure 1: Column reinforcement details

Column Section Analysis (Section 25 & 26)

The cross-sectional views provided by RebarCAD (Section 25 and Section 26) offer a precise look at the internal reinforcement arrangement, which is vital for verifying structural integrity and ensuring there is no congestion that could hinder concrete pouring.

- ❖ **Size & Alignment:** The analyzed columns have a rectangular cross-section of 800mm x 1100mm. A 75mm kicker is provided at the base to ensure perfect alignment from the footing.
- ❖ **Concrete Cover:** A clear cover is maintained to protect reinforcement from corrosion and ensure structural integrity.
- ❖ **Vertical Bars:** The section features 15-T32 longitudinal bars (32mm diameter) to carry vertical loads.
- ❖ **Links & Ties:** It includes T16 outer links and multiple inner ties to prevent bar buckling and provide shear resistance.
- ❖ **Code Compliance:** All hooks, laps, and development lengths follow ACI 318 and Saudi Building Code standard.

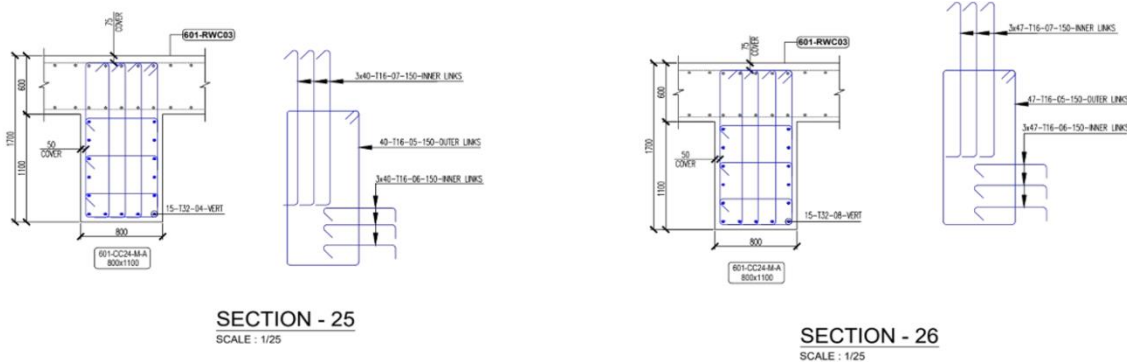


Figure 2: Column cross sectional details

Importance of Crank Bars in Column Detailing

Crank bars (or offset bends) are essential when a column size changes or when aligning vertical bars between floors.

- ❖ **Standard Slope:** As per ACI 318 and Saudi Building Code, the slope of the inclined portion of an offset bar must not exceed 1:6.
- ❖ **Purpose of the 1:6 Slope:** This gradual transition ensures that the vertical load is transferred safely through the steel without causing high stress concentrations or "kicking" forces that could burst the concrete.

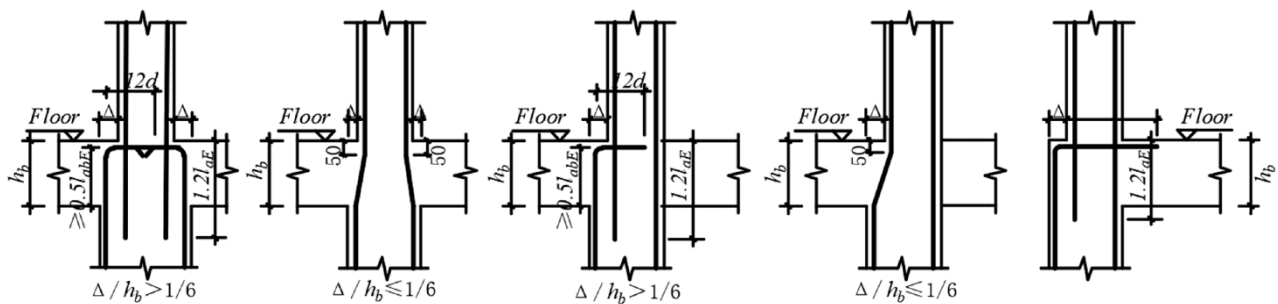
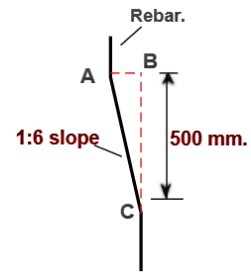


Figure 3: Different types of column crank

B. Analysis of Bar Bending Schedule (BBS)

One of the major outcomes of this project is the automatic generation of the Bar Bending Schedule (BBS). The BBS prepared using RebarCAD includes detailed information such as bar marks, diameter, length, number of bars, shape code, and total weight.

The automated BBS generation eliminated the need for manual calculations, thereby reducing errors and saving time. It also provided accurate quantity estimation, which is essential for cost control and material planning.

The BBS helped in:

- ❖ Efficient procurement of reinforcement steel
- ❖ Proper planning of cutting and bending operations
- ❖ Reduction of material wastage
- ❖ Better coordination between design and site teams

Member	Bar Mark	Type and Size	No. of Mbrs	Qty	Total Qty.	Length of each bar mm †	Shape code	A * mm	B * mm	C * mm	D * mm	E/R * mm	Shape	Weight (Kg)	Rev.
								F * mm	G * mm	H * mm	I * mm	J * mm			
DETAIL-17	01	T10	1	76	76	1340	99165	160	400	110	110			62.73	0
DETAIL-17	02	T10	1	38	38	1820	99165	400	400	110	110			42.6	0
DETAIL-17	03	T20	1	12	12	6605	26	5155	270	1180	45			195.46	0

END BBS

Weight 300.79

BAR SUMMARY	DIA MM	8	10	12	14	16	18	20	25	32	40	TOTAL(TON)
	TOTAL KG	0	105.33	0	0	0	0	0	195.46	0	0	0

Figure 4: Bar bending schedule (BBS)

C. Comparison with Conventional Methods

A comparison between conventional reinforcement detailing methods and RebarCAD-based detailing highlights several advantages.

In traditional methods, reinforcement drawings and BBS are prepared manually using 2DCAD or hand calculations. This process is time-consuming and prone to errors, especially in complex structures.

In contrast, RebarCAD provides:

- ❖ Automated detailing and scheduling
- ❖ High accuracy in calculations
- ❖ Faster project completion
- ❖ Easy modification of design changes

The ability to quickly update drawings and schedules in case of design revisions is a major advantage of using RebarCAD.

IV. CONCLUSION

The integration of BIM and RebarCAD significantly improves reinforcement detailing accuracy and efficiency. This digital approach eliminates manual calculation errors, reduces steel wastage, and ensures strict compliance with ACI 318 and Building Code standards. By using a 1:6 crank slope and 3D clash detection, engineers can visualize congestion early, leading to smoother site execution and higher project quality. Ultimately, these tools bridge the gap between complex design and practical construction.

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