

Original Article

Reinforcement Detailing And BBS Preparation For Stadium Beams Using RebarCAD

Ms.M.Sivaranjani¹, Mrs.V.Kani²

¹UG Student, Department of Civil Engineering, P.S.R. Engineering College, Sivakasi, Tamilnadu, India – 626140.

² Assistant Professor , Department of Civil Engineering, P.S.R. Engineering College, Sivakasi, Tamilnadu, India – 626140.

Abstract: This paper presents the application of Building Information Modeling (BIM) and RebarCAD software for reinforcement detailing and Bar Bending Schedule (BBS) preparation in a stadium structure. Modern construction projects require high precision, coordination, and efficiency, which cannot be effectively achieved using traditional 2D drafting methods. BIM provides a digital platform that integrates design, analysis, and construction data into a single model, improving visualization and collaboration. RebarCAD, a specialized structural detailing software, is used in this project to generate accurate reinforcement layouts and automated Bar Bending Schedules. The software enables precise calculation of bar lengths, shapes, quantities, and bending details, thereby reducing manual errors and improving efficiency. The generated BBS assists in cost estimation, material management, and site execution. The study demonstrates that the integration of BIM and RebarCAD significantly enhances productivity, accuracy, and construction quality, especially in large-scale and complex structures like stadiums. The results confirm that RebarCAD is an effective tool for modern structural detailing.

Keywords: Bar Bending Schedule, BIM, RebarCAD, Reinforcement Detailing, Stadium Design

I. INTRODUCTION

The construction industry is undergoing rapid transformation with the adoption of digital technologies. Building Information Modeling (BIM) has emerged as a revolutionary approach that improves the planning, design, and execution of construction projects. BIM is a digital representation of the physical and functional characteristics of a structure, enabling efficient collaboration among stakeholders. Traditional 2D drafting methods often lead to errors, inconsistencies, and lack of coordination between different disciplines. In contrast, BIM provides a 3D model that integrates structural elements, materials, and project data into a unified system. This is particularly important in large infrastructure projects such as stadiums, where structural complexity and precision are critical. Reinforcement detailing is a vital aspect of structural engineering, as it directly influences the strength, durability, and safety of the structure.

Manual preparation of reinforcement drawings and Bar Bending Schedules is time-consuming and prone to errors. To overcome these limitations, advanced software tools like RebarCAD are used. This project focuses on the use of RebarCAD for reinforcement detailing and BBS preparation in a stadium structure. The objective is to enhance accuracy, reduce errors, and improve overall efficiency in structural design and construction.

A. Introduction to RebarCAD

RebarCAD is a specialized software used for reinforcement detailing in reinforced concrete structures. It is widely used for preparing detailed reinforcement drawings and Bar Bending Schedules.



Figure 1: BIM-Based Workflow Linking Coordination Tools to RebarCAD

It allows engineers to:

- Create accurate reinforcement layouts
- Define bar shapes and bending details
- Automatically generate BBS
- Calculate quantities and weights

II. RESULTS AND DISCUSSION

A. Detailed Structural Analysis of Beam BV-22

The core of this project involves the transformation of structural design into executable reinforcement details for the stadium's primary beams. Using RebarCAD, the following detailing components were produced:

a) Longitudinal Elevation (Elevation-AP)

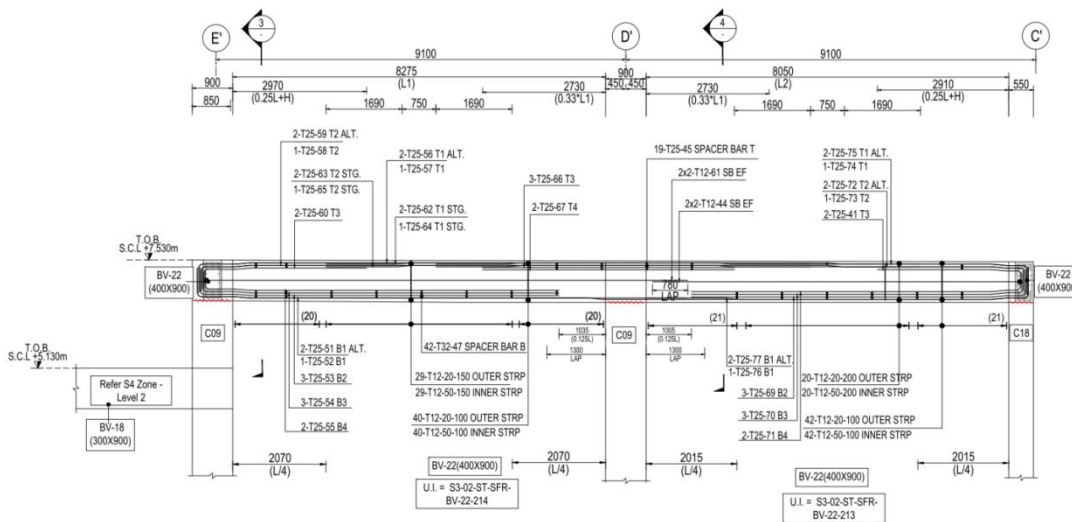


Figure 2: Long Sectional Elevation of Beam BV-22 showing Reinforcement Layout

The elevation view of Beam BV-22 (as shown in Figure 2) provides a comprehensive look at the reinforcement layout across multiple spans (9100mm and 8050mm). This view is critical for:

- **Bar Placement:** Mapping the exact start and end points of top and bottom reinforcement bars.
- **Lap Lengths:** Identifying the precise location of lap zones (1300mm LAP) near support regions like C09 and C18 to ensure tension continuity.

- **Development Lengths:** Ensuring that the bars are properly anchored into the columns (**BV-22** entering **Co9**).

B. Cross-Sectional Details (Sections 3 & 4)

To complement the elevation, detailed cross-sections (Figure 3) were generated to show the internal arrangement of the 400x900mm beam.

- **Reinforcement Layers:** Section 3 and 4 clearly illustrate the multi-layer arrangement of **T25** bars at the bottom (B1, B2, B3, B4) and top (T1, T2, T3, T4), which is essential for handling high bending moments in large-scale stadium structures.
- **Shear Stirrups:** The sections define the use of **T12** inner and outer stirrups (STRPS) at specific spacings (e.g., 100mm and 150mm c/c) to resist shear forces effectively.
- **Clear Cover:** A standard **40mm cover** is maintained throughout, as specified in the drawings, to protect the steel from environmental corrosion and ensure fire resistance.

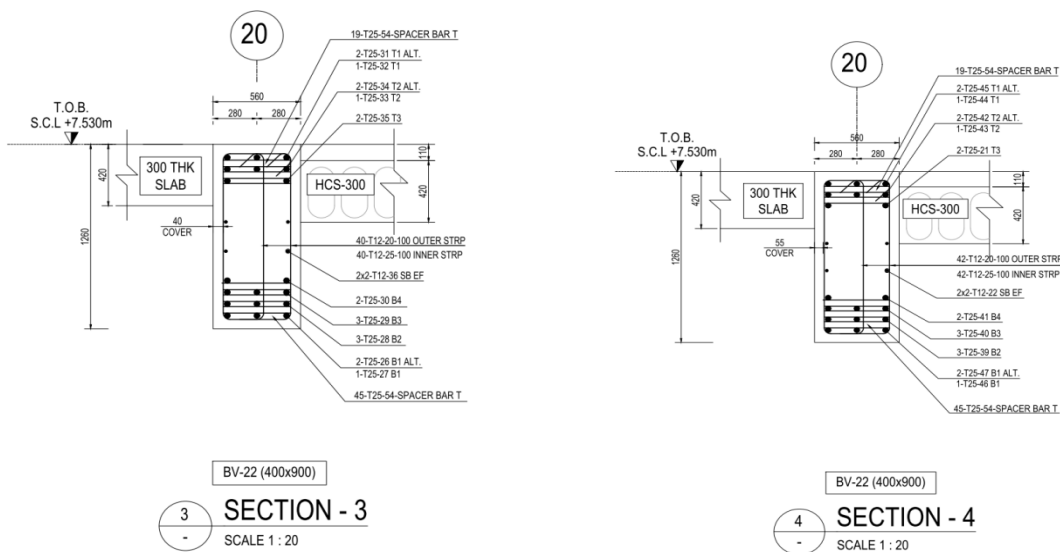


Figure 3: Cross-Sectional Details (Section 3, 4) of Beam showing Reinforcement Layers

C. Bar Identification and Marking

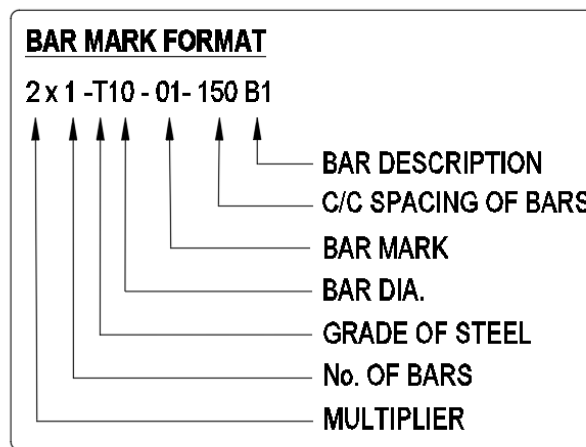


Figure 4: Standard Bar Mark Format used for Identification in BBS

D. Importance of Crank Bars in Detailing

Crank bars (Bent-up bars) are used in this project mainly to avoid reinforcement congestion and clashes at the beam-column junctions.

- **Avoidance of Clashes:** In continuous beams, when bars from one span meet the next, they might clash. Cranking allows the bars to shift levels (from bottom to top) so they can pass through without hitting the other bars.
- **Space for Concrete:** By avoiding these clashes, we ensure there is enough gap for the concrete to flow properly between the bars, preventing honeycomb formation.
- **Negative Moment:** Apart from avoiding clashes, the cranked portion helps the beam to handle the tension that occurs at the top near the supports.

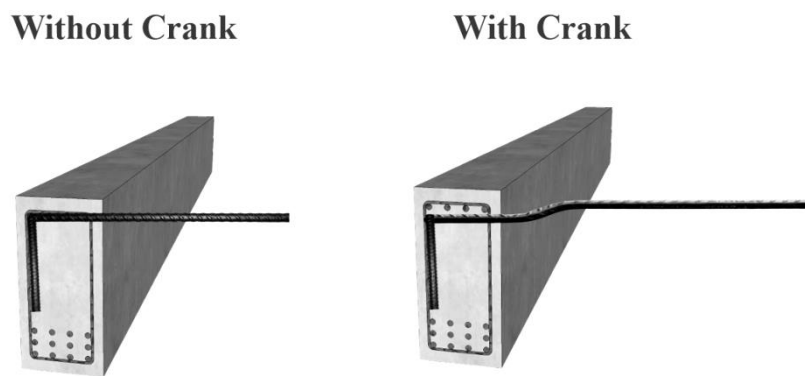


Figure 5: Comparison of Beam Reinforcement With and Without Crank

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 mark, 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 Members	No. of Bars in Each	Total No.	Cutting Length of each bar mm	Shape Code	Bend Shape	BENDING DIMENSIONS											Weight (Kgs)		
									A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	J (mm)	K (mm)	O (mm)			
ELEVATION -AQ	22	T25	1	2	2	11815	99266		790	500	330	55	8620	1315								90.98
ELEVATION -AQ	23	T25	1	1	1	12000	127			10025	335	850			790	55		330	11205		46.20	
ELEVATION -AQ	24	T25	1	1	1	9225	99266		790	500	335	55	5595	1740								35.52
ELEVATION -AQ	27	T25	1	3	3	7885	127			6520	335	380			650	55		330	7230		91.07	
ELEVATION -AQ	42	T25	1	5	5	5700	0			5700												109.72
ELEVATION -AQ	26	T25	1	3	3	7995	127			6520	335	440			700	55		330	7290		92.34	
ELEVATION -AQ	34	T25	1	1	1	4710	127			3265	335	410			700	55		330	4005		18.13	
ELEVATION -AQ	32	T25	1	2	2	7155	127			5710	335	410			700	55		330	6450		55.09	
ELEVATION -AQ	37	T25	1	1	1	7780	127			5985	335	760			700	55		330	7075		29.95	
ELEVATION -AQ	36	T25	1	2	2	5340	127			3545	335	760			700	55		330	4635		41.12	
ELEVATION -AM	10	T12	1	58	58	3145	T1		115	175	1320	175	1320		115							161.98
ELEVATION -AM	49	T10	1	82	82	1300	0			1300												65.67
ELEVATION -AM	50	T12	1	268	268	1025	T9		115	820					115							243.93

Figure 6: Bar Bending Schedule (BBS) Generated Using RebarCAD

Thus, the use of RebarCAD ensured a reliable and accurate BBS for the project.

III. CONCLUSION

The study concludes that integrating Building Information Modeling (BIM) and RebarCAD significantly improves the accuracy and efficiency of reinforcement detailing. The integration of BIM and RebarCAD significantly improves reinforcement detailing accuracy and efficiency. It reduces manual errors, saves time, and enhances construction quality. This makes it highly suitable for complex projects like stadium structures.

IV. REFERENCES

[1] Eastman, C., Teicholz, P., Sacks, R., and Liston, K., BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors, 3rd ed., Wiley, 2018.

[2] Autodesk Inc., RebarCAD User Manual and Reinforcement Detailing Guide, Autodesk Publications, 2020.

[3] Bureau of Indian Standards, IS 456:2000 – Plain and Reinforced Concrete – Code of Practice, New Delhi, India.

[4] Bureau of Indian Standards, IS 2502:1963 – Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement, New Delhi, India.

[5] Smith, D.K. and Tardif, M., Building Information Modeling: A Strategic Implementation Guide, Wiley, 2009.

[6] Hardin, B., and McCool, D., BIM and Construction Management: Proven Tools, Methods, and Workflows, Wiley, 2015.

Special Issue: *International Conference on Modern Engineering and Future Technologies (ICMEFT-26)*

[7] Barros, J.A.O. and Figueiras, J.A., "Flexural Behavior of Steel Fiber Reinforced Concrete," *Journal of Materials in Civil Engineering*, Vol. 11, No. 4, 1999, pp. 331-339.

[8] ACI Committee 318, *Building Code Requirements for Structural Concrete (ACI 318-19)*, American Concrete Institute, USA, 2019.

[9] Navon, R., "Automated Project Performance Control of Construction Projects," *Automation in Construction*, Vol. 14, Issue 4, 2005, pp. 467-476.

[10] Succar, B., "Building Information Modelling Framework: A Research and Delivery Foundation for Industry Stakeholders," *Automation in Construction*, Vol. 18, Issue 3, 2009, pp. 357-375.

[11] Kymmell, W., *Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations*, McGraw Hill, 2008.