FOSSEE Winter Internship Report

On

Creation of 2D drawings (Inkscape) and 3D Animations in Blender for Osdag Modules

Submitted by

Sagar Kumar

3rd Year B.Tech Student, Department of Electrical Engineering

Indian Institute of Technology (Indian School of Mines) Dhanbad

Dhanbad

Under the Guidance of

Prof. Siddhartha Ghosh

Department of Civil Engineering

Indian Institute of Technology Bombay

Mentors:

Ajmal Babu M S

Parth Karia

Ajinkya Dahale

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Sagar Kumar

Contents

Chapter 1

Introduction

1.1 National Mission in Education through ICT

The National Mission on Education through ICT (NMEICT) is a scheme under the Department of Higher Education, Ministry of Education, Government of India. It aims to leverage the potential of ICT to enhance teaching and learning in Higher Education Institutions in an anytime-anywhere mode.

The mission aligns with the three cardinal principles of the Education Policy—**access, equity, and quality**—by:

- Providing connectivity and affordable access devices for learners and institutions.
- Generating high-quality e-content free of cost.

NMEICT seeks to bridge the digital divide by empowering learners and teachers in urban and rural areas, fostering inclusivity in the knowledge economy. Key focus areas include:

- Development of e-learning pedagogies and virtual laboratories.
- Online testing, certification, and mentorship through accessible platforms like EduSAT and DTH.
- Training and empowering teachers to adopt ICT-based teaching methods.

For further details, visit the official website: www.nmeict.ac.in.

1.1.1 ICT Initiatives of MoE

The Ministry of Education (MoE) has launched several ICT initiatives aimed at students, researchers, and institutions. The table below summarizes the key details:

No.	Resource	For Students/Researchers	For Institutions
		Audio-Video e-content	
1	SWAYAM	Earn credit via online courses	Develop and host courses; accept credits
2	SWAYAMPRABHA	Access 24x7 TV programs	Enable SWAYAMPRABHA viewing facilities
		Digital Content Access	
3	National Digital Library	Access e-content in multiple disciplines	List e-content; form NDL Clubs
4	e-PG Pathshala	Access free books and e-content	Host e-books
5	Shodhganga	Access Indian research theses	List institutional theses
6	e-ShodhSindhu	Access full-text e-resources	Access e-resources for institutions
		Hands-on Learning	
7	e-Yantra	Hands-on embedded systems training	Create e-Yantra labs with IIT Bombay
8	FOSSEE	Volunteer for open-source software	Run labs with open-source software
9	Spoken Tutorial	Learn IT skills via tutorials	Provide self-learning IT content
10	Virtual Labs	Perform online experiments	Develop curriculum-based experiments
		E-Governance	
11	SAMARTH ERP	Manage student lifecycle digitally	Enable institutional e-governance
		Tracking and Research Tools	
12	VIDWAN	Register and access experts	Monitor faculty research outcomes
13	Shodh Shuddhi	Ensure plagiarism-free work	Improve research quality and reputation
14	Academic Bank of Credits	Store and transfer credits	Facilitate credit redemption

Table 1.1: Summary of ICT Initiatives by the Ministry of Education

1.2 FOSSEE Project

The FOSSEE (Free/Libre and Open Source Software for Education) project promotes the use of FLOSS tools in academia and research. It is part of the National Mission on Education through Information and Communication Technology (NMEICT), Ministry of Education (MoE), Government of India.

1.2.1 Projects and Activities

The FOSSEE Project supports the use of various FLOSS tools to enhance education and research. Key activities include:

- **Textbook Companion**: Porting solved examples from textbooks using FLOSS.
- **Lab Migration**: Facilitating the migration of proprietary labs to FLOSS alternatives.
- **Niche Software Activities**: Specialized activities to promote niche software tools.
- **Forums**: Providing a collaborative space for users.
- **Workshops and Conferences**: Organizing events to train and inform users.

1.2.2 Fellowships

FOSSEE offers various internship and fellowship opportunities for students:

- Winter Internship
- Summer Fellowship
- Semester-Long Internship

Students from any degree and academic stage can apply for these internships. Selection is based on the completion of screening tasks involving programming, scientific computing, or data collection that benefit the FLOSS community. These tasks are designed to be completed within a week.

For more details, visit the official FOSSEE website.

Figure 1.1: FOSSEE Projects and Activities

1.3 Osdag Software

Osdag (Open steel design and graphics) is a cross-platform, free/libre and open-source software designed for the detailing and design of steel structures based on the Indian Standard IS 800:2007. It allows users to design steel connections, members, and systems through an interactive graphical user interface (GUI) and provides 3D visualizations of designed components. The software enables easy export of CAD models to drafting tools for construction/fabrication drawings, with optimized designs following industry best practices [1, 2, 3]. Built on Python and several Python-based FLOSS tools (e.g., PyQt and PythonOCC), Osdag is licensed under the GNU Lesser General Public License (LGPL) Version 3.

1.3.1 Osdag GUI

The Osdag GUI is designed to be user-friendly and interactive. It consists of

- **Input Dock**: Collects and validates user inputs.
- **Output Dock**: Displays design results after validation.
- **CAD Window**: Displays the 3D CAD model, where users can pan, zoom, and rotate the design.
- **Message Log**: Shows errors, warnings, and suggestions based on design checks.

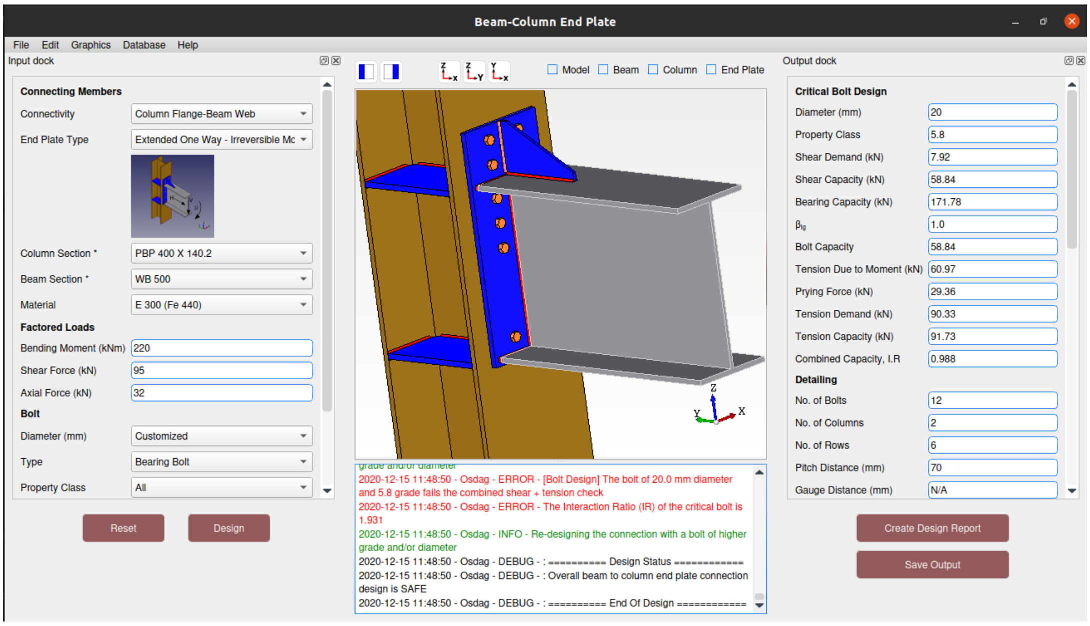

Figure 1.2: Osdag GUI

1.3.2 Features

- **CAD Model**: The 3D CAD model is color-coded and can be saved in multiple formats such as IGS, STL, and STEP.
- **Design Preferences**: Customizes the design process, with advanced users able to set preferences for bolts, welds, and detailing.
- **Design Report**: Creates a detailed report in PDF format, summarizing all checks, calculations, and design details, including any discrepancies.

For more details, visit the official Osdag website.

Chapter 2

Screening Task

2.1 Problem Statement

The screening task was designed to evaluate the ability to translate complex structural engineering concepts into accessible educational media using Free and Libre Open-Source Software (FLOSS).

The primary challenge was to recreate existing technical demonstrations for Osdag—an open-source steel design software—while modernizing the visual delivery. This involved two core requirements:

- Technical Accuracy: Accurately illustrating the structural behavior, fabrication processes, and failure mechanisms of steel buildings and bridges.
- Brand Realignment: Moving away from legacy visuals to adopt Osdag's upgraded branding, which required a specific color palette, updated typography, and a "clean" UI/UX aesthetic suitable for a professional engineering course.

2.2 Tasks Done

The following tasks were executed to fulfill the requirements of the screening phase:

- Asset Deconstruction & Analysis: Reviewed reference videos to identify key engineering milestones such as steel connections and load-bearing behaviors to highlight in the animations.

- 3D Modeling & Scene Setup: Built detailed steel structure models in Blender, aligned with real-world fabrication standards and optimized for smooth animation.
- Motion Graphics & Animation: Produced procedural animations to clearly demonstrate design workflows, component interfaces, and structural failure mechanisms.
- Visual Styling & Branding: Implemented the updated Osdag visual identity. This involved creating custom shaders, selecting appropriate typography for technical labels, and ensuring the color scheme met the readability standards for educational infographics.
- Post-Production & Instructional Overlay: Compiled rendered sequences in Blender's Video Editor and added synchronized explanatory text, labels, and visual cues for clarity.

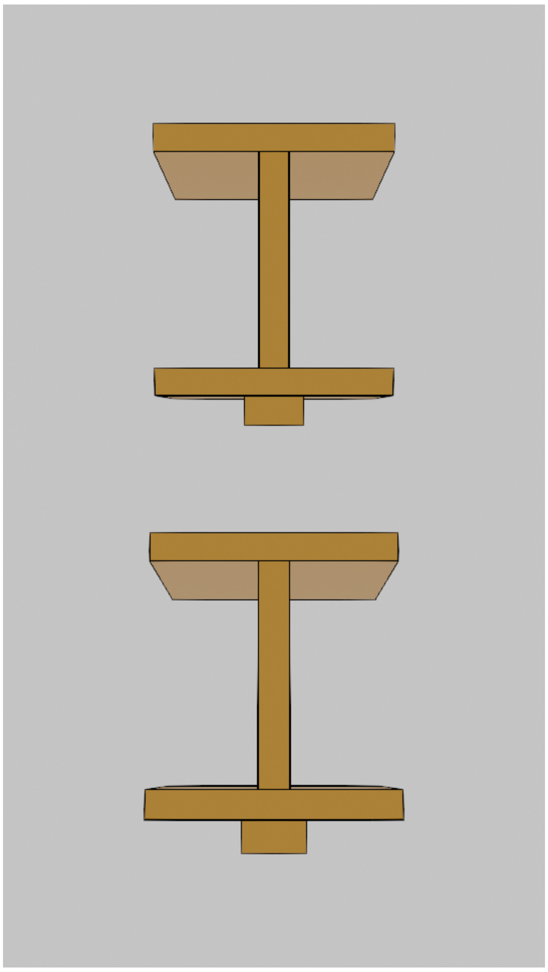

Figure 2.1: 3D Model with Textures

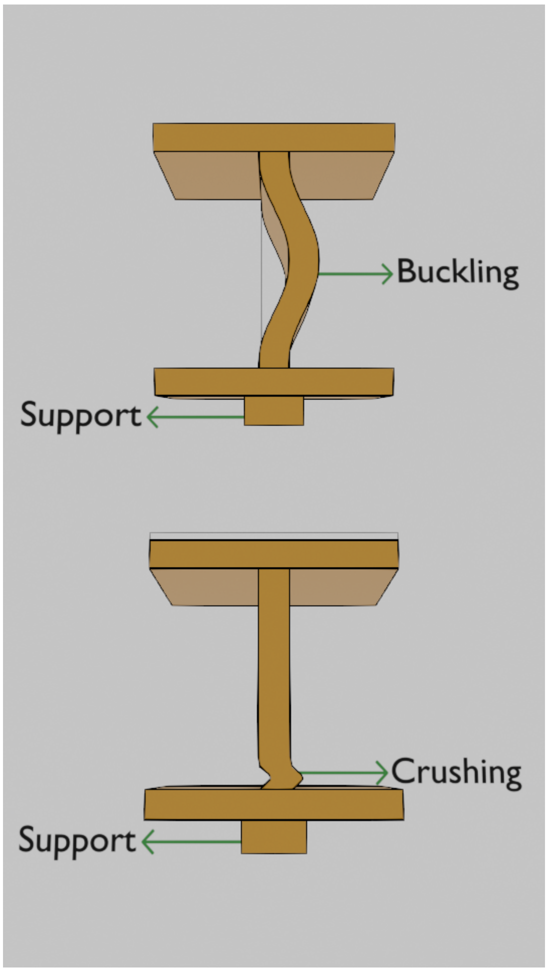

Figure 2.2: Animation with Text Overlays

Chapter 3

Internship Task 1

3.1 Task 1: Problem Statement

The objective of this task was to create accurate 2D technical drawings of all structural steel connections using Inkscape. The drawings were required to include multiple orthographic views (Front, Side, and Top) and maintain engineering clarity, dimensional consistency, and proper alignment with real-world structural standards as referenced from the Osdag application.

3.2 Task 1: Tasks Done

To successfully accomplish Task 1, the following activities were undertaken:

- **Learning and Familiarization**: Initially, time was invested in learning the fundamentals of Inkscape through Spoken Tutorials and hands-on practice. This included understanding tools such as paths, nodes, layers, grids, snapping, alignment, and SVG export settings, which are essential for technical drafting.

- **Reference Collection**: High-quality reference screenshots were taken from the Osdag application for each type of structural connection. These references ensured dimensional accuracy, correct orientation, and compliance with structural design conventions.

- **2D Drafting and View Creation**: Using Inkscape, scalable vector drawings (SVG format) were created for each connection. Care was taken to maintain uniform line thickness, symmetry, and proper spacing between elements such as bolts, plates, and beam/column members.

- **Standardization and Consistency**: All drawings followed consistent scaling, labeling style, and alignment practices to maintain a professional and uniform technical documentation standard.

3.2.1 Fin Plate Connection

For the Fin Plate Connection, the following steps were executed:

- Captured detailed reference screenshots from the Osdag software to understand component placement and bolt configurations.
- Created precise 2D SVG drawings in Inkscape representing Front View, Side View and Top View of all three structural scenarios
  - Column Flange – Beam Web
  - Column Web – Beam Web
  - Beam – Beam

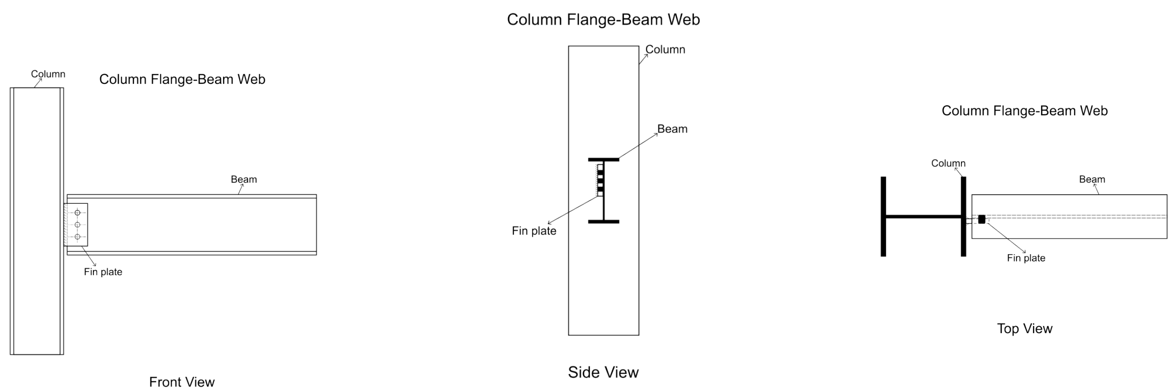

Figure 3.1: Fin Plate Connection – Column Flange-Beam Web

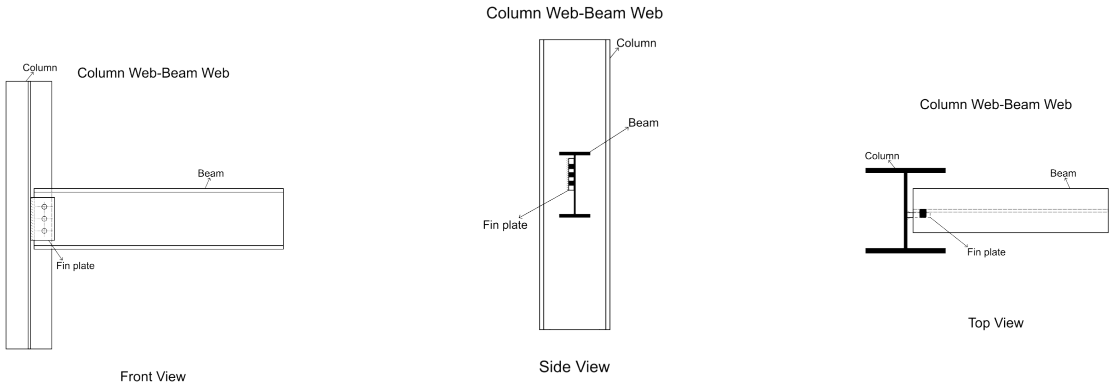

Figure 3.2: Fin Plate Connection – Column Web-Beam Web

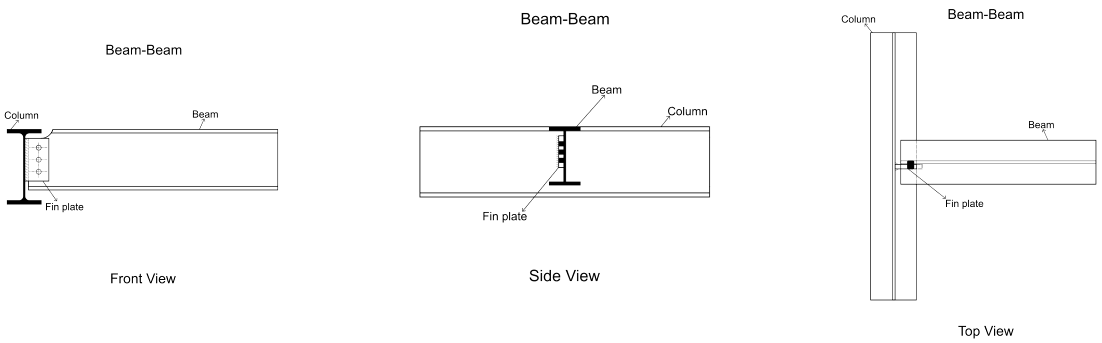

Figure 3.3: Fin Plate Connection – Beam-Beam

3.2.2 Cleat angle Connection

For the Cleat angle Connection, the following steps were executed:

- Captured detailed reference screenshots from the Osdag software to understand component placement and bolt configurations.
- Created precise 2D SVG drawings in Inkscape representing Front View, Side View and Top View of all three structural scenarios
  - Column Flange – Beam Web
  - Column Web – Beam Web
  - Beam – Beam

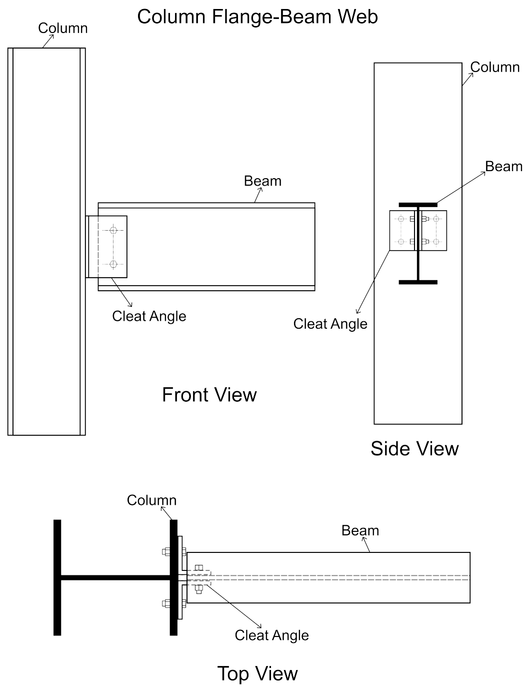

Figure 3.4: Cleat angle Connection – Column Flange-Beam Web

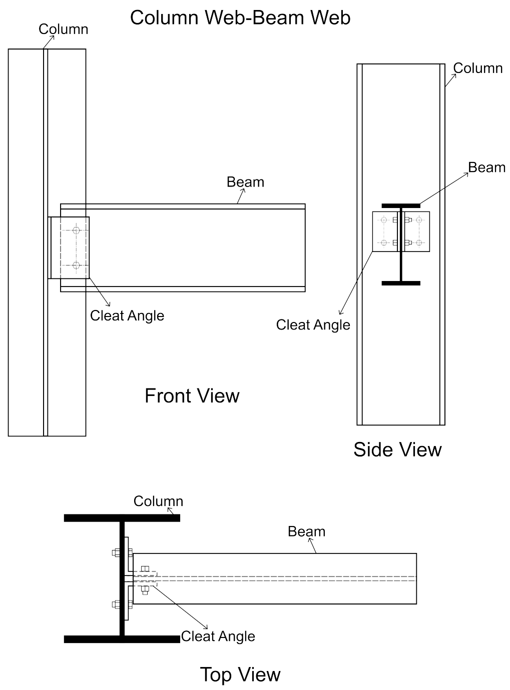

Figure 3.5: Cleat angle Connection – Column Web-Beam Web

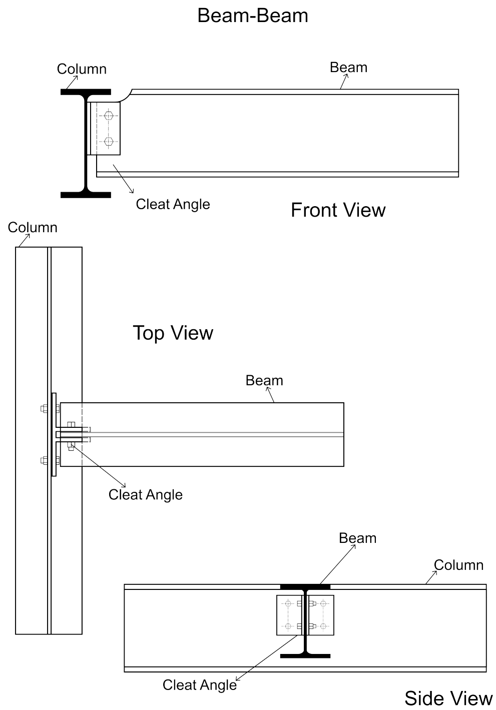

Figure 3.6: Cleat angle Connection – Beam-Beam

3.2.3 End Plate Connection

For the End Plate Connection, the following steps were executed:

- Captured detailed reference screenshots from the Osdag software to understand component placement and bolt configurations.
- Created precise 2D SVG drawings in Inkscape representing Front View, Side View and Top View of all three structural scenarios
  - Column Flange – Beam Web
  - Column Web – Beam Web
  - Beam – Beam

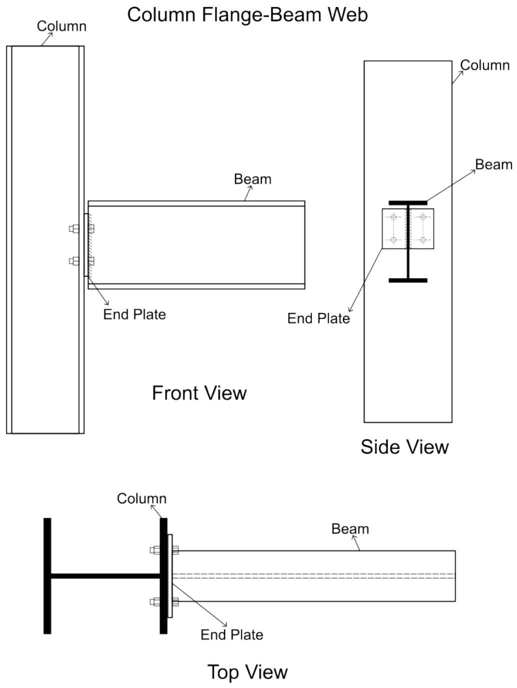

Figure 3.7: End Plate Connection – Column Flange-Beam Web

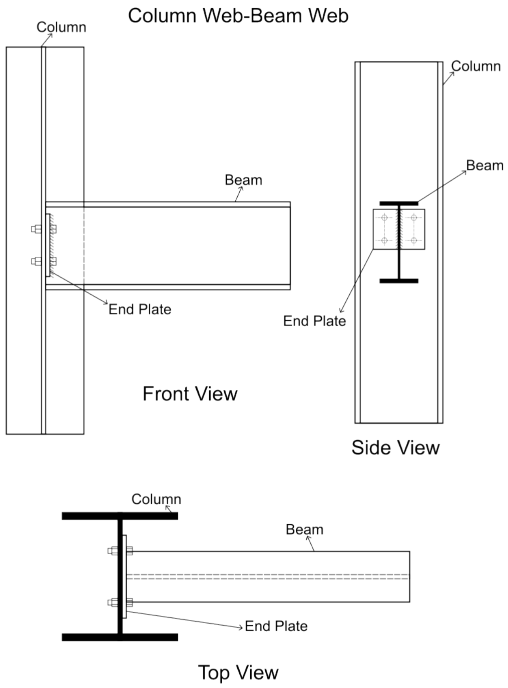

Figure 3.8: End Plate Connection – Column Web-Beam Web

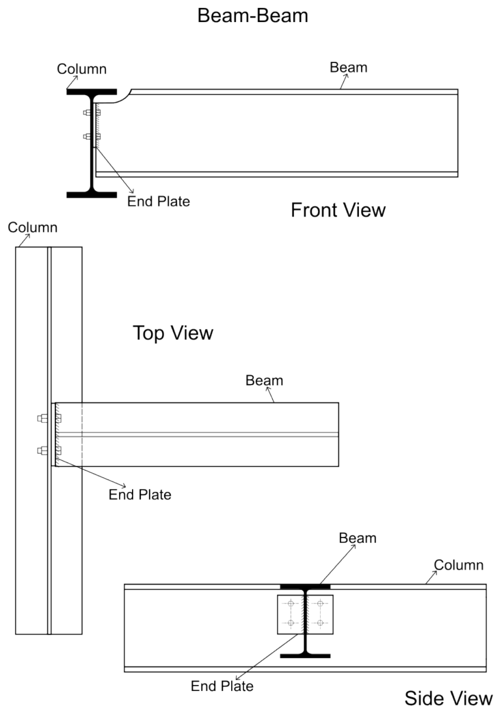

Figure 3.9: End Plate Connection – Beam-Beam

3.2.4 Seated Angle Connection

For the Seated Angle Connection, the following steps were executed:

- Captured detailed reference screenshots from the Osdag software to understand component placement and bolt configurations.
- Created precise 2D SVG drawings in Inkscape representing Front View, Side View and Top View of all three structural scenarios
  - Column Flange – Beam Web
  - Column Web – Beam Web

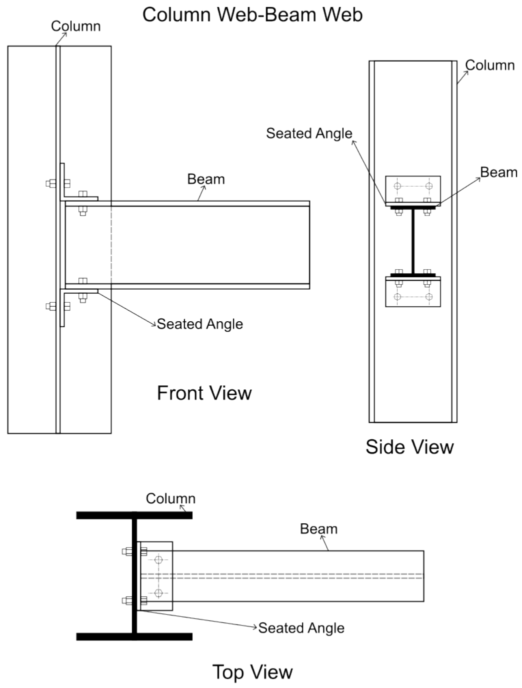

Figure 3.11: Seated Angle Connection – Column Web-Beam Web

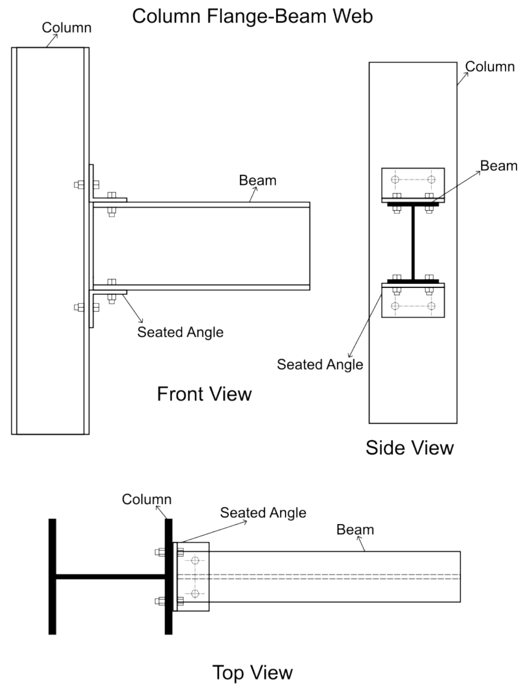

Figure 3.10: Seated Angle Connection – Column Flange-Beam Web

Chapter 4

Internship Task 2

4.1 Task 2: Problem Statement

The objective of this task was to design and recreate the required logos in a scalable vector format while strictly adhering to the provided design specifications. The task emphasized visual accuracy, brand consistency, and adaptability of the logo assets for use across digital and print media.

4.2 Task 2: Tasks Performed

The following activities were carried out to successfully complete Task 2:

- **Design Study and Analysis:** Carefully studied the reference logo designs to understand their geometric structure, typography, spacing, color palette, and overall visual hierarchy. Attention was given to proportions, symmetry, and alignment to ensure faithful reproduction.

- **Tool Familiarization:** Utilized **Inkscape** as the primary vector graphics software. Practiced advanced tools such as Bezier curves, node editing, path operations, gradients, layer management, and alignment utilities to achieve professional precision.

- **Logo Recreation:** Recreated the logos from scratch using vector paths instead of raster tracing to maintain scalability and sharpness at any resolution. All elements including icons, text, and shapes were reconstructed manually to ensure clean geometry.

- **Color and Typography Matching:** Matched the exact color codes (RGB/HEX) and font styles specified in the reference designs. Ensured consistent stroke widths and spacing between elements to maintain brand identity.
- **Refinement and Optimization:** Refined curves, anchor points, and path intersections to remove distortions and achieve smooth edges. Optimized file structure by grouping layers and removing redundant nodes.

4.3 Final Logo Outputs

The following figures illustrate the recreated logo designs produced during this task.

Figure 4.2: Recreated Logo Designs using Inkscape

Chapter 5

Internship Task 3

5.1 Task 3: Problem Statement

The objective of this task was to create a detailed **3D animation of a Fin Plate Connection assembly**. The animation was required to follow the provided script and storyboard guidelines, ensuring technical clarity, smooth transitions, and accurate representation of the structural assembly process. Additionally, the animation needed to comply with the updated **Osdag visual theme and color scheme** to maintain branding consistency.

5.2 Task 3: Tasks Performed

The following steps were undertaken to successfully complete Task 3:

- **Storyboard and Script Analysis:** The given storyboard and script were carefully reviewed to understand the sequence of assembly, camera movements, timing of transitions, and instructional flow. This helped in planning the animation structure before starting the 3D work.

- **STL File Inspection and Refinement:** The provided STL model files were imported into Blender. Minor refinements were performed, including correcting mesh normals, removing duplicate vertices, fixing topology irregularities, and ensuring proper scaling and alignment for animation readiness.

- **Scene Setup and Asset Preparation:** A structured 3D scene was created with appropriate lighting, camera angles, and object hierarchies. Objects such as beams, plates, and bolts were organized into collections to allow controlled animation and visibility toggling.

- **Animation of Assembly Process:** Step-by-step assembly animations were created to demonstrate how individual components of the Fin Plate Connection come together. Smooth keyframe transitions and controlled object movements were used to enhance visual understanding.

- **Color Scheme and Visual Styling:** Materials and shaders were applied in accordance with the new Osdag theme. Consistent color usage, contrast balance, and surface finishes were maintained to ensure visual clarity and brand alignment.

- **Text Overlays and Instructional Labels:** Explanatory text overlays were added at each significant step of the animation. These labels provided guidance on component names, assembly order, and technical notes, improving the educational value of the animation.

- **Rendering and Post-Processing:** The final animation was rendered using optimized render settings to balance quality and performance. Minor post-processing adjustments such as timing synchronization and overlay placement were completed using Blender's video editing tools.

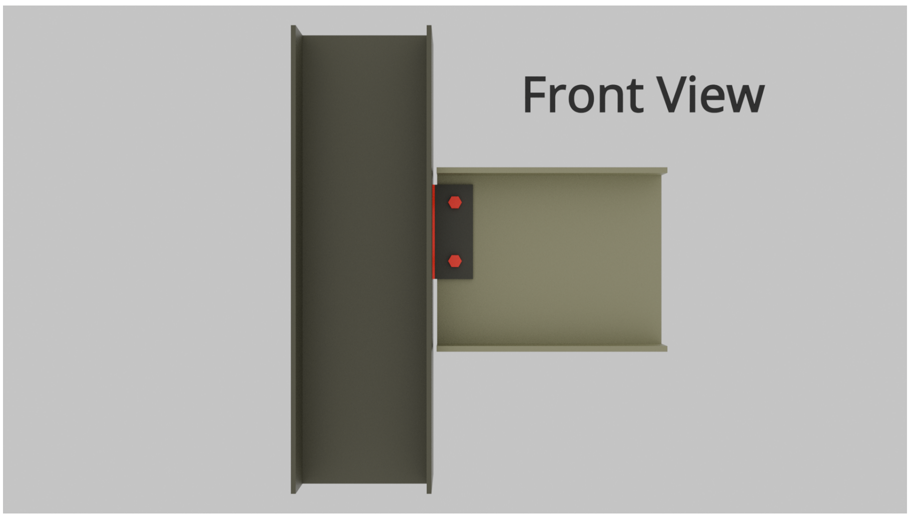

Figure 5.1: 3D Model with Textures and Texts overlays

5.3 Outcome

The final deliverable was a clear and technically accurate 3D animation demonstrating the complete assembly of a Fin Plate Connection. The animation successfully adhered to the storyboard, maintained the Osdag visual identity, and incorporated instructional overlays, making it suitable for educational and presentation purposes.

Animation Link - Fin Plate Connection assembly.

Chapter 6

Conclusions

6.1 Tasks Accomplished

During the course of the internship, multiple technical and creative tasks were successfully completed, contributing to both practical learning and project deliverables. The primary accomplishments include:

- **2D Technical Drafting of Steel Connections:** Developed accurate and scalable 2D orthographic drawings of various steel connections such as Fin Plate, Cleat Angle, End Plate, and Seated Angle using Inkscape. These drawings included front, side, and top views for multiple beam–column configurations while maintaining dimensional consistency and engineering clarity.
- **Logo Design and Vector Recreation:** Studied reference designs and recreated logos using vector tools in Inkscape. Ensured precision in geometry, color matching, typography, and scalability for both digital and print usage.
- **3D Animation of Fin Plate Connection Assembly:** Produced a step-by-step 3D animation demonstrating the assembly of a Fin Plate Connection using Blender. The animation adhered to the provided storyboard, incorporated the updated Osdag color scheme, and included instructional text overlays for enhanced understanding.
- **Asset Refinement and Optimization:** Performed mesh corrections and structural refinements on provided STL files to make them suitable for animation work-

flows and rendering efficiency.

Overall, the internship tasks provided a balanced exposure to drafting, graphic design, and 3D visualization, resulting in a comprehensive set of technical outputs suitable for educational and professional applications.

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6.2 Skills Developed

The internship significantly contributed to the development of both technical and professional competencies. Key skills acquired include:

- **Technical Skills**
  - Proficiency in **Inkscape** for vector graphics, SVG creation, and technical drafting.
  - Practical experience in **Blender** for 3D modeling, animation, material setup, and rendering.
  - Understanding of **structural steel connections** and their visual representation.
  - Knowledge of **file optimization techniques** including SVG/PDF exports and mesh refinement.
  - Experience in **LaTeX/Overleaf** for professional technical documentation.
- **Professional Skills**
  - Improved **attention to detail** and visual accuracy.
  - Enhanced **time management** and task planning abilities.
  - Strengthened **problem-solving** and iterative design skills.
  - Better **communication and presentation** of technical information.
  - Ability to work with **design guidelines and branding standards**.

The fellowship experience provided a strong foundation in digital design workflows, technical visualization, and structured documentation practices, which will be beneficial for future academic and professional pursuits.

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