FOSSEE Semester Long Internship Report

On

Development of osdag fullstack and infographics

Submitted by

Sasank Navuri

4th Year Integrated M.Tech Student, Department of Software Engineering

Vellore Institute of Technology Andhra Pradesh

Amaravati

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

February 1, 2026

Acknowledgments

- Start with a general statement of thanks. Express your overall gratitude to everyone who supported you during your project or research.
- Project staff at the Osdag team, Ajmal Babu M. S., Ajinkya Dahale, and Parth Karia,
- Osdag Principal Investigator (PI) Prof. Siddhartha Ghosh, Department of Civil Engineering at IIT Bombay
- FOSSEE PI Prof. Kannan M. Moudgalya, FOSSEE Project Investigator, Department of Chemical Engineering, IIT Bombay
- FOSSEE Managers Usha Viswanathan and Vineeta Parmar and their entire team
- Acknowledge the support from the National Mission on Education through Information and Communication Technology (ICT), Ministry of Education (MoE), Government of India, for their role in facilitating this project
- Acknowledge your colleagues who worked with you during your internship or project.
- If appropriate, thank your college, department, head, and principal for their support during your studies.

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.

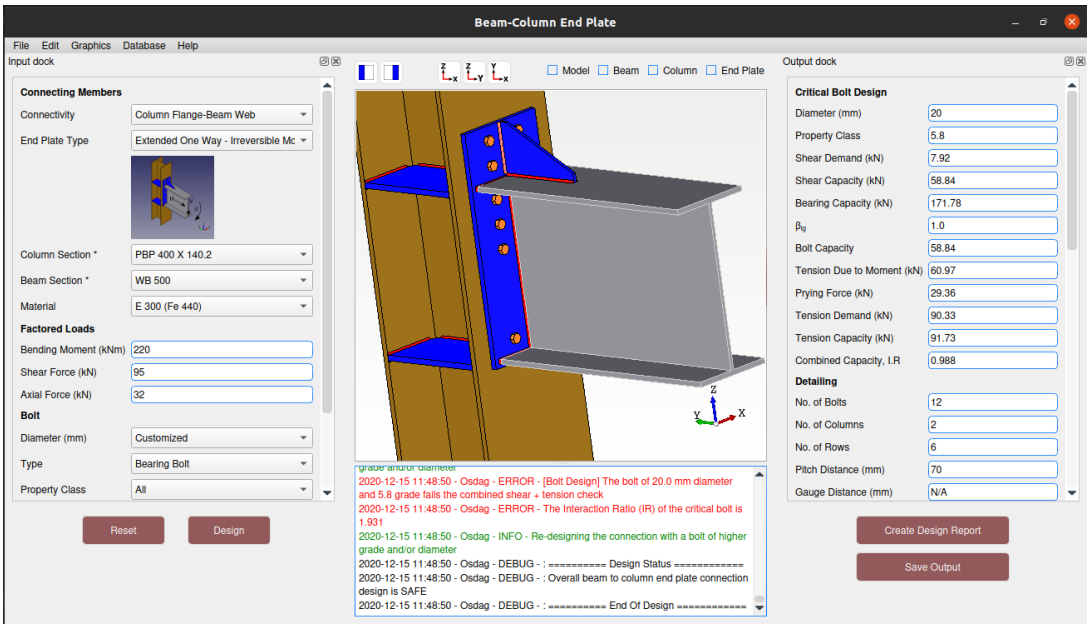


Figure 1.2: Osdag GUI

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

2.1.1 Problem Statement 1: Bending of Steel Structure Under Load

2.1.2 Problem Statement 2: Rupture Between Plates Under Tension Forces

2.2 Tasks Done

2.2.1 Screening Tasks – Documentation

During the screening phase, I was assigned two technically focused animation tasks, both of which were executed using **open-source software tools** as per the guidelines. The primary applications used were:

- **Blender** – for 3D modeling, structural simulation, and animation.
- **Audacity** – for integrating and editing sound effects to enhance the final output.

These tasks were aimed at visually explaining two advanced structural failure modes in steel structures using realistic and educational animation techniques.

Task 1: Lateral Torsional Buckling Animation

Objective:

To model and animate a steel I-section beam experiencing **lateral torsional buckling (LTB)**, a critical failure mode that occurs when a slender, unrestrained beam subjected to bending about its major axis begins to twist and laterally deflect.

Process Overview:

- Created a realistic I-section beam in **Blender** with appropriate boundary conditions to reflect a simply supported system.
- Simulated a gradually increasing vertical load applied at mid-span, representing real-world conditions.
- Animated the lateral displacement and twisting behavior, accurately reflecting the LTB phenomenon.
- Incorporated supporting elements such as arrows, labels, and deformation markers to highlight torsional behavior.
- Used **BlenderKit** for material realism and **Audacity** with **Pixabay** sound assets to provide subtle ambient sound effects, enhancing viewer understanding and engagement.

Outcome:

The final animation clearly demonstrated how a beam can fail through lateral torsional buckling, serving as a valuable visual aid for structural analysis education.

Task 2: Tension Member Block Shear Failure Animation

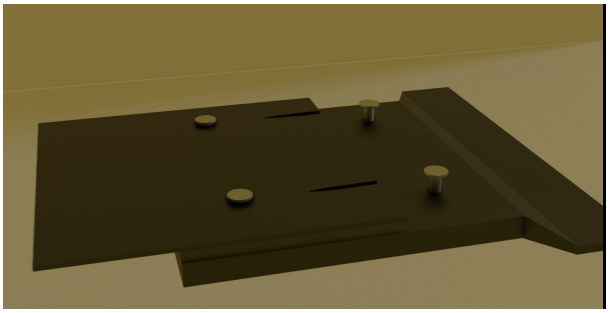
Objective:

To develop an animation depicting **block shear failure** in a tension member — a composite failure mechanism that combines tensile and shear rupture along the connection region of a steel plate.

Process Overview:

- Modeled a steel tension plate connected via bolts in **Blender**, replicating a typical tension connection detail.

Figure 2.1: steel structure under load



- Applied opposing tensile forces on either side of the member to simulate increasing load.
- Animated the initiation and progression of failure along the **shear planes (parallel to the force)** and **tensile rupture path (perpendicular to the force)**, forming the characteristic block shear pattern.
- Emphasized critical regions using stress indicators, crack propagation visuals, and zoomed-in views for clarity.
- Final compositing included relevant background sounds added via **Audacity** and sound assets from **Pixabay** to enhance the realism and instructional quality of the animation.

Outcome:

The animation effectively visualized how block shear failure occurs in tension members, helping illustrate an often misunderstood failure mode in structural engineering education.

Chapter 3

Internship Task 1: User Interface Enhancement of Osdag Application

3.1 Task 1: Problem Statement

Osdag is an open-source structural steel design software primarily focused on computational accuracy and compliance with Indian Standard (IS) codes. However, during initial usage and evaluation, it was observed that the graphical user interface lacked visual consistency and intuitive navigation elements. The absence of a visually engaging background and graphical navigation cues made the application less user-friendly, especially for first-time users and students.

The problem addressed in this task was to improve the visual appearance and usability of the Osdag application by introducing a structured background design and implementing navigation bar icons. These enhancements aimed to improve user experience without affecting the underlying computational modules or design logic of the software.

3.2 Task 1: Tasks Done

This task involved two major subtasks focused on graphical user interface (GUI) enhancement: (i) designing and integrating a background for the Osdag application, and (ii) implementing navigation bar icons for the first time in the application.

3.2.1 Design and Implementation of Osdag Application Background

The first subtask focused on developing a consistent and professional background for the Osdag application. The background design was created keeping in mind the structural engineering domain, ensuring that the visual elements remained subtle and non-distracting while improving the overall aesthetics of the software.

The methodology involved analyzing the existing Osdag GUI layout and identifying suitable areas where a background could be introduced without interfering with widgets, input fields, or design panels. The background image was designed to maintain adequate contrast so that text labels, buttons, and menus remained clearly visible.

Once finalized, the background image was integrated into the Osdag application by placing it in the appropriate resource directory and linking it through the GUI initialization logic. Special attention was given to resolution handling so that the background scaled correctly across different screen sizes.

Figure 3.1 shows the implemented background design in the Osdag application.

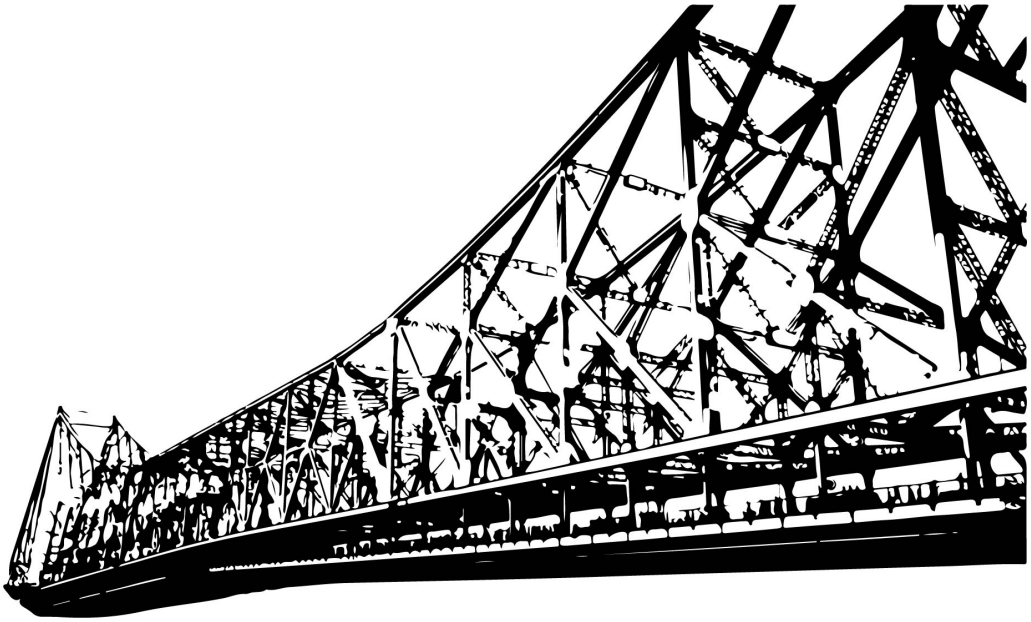


Figure 3.1: Osdag application background design implementation

3.2.2 Initial Implementation of Navigation Bar Icons

The second subtask involved the first implementation of navigation bar icons in the Osdag application. Prior to this enhancement, navigation options were primarily text-based, which limited intuitive interaction and increased the learning curve for new users.

In this task, suitable icons were selected to visually represent key application functions such as design selection, reports, settings, and exit options. The icons were designed and chosen to align with standard engineering software conventions, ensuring clarity and consistency.

The implementation process included placing icon assets in the designated resource directories, mapping them to their corresponding navigation actions, and adjusting alignment and spacing within the navigation bar. Uniform icon sizing and consistent color themes were maintained to ensure a professional look.

This initial implementation laid the foundation for future GUI improvements and enhanced the overall accessibility and usability of the Osdag application.

Figure 3.2 illustrates the navigation bar with newly implemented icons.

3.3 Task 1: Implementation Details

Although this task did not involve numerical design calculations, it required a clear understanding of the Osdag project structure and GUI framework. The implementation followed a modular approach to ensure that visual enhancements did not affect the core structural design logic.

Key implementation aspects include:

- Identification of appropriate resource folders for storing image assets.
- Integration of background images during GUI initialization.
- Mapping navigation bar icons to existing application functionalities.
- Ensuring visual consistency and responsiveness across different screen resolutions.

3.4 Task 1: Documentation Contribution

As part of this task, documentation support was provided by understanding and referencing the Osdag developer and user manual. The directory structure was studied to correctly place GUI resources and avoid conflicts with existing modules.

3.4.1 Directory Structure Relevant to GUI Enhancements

```
Osdag
├── osdagMainPage.py
├── Common.py
├── ResourceFiles
│   ├── images
│   ├── icons
│   └── last_designs
├── design_type
├── design_report
├── cad
└── gui
```

Program Start Calls

The main entry point of the Osdag application is `osdagMainPage.py`. The application can be launched by navigating to the Osdag root directory and executing the following command:

```
$ python osdagMainPage.py
```

These enhancements contribute to improving the usability, accessibility, and visual quality of the Osdag application while preserving its computational robustness and engineering accuracy.

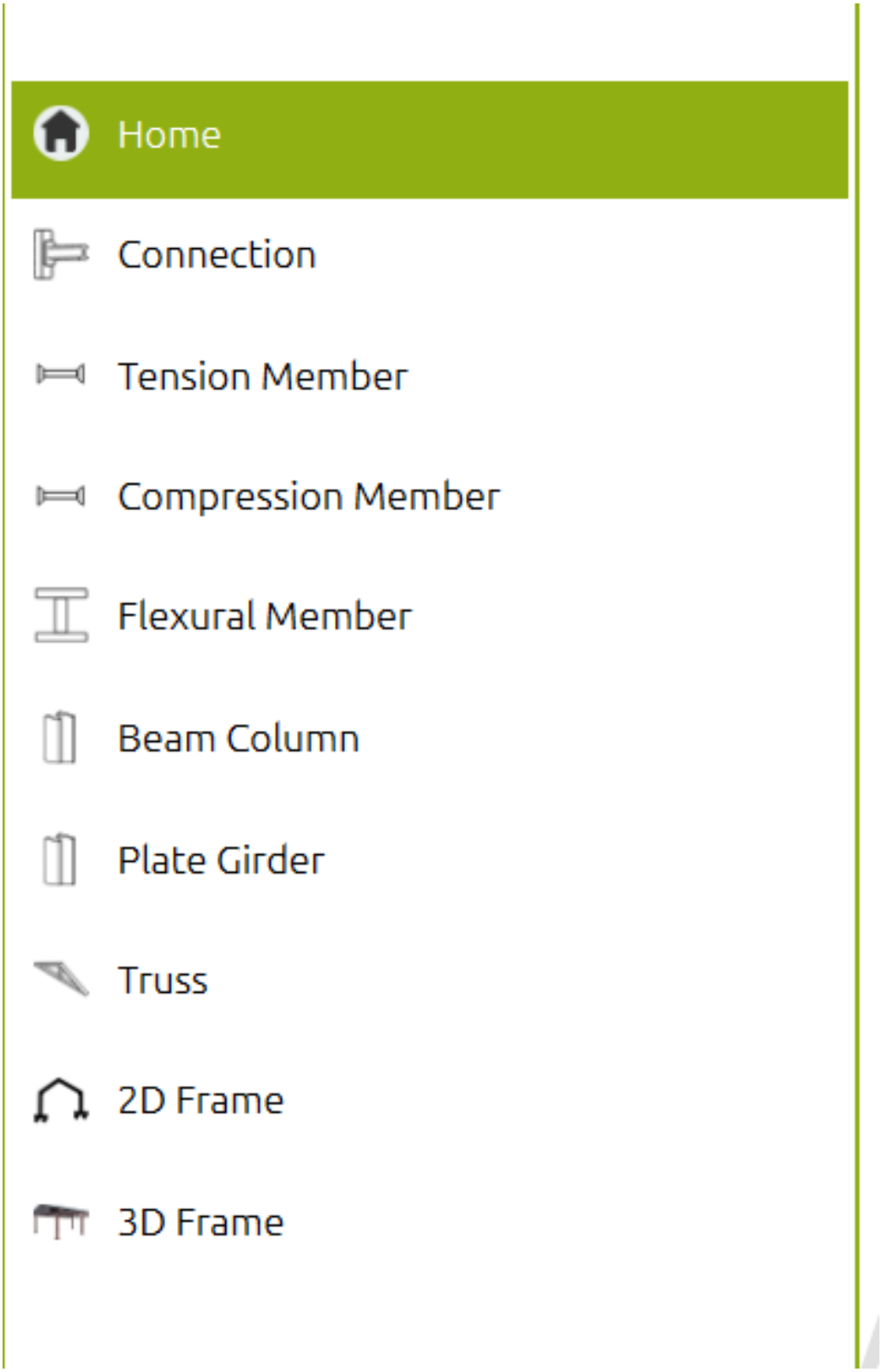


Figure 3.2: Navigation bar icon implementation in Osdag

Chapter 4

Internship Task 2: Development of Base Plate Module in Osdag Web Application

4.1 Task 2: Problem Statement

Osdag Web Application aims to provide structural steel design functionalities through a modern, web-based platform. While several design modules were already available, the Base Plate design module was not implemented in the web version of Osdag. Base plate design is a critical component in steel structures, enabling the safe transfer of loads from columns to foundations.

The problem addressed in this task was the absence of a Base Plate module in the Osdag web application. The objective was to design and implement a complete Base Plate module by developing a backend using Django for design logic and APIs, and a frontend using React for user interaction and visualization.

4.2 Task 2: Tasks Done

This task involved the end-to-end development of the Base Plate design module, including backend logic, API development, frontend interface creation, and integration between the two layers.

4.2.1 Backend Development Using Django

The backend of the Base Plate module was developed using the Django framework. The primary responsibility of the backend was to handle user inputs, perform base plate design calculations, validate inputs as per Indian Standard (IS) codes, and return structured design results to the frontend.

The backend architecture followed a modular approach where the base plate design logic was encapsulated within dedicated Django apps. RESTful APIs were created to facilitate communication between the frontend and backend. These APIs accept design parameters such as column section, axial load, bearing pressure, and material properties, and return computed outputs such as base plate dimensions, thickness, and safety checks.

The backend was designed to be scalable, allowing future enhancements such as anchor bolt design and foundation checks without major restructuring.

Figure 4.1 illustrates the backend implementation workflow of the Base Plate module.

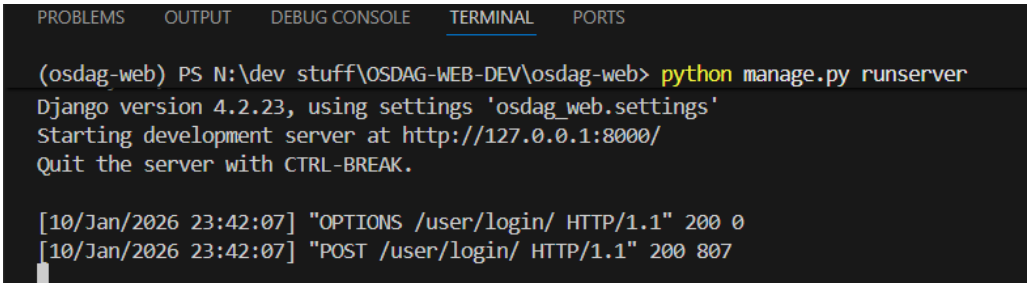


Figure 4.1: Backend development of Base Plate module using Django

4.2.2 Frontend Development Using React

The frontend of the Base Plate module was developed using React to provide a responsive and interactive user interface. The frontend allows users to input design parameters through structured forms and displays the design results obtained from the backend in a clear and user-friendly manner.

React components were designed for different sections of the module, including input forms, validation messages, and result displays. State management was used to handle user inputs and API responses efficiently. Proper error handling was implemented to notify users of invalid inputs or incomplete data.

The frontend design follows the visual consistency of the Osdag web application, ensuring seamless integration with existing modules.

Figure 4.2 shows the frontend interface of the Base Plate design module.

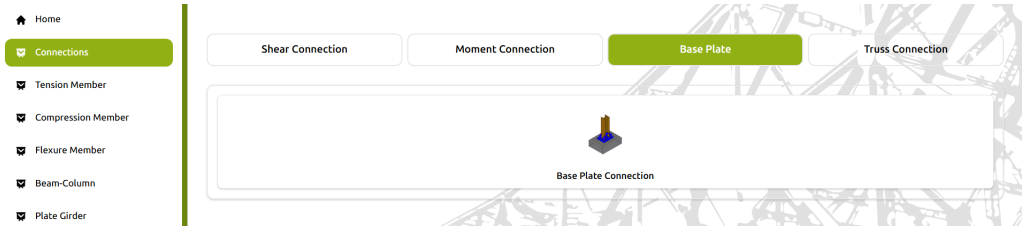


Figure 4.2: Frontend interface of Base Plate module developed using React

4.3 Task 2: Module Workflow

The Base Plate module follows a structured workflow to ensure accurate design and smooth user interaction. The workflow is summarized below:

- User enters base plate design parameters through the React-based interface.
- Input data is validated on the frontend and sent to the backend via REST APIs.
- Django backend processes the inputs and performs design calculations.
- Computed results and design checks are returned to the frontend.
- Results are displayed to the user in an organized format.

Figure 4.3 presents the overall workflow of the Base Plate module.

4.4 Task 2: Implementation Details

This task required coordination between frontend and backend development to ensure accurate data flow and reliable results. The key implementation aspects include:

- Design of RESTful APIs for base plate calculations.
- Separation of computational logic from presentation logic.
- Integration of Django backend with React frontend.

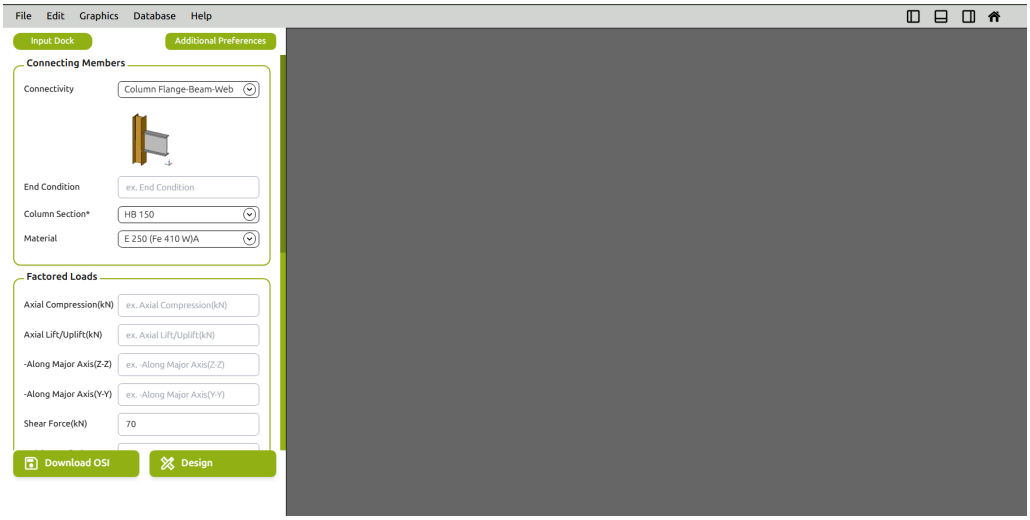


Figure 4.3: Workflow of Base Plate module in Osdag web application

- Validation of user inputs and handling of edge cases.
- Ensuring consistency with Osdag design philosophy and IS code compliance.

4.5 Task 2: Documentation Contribution

As part of this task, relevant documentation was studied and referenced to understand the existing Osdag web application structure. Contributions were made by following established directory conventions and maintaining consistency with other design modules.

4.5.1 Directory Structure for Base Plate Module

```
osdag-web
├── backend
│   ├── baseplate
│   ├── views.py
│   ├── urls.py
│   └── models.py
└── frontend
    ├── components
    ├── BasePlateForm.jsx
    └── BasePlateResult.jsx
```

Program Execution

The Django backend server is started using the following command:

```
$ python manage.py runserver
```

The React frontend is launched using:

```
$ npm start
```

The Base Plate module becomes accessible through the Osdag web application interface after successful integration of both frontend and backend services.

Chapter 5

Conclusions

5.1 Tasks Accomplished

During the course of the internship, two major tasks were successfully completed, contributing to both the desktop and web-based versions of the Osdag application.

The first task focused on enhancing the graphical user interface of the Osdag desktop application. This included the design and implementation of a structured application background and the initial introduction of navigation bar icons. These improvements enhanced the visual clarity, usability, and overall user experience of the software while maintaining compatibility with its existing structural design modules.

The second task involved the development of a Base Plate design module for the Osdag web application. This task required full-stack development, with the backend implemented using Django and the frontend developed using React. The module enables users to input design parameters, processes the data through backend APIs, performs design calculations, and presents the results through an interactive web interface. The implementation followed a modular and scalable approach, allowing for future enhancements and integration with other Osdag web modules.

Together, these tasks contributed to improving the accessibility, usability, and functionality of the Osdag platform across both desktop and web environments.

5.2 Skills Developed

The internship provided valuable exposure to both software development and engineering-focused application design. From a technical perspective, significant experience was gained in graphical user interface development, including layout design, resource management, and visual consistency for desktop applications.

Hands-on experience was also gained in full-stack web development through the use of Django for backend development and React for frontend implementation. This included designing RESTful APIs, handling data flow between frontend and backend, validating user inputs, and structuring modular and maintainable codebases.

In addition to technical skills, the internship helped develop professional skills such as understanding large open-source codebases, following existing project conventions, documenting work effectively, and collaborating within a structured development environment. Overall, the fellowship strengthened both technical competence and practical problem-solving abilities in the context of engineering software development.

Chapter A

Appendix

A.1 Work Reports

Internship Work Report

Name: Sasank N
Project: Osdag
Internship: FOSSEE Fellowship
Duration: 01 September 2024 – 30 November 2024

Date	Day	Work Description	Hours
01-Sep-2024	Sunday	Weekly Holiday	0
02-Sep-2024	Monday	Orientation and understanding Osdag project structure	4
03-Sep-2024	Tuesday	Studied Osdag desktop application UI architecture	5
04-Sep-2024	Wednesday	Analysis of existing GUI components	5
05-Sep-2024	Thursday	Designed background concepts for Osdag desktop application	6
06-Sep-2024	Friday	Implemented background assets and tested UI consistency	6
07-Sep-2024	Saturday	Refined background design and fixed layout issues	5
08-Sep-2024	Sunday	Weekly Holiday	0
09-Sep-2024	Monday	Designed navigation bar icon layout	6
10-Sep-2024	Tuesday	Integrated navigation bar icons into Osdag GUI	6
11-Sep-2024	Wednesday	Tested navigation actions and resolved UI issues	5
12-Sep-2024	Thursday	Documentation of UI enhancements	4
13-Sep-2024	Friday	Mentor review and UI refinements	4
15-Sep-2024	Sunday	Weekly Holiday	0
16-Sep-2024	Monday	Introduction to Osdag web application architecture	5
17-Sep-2024	Tuesday	Studied base plate design methodology and IS codes	6
18-Sep-2024	Wednesday	Planned Base Plate module structure	6
19-Sep-2024	Thursday	Setup Django backend for Base Plate module	5
20-Sep-2024	Friday	Implemented base plate calculation logic	6
22-Sep-2024	Sunday	Weekly Holiday	0
25-Sep-2024	Wednesday	Exam Break	0
26-Sep-2024	Thursday	Exam Break	0

Date	Day	Work Description	Hours
01-Oct-2024	Tuesday	Developed React frontend for Base Plate inputs	6
02-Oct-2024	Wednesday	Integrated frontend with backend APIs	6
03-Oct-2024	Thursday	Displayed and formatted design results	5
06-Oct-2024	Sunday	Weekly Holiday	0
09-Oct-2024	Wednesday	Leave	0
15-Oct-2024	Tuesday	Exam Break	0
16-Oct-2024	Wednesday	Exam Break	0
24-Oct-2024	Thursday	Leave	0
30-Oct-2024	Wednesday	Exam Break	0
31-Oct-2024	Thursday	Exam Break	0
30-Nov-2024	Saturday	Final internship review and closure	4

Bibliography

[1] Siddhartha Ghosh, Danish Ansari, Ajmal Babu Mahasrankintakam, Dharma Teja Nuli, Reshma Konjari, M. Swathi, and Subhrajit Dutta. Osdag: A Software for Structural Steel Design Using IS 800:2007. In Sondipon Adhikari, Anjan Dutta, and Satyabrata Choudhury, editors, *Advances in Structural Technologies*, volume 81 of *Lecture Notes in Civil Engineering*, pages 219–231, Singapore, 2021. Springer Singapore.

[2] FOSSEE Project. FOSSEE News - January 2018, vol 1 issue 3. Accessed: 2024-12-05.

[3] FOSSEE Project. Osdag website. Accessed: 2024-12-05.