Summer Fellowship Report

On

Python Code for Connection Designing, GUI modification , Adding Features , Debugging and Restructuring

Submitted by

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Acknowledgment

I am a student of Computer Science and Engineering at PDPM IIITDM Jabalpur Madhya Pradesh. I have worked under Osdag Software by using Python as FOSS Tool. This internship opportunity I had with FOSSEE IIT Bombay was a great chance for learning and professional development. Therefore, I consider myself as a very lucky individual as I was provided with an opportunity to be a part of it. I am also grateful for having a chance to meet so many wonderful people and professionals who led me though this internship period.

I would like to specially acknowledge Prof. Siddhartha Ghosh with my deepest gratitude who in spite of being busy with his duties, took time out to hear, guide and keep me on the correct path and allowing me to carry out my project at their esteemed research lab (SSRR lab).

It is my radiant sentiment to place on record my best regards, deepest sense of gratitude to my mentors of the Osdag team; Danish Ansari (Project Research Assistant), Ajmal Babu MS (Project Research Engineer) , to all the members of Osdag Team and to my fellowship mates for their careful, precious guidance and support which were extremely valuable for my study both theoretically and practically.I would like to extend my sincere thanks to all of them.

I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on

their improvement, in order to attain desired career objectives.

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Chapter 1

Introduction

Python is one of the FOSS(Free and Open Source Software) provided under FOSSEE project. Python is a general-purpose, high-level, remarkably powerful dynamic programming language that is used in a wide variety of application domains. Python supports multiple programming paradigms, including object-oriented, imperative and functional programming styles. FOSSEE project promotes the use of FOSS (Free and Open Source Software) tools to improve quality of education in our country. FOSSEE encourages the use of FOSS tools through various activities to ensure commercial (paid) softwares are replaced by equivalent FOSS tools.

The FOSSEE project is a part of the National Mission on Education through Infrastructure and Communication Technology(ICT), Ministry of Human Resources and Development, Government of India.

Osdag is also an open source software developing under the FOSSEE project and uses mainly Python as FOSS. The existing Osdag Software (https://osdag.fossee.in/) primarily built upon Python and other Python-based FLOSS tools, such as, PyQt, OpenCascade, PythonOCC, and svgwrite. It uses SQLite for managing steel section databases. Osdag is currently under development. The exisiting version needs a lot of

modification of GUI and modules.

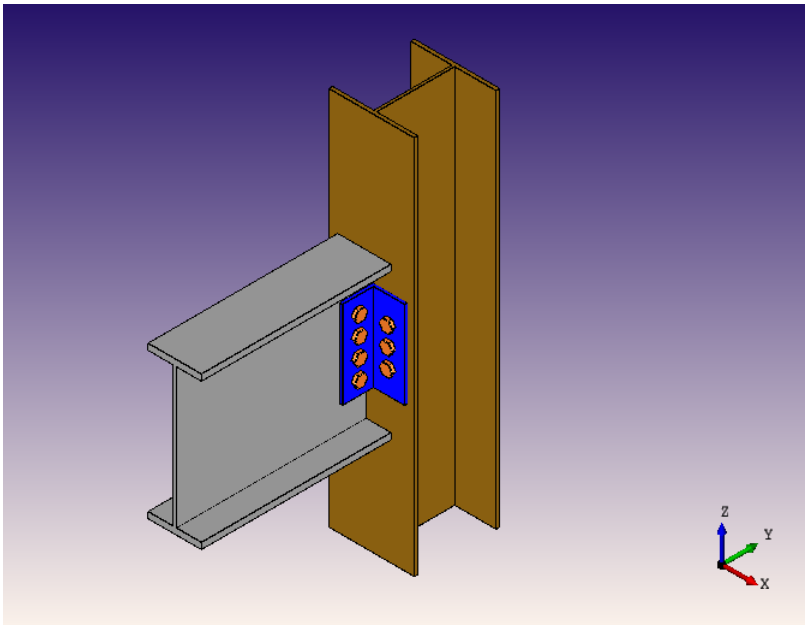
1.1 What is Osdag ?

Osdag is a cross-platform free and open-source software for the design of steel structures, following the Indian standard IS 800:2007. It allows the users to design steel connections, members and systems using a graphical user interface. The interactive GUI provides a 3D visualisation of the designed component and creates images for construction/fabrication drawings.

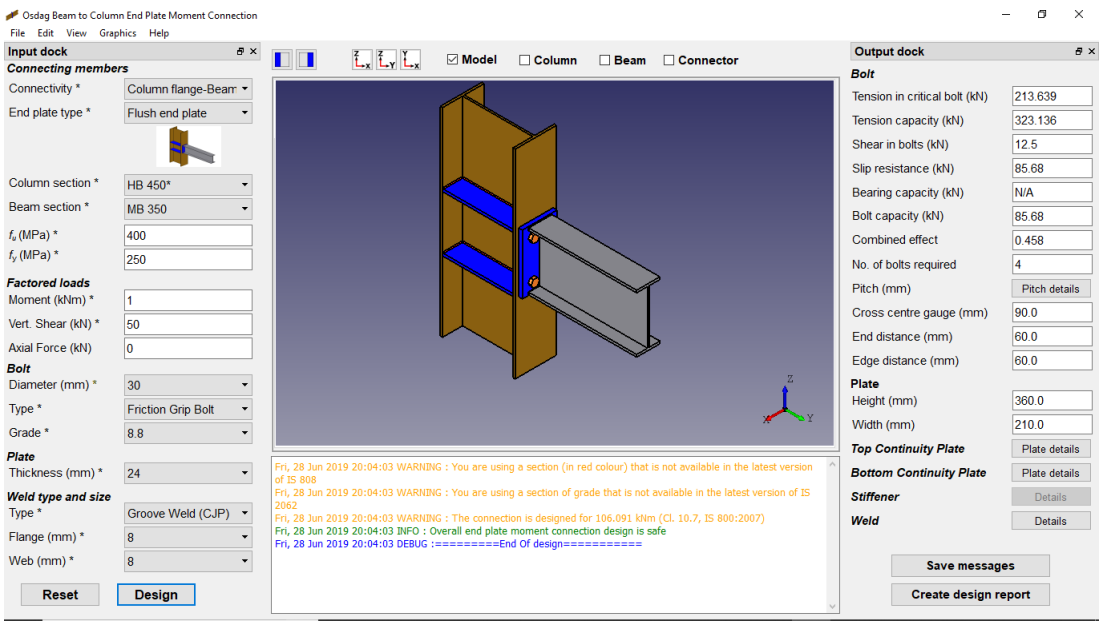
It is used for solving steel structures problems and to see how the connection will look after practical implementation. There are different modules available in Osdag with various connectivities.

Osdag provides various features such as:

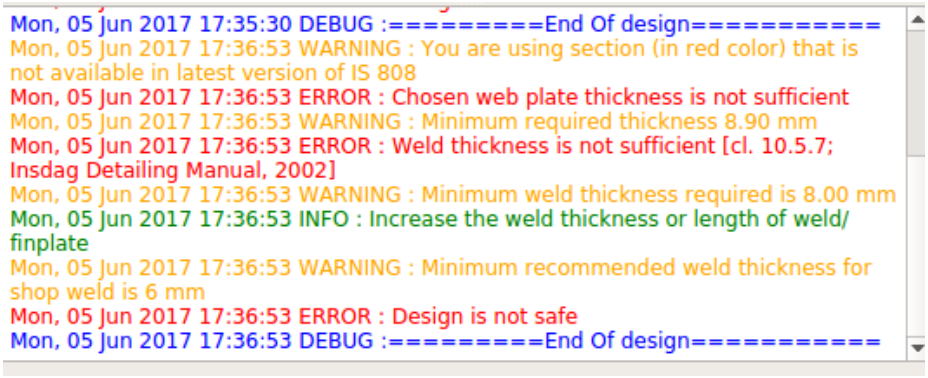
- An interactive window displaying a 3D CAD model, which provides a clear visualisation of the designed component.
- Creation of 3D CAD models that can be imported to generic CAD softwares.



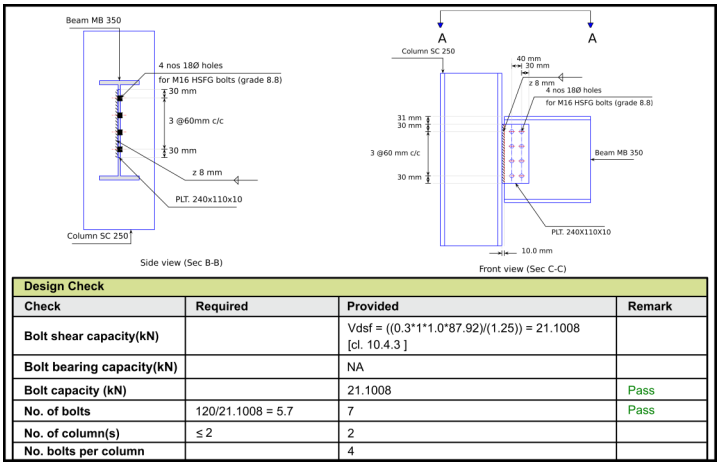
- User-friendly input and output docs, with text-validated fields grouped according to the design flow.



- A text window for message display, that also suggests necessary changes if a trial design is found unsafe.

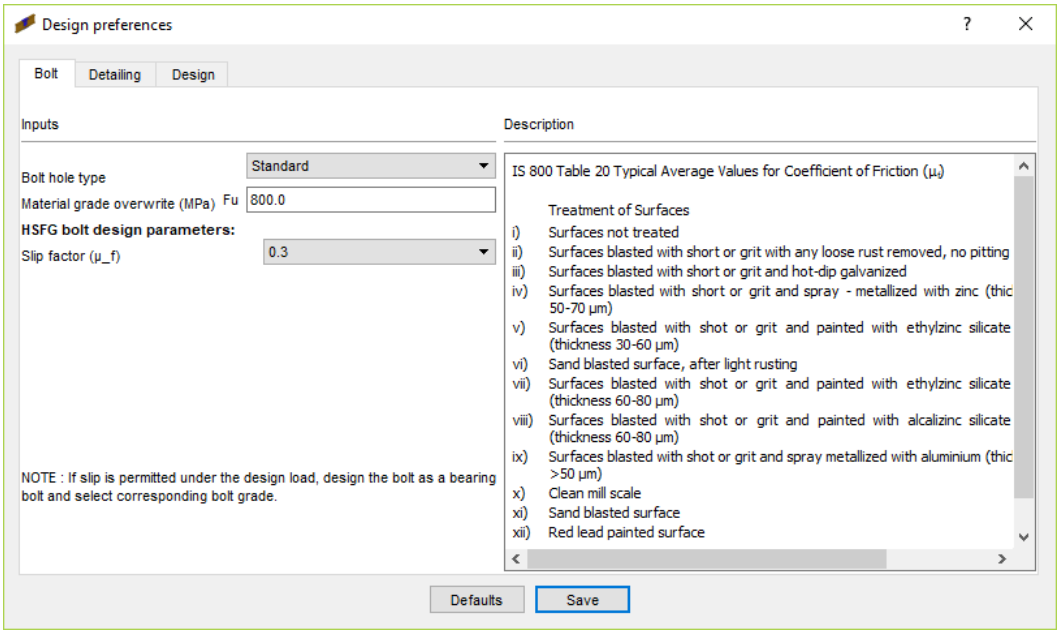


- Creation of a professional design report showing all necessary checks, design calculations as per IS 800:2007, and standard views of the designed component.



Design Check			
Check	**Required**	**Provided**	**Remark**
Bolt shear capacity(kN)		Vdsf = ((0.3*1*1.0*87.92)/(1.25)) = 21.1008 [cl. 10.4.3]	
Bolt bearing capacity(kN)		NA	
Bolt capacity (kN)		21.1008	Pass
No. of bolts	120/21.1008 = 5.7	7	Pass
No. of column(s)	≤ 2	2	
No. bolts per column		4	

- Creation of 2D vector (and raster) images that can be used in a design report or class assignment.
- Selection of design preferences, considering different construction and detailing aspects, using a design preference toolbox.



1.2 Who can use ?

Osdag is generally created for industry professionals but it also keep students in mind. As Osdag is funded by MHRD, Osdag team tries to manipulate software in such a way that it can be used by the students during their academics and to give them a better insight look in the subject.

Basically Osdag can be used by anyone starting from novice to professionals. It's simple and sober user interface makes it flexible and attractive than the other softwares. Also there are video tutorials to get started. The video tutorials of Osdag can be accessed here.

Chapter 2

Modification of GUI

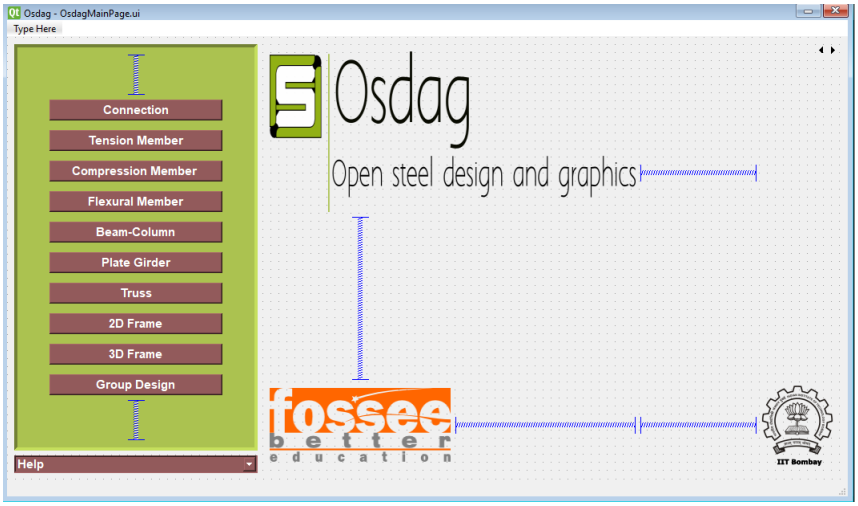
The current version of Osdag present at website had needed a lot of GUI modification so that it can look better to users.Thus Osdag can become easier to learn and use.A User Interface is needed to create a strong link between users and application.

2.1 Redesigning of whole GUI with layouts

The past version of Osdag had not contained base layouts. Layouts are necessary to control the sizes and positions.

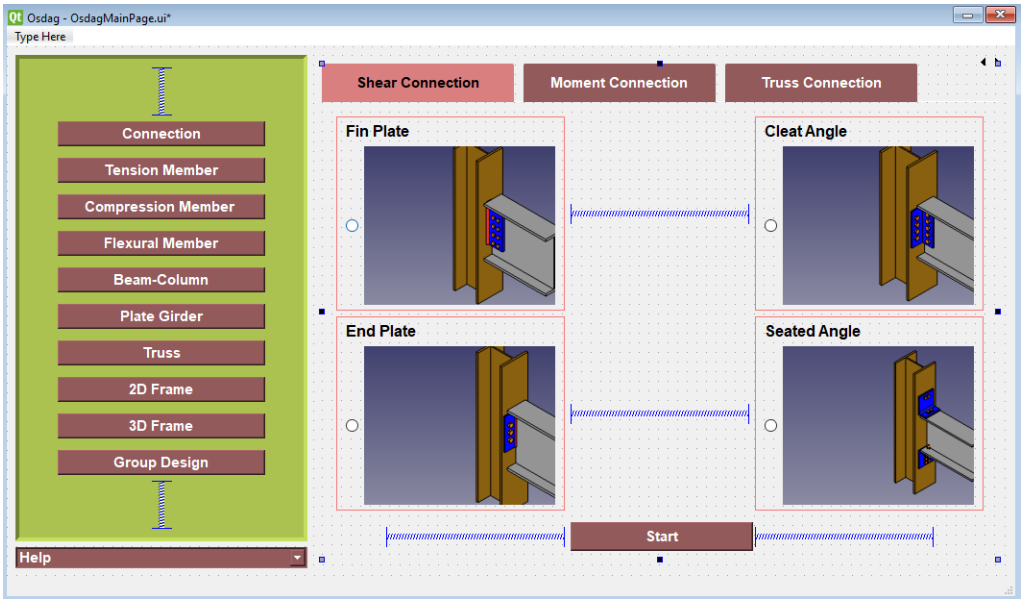
2.1.1 Main Page

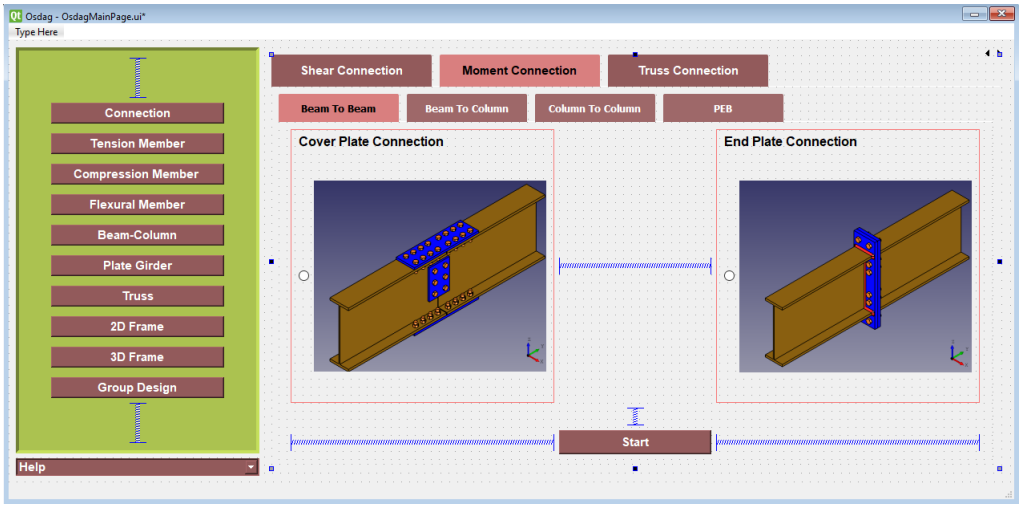
A Base Layout as Grid Layout is added to Main Page. A Vertical Frame is added to display the list of buttons.Vertical and Horizontal spacers are also added between logos. The layouts for Main window, ;Mystackedwidget' etc is recreated.

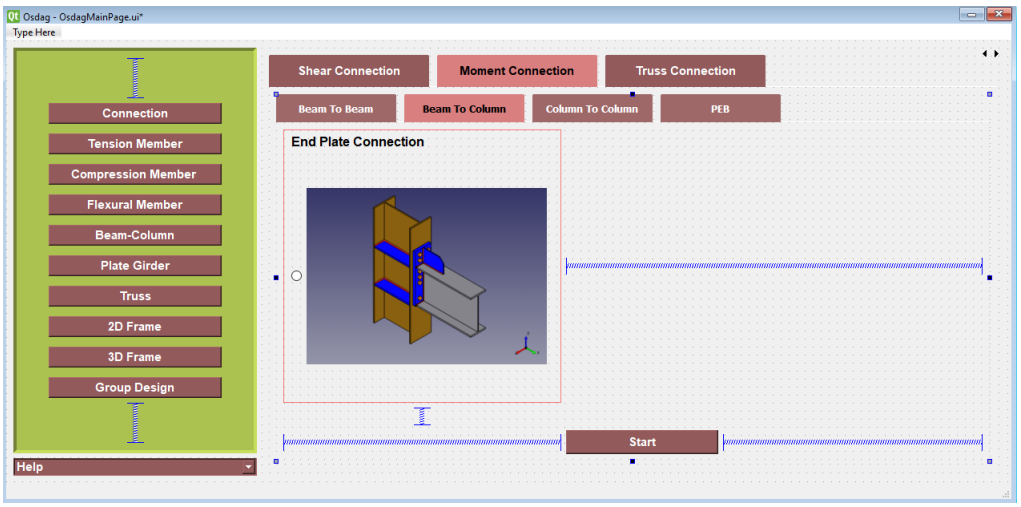


2.1.2 Connection Page

There are three types of connections - Moment, Shear, Truss. When it comes to User Interface these three are implemented as tabWidget. A Base Layout as Grid Layout is also added to each tab of the connection page. Vertical Layouts are also added to displaying each connections label+radio button images. Horizontal and vertical spacers are also added to fix the positions.



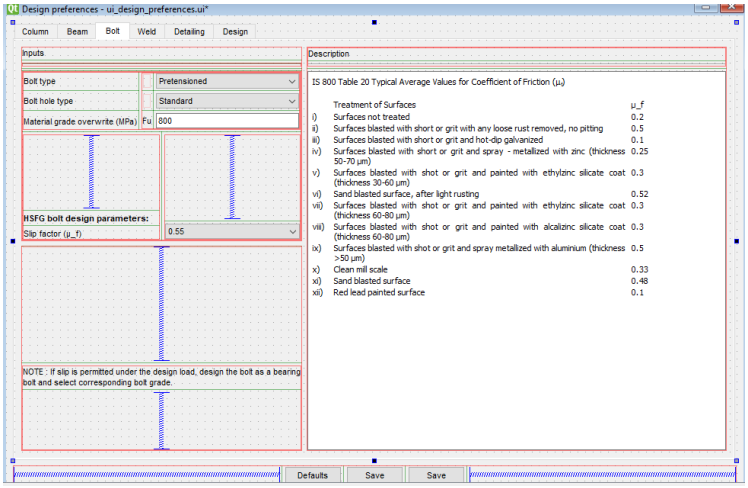


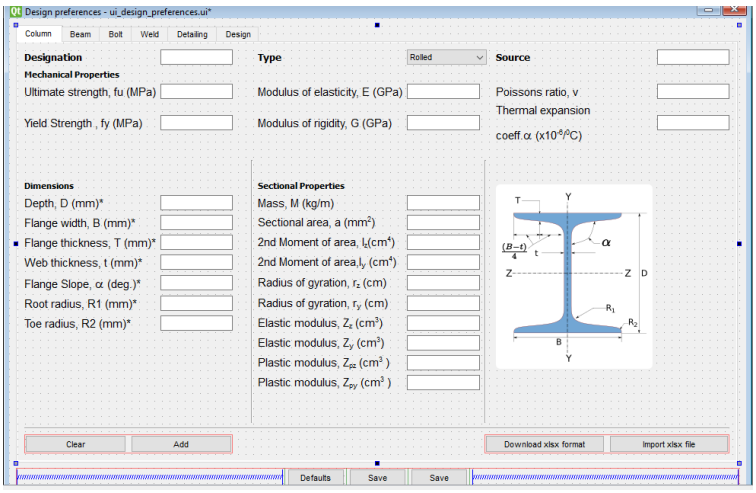


GitHub Links:-
https://github.com/Saumya-Mishra9129/Osdag/blob/9ff06e96cbf96ab2de0d8d341637caf65873cc11/osdagMainPage.py
https://github.com/Saumya-Mishra9129/Osdag/blob/9ff06e96cbf96ab2de0d8d341637caf65873cc11/ui_OsdagMainPage.py

2.1.3 Design Preferences

A Base Layout as Grid Layout is also added to each tab of design preference dialogue. This has been added to maintain changing screen resolutions due to difference in sizes of personal computers.





GitHub Links:-
https://github.com/Saumya-Mishra9129/Osdag/blob/5836889ed01cc53db0a20cf3d4c68f41891850d1/Connections/Moment/BCEndPlate/ui_design_preferences.py

2.2 Fixing Resolution

The layouts are added to fix the screen resolution. Different systems have different screen sizes and the window of application should manage it's size automatically with screen's resolution. Osdag while running on system of lower resolution caused the page to not fit in. Thus widgets at lower side of Main-window wouldn't appear on screen. Also the window could not be re-sized. The existed layout was inadequate and the size policy of the widgets were not accordingly provided.

The layouts for Main window, ;Mystackedwidget' etc is recreated. The size policy of each widget are changed suitably as preferred or expanding.

Chapter 3

New Features added

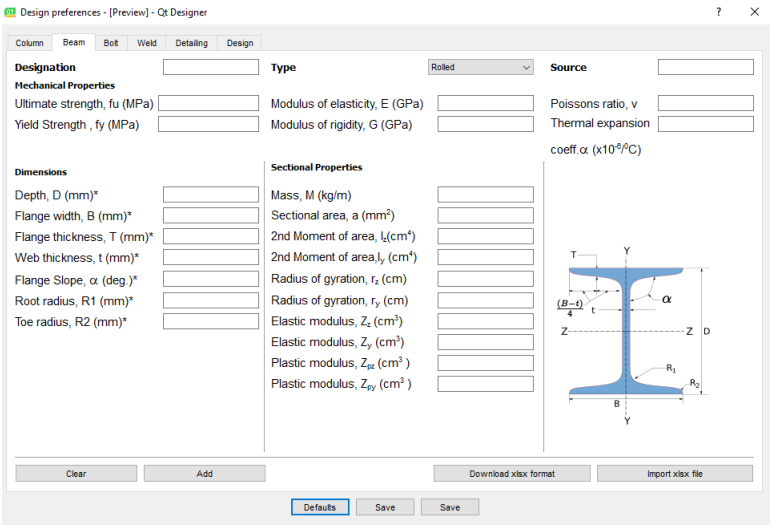
3.1 New Modules

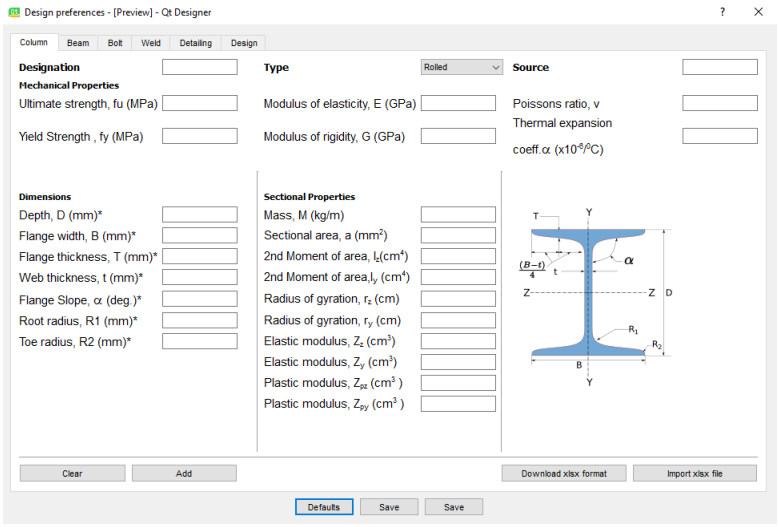
The past version of Osdag had only one Beam To Beam connection in moment connection.A New Module is added to Beam To Column tab of moment connection as End Plate Connection.

3.2 Add Sections in Design Preferences

The past version of Osdag had not the feature to add Beam or Column data to the database. A New Feature is added as to add, import new data to Beam and Column. User can download a spreadsheet and fill all the new data in that sheet and import data to database at once. It can also automatically calculate the values of Sectional properties based on mechanical properties and also dimensions in that form.

GitHub Links:-
https://github.com/Saumya-Mishra9129/Osdag/blob/52a192180eba8a89d65d5ae79bf7767e61f49a6d/Connections/Moment/BCEndPlate/bc_endplate_calc.py
https://github.com/Saumya-Mishra9129/Osdag/blob/52a192180eba8a89d65d5ae79bf7767e61f49a6d/Connections/Moment/BCEndPlate/bc_endplate_main.py
https://github.com/Saumya-Mishra9129/Osdag/blob/52a192180eba8a89d65d5ae79bf7767e61f49a6d/Connections/Moment/BCEndPlate/ui_design_preferences.py


Design preferences - [Preview] - Qt Designer
Column
Beam
Bolt
Weld
Detailing
Design
Designation
Type
Rolled
Source
Mechanical Properties
Ultimate strength, fu (MPa)
Modulus of elasticity, E (GPa)
Poissons ratio, v
Yield Strength , fy (MPa)
Modulus of rigidity, G (GPa)
Thermal expansion coeff.α (x10-6/°C)
Dimensions
Depth, D (mm)*
Flange width, B (mm)*
Flange thickness, T (mm)*
Web thickness, t (mm)*
Flange Slope, α (deg.)*
Root radius, R1 (mm)*
Toe radius, R2 (mm)*
Sectional Properties
Mass, M (kg/m)
Sectional area, a (mm2)
2nd Moment of area, Iz(cm4)
2nd Moment of area,Iy (cm4)
Radius of gyration, rz (cm)
Radius of gyration, ry (cm)
Elastic modulus, Zz (cm3)
Elastic modulus, Zy (cm3)
Plastic modulus, Zpz (cm3)
Plastic modulus, Zpy (cm3)
Clear
Add
Download xlsx format
Import xlsx file
Defaults
Save
Save


Design preferences - [Preview] - Qt Designer
Column
Beam
Bolt
Weld
Detailing
Design
Designation
Type
Rolled
Source
Mechanical Properties
Ultimate strength, fu (MPa)
Modulus of elasticity, E (GPa)
Poissons ratio, v
Yield Strength , fy (MPa)
Modulus of rigidity, G (GPa)
Thermal expansion coeff.α (x10-6/°C)
Dimensions
Depth, D (mm)*
Flange width, B (mm)*
Flange thickness, T (mm)*
Web thickness, t (mm)*
Flange Slope, α (deg.)*
Root radius, R1 (mm)*
Toe radius, R2 (mm)*
Sectional Properties
Mass, M (kg/m)
Sectional area, a (mm2)
2nd Moment of area, Iz(cm4)
2nd Moment of area,Iy (cm4)
Radius of gyration, rz (cm)
Radius of gyration, ry (cm)
Elastic modulus, Zz (cm3)
Elastic modulus, Zy (cm3)
Plastic modulus, Zpz (cm3)
Plastic modulus, Zpy (cm3)
Clear
Add
Download xlsx format
Import xlsx file
Defaults
Save
Save

Chapter 4

Fixing Bugs and Common issues of Software

Most of the common bugs and issues of existing software is solved.

4.1 Added Representative Images

The past version of Osdag had only simple radio buttons in moment connection.All representative images are added to their appropriate positions.

4.2 Colouring of Log Messages

All displayed Log Messages has divided in three categories- WARNING- Orange Colour, ERROR- Red Colour , INFO(suggestions)- Green Colour, DEBUG(result)- Blue Colour."set_osdaglogger" method of MainController is updated for this.

4.3 Tab Navigation

The Tab navigation is fixed for every widget to increase the compatibility of user. User can work properly without mouse. For this ui.py file is changed by adding orders of tab one by one in setupUi method of UI_MainWindow class- As example -

MainWindow.setTabOrder(self.combo_flangeSize, self.combo_webSize)

4.4 Load Input Problem

The Load Input problem is also fixed. Users don't have need to fill input dock again and again. They can just load their input file and all the data in input dock will be filled automatically. "load_design_inputs" method is changed for this.

4.5 Activation of Save Log Messages Button

Saving of Log Messages is necessary so that user can refer to log messages later also. This is fixed by adding "save_log_messages" function in MainController class.

4.6 Activate Show Column Button in menu bar

The Button was not activated.User could not be able to see the column used in design.This feature is also activated. "call_3DColumn" method of MainController class is updated for this.

4.7 Output Dock widget size problem

Initially when we open any connection's main page the output dock had not taken the size according to screen. It had not been expanding initially . After setting its size policy to expanding and also minimum size to 320mm. It is working properly.
Github Links:-

https://github.com/Saumya-Mishra9129/Osdag/blob/5836889ed01cc53db0a20cf3d4c68f41891850d1/Connections/Moment/BBSpliceCoverPlate/BBSpliceCoverPlateBolted/ui_coverplatebolted.py
https://github.com/Saumya-Mishra9129/Osdag/blob/5836889ed01cc53db0a20cf3d4c68f41891850d1/Connections/Moment/BCEndPlate/ui_bc_endplate.py

4.8 Disable All Quick access bar buttons on RESET

All quick access bar buttons will be disabled on clicking at RESET button. This is fixed by adding .setDisabled(True) in each button.

4.9 Disable weld sizes for groove weld should reset for fillet weld

This is fixed by adding following on_change function on Main-Controller class-

and following line is added to the _init_ function of the MainController class -
self.ui.combo_weld_method.triggered.connect(self.on_change)

Chapter 5

Software Testing and Debugging

The task was to test each and every module with its sub-connectivities currently available in Osdag. There was a need to test the software for edge and corner cases and make sure that the software gave appropriate results/suggestions. The Testing of the GUI and other small features was required to ensure smooth functioning of the software. This all we had at the time of Osdag workshop. The Osdag Training Program was held at 16-17th June and for that workshop we had to install Osdag in systems at computational lab. The task was very challenging as we had to make Osdag error free and smooth functioning software but it was too much fun also.

Finding new bugs was really a challenging task and it was given by my mentor Danish Ansari to check all the functionality of Extended End Plate module , to report any bug statement it was necessary to cross check that statement for every section, connectivity and for various input values. Generally my task follows the following flow chart.

Test the software $\rightarrow$ Find bugs (If any) $\rightarrow$ Bug fixing $\rightarrow$ Test the software after bug fixed.

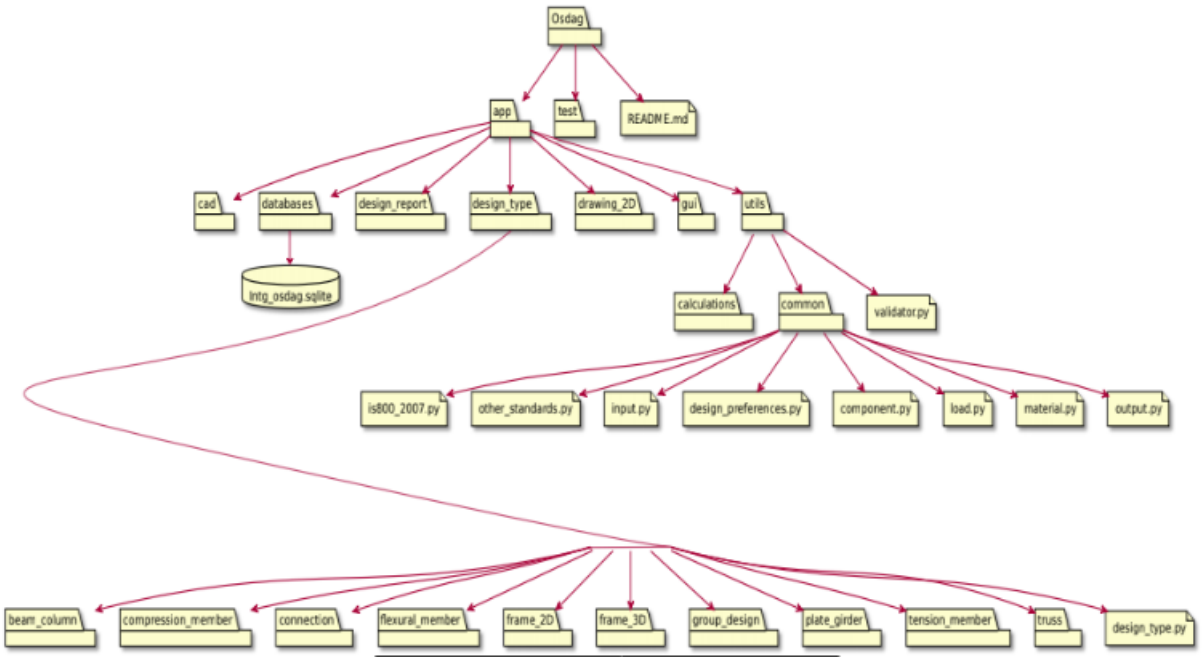
At workshop we also helped participants of workshop in any type of problem in working of Osdag they were facing. We also

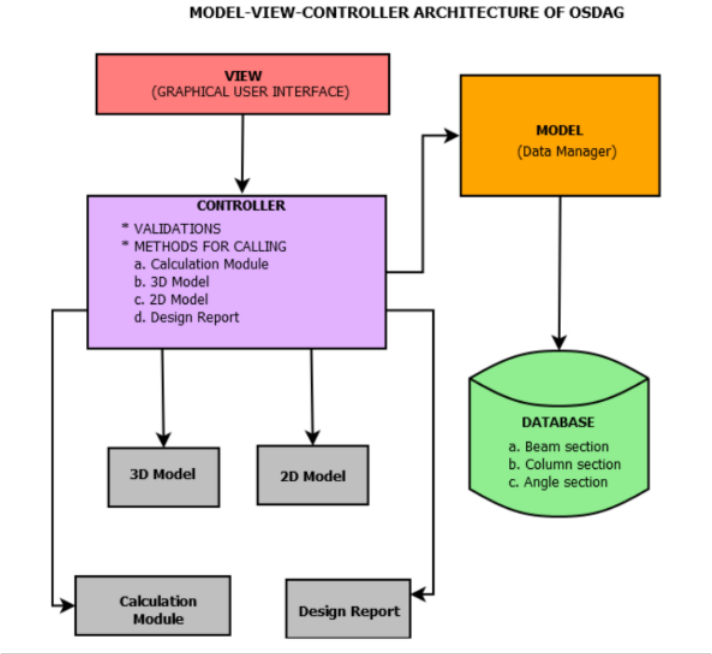
learned how to manage such types of workshop. That was a awesome experience.

Chapter 6

Restructuring of Modules

Restructuring is necessary to avoid code duplication and to maintain consistency. It will enhance modular development which makes easy to understand, test and maintain readability , test and bug fixing. Time and memory efficiency will also increase. We need to change the code in format which uses Object oriented programming concepts. Model-View-Controller (MVC) pattern of software architecture also need to implement. New Structure of Osdag is as follows-





In MVC pattern there should be a MainController class for each connection type as FinplateController or ExtendedEndplateController. Inside this class there will be a method named launchFinplateController which will create an instance of finplateConnection class which interacts with view methods and create GUI and input object also. User will click on design button and then input object interacts with models which have all calculation file and give output object and we will display all related values of output on GUI.

Chapter 7

Conclusion

On the whole, this internship was a useful experience. I have gained new knowledge, skills and met many new people. I achieved several learning goals, and have moved a step further in achieving other. I got insight into professional practice. Internship has proved to be satisfactory and it has allowed as an opportunity to get an exposure of the practical implementation of theoretical fundamentals.

Here during the internship period I developed my skills in following softwares/tools :

1. Osdag
2. Python(how different packages and libraries works and their uses)
3. Latex
4. Git and Git hub
5. Pyqt5
6. Sqlite3
7. Qt Designer

I would like to once again appreciate everyone who has made my internship training a superb experience.

References

- stackoverflow
- Qt Documentation
- GeeksForGeeks
- Corey Schafer- Git Tutorials
- ProgrammingKnowledge - Qt Tutorials
- SQLite Tutorial