

Summer Fellowship Report

On

Developing Osdag Section Modeller Module

Submitted by

Mohammad Azhar U Din Mir

Under the guidance of

Prof.Sidhartha Ghosh

Civil Engineering Department IIT Bombay

Under the Mentorship of

Danish Ansari Assistant Project Manager

July 1, 2020

Acknowledgment

I would like to thank FOSSEE for providing me a platform to work on something I am very interested in. I am thankful to everyone who thought of having and involved in selection process based on screening tasks. I am grateful to be a part of team which promotes open source software.

I thank all the Osdag members, who are wonderful mentors and great team. I thank Sourabh Das (Project Research Associate), Ajmal Babu MS (Project Research Associate), Danish Ansari (Project Research Assistant), Yash Lokhande (Project Research Assistant), Darshan Viswakarma (Project Research Associate), Anand Swaroop (Project Research Associate), Anjali Jatav (Project Research Assistant) and whole team, who made us feel welcome and planned all the tasks meticulously during this period.

I am grateful that I got a chance to work under Prof. Sidharth Ghosh, who took time to mentor us and monitored individual contributions as well.

Contents

1	Intr	roduction	3
	1.1	Osdag Internship	3
	1.2	What is Osdag?	3
	1.3	Who can use ?	4
2	Osd	lag Section Modeller Creation	5
	2.1	Define Section with Inputs	6
	2.2	Derivation of Formulas	7
	2.3	Development of rough CAD models for each template .	8
	2.4	Development of 2D Drawings	10
	2.5	Design of LaTex Report	12

Chapter 1

Introduction

1.1 Osdag Internship

Osdag internship is provided under the FOSSEE project. FOSSEE project promotes the use of FOSS (Free/Libre 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 availability of competent free software equivalent to commercial (paid) softwares.

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 one such open source software which comes under the FOS-SEE project. Osdag internship is provided through FOSSEE project. Any UG/PG/PhD holder can apply for this internship. And the selection will be based on a screening task.

1.2 What is Osdag?

Osdag is Free/Libre and Open Source Software being developed for design of steel structures. Its source code is written in Python, 3D CAD images are developed using PythonOCC. Github is used to ensure smooth workflow between different modules and team members. It is in a path where people from around the world would be able to contribute to its development. FOSSEE's "Share alike" policy would improve the standard of the software when the source code is further modified based on the industrial and educational needs across the country. Design and Detailing Checklist (DDCL) for different connections, members and structure designs is one of the important bi-products of this project. It would create a repository and design guide book for steel construction based on Indian Standard codes and best industry practices.

1.3 Who can use ?

Osdag is created both for educational purpose and industry professionals. As Osdag is currently funded by MHRD, Osdag team is developing 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.

Osdag can be used by anyone starting from novice to professionals. It's simple user interface makes it flexible and attractive than other software. Video tutorials are available to help get started. The video tutorials of Osdag can be accessed here.

Chapter 2

Osdag Section Modeller Creation

Osdag Section Modeller is a new feature dialog that helps design, visualize and save Sections to be further used in the Main Application. It helps the user create sections other than what are there in the IS Codes. For now the user can create 12 Built-Up Sections. The Section Modeller has 3 sections namely:

- 1. Define Section
- 2. CAD Viewer
- 3. Section Properties

Dialog	? ×
Define Section	
Section Type: Angle Section Section Template: Star Angles-4 Angles Section Parameters: Enter/Edit Parameters Section Designation:	
Section	Properties
Area, a(cm ²): 21.96	Properties Centriod, c_z(cm): 5.5
Section Area, a(cm²): 21.96 Moment of Inertia, I_zz(cm ⁴): 133.5025	Properties Centriod, c_z(cm): 5.5 Centriod, c_y(cm): 5.0
Section Area, a(cm²): 21.96 Moment of Inertia, I_zz(cm ⁴): 133.5025 Moment of Inertia, I_yy(cm ⁴): 363.4398	Properties Centriod, c_z(cm): 5.5 Centriod, c_y(cm): 5.0 Plastic Section modulus, Z_pz(cm ³): 38.746
Section Area, a(cm²): 21.96 Moment of Inertia, I_zz(cm4): 133.5025 Moment of Inertia, I_yy(cm4): 363.4398 Radius of Gyration, r_zz(cm): 2.4656	Properties Centriod, c_z(cm): 5.5 Centriod, c_y(cm): 5.0 Plastic Section modulus, Z_pz(cm³): 38.746 Plastic Section modulus, Z_py(cm³): 24.166 Elastic Section modulus, Z_zz(cm³): 400.0
Section Area, a(cm²): 21.96 Moment of Inertia, I_zz(cm4): 133.5025 Moment of Inertia, I_yy(cm4): 363.4398 Radius of Gyration, r_zz(cm): 2.4656 Radius of Gyration, r_yy(cm): 4.0682	Properties Centriod, c_z(cm): 5.5 Centriod, c_y(cm): 5.0 Plastic Section modulus, Z_pz(cm ³): 38.746 Plastic Section modulus, Z_py(cm ³): 24.166 Elastic Section modulus, Z_zz(cm ³): 109.8 Elastic Section modulus, Z_yy(cm ³): 120.78

Figure 2.1: Osdag Section Modeller

2.1 Define Section with Inputs

The Define section is where the user enters/selects the required parameters. It has 4 Inputs:

- 1. Section Type
- 2. Section Template
- 3. Section Parameters
- 4. Section Designation

There are 5 Types of section out of which user can select one. On selection of a type, the Section template drop down is automatically updated with the available templates for the selected section.Next, the user show enter the Section Parameters by clicking the 'Enter/Edit Parameters' button.This opens a separate dialog which has the required parameters for the selected template. As soon as the user clicks save on the Section Parameters dialog and if the parameters are all valid, then a CAD model is created and displayed in the CAD viewer and all the Section Properties are updated and displayed in their respective text boxes.

D	efine Section	
Section Type:	Angle Section	•
Section Template:	Star Angles-4 Angles	*
Section Parameters:	Enter/Edit Parameters	
Section Designation:		

Figure 2.2: Define Section



Figure 2.3: Section Parameters Dialog

2.2 Derivation of Formulas

Formulas were derived for each section property that are necessary for the design of any built-up section. These formulas were further coded in python. Coded formulas from manual calculations provided by fetching data from the user as well as the database. These formulas were then used to update the respective Section Property in the Section Properties Section. Each time a user saves the Section parameter, the Section properties are updated if the parameters entered are valid.

Section Properties								
Area, a(cm ²):	21.96	Centriod, c_z(cm):	5.5					
Moment of Inertia, I_zz(cm ⁴):	133.5025	Centriod, c_y(cm):	5.0					
Moment of Inertia, 1 vv(cm4):	363.4398	Plastic Section modulus, Z_pz(cm ³):	38.746					
		Plastic Section modulus, Z_py(cm ³):	24.166					
Radius of Gyration, r_zz(cm):	2.4656	Elastic Section modulus, Z_zz(cm ³):	109.8					
Radius of Gyration, r_yy(cm):	4.0682	Elastic Section modulus, Z_yy(cm ³):	120.78					

Figure 2.4: Section Properties

2.3 Development of rough CAD models for each template

CAD models were created for every template and then developed by a CAD Intern.Respective CAD model creation and display in OCC Viewer coded with input and database parameters for each model. Each time a user saves the Section parameter, respective CAD model based on parameters is created and displayed if the parameters entered are valid.



Figure 2.5: CAD Model Examples

2.4 Development of 2D Drawings

2D drawings will help identify the user all the input parameters that the user needs to feed in order to design the built-up section.



Figure 2.6: 2D Drawings Examples

2.5 Design of LaTex Report

The design of the report that will be created after the end of a successful design. This report can be then saved/exported by the user. The Import feature helps import previously saved Sections from the location of choice in the system.

The Export feature allows the creation of a LaTex formatted Design report of the Designed Section.

The Save feature helps save Designed Sections into .osm file to be used further in the Application or the Modeller itself.

Group/Team Name		rioject rite	Angle Section				
D 1	FSF-2020	Subtitle	None	4 3D	View		
Designer	Satyam Singh Niranjan	Job Number	2 Poll Trees	 4 3D	VICW		
Date	10 /06 /2020	Client	Self-Test				
Design Co	onclusion						
Section Designation		Remarks					
20X20X4_BoxSectio	on_4xAngle	Pass					
Section De	etails						
Section Type		Angle Section					
Section Template		Box Section-4 An	gles				
Section Pa	arameters						
Angle Section Typ	pe	20 20 X 4					
Spacing between 5	Sections_Horizontal, S(mm)	38					
Spacing between 5	Sections_Vertical, S*(mm)	38					
Plate Length(Hor	izontal), l(mm)	38					
Plate Length(Vert	tical), l*(mm)	38					
Plate Thickness, t	t(mm)	38				~	
	roperties						
Area	•	5781.8				\vee	
Area Radius of Gyratio	m	5781.8				V	
Area Radius of Gyratio Rzz(mm)	n	5781.8 29.521				Y	
Area Radius of Gyratio Rzz(mm) Ryy(mm)	'n	5781.8 29.521 40.5014				¥	
Area Radius of Gyratio Rz(mm) Ryy(mm) Elastic Section Me	on oduli	5781.8 29.521 40.5014				Y	
Area Radius of Gyratio Rzz(mm) Ryy(mm) Elastic Section Me Zzz(mm ²)	oduli	5781.8 29.521 40.5014 238066.1932				Y	
Area Radius of Gyratio Rzz(mm) Elastic Section Me Zzz(mm ²) Zyy(mm ³)	n oduli	5781.8 29.521 40.5014 238066.1932 369659.9612					
Area Radius of Gyratio Rzz(mm) Ryy(mm) Elastic Section Me Zzz(mm ³) Zyy(mm ³) Centroid Centroid	oduli	5781.8 29.521 40.5014 238066.1932 369659.9612 41.1751				Ĭ	
Area Radius of Gyratio Rzz(mm) Ryy(mm) Elastic Section Me Zzz(mm ³) Zyy(mm ³) Centroid Cy(mm) Cofmm)	n oduli	5781.8 29.521 40.5014 238066.1932 369659.9612 41.1751 63.9051					
Area Radius of Gyratio Raz(mn) Ryy(mn) Elastic Section Me Zzz(mn ³) Zyy(mn ³) Centroid Cy(mn) Cz(mn) Momant of Inartii	n oduli	5781.8 29.521 40.5014 238066.1932 369659.9612 41.1751 63.9351					
Area Area Radius of Gyratio Rz(mm) Elastic Section Me Zz(mm ³) Zyy(mm ³) Centroid Cy(mm) Cz(mm) Moment of Inertic Ize(mm)	oduli	5781.8 29.521 40.5014 238066.1932 369659.9612 41.1751 63.9351 5038790.855					
Area Radlus of Gyratio Rzy(mn) Elastic Section Mc Zzy(mn ²) Zyy(mn ²) Centrold Cy(mn) Cc(mn) Moment of Inertia Izt(mn) Ivy(mn)	a	5781.8 29.521 40.5014 238066.1932 360659.9612 41.1751 63.9351 5038790.855 9484206.4653					
Section Pr Area Radius of Gyratio Raz(mm) Ray(mm) Elastic Section Mi Zay(mm ³) Centroid Cy(mm) Cz(mm) Moment of Inertia Izz(mm) Izz(mm) Izz(mm)	a	5781.8 29.521 40.5014 238066.1932 369659.9612 41.1751 63.9351 5638790.855 9484206.4653 7048590.668					
Area Radius of Gyratio Raz(um) Ryy(um) Elastic Section Ma Zzu(um ³) Zyy(um ³) Centroid Cy(um) Cy(um) Cy(um) Moment of Inertia Izu(mn) Myy(um) Isy(um) (*)	a	5781.8 29.521 40.5014 238066.1932 369659.9612 41.1751 63.9351 5038790.855 9484206.4653 7048090.088 45					
Section Pr Area Radius of Gyratio Ra(nm) Ry(nm) Elastic Section Ma Za(nm ³) Zy(nm ³) Centroid Cy(nm) Ca(nm) Moment of Inertia Iza(nm) Iyy(nm) Iyy(nm) (¹) Igy(nm)	n ooduli a	5781.8 29.521 40.5014 238066.1932 369659.9612 41.1751 63.9551 503570.555 9481206.4653 7048600.068 45					
Section Pr Area Radius of Gyratio Raz(um) Ryy(mn) Elastic Section Md Zzz(um ⁹) Zzy(um ⁹) Centroid Cy(mm) Cc(um) Moment of Inertiz Izz(um) Dyy(um) Lyy(um) Lyy(um) (¹) (¹) (¹)	n aduli	5781.8 29.521 40.5014 238066.1932 36669.0612 41.1751 63.9351 9451206.4653 704660.668 45 45 61380970.784					
Section Pr Area Radius of Gyratio Rze(mm) Ryy(mm) Elastic Section Mc Zzy(mm ²) Centroid Cy(mm) Cy(mm) Cx(mm) Moment of Inertic Izz(mm) Hyy(mm) Ryy(mm	n ooduli a	5781.8 29.521 40.5014 236066.1932 3360569.9612 41.1751 63.9351 41.1751 63.9351 948.2266.4653 7048600.668 45 61380970.784 88654231.254					
Section Pr Area Radius of Gyratio Radium) Ry(mm) Elastic Section Md Zy(mm ³) Centroid Cy(mm) Cy(mm) Cy(mm) Moment of Inertia La(mm) Moment of Inertia La(mm) Vy(mm) (¹) Plastic Section Md Zpy(mm ³)	n addii a	5781.8 29.521 40.5014 228660.1002 236660.9612 41.1751 63.3551 5035790.855 9484206.4053 7048600.663 45 61.36970.784 48.54221.254 3341363.4952					

Figure 2.7: Design Report

<pre>[]'Section_Designation': '2AnglesOppSide',</pre>
<pre>'Section_Parameters': {'parameterText_1': ['Angle Section Type',</pre>
'65 x 65 x 8'],
'parameterText_6': ['Gusset Plate Length, l(mm)',
·65.0'],
'parameterText_7': ['Gusset Plate Thickness, t*(mm)',
'10']} ,
'Section_Properties': {'A': '26.2',
'Cy': '4.2489',
'Cz': '7.0',
'Iyy': '191.3713',
'Izz': '381.1444',
'Ryy': '2.7026',
'Rzz': '3.8141',
'Zpy': '49.158',
'Zpz': '36.1978',
'Zyy': '183.4',
'Zzz': '85.15'},
'Section_Template': 4,
'Section_Type': 3}

Figure 2.8: Saved Section