PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL AT PASSI CITY ILOILO

A Project Study Presented to

The Faculty of the Department of Civil Engineering

Central Philippine University

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In Partial Fulfillment

of the Requirements for the Degree of

Bachelor of Science in Civil Engineering

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-The Researchers

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PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL AT PASSI CITY ILOILO

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ABSTRACT

The executive branch of the government is manifested by the local government units (LGUs). Common administrative functions include governance, public services, revenue generation, and intergovernmental relations. For an LGU to function properly it needs a City Hall that is organized and competent in handling transactions, something the current City Hall of Passi lacks. This disarray and congestion of offices results in longer and inefficient transaction time. This project study provides the design for a four-storey. 6293 sq. m. city hall with 36 offices, a waiting area, pantries and conference rooms. Special features include the use of film-coated windows for temperature and UV rays control. The structural design was based on the National Structural Code of the Philippines (NSCP) 2015 while the plumbing, sanitary and electrical designs followed their respective codes and standards. The estimated cost of the project is PhP 129,039,164.59 based on the present cost of materials. The construction time of the structure is approximately 360 working days and shall be funded by the LGU-Passi City. It is recommended to consider other sources of water to meet future demands of the clients for drinking and for other domestic uses.

Chapter 1

Introduction

1.1 Background and Rationale

By definition the city hall is the structure that houses the main offices of a city council. It is categorized as an institutional building, and it serves a similar function with higher government structures; which can generally be said to perform works that mainly focus on affairs that attempt to improve, advance, and expand the range of the people it serves. City hall is also considered as the backbone of a progressive and thriving place, for it functions as its center of governance and excellence. It is also a place that provides inspiration for its constituents to strive harder and it serves as a benchmark of how far the city has come; by which in this study, it is located and focused in the City of Passi.

Formerly recognized as “Municipality of Passi;” Passi is a region located in the outskirts of the Western part of Iloilo and is known to occupy 251.39 square kilometers of the entire part of Iloilo, which is 5.39% of the province's area. Based on the 2020 census, it has a population around 88,873; which is equal to 1.12% of residents in Western Visayas and 4.33% of the entire residents in Iloilo Province. Based on the data, the population mass can be calculated to 354 residents for each square kilometer.

With an annual income of P300,860,719, general income of P26,732,922, special educational fund of P37,287,853, and trust fund, with a total current operational income of P364,881,424, Passi is classified as a 4th class component city. The R.A. No. 8469 designates Passi as a component city, which was signed by a President. On January 30, 1998, Fidel Valdez Ramos, according to Figure 1, it is bordered on the north of San Enrique, on the east of Calinog, on the west of Lemery, and on the south of Capiz. It is predominantly a mountainous area that is divided into 51 barangays on a political level. It has the biggest land area in the province, at 25,139 hectares, and is the farthest distance from Roxas and Iloilo by roughly 50 and 70 kilometers, respectively.

Figure 1

Location of Passi City, Iloilo

Figure 2

Facade of the Current City Hall of Passi City

Rice and sugar are mainly produced in Passi. It is the only component city and the largest city in the Province of Iloilo in terms of land size, population, and income. Due to its huge pineapple farms and annual fruit production, it is referred to as the "Sweet City in the Heart of Panay". During this time, Passi started to advance and has grown significantly. Due to its valuable position, Passi developed into a hub of trade and business, increasing the municipality's chances for investment. It has finally gained prominence and been acknowledged as the first component city on the island of Panay due to its high income, fast population expansion, and wide land area. For this reason, the City Hall must reflect the progress the city has made by not just going through good changes in its appearance; but also undergoing some changes in its sizes, like making bigger offices; signifying that through these wider and bigger rooms, there are new opportunities for people who need jobs. This is also a good indication that there will be an increase in manpower, so in return, the city leaders can provide and extend better support and services to the people.

The Passi City Hall is over 20 years old in terms of its age as a structure, it has a total floor area of 3012 sq meters, and within those 20 years, the city hall is showing signs of cracking in its walls and in some parts of the city hall, the beams also show some cracking. Water and Termite damage has been imminent and visible all throughout the ceiling of the building making it especially hard when it rains.

Table 1

List of Offices at City Hall of Passi City

No.	*Office Name:*
1.	Office of the City Mayor
2.	Project Monitoring Section
3.	Motor Pool Section
4.	Population Section
5.	Public Utilities Section
6.	Public Employment Service Section
7.	Office of the Resource and Development
8.	Office of the Business Permit and Licensing
9.	Office of the City Tourism
10.	Office of the City Information
11.	Office of the City General Services
12.	Office of the City Economic Enterprise and Management
13.	Slaughterhouse Section
14.	Office of the Sangguniang Panlungsod
15.	Office of the City Planning and Development Coordinator
16.	Office of the City Budget
17.	Office of the Accountant
18.	Office of the City Treasurer
19.	Office of the City Health
20.	Office of the City Assessor
21.	Office of the City Registrar
22.	Office of the City Engineer

23.	Office of the City Agriculture
24.	Office of the City Environment and Natural Resources
25.	Office of the City Social Welfare and Development
26.	Office of the City Administrator
27.	Office of the City Legal
28.	Passi City College
29.	Office of the City Waste Management
30.	Office of the City Sports and Development
31.	Office of the City Local Economic Development and Investment Promotion
32.	Office of the City DRRM

Source: Passi City Engineer's Office

As shown in Table 1, the current City Hall is made up of the following 29 separate offices and 3 sub-offices for the Mayor's Office, each of which has its own designated space. Some of them are housed in a different building apart from the main one, such as the City Office for Agriculture, which is located next to the Motorpool as shown in Figure 3. People who visit city hall can receive a variety of services from each of these offices. The City Mayor's office provides the services that a transactor needs such as a mayor's clearance, job recommendations, and certifications. The City Treasurer's office provides the services that the transactor needs for check issuance and release, cash disbursement, transfer tax certificates, tax clearance and office certifications, and receipts for other fees. There are additional offices that are not listed here, but each one provides a variety of services that are tailored to the unique requirements of the residents of Passi City (see Appendix D for Reference).

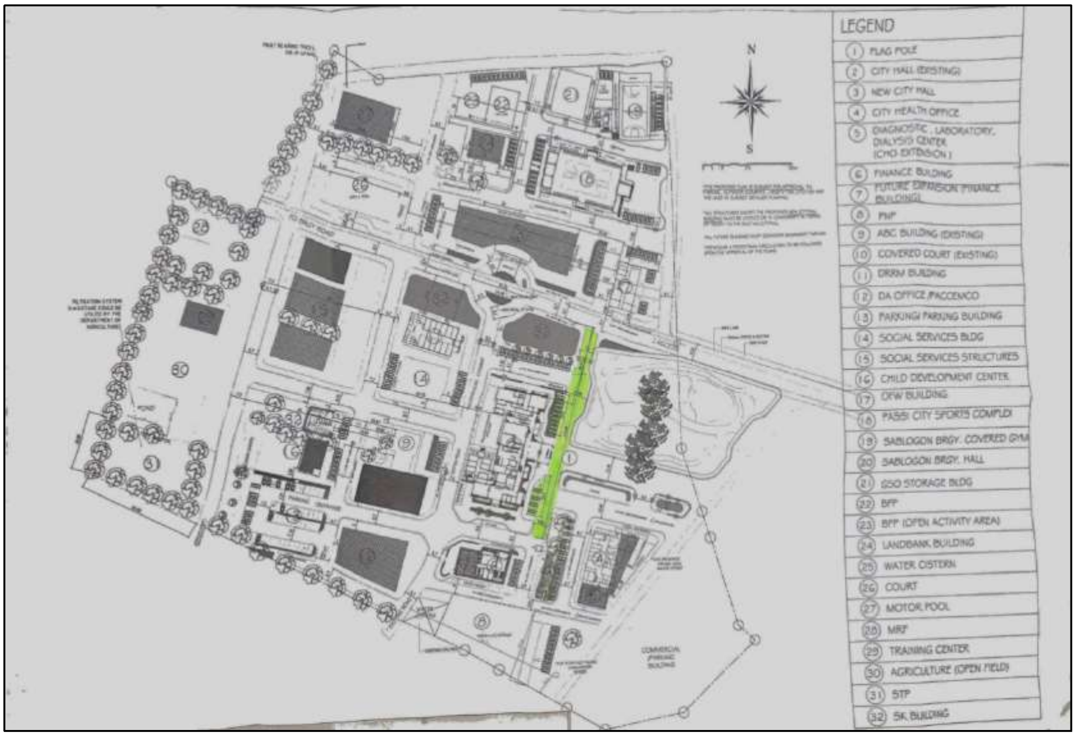


Figure 3

Development Site of the City Hall Complex

According to Figure 4, the new City Hall's proposed location is to the north of the current building and has a total area of around 4000 square meters. The current city hall will subsequently be used for other purposes; it won't be demolished. All previous activities will then be transferred to the new city hall, which will also include more offices for national government agencies.

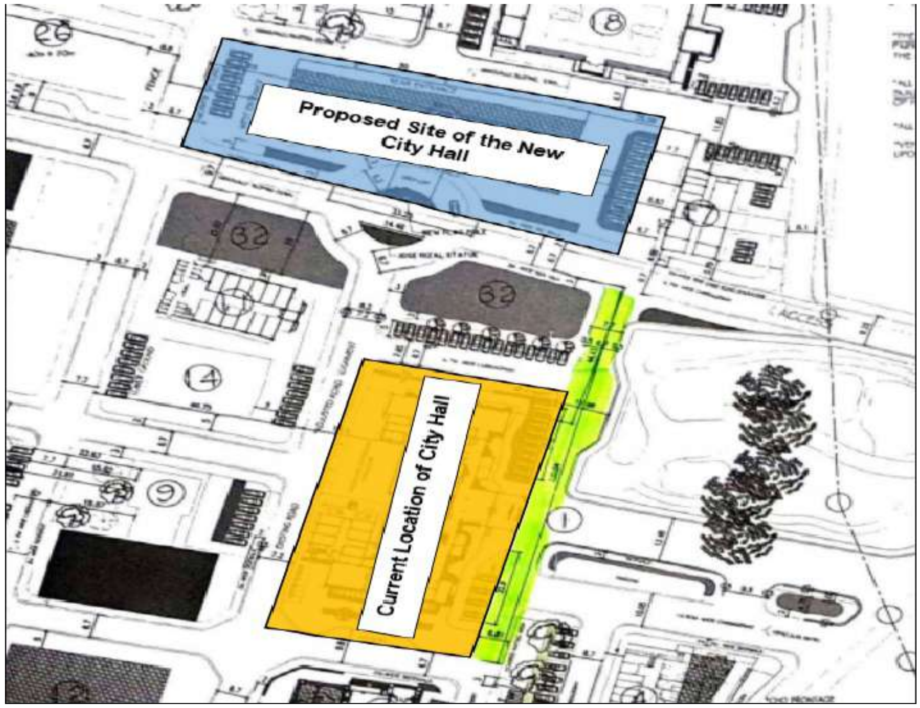


Figure 4

Proposed Site of the New City Hall

1.2 Problem Identification

Overcrowding of Offices*.* The city hall of Passi is meant to house a lot of rooms and offices; Just like how different agencies are formed in order to accommodate certain needs of people; offices are the place where these workers stay and are meant to perform their services and do their appointments. But due to the increasing number of demands and the growing number of people, it cannot be denied that adding new employees must also be considered in order to assist and serve the locals. So, what follows, is a new problem; with the growing number of employees, the offices get overcrowded and there is a huge possibility that this may cause inconvenience and disarray on their work, thus, affecting their productivity.

Table 2

Respective Floor Areas of Each Office

Office Name	*Area Sq.m*
Office of the City Mayor	208.226675
Office of the City General Services	95.25
Office of the Sangguniang Panlungsod	97.425911
Office of the City Planning and Development Coordinator	131.25
Office of the City Budget	104.252754
Office of the Accountant	85.5
Office of the City Treasurer	158.521
Office of the City Assessor	107.336438
Office of the City Engineer	190.646827
Office of the City Administrator	125.998755
Office of the City Legal	32.4
Office of CHR	59.474085
Office of DILG	19
Office of BAC	49.075
Total:	**1464.357445**

Source: Passi City Engineer’s Office

Table 2 indicates the total offices that the city hall houses. There are 14 offices inside the city and these offices have a total of 1464.36 sq. meter of area. Although it seems that the offices have a lot of floor area, in daily set-up, this area is not enough to house the employees and the people that have an appointment in each of these offices.

For example, the City Engineers Office if every employee needs at least five sq.m of space and there are 47 employees in total as shown in Table 3, the total area needed will be at least 235 sq.m.

Figure 5

Office of the City Accountant

Figure 6

City Engineer's Office

Table 3

List of Number of Employees and Overcrowded/Undercrowded Offices of Passi City LGU

Office Name	*Number of Permanent Employees*	*Remarks*
Office of the City Mayor	35	Uncrowded
Project Monitoring Section	3	
Motor Pool Section	55	
Population Section	7	
Public Utilities Section	26	
Public Employment Service Section	4	
Office of the Resource and Development	20	
Office of the Business Permit and Licensing	17	
Office of the City Tourism	8	
Office of the City Information	21	
Office of the City General Services	36	Overcrowded
Office of the City Economic Enterprise and Management	50	
Slaughterhouse Section	29	
Office of the Sangguniang Panlungsod	34	Overcrowded
Office of the City Planning and Development Coordinator	22	Uncrowded
Office of the City Budget	37	Overcrowded
Office of the Accountant	25	Overcrowded
Office of the City Treasurer	57	Overcrowded
Office of the City Health	62	

Office of the City Assessor	28	Overcrowded
Office of the City Registrar	22	
Office of the City Engineer	47	Uncrowded
Office of the City Agriculture	31	
Office of the City Environment and Natural Resources	17	
Office of the City Social Welfare and Development	11	
Office of the City Administrator	8	Uncrowded
Office of the City Legal	11	Overcrowded
Passi City College	24	
Office of the City Waste Management	4	
Office of the City Sports and Development	13	
Office of the City Local Economic Development and Investment Promotion	7	
Office of the City DRRM	6	
Total:	**777**	

Source: Passi City Engineer's Office

With a total of 777 employees working in the Local Government Unit at Passi City, averaging to about 27 employees working at every office requiring at least four-square meters of working space, as referenced from section 807 of the 8th chapter of NBCP, it was realized that the current working spaces of most offices, as presented in Figure 5 and 6, are very limited.

The offices shown in Table 3 that have remarks of uncrowded/overcrowded are the list of rooms that were found within the main building of the city hall. The remarks of the offices were based on the computation found in Appendix E. Based on these data, it was deduced that 63.64% of the offices in the main building of the city hall are already overcrowded, with only the remaining 36.36% considered as uncrowded. By comparing the percentages between the two, it was evidently shown that overcrowding of the offices is indeed one of the main problems in the city hall.

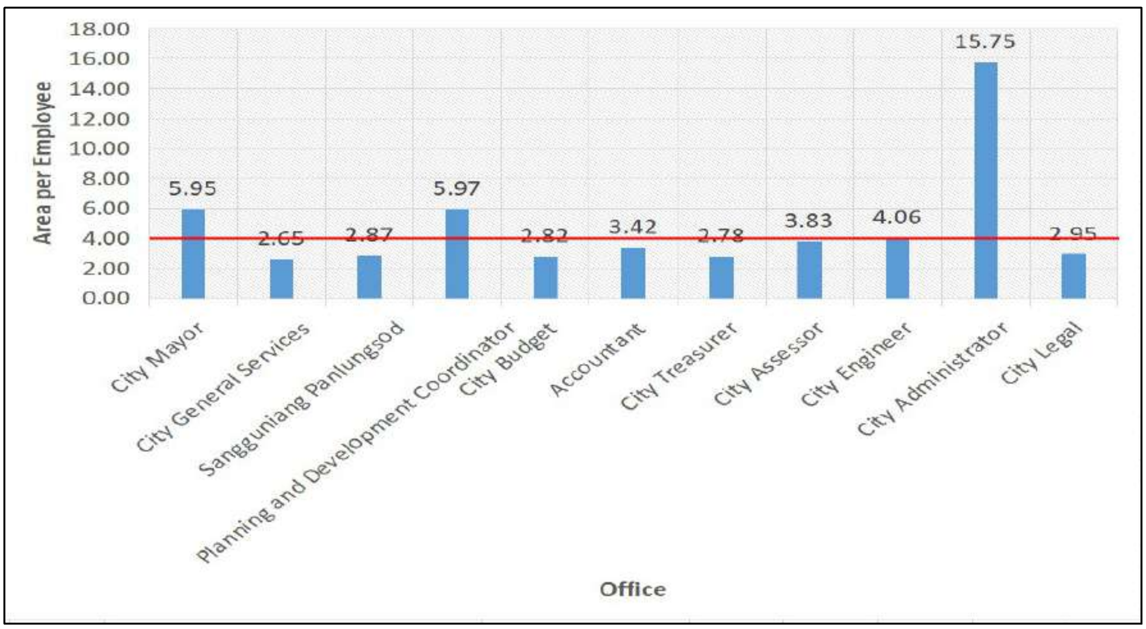


Figure 7

Overcrowded Offices

Improper Arrangement of Offices of the City Hall. At least 1000 people are served every day, as proven in Table 6. Everybody transacts differently, and some people go to at least one workplace every day. Given the number of people entering city hall, the information desk cannot accommodate all of the customers. Additionally, the location of offices is crucial because not everyone who enters the city hall is familiar with the entire building. The Motorpool Office and the Office of Agriculture, for example, have their own separate buildings from the main city hall building, as can be seen in Figure 3 and 14. Also, other offices are dispersed around the exterior of the main city hall building. Due to this arrangement, transactions are being delayed; hugely affecting those who need to go to the mayor's office or the cashier but must go from the opposite side to the city hall building. Because of this, it was decided that these offices will be included in one building together with additional offices for government agencies in the new city hall's proposed design.

Relative to PD 1096 or National Building Code of the Philippines or NBCP, Figures 8 to 13 present the steps on how to secure permits, namely being the building, electrical, sanitary/plumbing, mechanical, electronics, and other ancillary permits and its accessories; in which 30 people are assigned to process it at the office of Engineering on a daily basis. Next shown are provisions on assistance to individuals in crisis situations located at Social Welfare and Development, and how to request for a service vehicle that is being approved at the office of Motorpool. And by basing on the mapping, it was concluded that the transaction processes for these services are not streamline and very time consuming.

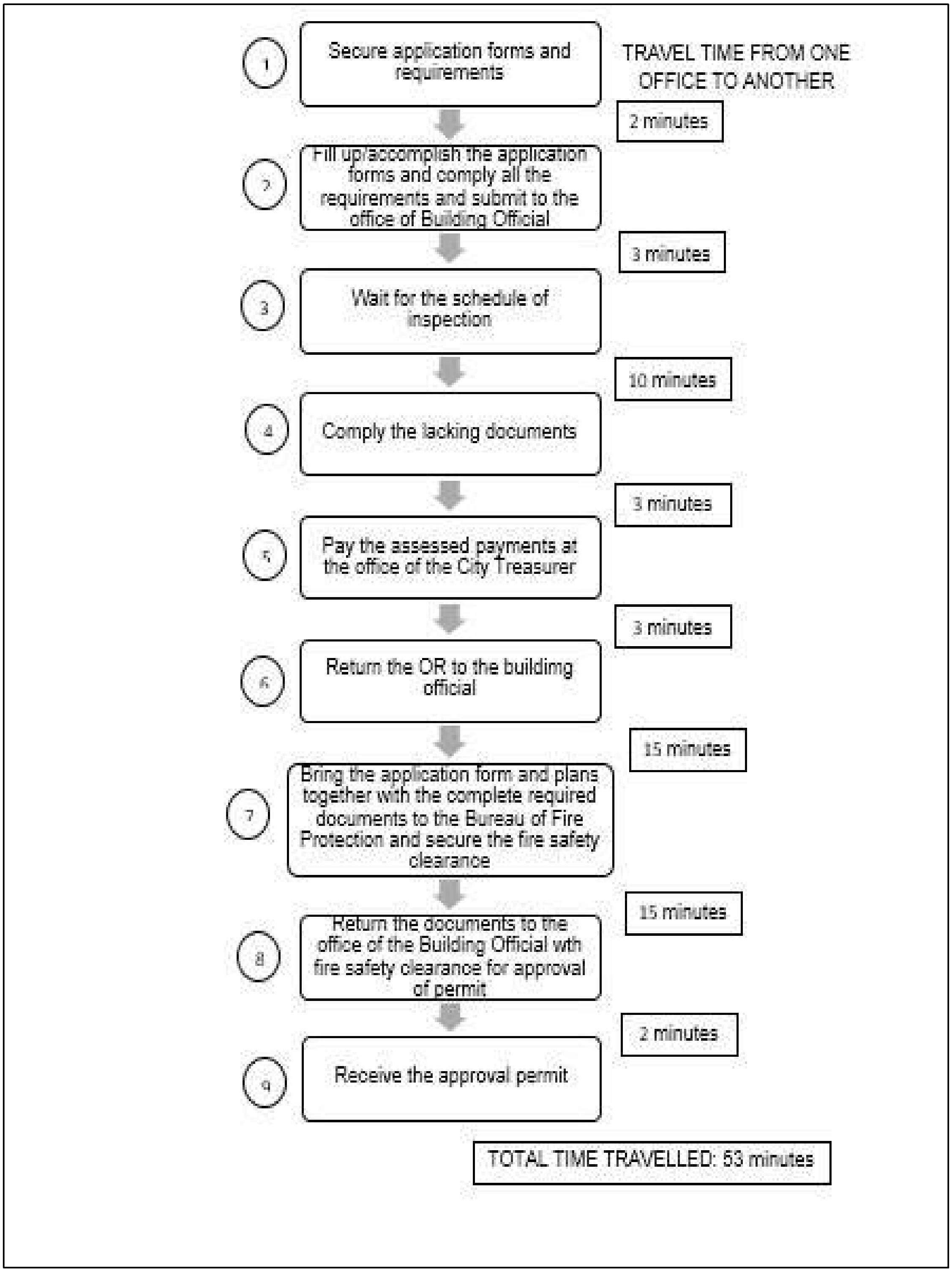


Figure 8

Steps on How to Secure Permits Relative to PD 1096

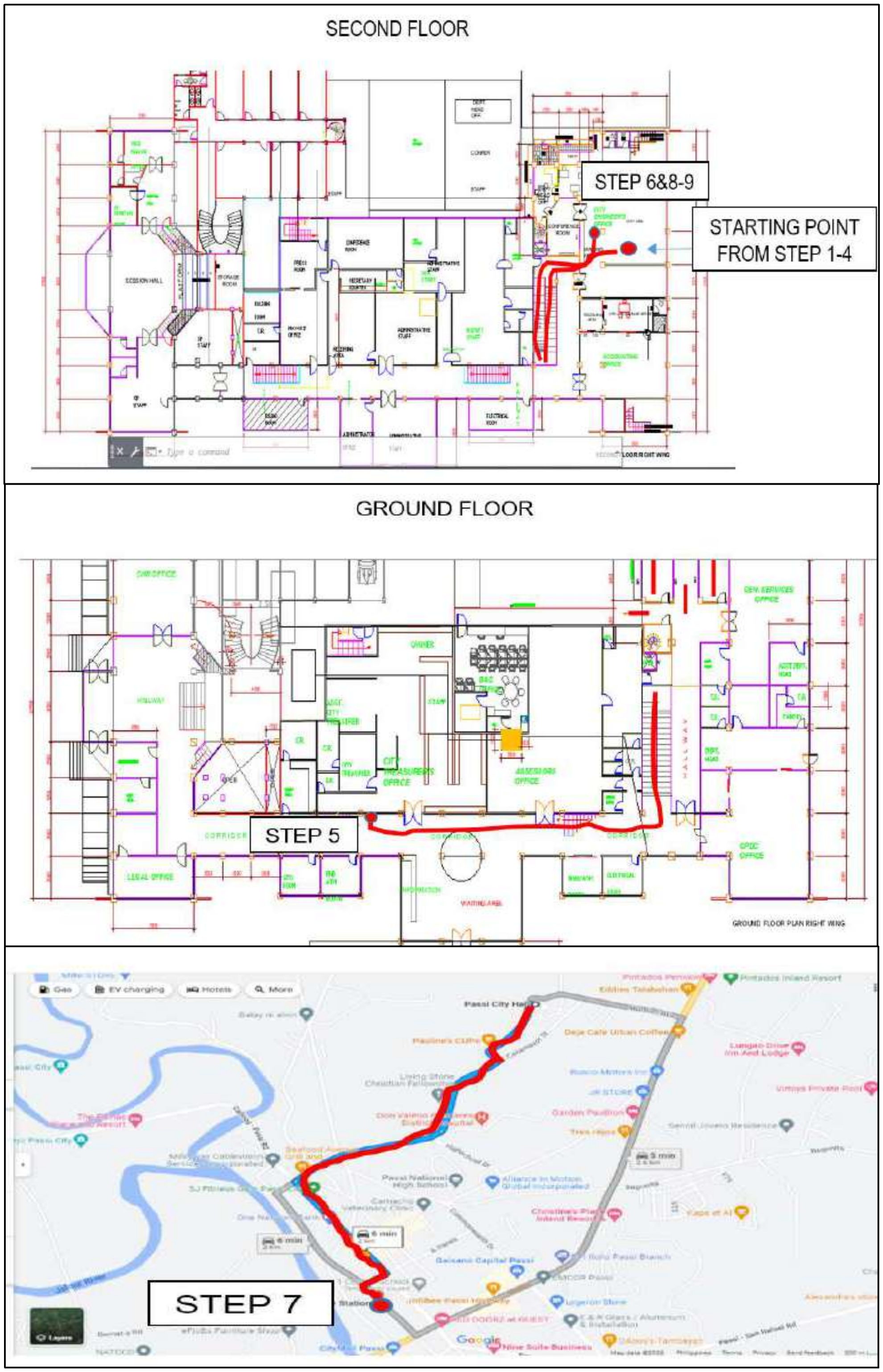


Figure 9

Mapping of How to Secure Permits Relative to PD 1096

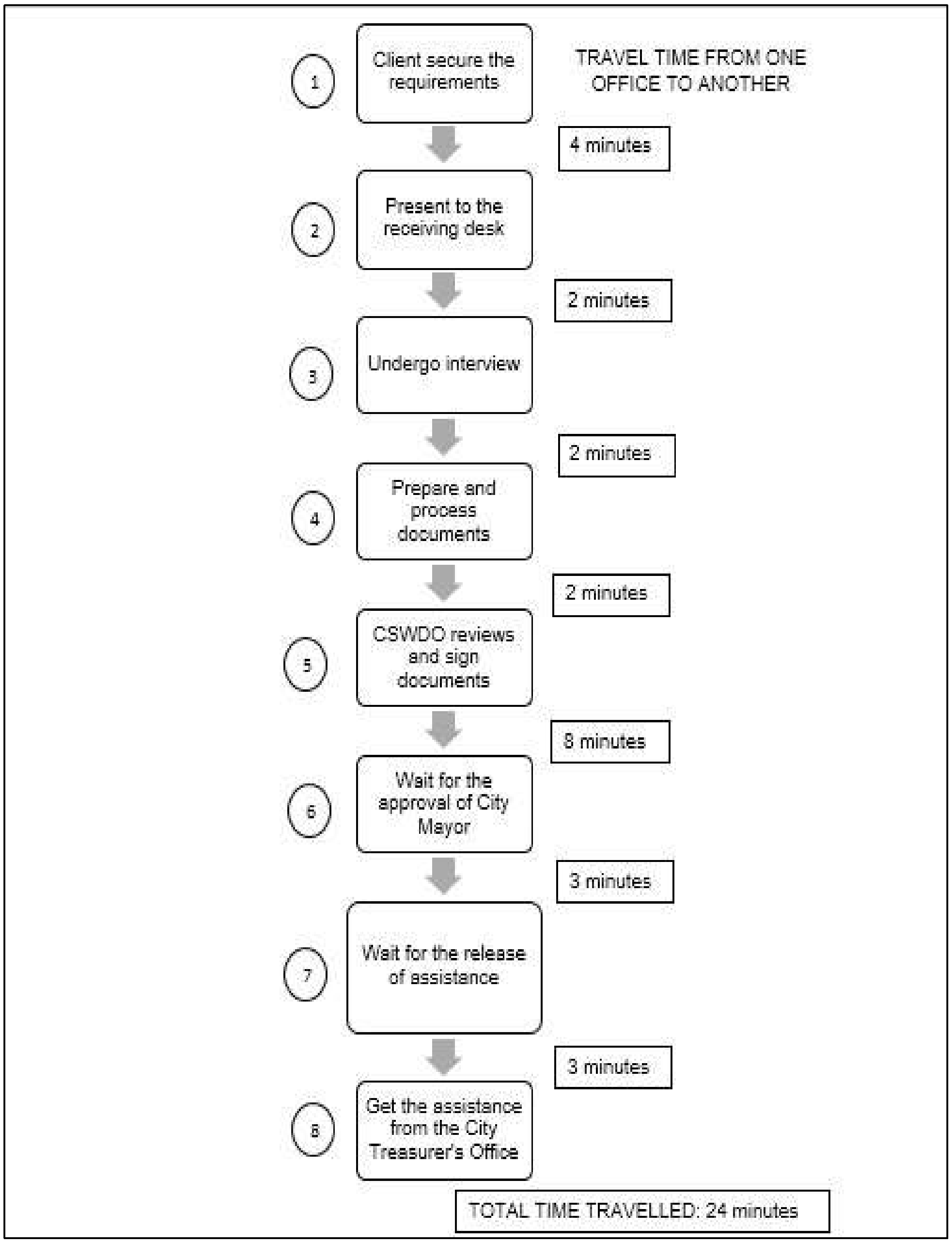


Figure 10

Steps on the provision of Assistance to Individuals in Crisis Situation

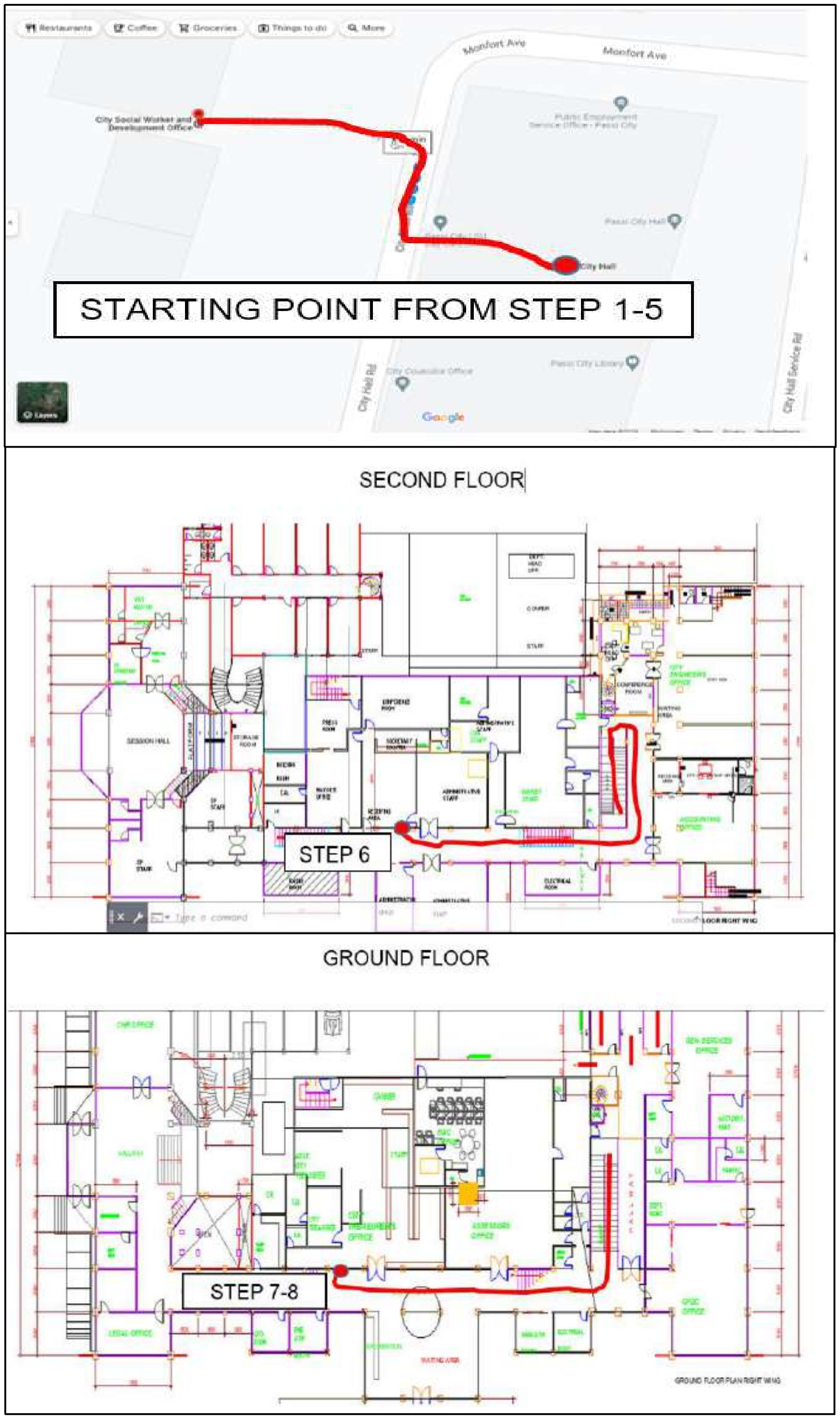


Figure 11

Mapping of Provision of Assistance to Individuals in Crisis Situation

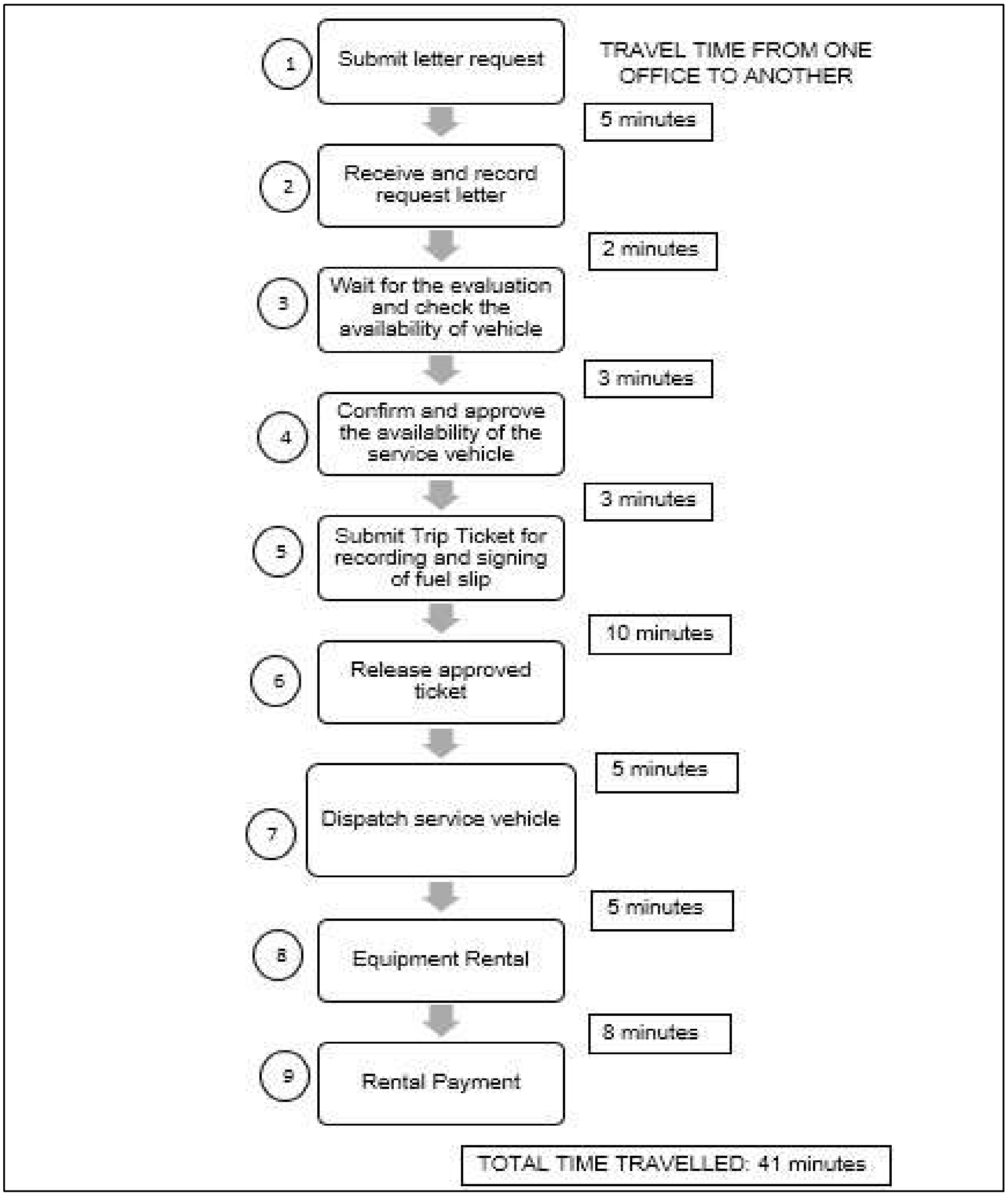


Figure 12

Steps on how to Request for Service Vehicle

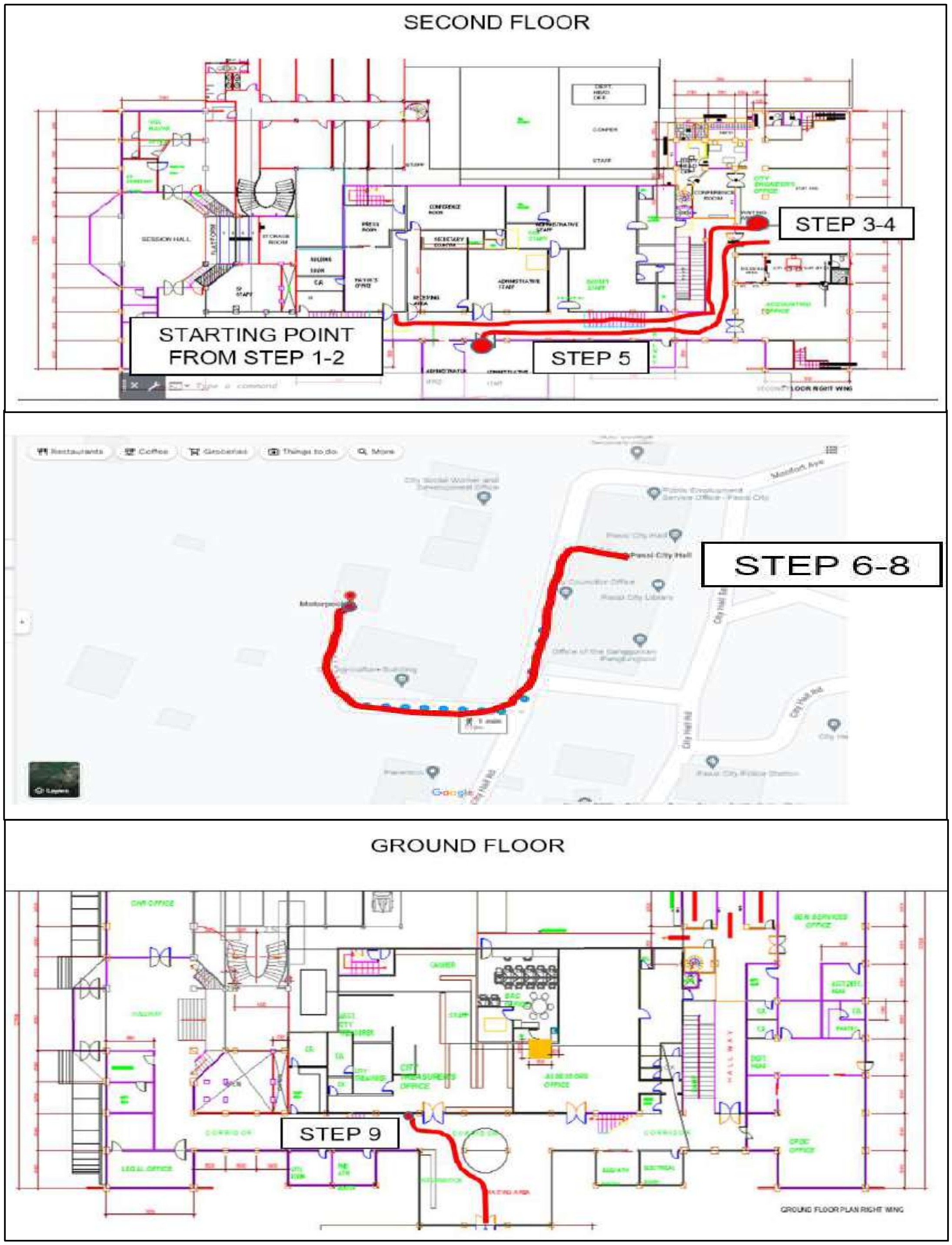


Figure 13

Mapping of how to Request for Service Vehicle

Table 4

List of Offices in the Main City Hall Building

Office Name
First Floor:
City Treasurer's Office
Office of the City Assessor
Office of the City Planning and Development Coordinator
Office of the City General Services
Office of the Resource and Development
Office of the City Legal
Second Floor:
Office of the City Mayor
Office of the City Budget
Office of the Accountant
Office of the City Administrator
Office of the City Engineer
Office of the Vice Mayor

Source: Passi City Engineer's Office

Lack of Proper Parking Area. As shown in Table 5, it can be seen that of all the offices in the current city hall, the Office of the City Mayor alone has 300 daily transactions. In addition to this, the City Hall cannot accommodate the number of automobiles that a few additional persons would need, and this excludes the regular personnel who enter and exit the building. Due to the inconvenience caused by the lack of a proper parking area, People who don't have a parking spot for their car may get disinterested in conducting business at City Hall. Additionally, traffic congestion caused by too many cars circling the area in search of parking spaces may delay those who attend the city hall to conduct business. It is also crucial to keep in mind that parking can be difficult to obtain and that a lack of parking spots may lead drivers to park their cars on minor roads, which are obviously not designed for such a purpose. As displayed in Table 6, the total Parking space for the City Hall is about 400 sq.m., with the building having a gross floor area of 3012 sq.m, while the required parking space in reference to the minimum requirements of the National Building Code of the Philippines (Table VII.4), is about 444 sq.m. in contrast to the available parking space which is 388 sq.m. From this data, it was inferred that the Parking area indeed lacks space, considering that the area is for Building Employees alone and does not take into account the People having transactions to the city hall.

Also in Figure 16, it was seen that the City Hall has no formal Parking space for bicycle type of vehicles leaving owners to park on the driveway and in front of the City Hall; limiting vehicle entry and increasing parking congestion.

Table 5

Daily Rate of Transactions

Office Name	*Daily Rate of Transactions*
Office of the City Treasurer	500
Office of the City Assessor	500
Office of the City Mayor	300
Office if the City Administrator	90
Office of the Resource and Development	75
Office of the City Budget	50

Office of the City General Services	36
Office of the City Planning and Development Coordinator	35
Office of the City Engineer	30
Office of the Sangguniang Panlungsod	15

Source: Passi City Engineer's Office

Table 6
Minimum Parking Slots for Office Type Buildings (National Building Code of the Philippines)

Total Available Parking Area	*Gross Floor Area*	*Parking Space Required*	*Available Parking space*
398 sq.m	3012 sq.m	444 sq.m	388 sq.m

Source: Passi City Engineer's Office

Figure 14

Top View of the City Hall Complex

Figure 15

Assigned Parking Space in Front of the City Hall

Figure 16

Current Parking Situation of the Vehicles at front of the City Hall

1.3 Objectives of the Study

1.3.1 General Objective

The General Objective of this study was to design the proposed new city hall at Passi City, Iloilo.

1.3.2 Specific Objective

The following are the specific objectives that were met in the course of this study:

a) Gathered all necessary data through consultation and coordination with the head of the city engineer's office and analyze the data collected.

b) Recognized the different design criteria required and incorporated it in the creation of the proposed design.

c) Conducted project site and soil analysis examination to determine building limits and soil capacity of the site.

d) Provided structural, architectural, plumbing, electrical, fire exit plans, and parking plans that aligned with the specifications of the project.

e) Prepared Bill of Quantities and Work Schedule for the construction of the project

1.4 Significance of the study

This project study focused on the design of the proposed design of the new city hall at Passi City, Iloilo. In relation, the outcomes of this study will be favorable to the following:

Passi City. This study provided a design of a new City Hall in Passi City, which will symbolize the progress of the city economically.

City Hall Employees. This study provided a new design for a city hall which in turn will help serve and improve the working conditions of all office workers in the city all by providing them with ample space and effective flow of work around the new design of city hall.

Researchers. This study has helped the researchers practice and apply engineering principles and knowledge during the design process.

Future studies. This study serves as a guide for future researchers who will have a similar study to conduct. This will also serve as a reference for future studies for other researchers.

1.5 Scope and Limitation of the Study

This study concentrated on the precise layout of the planned new Passi city hall. Iloilo. The site development, structural, architectural, electrical, plumbing, and fire exit plans were all included in the design. This proposal also included technical specifications, cost estimates, and construction schedules.

The Passi City Local Government Unit (LGU) in Iloilo will be in charge of the project's financing and allocation of land. The project's implementation, which includes the City Hall’s construction, operation, and maintenance, as well as its landscape design, were not considered in the study and will be managed by the LGU.

Chapter 2

Review of Related Literature

In a city, numerous people are clustered closely together reasonably. For maintenance and provision, cities frequently have self-regulating administrations, systems, and utilities. A municipality or group of barangays could become a component city if it has a geographical area of 100 square kilometers or a population of at least 150,000, and if its average yearly income over the preceding two years, calculated using constant prices from year 2000, has been at least PhP100 million.

The city's health and development depend on well-designed government buildings, which are an important component of cities. The government building is where they house, facilitate, and provide public services as well as raise the value of the city's urban fabric and open areas. A government building is a type of building that expresses the community's beliefs and progress. It must be effective, honorable, and show excellent environmental management.

This chapter discusses the related literature and related studies that support the proposed design of the city hall at Passi City, Iloilo.

2.1 Design Code Standards

The National Building Code of the Philippines (NBCP), National Structural Code of the Philippines (NSCP) 2015, Ultimate Stress Design (USD), and other design standards authorized by law would be the foundation for the proposed project's design.

The design must adhere to the engineering principles for safe design and must rigorously follow the codes.

2.2.1 Philippine Green Building Code

By establishing accepted standards that will improve resource and environmental management, the Green Building Code seeks to increase the effectiveness of a building's performance. In the interest of the common good and overall welfare, it must protect the environment, property, and public health. A NBCP referral number (DPWH, 2019).

2.2.2 National Building Code of the Philippines

2.2.2.1 Materials and systems of fire-resistive purposes

In line with internationally recognized testing procedures and according to the limitations of this Section, materials must be given a fire resistance rating.

a) Steel joists. Based on widely recognized technical standards, steel joist floors must have a one- to four-hour fire resistance rating.

b) Flame-Resistant Materials. When treating materials that need to be flameproof, flame-retardants must have a flame-spread value of 50 or less as determined by the "Tunnel Test."

[Section 2.02.02: Fire-Resistive Standards, National Building Code of the Philippines]

2.2.2.2 Maintenance

Every building or structure must be maintained in a clean and secure manner. All devices or safeguards mandated by this Code within a building or structure must be kept in good working order during construction, remodeling, or repair.

[Section1.01.06. Maintenance, National Building Code of the Philippines]

Table 103-1 Occupancy Category

OCCUPANCY CATEGORY	OCCUPANCY OR FUNCTION OF STRUCTURE
I Essential Facilities	Occupancies having surgery and emergency treatment areas, Fire and police stations, Garages and shelters for emergency vehicles and emergency aircraft, Structures and shelters in emergency preparedness centers, Aviation control towers, Structures and equipment in communication centers and other facilities required for emergency response, Facilities for standby power-generating equipment for Category I structures, Tanks or other structures containing housing or supporting water or other fire-suppression material or equipment required for the protection of Category I, II or III, IV and V structres Public school buildings, Hospitals, Designated evacuation centers and Power and communication transmission lines.
II Hazardous Facilities	Occupancies and structures housing or supporting toxic or explosive chemicals or substances, Non-building structures storing, supporting or containing quantities of toxic or explosive substances.

Table 103-1 (cont'd)Occupancy Category

OCCUPANCY CATEGORY	OCCUPANCY OR FUNCTION OF STRUCTURE
III Special Occupancy Structures	Buildings with an assembly room with an occupant capacity of 1,000 or more, Educational buildings such as museums, libraries, auditorium with a capacity of 300 or more occupants, Buildings used for college or adult education with a capacity of 500 or more occupants, Institutional buildings with 50 or more incapacitated patients, but not included in Category I, Mental hospitals, sanitariums, jails, prisons and other buildings where personal liberties of inmates are similarly restrained, Churches, Mosques, and other Religion Facilities, All structures with an occupancy of 5,000 or more persons, Structures and equipment in power-generating stations, and other public utility facilities not included in Category I or Category II, and required for continued operation.
IV Standard Occupancy Structures	All structures housing occupancies or havingfunctionsnotlistedinCategory I, II orIIIandCategoryV.
V Miscellaneous Structures	Privategarages,carports,shedsandfences over 1.5mhigh.

Figure 17

Occupancy Category from National Structural Code of Philippines

Use or Occupancy		Uniform Load [1]	Concentrated Load
Category	Description	kPa	kN
1. Access floor systems	Office use	2.4	9.0 [2]
	Computer use	4.8	9.0 [2]
2. Armories	--	7.2	0
3. Theaters, assembly areas [3] and auditoriums	Fixed seats	2.9	0
	Movable seats	4.8	0
	Lobbies and platforms	4.8	0
	Stage areas	7.2	0
4. Bowling alleys, poolrooms and similar recreational areas	--	3.6	0
5. Catwalk for maintenance access	--	1.9	1.3
6. Cornices and marquees	--	3.6 [4]	0
7. Dining rooms and restaurants	--	4.8	0
8. Exit facilities [5]	--	4.8	0 [6]
9. Parking Garages and Ramps	General storage and/or repair	4.8	-- [7]
	Public parking and ramps	4.8	-- [7]
	Private (residential) or pleasure-type motor vehicle storage	2.4	-- [7]
10. Hospitals	Wards and rooms	1.9	4.5 [2]
	Laboratories and operating rooms	2.9	4.5 [2]
	Corridors above ground floor	3.8	4.5
11. Libraries	Reading rooms	2.9	4.5 [2]
	Stack rooms	7.2	4.5 [2]
	Corridors above ground floor	3.8	4.5
12. Manufacturing	Light	6.0	9.0 [2]
	Heavy	12.0	13.4 [2]
	Building corridors above ground floor	3.8	9.0

Figure 18

Minimum Uniform and Concentrated Live Loads A

Component	Load
CEILINGS	
Acoustical fiber board	0.05
Gypsum board (per mm thickness)	0.008
Mechanical duct allowance	0.20
Plaster on tile or concrete	0.24
Plaster on wood lath	0.38
Suspended steel channel system	0.10
Suspended metal lath and cement plaster	0.72
Suspended metal lath and gypsum plaster	0.48
Wood furring suspension system	0.12
COVERINGS, Roof and Wall	
Asphalt shingles	0.10
Cement tile	0.77
Clay tile (for mortar add 0.48 kPa)	
Book tile, 50 mm	0.57
Book tile, 75 mm	0.96
Ludowici	0.48
Roman	0.57
Spanish	0.91
Composition:	
Three-ply ready roofing	0.05
Four-ply felt and gravel	0.26
Five-ply felt and gravel	0.29
Copper or tin	0.05
Corrugated asbestos-cement roofing	0.19
Deck, metal 20 gage	0.12
Deck, metal, 18 gage	0.14
Fiberboard, 13mm	0.04
Gypsum sheathing, 13 mm	0.10
Insulation, roof boards (per mm thickness)	
Cellular glass	0.0013
Fibrous glass	0.0021
Fiberboard	0.0028
Perlite	0.0015
Polystyrene foam	0.0004
Urethane foam with skin	0.0009
Plywood (per mm thickness)	0.0060
Rigid insulation, 13 mm	0.04
Skylight, metal frame, 10mm wire glass	0.38
Slate, 5 mm	0.34
Slate, 6 mm	0.48
Waterproofing membranes:	
Bituminous, gravel-covered	0.26
Bituminous, smooth surface	0.07
Liquid, applied	0.05
Single-ply, sheet	0.03
Wood sheathing (per mm thickness)	0.0057
Wood shingles	0.14

Component	Load
FLOOR FILL	
Cinder concrete, per mm	0.017
Lightweight concrete, per mm	0.015
Sand, per mm	0.015
Stone concrete, per mm	0.023
FLOOR AND FLOOR FINISHES	
Asphalt block (50 mm), 13 mm mortar	1.44
Cement finish (25 mm) on stone-concrete fill	1.53
Ceramic or quarry tile (20 mm) on 13 mm mortar bed	0.77
Ceramic or quarry tile (20 mm) on 25 mm mortar bed	1.10
Concrete fill finish (per mm thickness)	0.023
Hardwood flooring, 22 mm	0.19
Linoleum or asphalt tile, 6mm	0.05
Marble and mortar on stone-concrete fill	1.58
Slate (per mm thickness)	0.028
Solid flat tile on 25-mm mortar base	1.10
Subflooring, 19 mm	0.14
Terrazzo (38 mm) directly on slab	0.91
Terrazzos (25 mm) on stone-concrete fill	1.53
Terrazzo (25 mm) on 50-mm stone concrete	1.53
Wood block (75 mm) on mastic, no fill	0.48
Wood block (75 mm) on 13-mm mortar base	0.77
FRAME PARTITIONS	
Movable partitions	0.24
Movable partitions (steel)	0.19
Wood or steel studs, 13 mm gypsum board each side	0.38
Wood studs, 50 x 100, unplastered	0.19
Wood studs 50 x 100, plastered one side	0.57
Wood studs 50 x 100, plastered two side	0.96

Component	Load
FRAME WALLS	
Exterior stud walls:	
50x100 @ 400mm, 15 mm gypsum, insulated, 10 mm siding	0.53
50x150 @ 400mm, 15 mm gypsum, insulated, 10 mm siding	0.57
Exterior stud wall with brick veneer	2.30
Windows, glass, frame and sash	0.38
Clay brick wythes:	
100 mm	1.87
200 mm	3.74
300 mm	5.51
400 mm	7.48

CONCRETE MASONRY UNITS

Hollow Concrete Masonry Units Unplastered. Add 0.24 kPa for each face plastered

Grout Spacing	Wythe thickness (mm) 100	150	200
16.5-kN/m^3 Density of Unit			
No grout	1.05	1.15	1.48
800	1.40	1.53	2.01
600	1.50	1.63	2.20
400	1.79	1.92	2.54
Full	2.50	2.63	3.59
19.6-kN/m^3 Density of Unit			
No grout	1.24	1.34	1.72
800	1.59	1.72	2.25
600	1.69	1.87	2.44
400	1.98	2.11	2.82
Full	2.69	2.82	3.88
21.2-kN/m^3 Density of Unit			
No grout	1.39	1.44	1.87
800	1.74	1.82	2.39
600	1.83	1.96	2.59
400	2.13	2.2	2.92
Full	2.84	2.97	3.97

Figure 19

Minimum Design Dead Loads

Use or Occupancy		Uniform Load [1]	Concentrated Load
Category	Description	kPa	kN
13. Office	Call centers and business processing offices	2.9	9.0
	Lobbies and ground floor corridors	4.8	9.0
	Other offices	2.4	9.0 [2]
14. Printing plants	Press rooms	7.2	11.0 [2]
	Composing and linotype rooms	4.8	9.0 [2]
15. Residential [8]	Basic floor area	1.9	0 [6]
	Exterior balconies	2.9 [4]	0
	Decks	1.9 [4]	0
	Storage	1.9	0
16. Restrooms [9]	--	--	--
17. Reviewing stands, grandstands, bleachers, and folding and telescoping seating	--	4.8	0
18. Roof decks	Same as area served or occupancy	--	--
19. Schools	Classrooms	1.9	4.5 [2]
	Corridors above ground floor	3.8	4.5
	Ground floor corridors	4.8	4.5
20. Sidewalks and driveways	Public access	12.0	-- [7]
21. Storage	Light	6.0	--
	Heavy	12.0	--
22. Stores	Retail	4.8	4.5 [2]
	Wholesale	6.0	13.4 [2]
23. Pedestrian bridges and walkways	--	4.8	--

Figure 20

Minimum Uniform and Concentrated Live Loads B

2.3 City Hall

According to the Kiddle Encyclopedia, a city hall or town hall serves as the administrative center for a city or town and often contains the council, related departments, and staff members. It serves as the typical home base for the mayor of a city, town, or county. A town hall design ought to reflect the culture of your neighborhood. It should emphasize what it entails to live there and the traits that go along with that. It meant to provide services that live up to such standards.

Council meetings and other important gatherings could take place in the hall. The term "town hall" (and its later form, "city hall") refers to this sizable room and has come to refer to the entire structure as well as the administrative body headquartered inside. If a huge hall is lacking within the structure, the phrases "council chambers," "municipal building," alternatives could be utilized locally instead of "town hall." The local government might make an effort to use the structure to advance and improve the community's living conditions. "Town halls" frequently feature spaces for various civic and cultural events in addition to serving as offices for the administration. These could include exhibitions, plays, performances on stage, and festivals. Modern "civic centers" or town halls are frequently created with a wide range of purposes in mind (DBpedia, 2019).

Wold Architects and Engineers (2022) define three things a city hall design should have are:

1) **Streamlined Customer Support**. Customer service has improved as city halls have developed, among other things. In the 20th century, distinct departments inside a city hall frequently had their own service windows. Now, municipal halls are made with the intention of giving residents an effective experience.

2) **Support for Community Development.** The community of a town or city anticipates that as the population grows, so will the city's services. Cities are under increasing pressure to offer all necessary services while also doing so effectively. However, growth is not usually measured in square footage. It frequently includes a review of the city hall's strengths and areas for improvement.
3) **Improved Safety Measures.** Despite the fact that safety was given first priority while designing city hall, it is essential to make sure that security measures do not make visitors feel unwelcome. A thorough discussion of the safety measures the constituents would want in the design is necessary to make sure that goals are matched for safety.

2.4 Building Design and Management

The management and design of buildings were covered in Chapter 9 of the book "Sustainable Philippine Cities 2030." The effects of buildings' residual use were discussed in the introduction, along with the percentage of energy used by government buildings. Additionally, it discussed how government buildings are beginning to adopt sustainable architecture, sometimes known as "green buildings." If the national and local governments actively coordinate, green buildings can be more effective.

The chapter's objective is to give local government units (LGUs) better knowledge about managing sustainable building design. Additionally, green buildings are typically constructed with extra attention paid to their lifetime resource efficiency and environmental friendliness. A long-term plan by the government to diminish the consequences in the future and serves as the implementation to reach the vision of a sustainable country in 2030, reducing the overall adverse impact of buildings on human health and the environment is the goal.

2.5 Occupational Safety and Health Standards

According to the Department of Labor and Employment, Occupational Safety and Health Standards were instituted in 1978 in accordance with the constitutional obligation to preserve the worker's financial and social well-being as well as his health and physical security. The 1978 Standards, which were adopted under the tried-and-true democratic system of tripartism, are regarded as a turning milestone in Philippine labor and social law.

However, as industrial development and ongoing technological advancements have taken hold in our country, so too have the quantity and variety of occupational hazards to which our employees are exposed. When this circumstance was taken into account, it became urgently necessary to update the Standards in order to keep them truly adaptable to the needs of the workforce.

The published work notes that the typical space restrictions in workrooms must be at least 2.7 meters (8 ft. 10 in.) high from floor to ceiling, while existing heights of no less than 2.4 meters (7 ft. 10 in.) may be permitted in air-conditioned spaces where unrestricted mobility is possible. In a workroom area, no more than one worker is allowed for every 11.5 cubic meters of space (400 cu. ft.). No allowances for benches or other furniture or equipment shall be made when determining the area. or materials, but heights higher than 3 meters (9 ft. 10 in.) shall not be included. To allow for routine operation, maintenance, or repair as well as the free flow of supplies being processed or finished, adequate spacing between machinery or equipment must be supplied. There must be at least 60 centimeters (24 in.) between pieces of machinery or equipment.

2.6 Related Studies

2.6.1 Greening government's office buildings: PWD Malaysia experiences

Awareness of environmentally friendly, sustainable and efficient office buildings was the primary objective of this study. The initiative of the Public Works Department Malaysia (PWD) of proposing a Greening government' office buildings with the goal of achieving a green nation by 2020 can be stated as a success based on the data and files obtained. The PWD Malaysia's goal is to improve the quality of government buildings and daily living for the people. Furthermore, it does not just prioritize physical development; it also takes into account the development of energy efficient and green building designs.

The role of the government does not only focus on giving a quality and efficient service to the community but should also provide a clean and healthy environment. Thus, Government Green buildings contribute to a quality energy performance and accomplish the goal of a quality and effective service from the different government sectors to the community.

According to the office of Energy Efficiency & Renewable Energy, commercial buildings use nearly one-third of the energy in the globe. As a result, when focusing on the construction and operation of a building, energy conservation should be taken into account.

2.6.2 New City Hall from Balanga City

This constructed city hall in Balanga City was made to be more accessible than the conventional monolithic versions since it is the focal point of the new city center, which encourages walk-able and permeable communities. The new city center divides the program into groups of buildings connected by a green spine to form a complex, rather than enclosing it in a solid, monolithic structure, providing an integrated city hall park. This idea leans toward progression, suggesting a more open, transparent, and participative form of governance, sustainable growth and development, and an environment that prioritizes the needs of its citizens. The Balanga City Hall is a huge 11.865 square meter construction that rethinks the idea of a civic center and is intended to be the focal point of a projected city center.

2.6.3 New City Hall from Bayombong, Nueva Vizcaya

The site is situated in Nueva Vizcaya, Philippines, in the Municipality of Bayombong. Along with the LGU of Bayombong, which is now vying for similar status, the prosperous municipality is expected to become a city. Due to this, more departmental offices are needed to be housed in its new facilities. The issues emerge because the town's citizens would not be able to use the present municipal building's facilities if it ever attained a city status. It is intended to provide the younger and some new upcoming generations of Balanguenos with a contemporary lifestyle. The site, which will include the spaces holding the administrative building, the parking area, the bureau of fire protection, the gym area utilized for recreational purposes, and other nearby small structures, are located on the present site of Bayombong Municipal Hall. Due to the small proximity of the majority of commercial enterprises, the site is situated in a town that is very populous. In addition, the building's width was intended to exceed or extend beyond that of the existing structures. This is a result of the fact that the city halls need greater room and space than municipal halls do. In order to support the expanding municipal system, more departmental offices were required due to the city's rapid progress and growing commercial business sectors. The spaces and departments that were needed and included in the design and construction of the City Hall were the Engineering Department, Legal Department, Accounting Department, Public Affairs, Administrative Department, Amenities, Utilities, Circulation, and some optional facilities like Water Department, Regional Health Office, Electrical Billing, and Police Departments and other Rescue Agencies. After identifying all the departments necessary structures to be part of the design, a department layouting was followed up. The first step that was made was to assess the work done by the department, of which workflow was thought to be an important component that needed to be well understood and studied. Later on, a detailed list consisting every person and piece of equipment that will be occupying the room was created. Additionally, provisions were also established for more staff in case of any future development. As it was needed to be practical and should be in a single simple direction; the movement and places for optimal workflow were taken into account. In most cases, employees should be able to come to work rather than the other way around. So here, it was made sure that minor activities can be arranged around areas of major activity.

2.6.4 Proposed reconstruction of Cabatuan Municipal Hall.

The concern of the study was more focused on the probable failure that might occur on the structure so the design & detail and the study conducted was more to be strength oriented rather than being economy oriented.

Here, the reconstruction of the municipal hall was designed in a way that various offices for officials and rooms for certain agencies could be confined only in one area. This is to give people way better access to the services rendered by officials and other government employees. It is through this new design of the Municipal Hall where the municipality hopes that people would feel the building as a place where they could exercise their civil rights by being able to transact their business or share and voice out their concerns. Also, this proposed reconstruction of the municipal hall is rooted on the problem that some rooms are no longer sufficient to accommodate enough people and agencies. These are supported by the fact that some rooms are compelled to cater more than two agencies within just one room, or the building lacks some office for SB members, leading to inconvenience and delays. In order to solve the problems, the offices had to be rearranged and some rooms had to be enlarged, thus making sure that they suit the needs of the employees as well as being able to provide faster transactions by the residents.

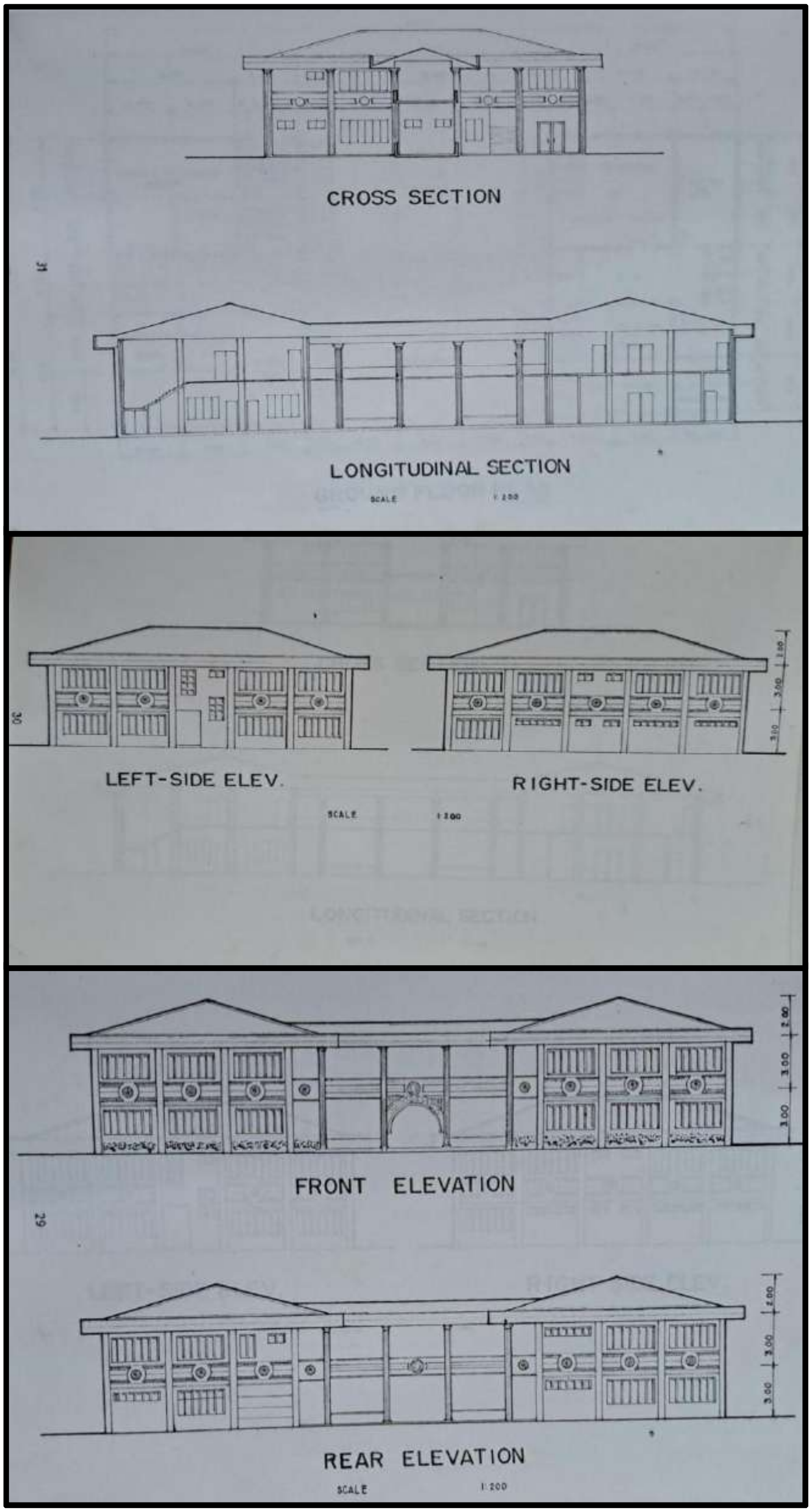


Figure 21

Perspective of the Municipal Hall at Cabatuan, Iloilo

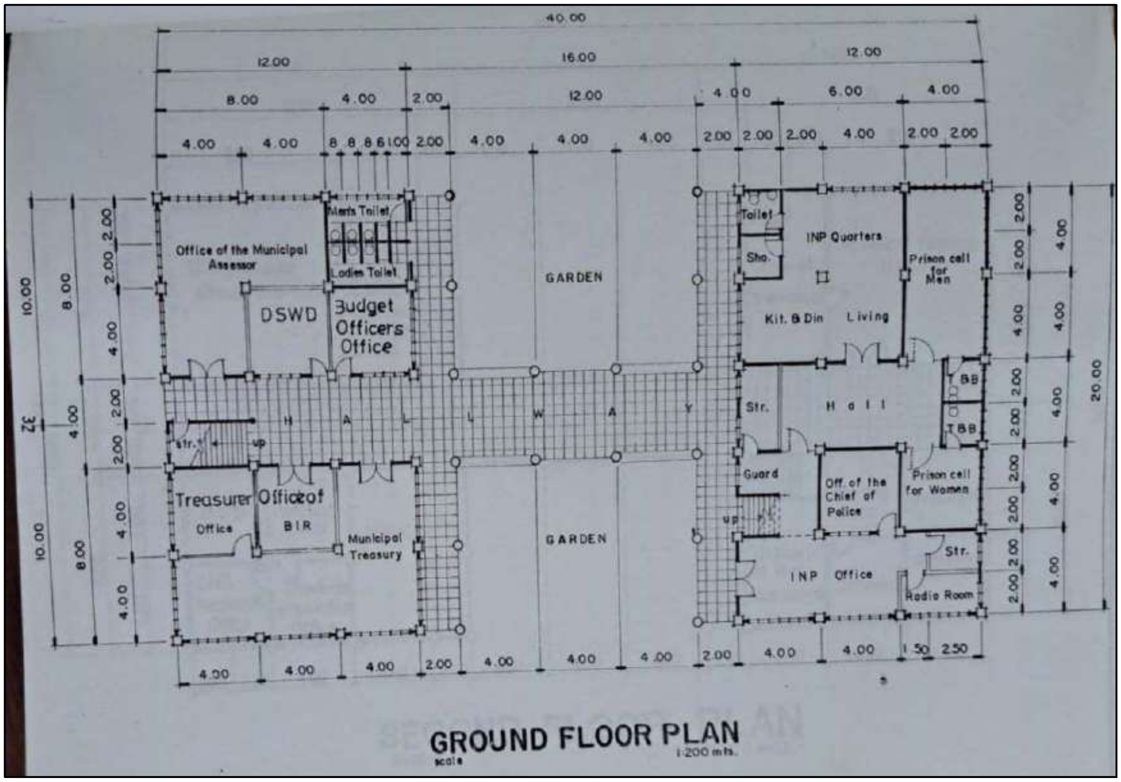


Figure 22

Ground Floor Plan of the Municipal Hall at Cabatuan, Iloilo

2.6.5 Proposed Two-Storey Municipal Hall Annex Building in Santa Barbara, Iloilo

Santa Barbara is a second-class municipality located in the province of Iloilo. It has a total of sixty (60) barangays and during the 2020 consensus by Philippine Statistics Authority, the municipality has a total of 67 630 people.

The existing main municipal hall was observed to have some problems such as limited space, poor efficiency in terms of transactions, lack of proper arrangement and the like. To achieve the goal of having a people friendly, quality working environment and giving an efficient service, the researchers proposed a municipal hall annex.

The Proposed Municipal Hall Annex Building in Santa Barbara, Iloilo is a two-storey building and has a total of 1797.13 sq. floor area including the roof deck. It is a two-storey building, a lobby and seven offices on the ground floor and five on the second. offices and a function room that could occupy 150 persons. Since comfort rooms, janitor's closet, storage rooms, and electrical rooms are some important parts of a building, it is located on every floor of the building.

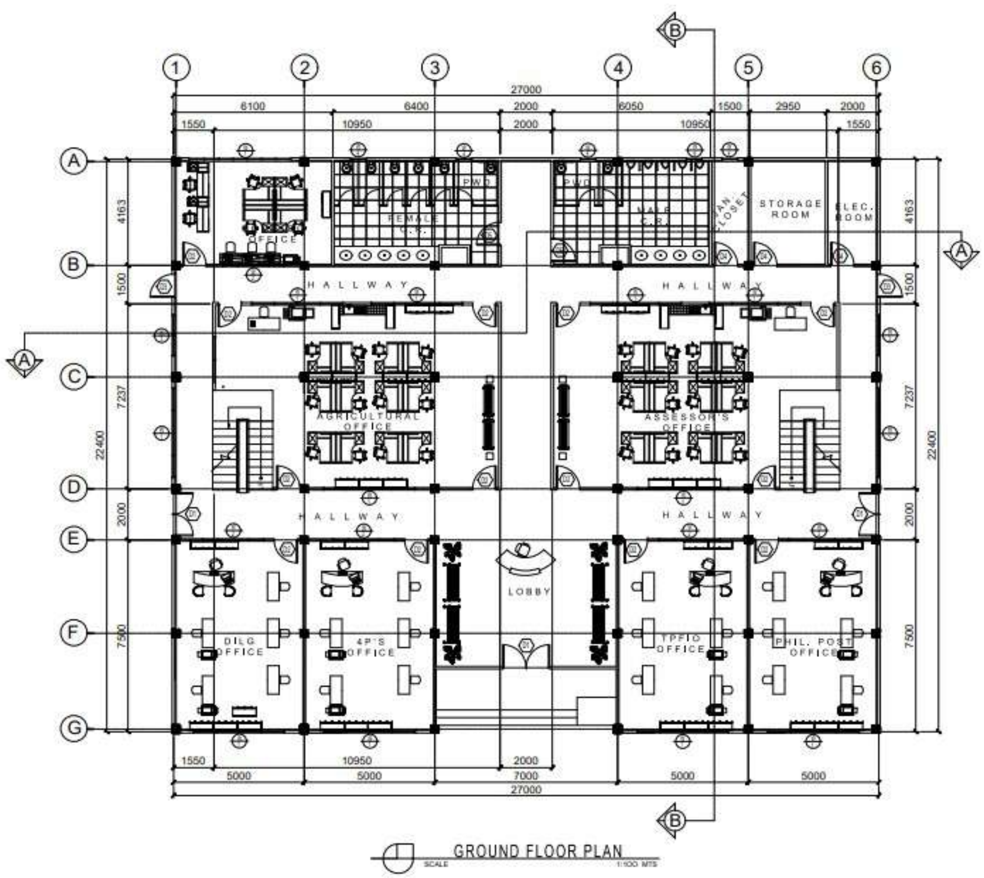


Figure 23

Ground Floor Plan of the Proposed Municipal Hall at Sta. Barbara, Iloilo

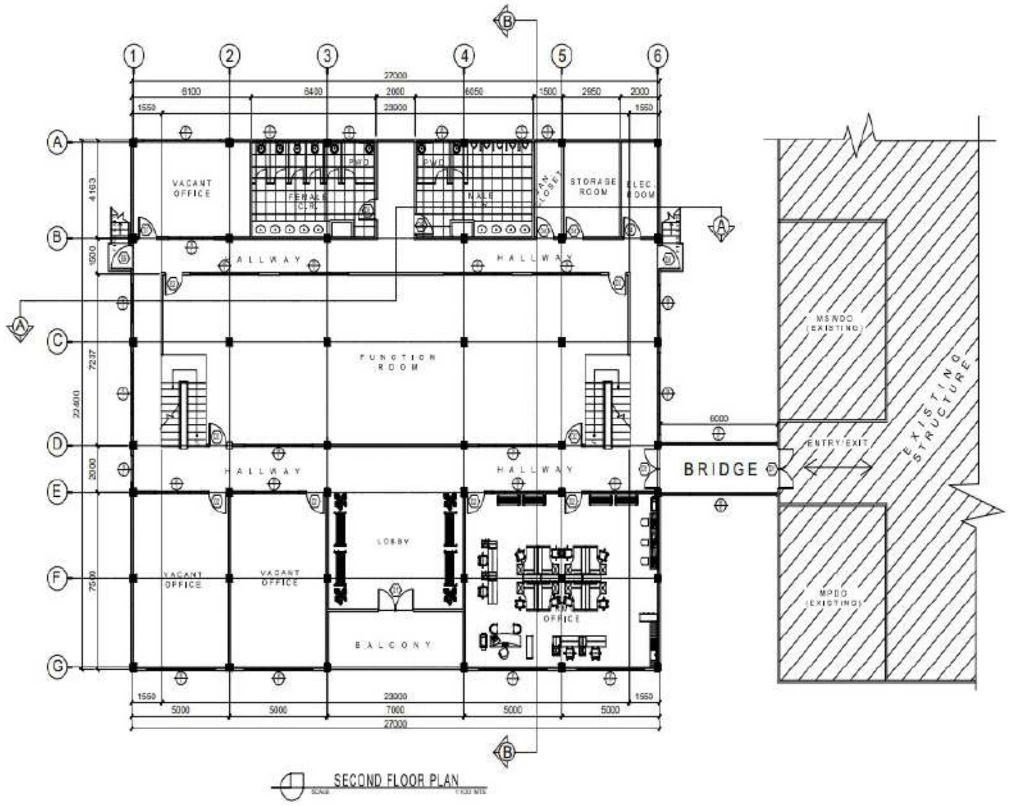


Figure 24

Second Floor Plan of the Proposed Municipal Hall at Sta. Barbara, Iloilo

2.7 Synthesis

In accordance with the Design Code Standards presented above, it is assured that The proposed project being designed followed and satisfied the design codes and guidelines set by the National Structural Code of the Philippines (NSCP 2015) for the standard and specifications of the proposed project design. The design of the structure is also made sure to provide a quality and efficient structure.

By incorporating the existing issues with the consolidated ideas selected from the related studies above, it was decided that the new city hall will include wider offices for the employees, with the addition of a far more organized flow of transactions in the facilities and better accommodation for the people who will have transactions within the city hall. The proper amount of space designed within the offices will eliminate all the inconveniences that the office worker and the people with transactions will experience. This kind of design is the fruit of the Cabatuan Municipal Hall, which promotes better service for the people. Modernizing the city hall of Passi City will make the city even more appealing to its people and also for the visiting tourists of the city.

Based on the Green Government building by the Public Works Department Malaysia, it was assured that not only the quality or the physical appearance of the structure or building are greatly considered but also its effective functions and its environmental effects to the community. The proposed project design also adopted the Green Government’s emphasis on environment friendly building that could have a significant impact with the community.

The Annex Municipal Hall in Sta. Barbara, Iloilo, City aims to provide a quality and efficient service to its fellowmen. The connection it has with the proposed Passi new city hall is that it is both cost efficient and has the same goal of giving a quality and people friendly government service.

To prioritize the social and economic well-being of the city hall staff, the new city hall project has also decided to adopt the design of the occupational safety and health standards. Also, the design for the proposed project has also incorporated sustainable building design in order to lessen the carbon footprint it will produce during its lifetime.

Chapter 3

Methodology

The project study's design limitations and current concerns are covered in the third chapter. In addition, the chapter provides an explanation of the techniques applied for data collection, design and data analysis, project cost estimation, construction scheduling, and usage of resources and facilities.

3.1 Design Constraints

3.1.1 Window Systems

Windows are regarded as one of the most essential and exceptional components of a building because they allow light, air, and sound to enter a space. The internal area of a home links with the outdoor space through windows, allowing the residents to enjoy the outside environment. Windows also perform vital services in a structure, such as delivering regulated natural ventilation or contributing significantly to the visual look of buildings, absorbing and filtering out harmful rays, or even insulating sounds, among many others.

The criteria involved in selecting the type of windows include the functionality, aesthetics, installation, and maintenance.

3.1.1.1 Film Coated Windows

Film Coated Windows are thin films having selective qualities that are applied to the surface of glass. They are distinguished by their capacity to control the quantity of heat emitted by the sun within broad boundaries. These coatings are also known as Heat Insulating Window Coatings. These types of windows allow for the blockage of inbound energy rays from the sun during warm weather conditions, as well as heat insulation to regulate room temperature, reducing the need for cooling equipment. Aside from the functions that it provides, the placement of coats could vary with preferred color designs, with every coat being installed expected to last more than 10 years. Though expensive, replacement of film coats is possible and is easy to maintain (Bhattacherjee, 2020).

3.1.1.2 Double-Paned UV-Proof Windows

The majority of the windows that are fitted do not protect against UV radiation on their own. Just a few types of windows, including "Low-E" windows, can do so. These single and double-pane windows protect against UV and infrared rays while still allowing sunlight to pass through, much like ordinary windows. This is an excellent alternative if enjoying and experiencing bright, real sunlight indoors is crucial, because other protection options on the market tend to darken windows, resulting in lesser lighting. Unlike the Film Coated type of windows; UV proof windows are able to allow maximum natural sunlight while filtering out harmful UV radiation that could penetrate to any normal windows. Its Installment, however, requires a higher price, given that it should be manufactured and installed meticulously. In this type of model, Double-paned window usually demands a higher cost of maintenance due to certain types of fluids that are placed within the window to absorb UV radiation, which could last around 20 years in most cases (The Importance of UV Protection in Windows | Clera Windows + Doors, 2020).

3.1.1.3 Soundproof Windows

No residential window completely eliminates all noise. "Soundproof" refers to noise reduction windows that filter up to 90% to

95% of outside noise. Low-frequency noises, such as garbage trucks crushing rubbish, are more difficult to block than higher-frequency sounds, such as birds tweeting; and all of these are dependent on the distance between the fitted sound proof glass and the source. When choosing sound-reducing windows, it is critical to understand "what frequencies you want to soundproof against," according to John Storyk, an acoustical expert and founder of the Walters-Storyk Design Group in Highland, New York. The need for the use of double-paned windows is what usually makes it more expensive than any other normal windows, excluding the maintenance and installation cost (Gordon, 2014).

3.1.2 Supplementary Water Supply Systems

In the field of engineering, whether an individual is working on a corporate, residential, or farming project, access to water is one primary consideration that any owner should always take into account. Any place where there is insufficient onsite water supply, it’s hard not to recognize the indispensable role that a water distribution system takes in transporting water. Almost any water distribution system's essential goal is to transport, distribute, and deliver water from point A to point B—from its point of origin to the place(s) of use. "Water distribution systems consist mainly of reservoirs, pipelines, pumps, and valves," according to the International Water Association (IWA). They are properly designed and optimized in order to function properly and deliver the required water volumes to consumers."

These systems, however, must also be stable—strong enough to endure time, the environment, and other elements, and able to perform well given the surroundings and limits surrounding it. They are not just built to transport water efficiently; they must also be trustworthy. So in order for this to happen, engineering teams must follow a certain criteria and select the best option according to its functionality, operation, and maintenance (The Importance of Water Distribution Systems for Site Engineering).

3.1.2.1 Rain Water Collection Systems/ Rain Water Harvesting

The process of gathering runoff from a structure or other impermeable surface and conserving it for later use is known as rainwater harvesting. This traditionally involves gathering rainwater from a roof. Rain will collect in gutters, where it will flow through downspouts and into a storage container. Systems for collecting rainwater can be as simple as using a rain barrel or as complicated as harvesting rainwater into huge cisterns to provide all of your home's needs. Rainwater collection is a useful practice in a city. Simply collect the free water that falls from the roof to use this resource and transfer it to a rainwater storage tank. In terms of maintenance, and simplicity, utilizing rainwater collection systems is relatively less expensive than any other traditional water collection method and is somewhat easier to set up; it's only downside is the cost in the installation of the pipe system that will link the storage tank to the building’s existing pipe system (Rainwater Harvesting 101 | Your How-To Collect Rainwater Guide, 2004).

3.1.2.2 Grey Water Collection System

Greywater is waste water that has been sparingly used and is produced in places like the kitchen, bathroom, and laundry. It is quite sanitary and cannot be contrasted with blackwater from the toilet. Any water that is drained from a home aside from toilet water is referred to as "greywater." Contrarily, grey water may contain traces of food, oil, hair, filth, or certain household cleaning agents. Despite how it may appear, greywater can be put to a variety of applications and is not required to be dumped into the sewage system like other types of wastewaters. This suggests that what is being called wastewater may potentially be repurposed for safe and practical uses like yard irrigation. As a result, it can be utilized in place of fresh water for a variety of purposes, enabling water conservation and reducing the volume of water that needs to be treated before being released into the sewage system.

3.1.2.3 Deep Well Water System

Deep well systems are gravity drainage systems made up of widely separated wells. Systems are built to pump enormous volumes of groundwater, resulting in a broad cone of effect. Wells can be set on rather broad centers, although they must be dug considerably deeper than wellpoints. Deep water wells have certain downsides. Its pumps are submerged, which means they may have to be raised from hundreds of feet below to service any problems. They are also substantially more expensive to build since they need significantly more personnel and heavier equipment.

3.1.3 Roof Systems

Roofs, regardless of their appearance, are the most vital feature of any property. This house element is more than just a layer or a covering, despite the fact that it is sometimes disregarded. The roof is a certain attribute of any home, it creates the coping, which is the most important aspect. The roof performs a vital role when it comes to weather protection in addition to its aesthetic value. The climatic circumstances where the residence will be located are typically taken into consideration when building the roof form. Some other characteristics include usefulness, installation and maintenance, and the cost of building. (Dynarowicz, 2020).

3.1.3.1 Roof Deck

A roof deck is the topmost part of a building that does not employ traditional sloped roof covering; rather, the space is utilized as a rooftop patio or garden area, among others. For safety concerns, many of these decks are built and manicured with fences of metal or wooden rails or slatted patterns. While newer designs of roof deck fences may be made of transparent acrylic or tempered glass for aesthetic purposes, allowing the view to be observed more clearly. This clear style of fencing and roofing not only helps provide more unimpeded views of lake, forest, or cityscape, but also gives roof spaces a more expansive purpose. Utilized as a building's extension, the roof deck structure are designed to be sturdy and solid to support the weight of people walking on it. Some roof decks are partially covered, while many are not. On a rooftop deck, patio tables with umbrellas to protect against the sun and rain can be employed. Depending on the temperature, soil, and drainage; trees, flowers, and vegetables can be cultivated on a rooftop deck; along with this, however, roof deck is a type of roofing system that is designed to have versatile function and its extension is not just limited to gardening. Though really expensive in terms of construction, and maintenance, the majority of rooftop decks include so many functions. It is frequently nicely arranged to form a technical landscape on the roof deck, such as for placement of air conditioning units, water storage tanks, rainwater harvesting systems, solar panel systems, among many others (LINER | Collect Your Favorites, 2023).

3.1.3.2 Roof Truss

Apart from the obvious roof panels on the outside of structures, roofs are made up of several components that aid in the function of shielding structures from potential hazards such as harsh weather or animals. A roof truss is one of the most significant roofing components. Roof trusses reinforce and support roofs. These are triangle constructions made up of top, bottom, posts, and webbing chords. Trusses are placed under stress but are not bent. Its major duty is to support loads and protect the roof from damage, hence they are essential roof components. Trusses also serve to block damaging solar rays from quickly entering your home, making it more pleasant. Roof trusses can be categorized based on how they are constructed. Trusses include King Post Trusses, Queen Post Trusses, Fink Trusses, Attic Trusses, Gable Roof Trusses, Hip Trusses, Scissor Trusses, and many others. Roof trusses can also be categorized according to its material, such as wood or steel. Roof truss is an incredibly adaptable sort of roofing system because it permits the use of numerous designs for its many styles and purposes. Finally, roof trusses are widely utilized because of its three major advantages: longevity, inexpensive maintenance, and fire protection.

3.2 Contemporary Issues

3.2.1 UN Sustainable Development Goals

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a call to action for people all over the world to fight poverty, protect the environment, and ensure that everyone will live in prosperity and security by the year 2030 (undp.org).

3.2.1.1 SDG 11-Sustainable Development

Over fifty percent of the world's population now lives in cities. By 2050, 6.5 billion people will make up two thirds of the whole human race. Sustainable development requires a fundamental shift in the way that cities are planned and maintained. Extreme poverty is usually concentrated in high levels in urban areas, and local and federal governments struggle to keep up with the area's expanding population. Slum settlements must be made safer and more livable if we are to build sustainable urban ecosystems. It also requires strengthening inclusive and participatory urban planning and management, expanding public transit, and creating green public spaces.

SDG 11 aims to remodel and design cities and other human settlements in a way that minimizes resource use and environmental impact in order to create opportunities for every individual, especially access to basic utilities, power, housing, transportation, and green public spaces.

In this study, the proposed project includes Sustainability as one of the criteria in designing the design of the new proposed city hall as a response to the campaign on SDG 11. In order to reduce negative ecological impacts, it will make use of technology like resource management that is efficient and green construction techniques in the design.

3.2.1.2 SDG 8-Economic Growth

COVID-19 has destroyed billions of lives and endangered the global economy. The International Monetary Fund (IMF) predicts that the global economy will experience a recession that is as bad as or worse than the one that occurred in 2009. The International Labor Organization estimates that as job losses rise, over half of the global workforce could lose their positions.

Decent Employment and Economic Growth are the topics of Sustainable Development Goal 8. SDG 8 advocates for sustainable and inclusive economic growth that includes decent labor and productive employment. It aims to guarantee sustained economic growth for every worker, regardless of their origin, sexual preferences, or race. Through adopting policies that expand employment possibilities and job creation, SDG 8 aims to achieve better levels of economic development.

In this proposal, the SDG 8 was addressed through the proposed new architecture of the city hall. In comparison to the current building, the new city hall was planned to have a larger amount of office space, ensuring the smooth running of the city LGU's daily activities and providing space for more staff to be hired. Due to this, it is expected that the improved level of services provided by the local administration as a result of the new city hall design will have a favorable effect on the city's economic development. The new city hall will enable smooth transaction flow, attracting more investors to the city as a result. More investors will imply more enterprises, which will help increase employment possibilities and promote economic progress.

3.2.1.3 SDG 13-Climate Actions

The environment that surrounds us is rapidly expanding and changing, with catastrophic storms, flash floods, severe droughts, rising temperatures, melting glaciers, and rising sea levels being the consequences of climate change that have obviously brought a negative impact on our planet, people, and animals. When compared to earlier decades, these catastrophes seem to be happening more frequently.

In response to this issue, SDG 13 was selected to help increase public understanding of and sensitivity to climate change. Climate change mitigation strategies will be incorporated into national policy and strategic planning; also it will aid in the increase of the capacity for resilience and adaptation in relation to impact reduction and mitigation of climate change, and to encourage the use of practical planning techniques for managing and planning for climate change in the least developed nations.

This study's goal is to plan and construct the project in compliance with SDG 13's objectives and to deliver acceptable results for reducing climate change's consequences. The goal of the study is to develop and use environmentally friendly resources to design a green and sustainable structure that uses less electricity.

3.2.2 PWD Friendly Building Design

Accessible structures are crucial because they provide more equal and ideally egalitarian access for people of different abilities. With the newly constructed ones, accessibility is usually easier to achieve because it is often accounted for from the beginning of the plans. Existing structures, however, particularly older ones, are frequently inacb cessible to people with a certain range of disabilities.

According to UN's Accessibility for the Disabled - A Design Manual for a Barrier Free Environment, the list of building types that must adhere to accessibility requirements for the disabled shall include all government structure, facilities and institutions, office structures, residential structures, business establishments, medical facilities, educational establishments, restaurants, entertainment centers, athletic fields, religious buildings, and all of the other structure types typically used by the general public. In this study, extensive architectural considerations were used to guarantee that the new city hall will be accessible, particularly to all disabled city residents, so they won't struggle to complete their transactions there.

3.2.3 Inclusive Design in Buildings

The internet is gradually turning the world into a global neighborhood as people are living longer and racial, economic, and gender identity lines are becoming hazier. In addition to being considerate and inclusive, architects and engineers can utilize their design talents to create an environment that makes its users aware of somebody else's needs. This can help foster tolerance and broad acceptance of people and their diverse personalities. So, in order to create smart and inclusive measures that promote the comfort and wellness of people from all socioeconomic strata, these elements were taken into consideration in the architectural design. (re-thinkingthefuture, 2022).

3.3 Design Framework

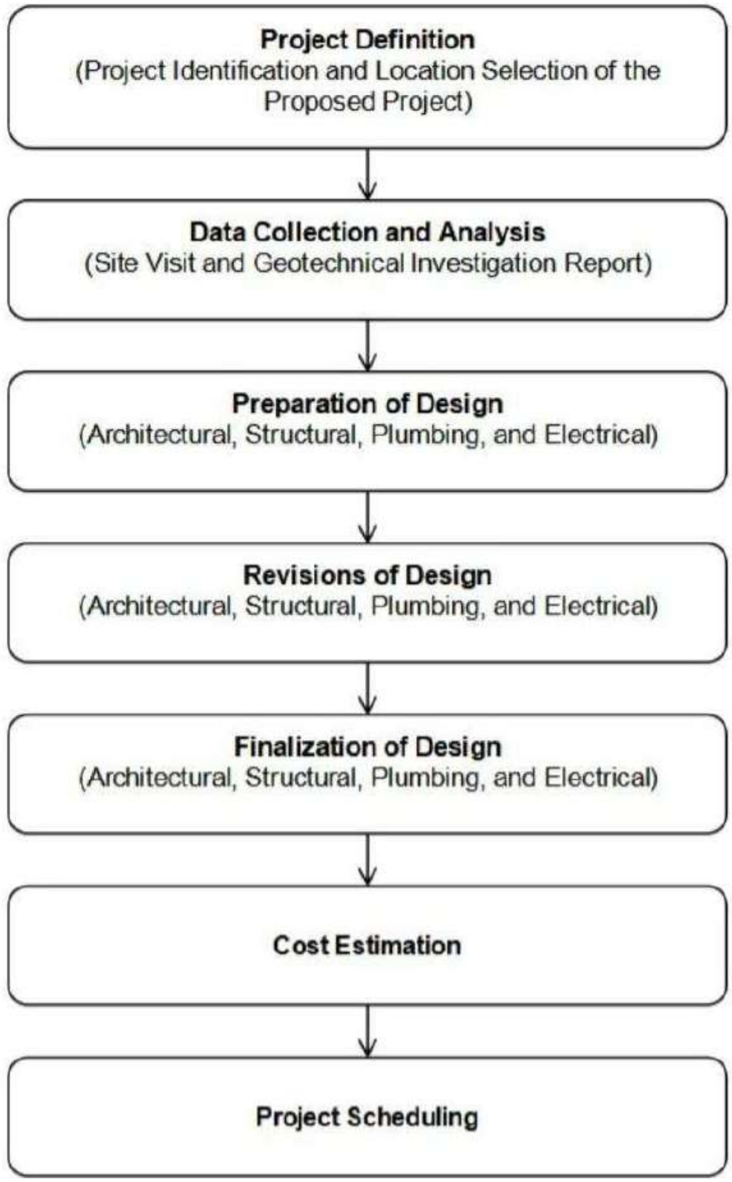


Figure 25

Design Framework of the Proposed Study

The study's Design Framework shows the procedures that the researchers followed all throughout the study.

3.4 Project Definition

3.4.1 Problem Identification and Location Selection of the Proposed Project

The researchers sent a letter for a checklist of top projects to the city of Passi. The main problems of the said city are listed, as follows: The increase of population and government employees, crowded government offices, unimproved government facilities, and lack of parking area around the city hall. These discovered issues made the need for the study clear. Furthermore, local data about the project were taken from the city hall to support the need for the project proposal.

The selection of the proposed project was recommended by the city engineering's office of Passi City based on the accessibility of the land area and appropriateness of the location in terms of space, soil and topography. The proposed site is located at Brgy. Sablogon, Passi City, Iloilo which is just beside the city hall. In particular, the facilities and of the planned structure were decided in accordance with the inclination of the city.

3.5 Data Collection and Analysis

3.5.1 Site Visit

Interviews were conducted from the City Engineer's Office of Passi City to gather data about the status of the current city hall, the amount of people the city hall can accommodate, the state of the offices for the employees, and the structural integrity of the current city hall. After asking for the necessary data needed, pictures were taken for documentation of the problems stated in the interview. The collected data were utilized as the basis for the design process of the proposed new city hall.

3.5.2 Geotechnical Investigation Report

Soil samples were taken from two bore-holes 1.5 meter deep. The samples were placed inside sealed plastic bags to preserve its moisture content and maintain in situ conditions. The samples were taken to the soil laboratory and were tested to determine the specific gravity, moisture content, unit weight, liquid limit, plastic limit, plasticity index, unconfined compression strength and grain size distribution. Meyerhof's equation was used to analyze the ultimate soil bearing capacity. The allowable soil pressure, which was used in footing design was determined by computing the ultimate bearing capacity and the answer was divided by the factor of safety of three.

Presumptive Load-Bearing and Lateral Resisting Values from Section 304.2 of NSCP 2015 was the alternative method planned to be applied, that was, if given the situation that Geotechnical Investigation Report becomes unavailable or impossible to obtain. The presumptive load-bearing and lateral resisting values shown in Figure 26 must be used when no thorough geotechnical site research was carried out, particularly when no in-situ or very restricted testings were conducted. The foundation design engineer must be at the very least inspect the site and be familiar with its primary soil or rock features in order to use these values.

Class of Materials[1]	Allowable Foundation Pressure[2] (kPa)	Lateral Bearing Below Natural Grade[3] (kPa/m of depth)	Lateral Sliding[4]	
			Coefficient[5]	Resistance[6] (kPa)
1. "Intact" Tuffaceous Sandstone [a]	1,000	300	-	-
2. "Lightly Weathered" Tuffaceous Sandstone [b]	500	150	-	-
3. Sandy Gravel and /or Gravel(GW & GP)	100	30	0.35	-
4. Well-graded Sand, Poorly-graded Sand, Silty Sand, Clayey Sand, Silty Gravel and Clayey Gravel (SW, SP, SM, SC, GM and GC)	75	25	0.25	-
5. Clay, Sandy Clay, Silty Clay and Clayey Silt (CL, ML, MH, and CH)	50 [c]	15	-	7

Figure 26

Allowable Foundation and Lateral Pressure

Presumptive load-bearing values must be applied to materials having equivalent physical characteristics. Mud, organic silt, organic clays, peat, or unprepared fill's presumptive load-bearing capacity should never be used without supporting data from a geotechnical site study and investigation.

3.6 Preparation of Design

3.6.1 Architectural Design

The architectural design followed the standards for city halls designs. It also included the site location, elevation, perspective of the city hall, and the floor plan of the proposed city hall.

3.6.2 Structural Design

The guide utilized for the design of the footings, columns, beams, slabs, and any structural members that involved loadings and occupancy provisions for the proposed city hall was the National Structural Code of the Philippines 2015 (NSCP 2015) while the characteristic and functionality of the proposed city hall were based on the National Building Code of the Philippines (NBCP).

3.6.3 Plumbing Plan.

The design of the plumbing layouts for the proposed city hall were based on the provision set by the National Plumbing Code of the Philippines (NPCP).

3.6.4 Electrical Plan

The design of the electrical layouts for the proposed city hall were based on the provision set by the Philippine Electrical Code (PEC).

3.7 Revisions of Design

Plans in this project design were revised multiple times as the study also progressed to reflect technical changes from the advisor, the Faculty of Civil Engineering, and other professionals including architects, master plumbers, and electrical engineers.

3.8 Finalization of Design

The designs were finalized after modifications and other changes had been incorporated into the study in order to allow more efficient procedures and to maximize plan efficiency.

3.9 Cost Estimation

The materials, labor, equipment, and contingencies for the proposed project were included in the project cost estimate. Estimates for materials and equipment were determined based on the current marketability, availability, and cost of the required raw materials. As a result, the materials are expected to be sufficient and of a high enough caliber to qualify for the project cost estimation. The values depended on the current salary wage required by law in terms of labor costs. The parties involved were determined and have agreed on the potential outcomes subjectively, or the laws that will be imposed. The RICS New Rules of Measurement, Volume 2, Detailed Measurement of Building Works, which offered crucial direction in the conduct of quantitative measurement, were effectively applied in this process to aid in the project cost estimation. The standards were developed to provide a common set of measurements that everyone involved in a construction project could understand and to aid in the communication process between the project team and other parties who were interested.

3.10 Project Scheduling

The period of the proposed structure's implementation and development will be tracked and projected using the project work schedule. The project's activities and associated duration will be monitored using the Program Evaluator and Review Technique and Critical Path Method (PERT-CPM). Additionally, Gantt charts will be utilized to show progress and make it simple to follow the planned tasks during its implementation. PERT-CPM was used to identify the critical path of the construction work schedule in order to prevent delays in the project. The S-Curve will also be utilized to track construction progress through time and gauge the project's current state. Maximizing the project work schedule results in the most cost-effective timetable.

3.11 Resources and Facilities

The following tools and resources were available to the researchers for the data gathering, design, analysis, and presentation:

Microsoft Word. The data gathered were input using one of the Microsoft programs.

Considering the project study's overall substance in order to complete and provide the papers in this study.

Microsoft Excel. This Microsoft program was used to encode mathematical data. equations, calculations, and data.

Microsoft PowerPoint. This application was used by the researchers to produce the presentations necessary for the defense of their proposal.

AutoCAD. This software application was used by the researchers to draft 2D plans for the Architectural, structural, plumbing, and electrical plan; along with it were the detailing works included both in the making of CPM and project study's designs and layout.

SAP 2000 and MathCAD. The researchers utilized this software to design, examine, and model various structural elements, such as trusses, beams, slabs, columns, and footings, of the planned project by inputting the properties and characteristics of the materials.

Internet and Past Literature. The information from reliable sources to gather data for the study were effectively utilized. The context of the investigation and a review of related literature have provided the core of this material. An important component of this project study is that previous project studies that we found pertinent to the study were used as a reference or direction for the researchers.

Passi City Engineer's Office. Records such the socio-economic profile, current plans, lot area, the City's Comprehensive Development Plan (CDP) through its Annual Investment Program (AIP), and a map of the area around the proposed project are all provided. These facts have significantly aided the researchers to plan the suggested project.

National Structural Code of the Philippines 2015 (NSCP 2015). The book served as a foundation and source of information when the proposed project was still in the structural and geotechnical design phase.

Laptops, Cameras and Smartphones. While laptops were used to record the project study using computer-generated software and programs, the researchers also used the camera to capture evidence needed for the investigation, such as the recommended site for justification of problem characterization. Smartphones were also an effective tool for note taking and were best used for communication purposes.

Chapter 4

Project Area

4.1 Background and General Features of Passi City, Iloilo

4.1.1 Historical Background

Passi City, is a rice and sugar-rich region and the island of Panay's sole component city. Passi City in Iloilo is one of the earliest communities established as a "pueblo," with its first chapel erected in 1766 (Passi City | Iloilo Provincial Government).

While it was established as a pueblo in 1766, Malay migrants had lived there for a long time before the arrival of the Europeans. According to the myth, Spanish explorers arrived downstream. In the mouth of the Lamunan River, further to the west, they anchored at a location known as Ansig. They came to an elderly woman winnowing pounded palay in a little cottage by the river. Someone questioned her. "Como se Llamas Esta Lugar," obviously not speaking the language. The elderly woman quickly responded, "Pasi," which signifies part of the rice with no husks on her basket carried in her two hands, much to the old woman's astonishment and possibly enthusiasm. Because she was unable to grasp their language, she must have assumed that they were curious to find out what was in the basket and what she was doing. The Spaniards started calling the location "Pasi" from that point on. Later, the term changed to become known as "Passi" (Passi City | Iloilo Provincial Government).

Then, Passi changed for the better and made significant improvement throughout this time. Passi became a hub for trade and business as a result of its advantageous position, bringing new investment opportunities to the town. Its prosperous economy, quick population expansion, and significant acreage have allowed it to eventually be acknowledged as the "first component city" on the Island of Panay. The passage of R.A. marked the completion of its conversion into a city. By way of Executive Order No. 8469, which the then-President of the Philippines, Pres. Fidel V. Ramos (Passi City | Provincial Administration of Iloilo).

4.1.2 Climate

The City of Passi has a tropical monsoon climate which makes their Classification, Am. The city has two seasons, dry season, and wet season. According to the Global Historical Weather and Climate Data, the driest month is usually every February and the wettest comes in July. The average annual temperature is 29.58ºC, has a prevailing wind humidity average of 81.18% and receives around 90.36 mm of precipitation.

Figure 27 shows the Latest Weather Report, February 2023. With the maximum temperature of 87ºF, minimum and average temperature of 84ºF, Average Dew point of 80ºF, Average precipitation of 0.28 inch and Average wind speed of 8.81mph.

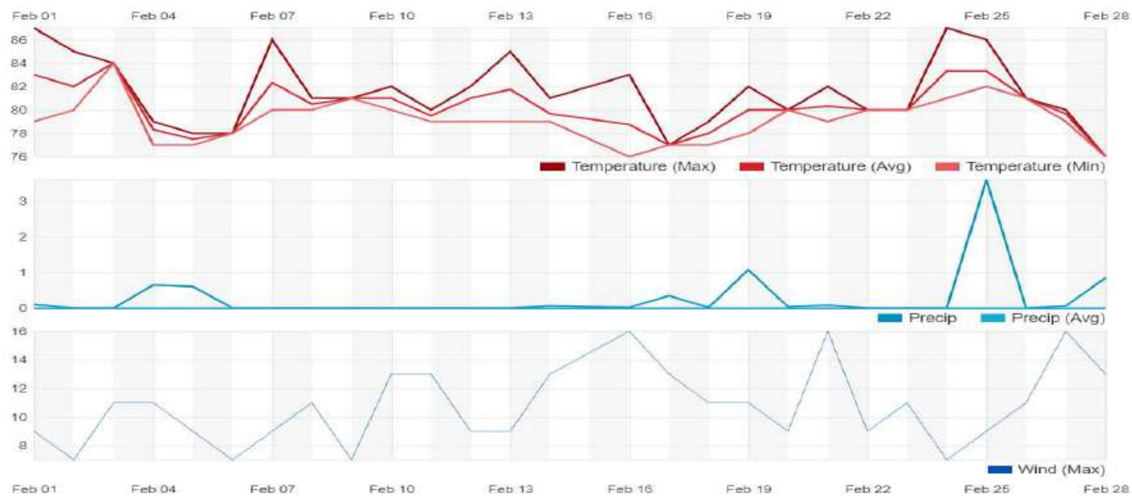


Figure 27

February Climate Summary in Passi City, Iloilo

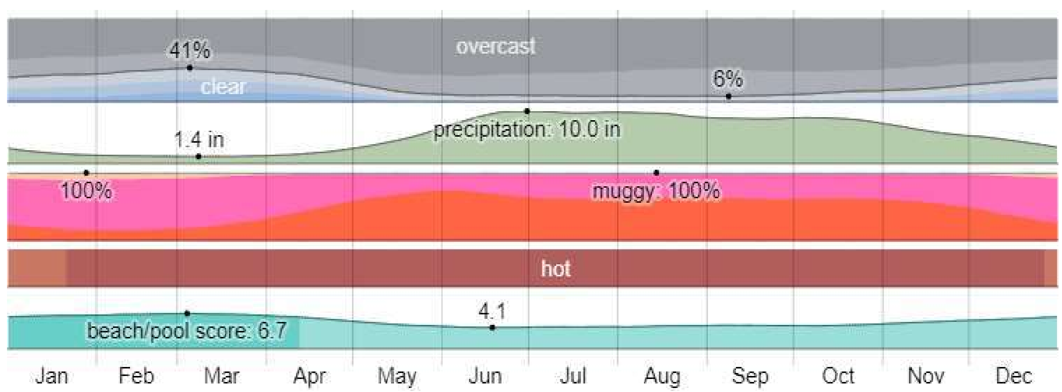


Figure 28

Annual Climate in Passi City, Iloilo

4.1.3 Land Area

Passi is one of the biggest towns in the Province of Iloilo in terms of land area, population, and income. Any means of land transportation allows for reaching Passi City, which is situated in the island of Panay's center, by the Nautical Highway in 45 minutes from Iloilo City and an hour from Roxas City.

Additionally, according to Passi City's Profile 2017 report, it is physically situated south of Dumarao, southeast of Bingawan, east of Calinog, northeast of Dueñas, north of San Enrique, and southeast of San Rafael.

Passi has an overall land area of 25,139.13 square kilometers. or 251.3913 sq. km. This is equal to 5.39 percent of the province of Iloilo's total land area. There are 15 urban and 36 rural barangays in it. It is characterized by slender valley plains and rolling hills. The Jalaur River, the Lamunan River, the Hin-ayan River, the Asisig River, and the Malao River are the five significant rivers that pass the city. Like much of Iloilo, Passi City has a third-type climate with a one- to three-month dry season and no clearly defined maximum rainy season.

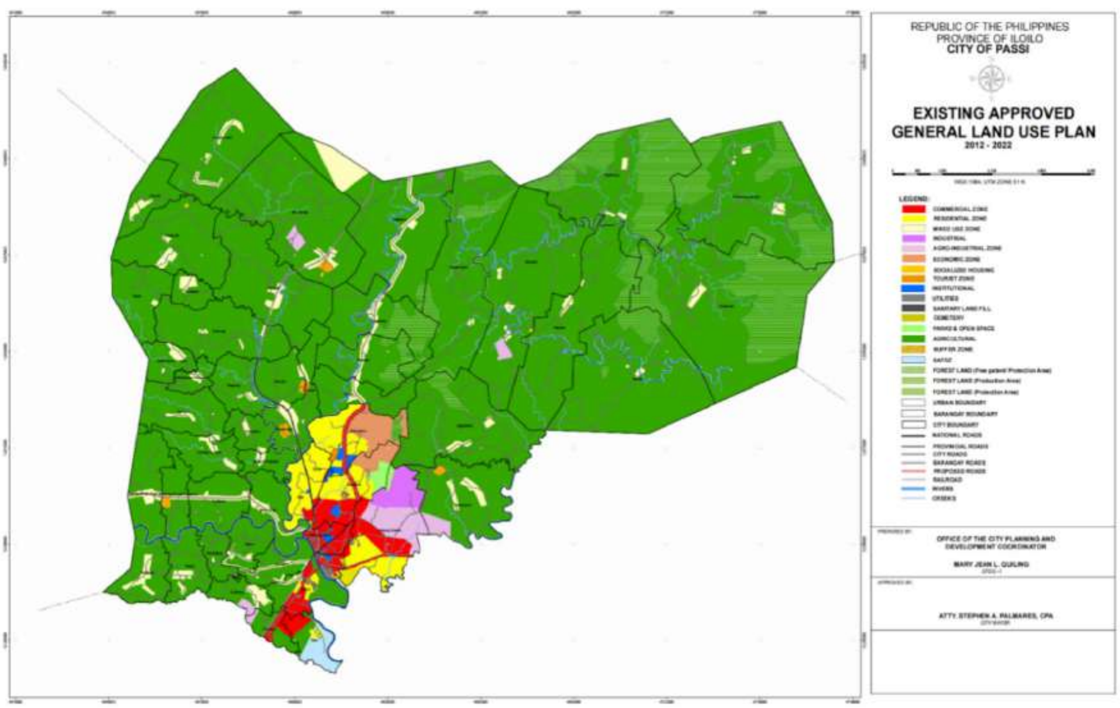


Figure 29

Passi City Land Map

4.1.4 Topography, Slopes and Elevation

Although being categorized as a mountainous location, Passi is known to have a considerably lower elevation than its adjacent municipalities such as San Rafael in the east and some parts of Calinog in the west. Its comparatively flat topography spans beside the Jalaur and Lamunan Rivers, with the majority of its mountainous portions only located in the city's northern outskirts. Passi has a lowest and greatest elevation of 0 ft and 1847 ft, respectively, relative to sea level. The average elevation of Passi's territory, on the other hand, is just about 266 feet. This is primarily due to its natural features, which include rolling hills and narrow valley plains. Mount Caapasan and Mount Bayoso encircle the area. (Passi Topographic Map, Elevation, Terrain) The elevation of Passi, its neighboring Municipalities, and their respective color codes are shown below.

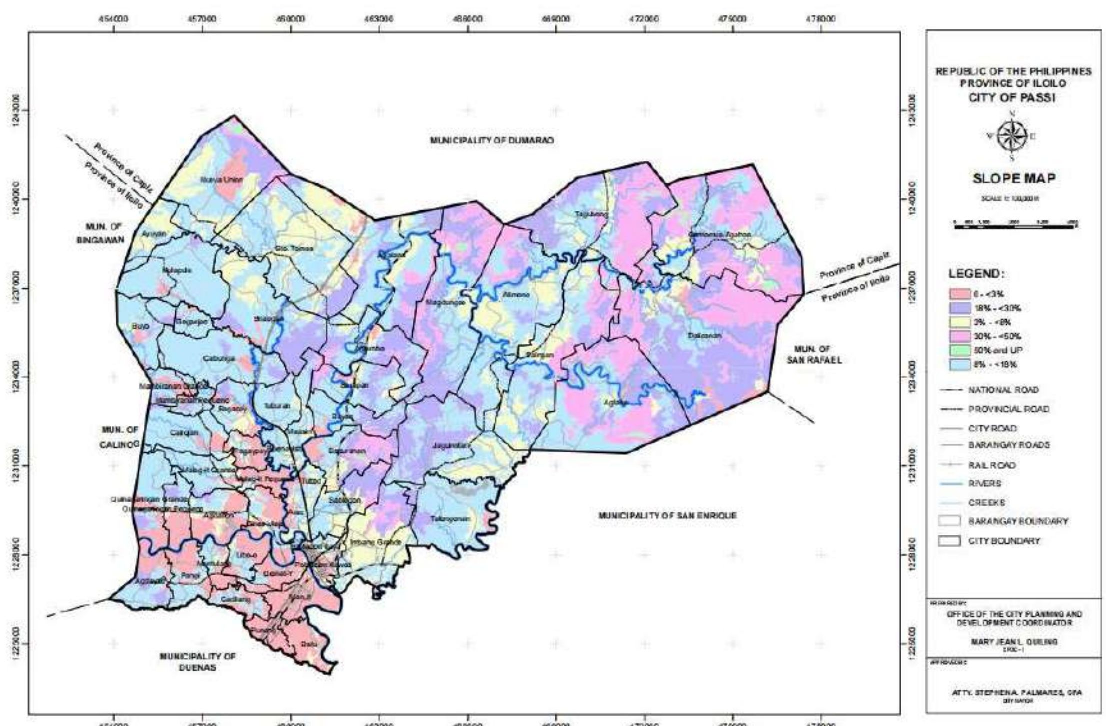


Figure 30

Passi City Topographic Map

4.1.5 Geology

In general, Passi has abundant surface and groundwater, reasonably good soil types, rolling hills, tiny valley plains, and no distinct dry or wet seasons, making it suitable for a variety of agricultural products like rice, sugarcane, and pineapple. However, Passi is also a region mainly known to have mountainous terrains, and in most cases, contain soils that are very varied and would differ greatly within limited regions due to differences in exposure and steepness.

4.1.6 Location and Accessibility

Passi City is stationed in the Northeastern portion of the province of Iloilo, at 11°10' 7.67" North latitude and 122°39' 1.26" East Longitude. As shown in Figure 32, the city is bounded by the Municipality of Dumarao in the North, Municipality of San Rafael in the East, Municipality of San Enrique in the Southeast, Municipality of Dueñas in the South, Municipality of Calinog in the West and finally the Municipality of Bingawan in the North West. Figure 29 shows the location of Iloilo Province with respect to the whole Philippines, and that of Passi City with respect to the Province of Iloilo.

Figure 31

Relative Position of Passi City in Panay Island

The New Iloilo-Capiz Highway, which passes through Malay, Aklan from Roxas City up to Kalibo and the Caticlan Jetty Port, can be used to get to the City of Passi. Iloilo City is 50 kilometers (31 miles) distant, and Roxas City is 66 kilometers (41 miles) away. The journey from Iloilo City to Passi City is seen in Figure 31.

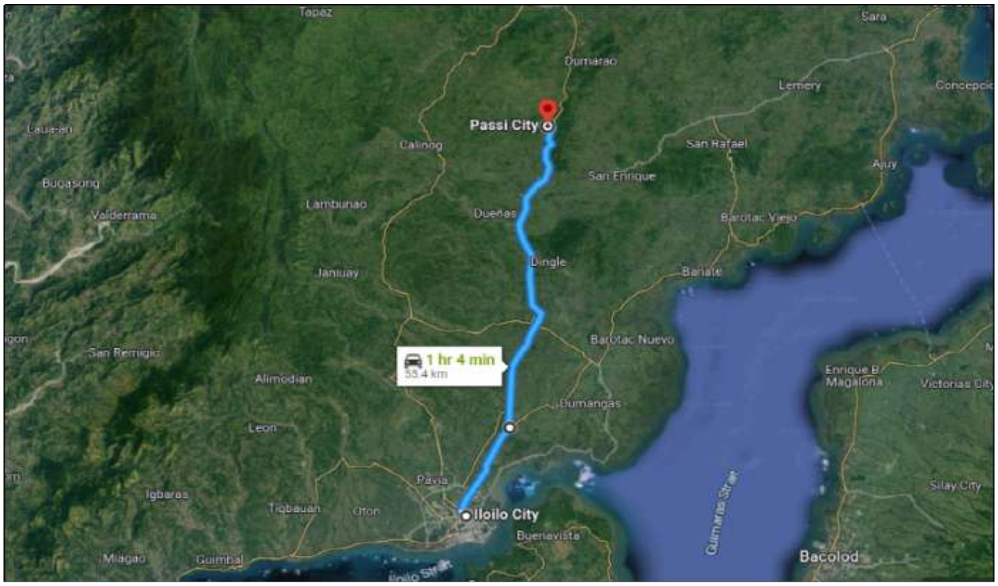


Figure 32

Distance and Travel Time from Iloilo City to Passi City

4.2 Background and General Features of the Project Site

4.2.1 Brief Historical Background

The location of the proposed four storey new city hall is located within the city hall complex of Brgy. Sablogon, Passi City, Iloilo. The city hall complex has an area of 82856.926 sq. m., it was donated to the local government.

The current city hall complex houses the current City Hall, Motorpool, City Health Office, the Passi City Sports Complex, and the OFW building. And the local government plans to house all of the offices within the city hall complex. During office hours, the current city hall transacts almost 500 people daily. People uses both private and public vehicles when going to the city hall complex. The most prominent public transportation being used are tricycles.

4.2.2 Location and Accessibility

The proposed four-storey city hall is located in one of the 51 barangays in Passi City. The barangay is identified as Sablogon, Imbang Grande. Based on the 2020 census, its population was 2,797 covering 3.15% of the total population of Passi City. It is approximately located 11.1057, 122.6598, in the island of Panay. The elevation is calculated to be 53.2 meters or 174.5 feet above mean sea level based on the coordinates.

The city hall is accessible by three main routes from the Ceres Bus terminal located at the back portion of City Mall. The first route is the fastest at 2.7 km via Iloilo-East Coast Capiz Road and it takes approximately 7 minutes when riding a tricycle, motorcycle, car, etc. Next route is 2.5 km via F. Palmares Sr. Street and it takes 8 minutes when riding any transport vehicle. The third route is 2.4 km via Santillan Street and it takes 8 minutes to arrive as shown in Figure 33. Based on the three routes, the travel time depends on the flow of traffic within the city.

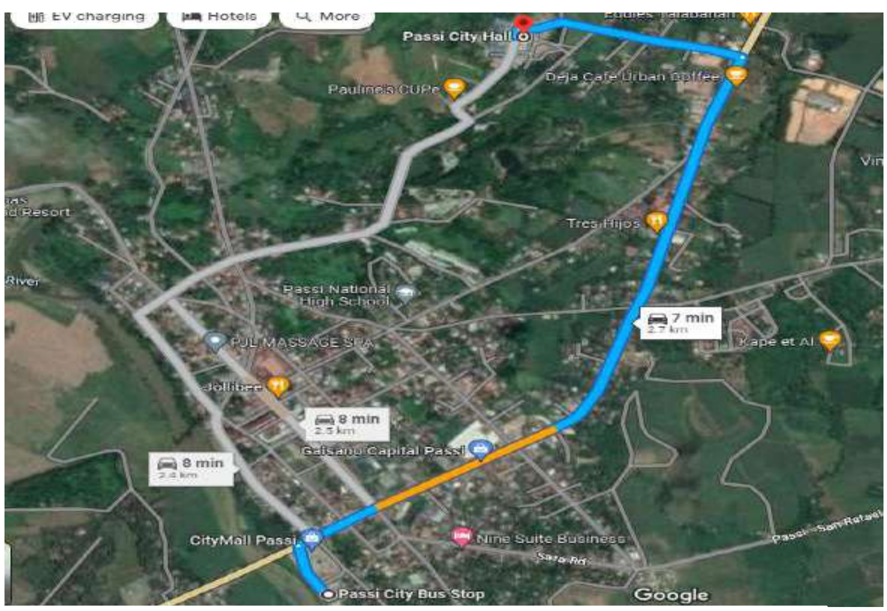


Figure 33

Routes from the Passi Bus terminal to Passi City Hall

4.2.3 Topography

The topography of the site was given by the local government unit and it is shown in Figure 34. The proposed site can be seen gradually sloping down eastward. With the East most part of the Site starting with an elevation of 96 meters and slowly sloping downwards the west part of its boundary at an elevation of 88 meters.

Figure 34

Vicinity Map of the Proposed Site

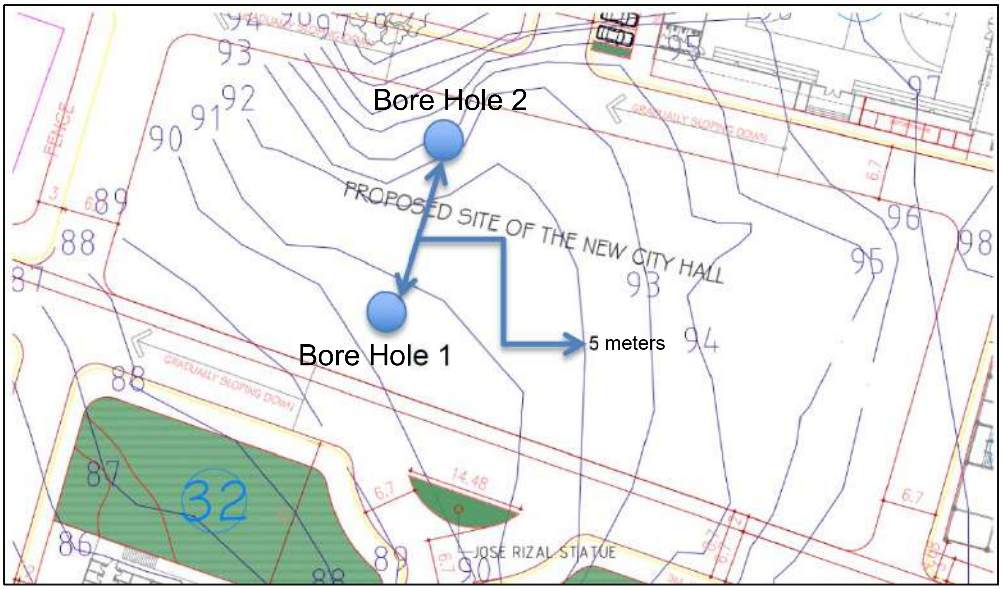


Figure 35

Topography of the Proposed Site

4.2.4 Geology

The soil investigation that was done in the proposed site showed that the site has a consistent layer of clay at the far left corner of the lot while the right side portion of the lot consist of thin layer of soil sitting on top of wide lime stone slabs. Two boreholes were initially intended to reach a depth of 8 feet, both boreholes are 5 meters apart locations is shown in Figure 35, but at the six feet mark depth, the soil is too hard to be dug down further. Both boreholes have a consistent layer of clays; and based on the data that were gathered from the investigation, the soil has a natural moisture content of about 27.911%. Further investigations and some series of tests involving unit weight and specific gravity revealed that the soil is classified as clay soils, with a bulk unit weight of 15.6 kN per cubic meter and specific gravity of about 2.15 which also suggests that it is close to the characteristic of an organic soil. The soil profile of the site for the four-storey city hall is shown in the Figures 36 and 37.

Figure 35

Borehole 1 of the Proposed Site

Figure 36

Borehole 2 of the Proposed Site

4.2.5 Land Area

The proposed New City Hall's site area is located in the north wing of the current building and through calculations and project site survey, it has been determined that it has around a total area of 4000 square meters. The site is a vacant lot that will serve a purpose to its city, so thus the old city hall will not be demolished, and, instead, will be utilized for other legal uses and government occupations.

Chapter 5

The Proposed Project

5.1 Consideration of Constraints

The following are significant responses to the constraints mentioned in the methodology of the study:

5.1.1 Window Systems

As windows deliver natural ventilation and contribute significantly to the aesthetics of the building, Windows can be seen in the design and will serve its functions. Types of windows that were suggested specifically are, aluminum sling windows and fixed frame glass windows. In Comparison the design constraints mentioned in the Window Systems, Film Coated type of window is highly recommended, budget wise and it could improve the energy efficiency of windows by reducing heat transfer. On it aesthetics, especially interiorly, these windows can improve visual comfort and protects the furniture inside.

Table 7
Design Constraints on Window System

	Aesthetics	Cost	Maintenance
Film Coated Window	Placement of coats could vary with preferred color designs.	The price can range from Php 2750 to Php 5000 per square meter. Can regulate	The Heat Insulation Films that are installed with the windows help maintain the room

		room temperature, reducing the amount of air conditioning units.	temperature. Can control the quantity of heat the sun emits.
Double-Panned UV-Proof Window	It keeps the room cooler during summer time and warmer during rainy season.	It traps heat in the room resulting in high temperature. Once broken it cannot be repaired. Its Installment requires higher price, given that it should be manufactured and installed meticulously.	Unlike the Film Coated type of windows; UV proof windows can allow maximum natural sunlight while filtering out harmful UV radiation that could penetrate to any normal windows. It may cost more but it has a high amount of savings in the long run.
Soundproof Window		The price for the soundproof windows can range from Php 5000 to Php 11000 per square meter.	Help in insulating the noises around the home and help keep the external noises from entering the building. It is great at reducing noise pollution.

	It is difficult to break resulting in better security of the city hall.

5.1.2 Supplementary Water Supply Systems

The choice of the water supply system was done accordingly in agreement with the suggestions of the Sanitary Engineer and the Researchers. Through the main line of the City Water District, National Waterworks and Sewerage Authority (NAWASA), a conventional method, is recommended in order to ensure and give a quality water supply system because it is dependable and consistent in contrast to other sources that are susceptible to pollution and other seasonal variations. The soil and rock strata operate as a natural filtration system, eliminating many contaminants and toxins, providing the water a high quality. Additionally, it has a long lifespan, does not need expensive installation, and might give a reliable water supply for many years.

Table 8
Comparison of Grey Water Collection System, Rain Water and Deep Well

	Advantages	Disadvantages
Grey Water Collection	Reduces the need for fresh water	Water typically lasts longer and needs less quality monitoring
	Lowering the amount of wastewater entering sewage networks or on-site treatment facilities	It can be potable
Rain Water Collection	Lessen water demand and saves energy	Design process is crucial
	Reduces the need for imported water	Limited Supply

	Cost Efficient	Requires sufficient space requirements
Deep Well	Untreated gray water may cause health problems to consumers It is only allowed for outdoor uses except for toilet flushing	The installation cost is high Pumps need to be replaced every 10 years

5.1.3 Roof Systems

Roofs are the most important component of any building, regardless of how they seem. Even though it is often ignored, this building's component is more than just a coating or a covering. Talking about Structural Integrity, unlike the Roof Deck, Roof truss could perform heavy duty as it could protect and support the roof accordingly. The materials for truss construction and affordable than the roof deck. Considering its longevity, maintenance and protection to natural or man-made hazards, roof truss is the considered roof system for the design.

Table 9
Comparison of Roof Deck and Trussed Roof

Roof Deck		Trussed Roof	
Advantages	The use of roof Deck in replacement of trussed roof provide additional space for use. Perfect for installment of Rain Water Tank.	Advantages	Relatively cheaper when compared to roof deck. They are versatile. Has strong Load bearing capacity. Effective use materials
Disadvantages	Roof deck is relatively more expensive.	Disadvantages	The space is not utilized for occupation. Installation requires a lot

		of space. Interconnected triangular components must be large.

5.2 Technical Plans and Specifications

The following plans and designs abide with the specifications that were required in building a City Hall.

5.2.1 Architectural Design

The Architectural Plan of the Proposed Design of the New Four-Storey City Hall at Passi City Iloilo included the following in accordance with the Requirements and Specifications of Constructing a City Hall, perspectives of the structure, floor plans, section plans, elevations, and schedule of doors and windows.

5.2.2 Structural Design

The Structural Plan of the Proposed Design of the New Four-Storey City Hall at Passi City Iloilo included the following; foundation plan, Beam, Columns, Slab, Footing, and Tie beams. All the design details are in accordance with the requirements stated in the National Structural Code of the Philippines (NSCP 2015).

5.2.3 Electrical Plan

The Electrical Plan of the Proposed Design of the New Four-Storey City Hall at Passi City Iloilo included Convenience Outlet Layout, Lighting Outlet Layout and Rasier Diagram in accordance with the Requirements and Specifications of Constructing a City Hall and the provisions of Philippine Electrical Code (PEC).

5.2.4 Plumbing Design

The Plumbing Plan of the Proposed Design of the New Four-Storey City Hall at Passi City Iloilo abides with the specifications and requirements of a city hall stated in the National Plumbing Code of the Philippines. All necessary details and specifications are found in the Plumbing Plan.

5.2.5 Seismic Analysis

The seismic specifications of the project location were assessed and are shown in Table 12. In order to determine the design base shear and confirm that the structure can bear lateral stresses, this information was used. The details and values were all according to the code.

Table 10
Seismic Properties

Design Loads	*Reference*	*Classification*
Seismic Importance Factor (Office), I	I Table 208-1	1.5
Soil Profile Type	Table 208-2	Sd
Seismic Zone Factor. Z (Zone 4)	Table 208-3	0.4
Seismic Source Type	Table 208-4	A
Near Source Factor, Na	Table 208-5	1
Near Source Factor, Nv	Table 208-6	1
Seismic Response Coefficient, Ca	Table 208-7	0.44
Seismic Response Coefficient, Cv	Table 208-8	0.64
Numeric Coefficient (Concrete, SMRF), R	Table 208-11A	8.5

5.2.6 Technical Specifications

Other Detailed Technical Specifications such as its materials and conditions for the Proposed Design of the New Four-Storey City Hall at Passi City Iloilo can be seen in Appendix F.

5.3 Project Cost and Estimation

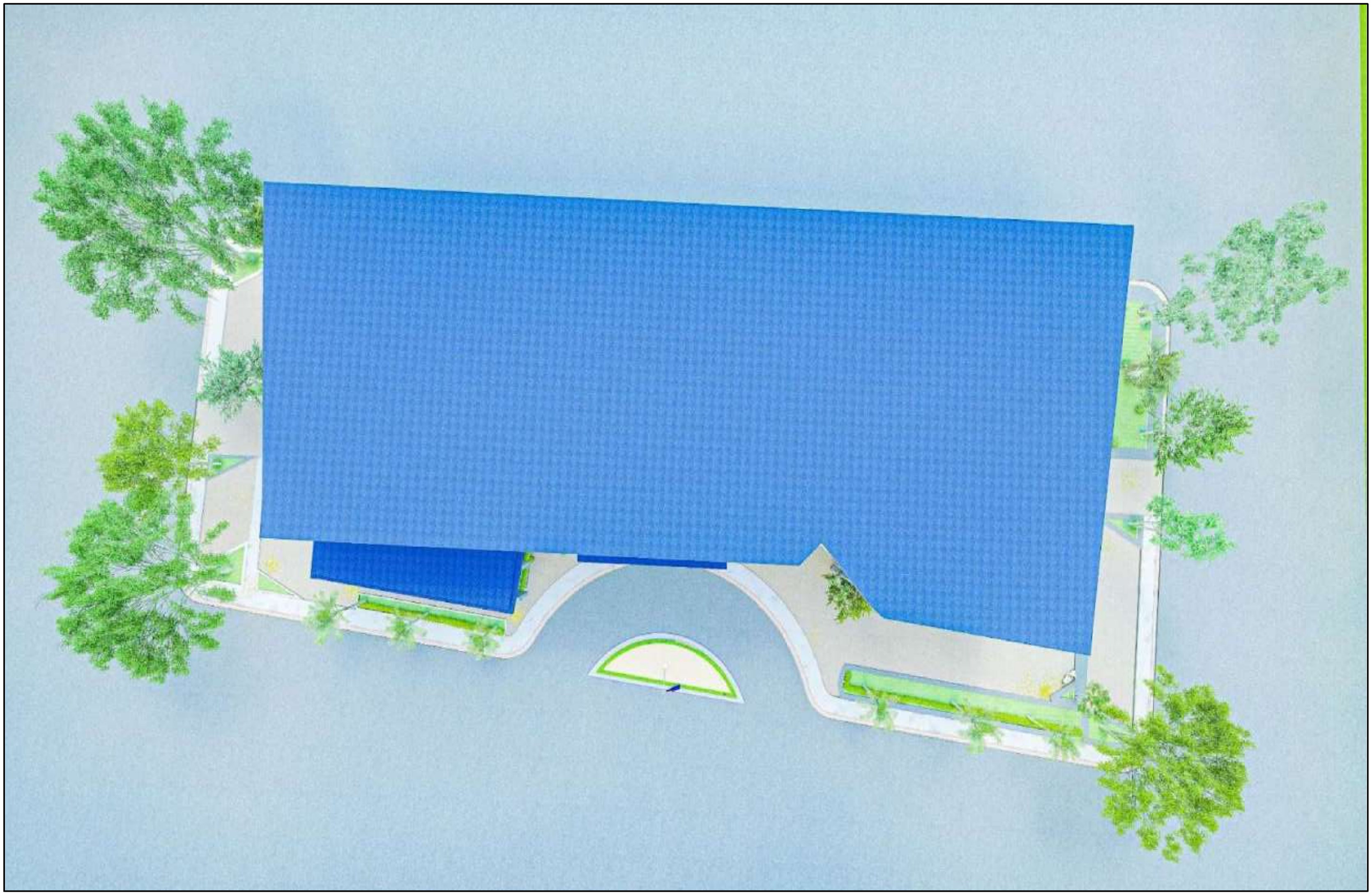
The proposed design structure's estimated project cost is 128, 406, 869.44 Php. The estimates take account of pre-construction, construction, and other related legal costs. Other relevant details regarding the project's cost in.

5.4 Construction Work Schedule

The proposed design has an estimated construction project duration of 360 calendar days.The project scheduling is based on PERT-CPM. The project is projected to have an over all estimated price of Php 129,039,164.59.

ARCHITECTURAL PLANS

3D RENDERING



Proposed Perspective of the New City Hall (Top View)

Proposed Perspective of the New City Hall (Front-Up View)

Proposed Perspective of the New City Hall (Close-Up View)

The details of the structural elements are as follows:

1. The new city hall has a total of 49 square footing, out of this 49 square footing, there are seven corner footing, 15 edge footing, six circular footing, and 21 interior footing. There are also 17 combined footing in the new city hall. The details of these footings are shown in table 11.

Table 11
Footing Detail

	Dimension (mm)	*Thickness (mm)*	*Ø Main Bar (mm)*	*Ø S and T Bar (mm)*	*Number of Main Bar*	*Number of S and T Bar*	*Spacing of Main Bar (mm)*	*Spacing of S and T Bar (mm)*
Corner	2400 by 2400	300	20	16	15	15	150	150
Edge	2400 by 2400	350	20	16	29	19	150	150
Interior	3500 by 3500	400	20	16	23	23	150	150
Circular Column	2300 by 2300	500	20	16	13	13	175	175
Combined	3900 by 5100	350	20	16	25(shor span), 33(long span)	25(shor span), 33(long span)	150	150

2. The design of the column of the new city hall are square and circular. The square column for the ground and second floor has total number of 71, while the succeeding floors has 66. For the circular column it has a total number of 6 per floor. The details of these columns are shown in Table 12.

Table 12
Column Details

	Dimension (mm)	*Ø Main Bar (mm)*	*Ø Lateral Ties (mm)*	*Number of Main Bars*	*Spacing of Lateral Ties (mm)*
Square	600 by 600	25	16	12	400
	Diameter (mm)	*Ø Main Bar (mm)*	*Ø Spiral Ties (mm)*	*Number of Main Bars*	*Pitch of Spiral Ties (mm)*
Circular	500	25	16	8	400

3. The city hall has girders and intermediate beams in the design. The total number of girders in the second floor is 122 and for the succeeding floors the number of girders is 116. The intermediate beam has a total number of 68 for the second floor and for the third and fourth floor, the total number is 62. The details of the girders and intermediate beams are shown in Table 13.

Table 13
Girder and Intermediate Beam Details

	Dimension (mm)	*Ø Main Bar (mm)*	*Ø Stirrups (mm)*	*Concrete Cover (mm)*
Girder	500 by 700	16	10	70
Intermediate Beam	350 by 550	16	10	70

4. The new city hall has a slab system of one-way and two-way slab. The total number of one-way slabs in the second floor is 77 and for the two-way slabs is 18. For the third and fourth floor, the number of one-way slabs is 73 and for the two-way slabs is 16. The details of one-way and two-way slabs are shown in Table 14 and 15.

Table 14

One-Way Slab Detail

Thickness (mm)	*Number of Top Main Bars per Meter Strip*	*Number of Bottom Main Bars per Meter Strip*	*Number of S and T Bars per Meter Strip*	*Spacing of Top Bars (mm)*	*Spacing of Bottom Bars (mm)*	*Spacing of S and T (mm)*
150	3-16mm	3-16mm	3-12mm	325	325	325

Table 15

Two-Way Slab Details

Thickness (mm)	*Number of Top Main Bars at Column Strip – Short Span*	*Number of Top Main Bars at Column Strip – Long Span*	*Number of Bottom Main Bars at Middle Strip – Short Span*	*Number of Bottom Main Bars at Middle Strip – Long Span*	*Spacing for All Main Bars (mm)*	*Number of S and T Bars Both Ways*	*Spacing of S and T Both Ways (mm)*
150	3-16mm	3-16mm	3-16mm	3-16mm	325	3-12mm	325

Chapter 6

Project Implementation

6.1 Implementing System

The Project Study will serve as an orientation material for the Project Proposal which will be presented to the Local Government Unit of Passi City. For Examination and Evaluation of the project details, plans, and cost estimates, the Project Study will be submitted to the Passi City's assigned engineer. This will then be returned to the school's administration for approval and eventual implementation of the project proposal. The Local Government Unit of Passi City will have full authority and discretion for the implementation of the Project Proposal.

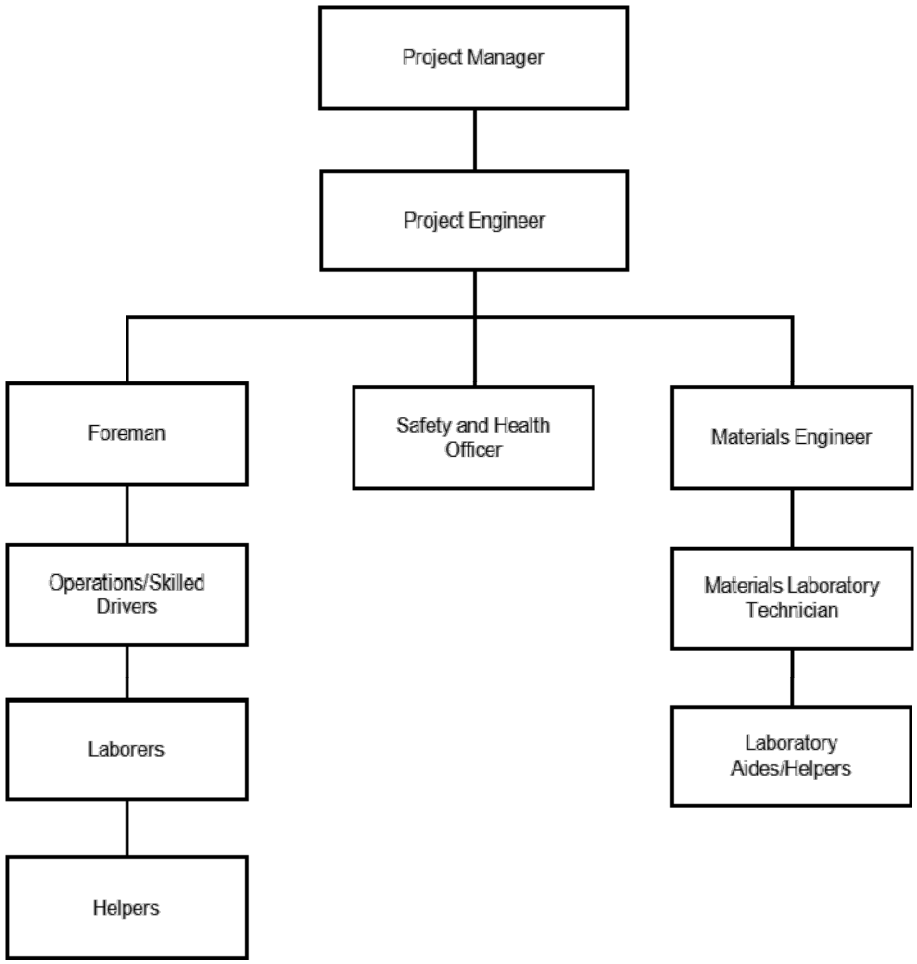
6.2 Financing

One of the aims and initiatives of the present City Administration is the building of Passi City's new city hall. The proposed construction of the new City Hall, among other high-priority building projects, are funded, according to the Passi City LGU.

6.3 Construction Management

The duration of the construction period shall be handled by the Passi City LGU's preferred engineer or a construction firm determined by way of bidding. Given plans, specifications, and construction, project schedule must be followed after it is evaluated and approved to avoid delay in the project.

6.4 Organizational Structure



The Local Government Unit of Passi City through their City Engineering Office will be the governing body alongside their designated/assigned Project Manager. The distribution/releasing of funds based on the work progress, and supervision and monitoring of the construction progress will be the responsibility of the Project Engineer. The Foreman, Safety and Health Officer and Materials Engineer will give its timely reports to the Project Engineer same with the respective positions below them as shown in the chart..

Chapter 7

Summary, Conclusion and Recommendation

7.1 Summary

The proposed project is a four- storey city hall located in Sablogon, Imbang Grande, Passi City. The structure has a total area of 1865.62 sq.m. The first floor is composed of 11 offices and a pantry, the second floor is composed of nine offices, then the third floor is composed of five offices and conference rooms, and the fourth floor is composed of six offices.

The city hall of Passi cannot accommodate all the clients transacting every day and some of the offices are placed outside the vicinity. The processing time of each client takes a while because they need to transfer from one building to another. Moreover, the office spaces are constricted and improperly arranged.

With the assistance of an architect and in compliance with the requirements of the Philippine National Building Code, the architectural design and plans were created. It included the digitally produced rendered viewpoints for the elevation. The group used technical software using AutoCAD to create the floor plans.

The team designed the structural plans under the supervision of experts in civil engineering. The design conformed fully to the 2015 Philippine National Structural Code and the Ultimate Stress Design (USD). The structural elements were analyzed using a variety of engineering applications, including SAP2000, PTC MathCad and Microsoft Excel.

Electrical plans for the proposed project were created by an electrical engineer who conformed strictly to the requirements and guidelines of the Philippine Electrical

Code. The plumbing plans, which complied to the National Plumbing Code of the Philippines (NPCP), were created with the help of an architect.

With this, a designed new city hall was presented to the City Mayor and City Engineering’s Office to aid as a solution to the mentioned problems. The client was shown the plans with a possibility of revisions for assessment and approval. After receiving approval for all of the plans and designs, the group created estimates and project schedule. The material costs were then determined using Iloilo City's/Passi City’s current cost per unit pricing.

7.2 Conclusion

The proposed study is envisioned to house the offices in one structure and lessen the time frame of each transaction through effective arrangement of the offices per floor. For the parking facilities, ample parking slots layout for the proposed design of the new City Hall was given by consulting the minimum parking spaces required by the National Building Code of the Philippines. The specific objectives and problems identified were addressed accordingly. Moreover, the structural design and design constraints stated in this study were given solutions. As shown in Table 16 the comparison of the new office space of each department as compared to the existing one.

Table 16
Areas of Existing City Hall Offices and the Proposed City Hall Offices

Office Name	*Area of Existing City Hall (sq. m)*	*Area of Proposed City Hall (sq.m)*
Office of the City Mayor	208.2267	288.2026
Office of the City Vice Mayor	--	178.0606
Office of the City General Services	95.25	136.2516
Office of the Sangguniang Panlungsod	97.4259	150.5623
Office of the City Planning and Development Coordinator	131.25	131.7262
Office of the City Budget	104.2527	144.9
Office of the Accountant	85.5	109.8233
Office of the City Treasurer	158.521	278.2318
City of the City Assessor	107.3364	155.1415
Office of the City Engineer	190.6468	375.9636
Office of the City Administrator	125.9988	157.6218
Office of the City Legal	32.4	84.3617
Office of the City Registrar	--	120.9842
Office of the City Information	--	98.2623
Office of CHR	59.4741	62.3622
Office of DILG	19	36.8898
Office of BAC	49.075	49.075
Office of the City Environment and Natural Resources	--	73.6575
Department of Interior and Local Government	--	36.8898
Department of Risk Reduction	--	54.1518

Management		
Public Utilities Section	--	105.1053
Public Employment	--	36.9
Population Section	--	52.7062
Project Monitoring	--	21.6234
Office of the Social Welfare and Development	--	47.0341
Office of the Resource and Development	--	105.144
Office of the City Local Economic Development		173.2216
Office of Business Permits		83.3878
Total	**1464.3574**	**3050.3136**

The data of geotechnical investigation was tested at Central Philippine University, soil laboratory and the soil were classified a clay sand. The structural, electrical, plumbing, architectural plans were designed based on the 2015 National Structural Code of the Philippines, National Building Code of the Philippines, as well as the National Plumbing Code of the Philippines. An elevator, fire exits and parking area were included in the design in align with the specifications of the project. All necessary plans and deliverable were checked and analyzed by the designers and professionals whose expertise is in the field of engineering.

Hence, cost estimate was completed with adherence to the latest price of tools and materials and the project schedule was done for a particular period to maximize the cost.

7.3 Recommendations

The four-storey design proposal is recommended to be accomplished soon after checking the designs, specifications, cost estimates and scheduling. Moreover, it is also recommended to be carried out with supervisions of civil engineers from Passi City and in proper coordination with the faculty of Civil Engineering Department at Central Philippine University. If revisions and adjustments are necessary, replacing some data is recommended as long as it follows the provisions set by the codes to ensure the adequacy of structures.

The City Engineering's Office should further study the structural analysis of the structure if additional floors shall be considered. It is recommended to consider other sources of water to meet future demands of the clients for drinking and for other domestic uses.

For cost estimates, a thorough checking of computations shall be performed to ensure accuracy and make some changes in the total price of the project based on the latest market value of the materials. To conserve power consumption, it is recommended to install solar panels. After implementation, security devices shall be added to guarantee the safety of the office staffs and clients of the city hall.

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APPENDICES

APPENDIX A
LETTER TO MAYOR, CERTIFICATE OF APPROVED ARCHITECTURAL DESIGN, CERTIFICATE OF APPEARNCE AND CURRENT NUMBER OF EMPLOYEES OF PASSI CITY LGU

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY [illegible]
Tel Nos. (033) 329-1971 [illegible]
Fax No. [illegible]
CIVIL ENGINEERING DEPARTMENT

September 11, 20[illegible]

Mayor Stephen A. Palmares
City of Passi
Iloilo, Province

Dear Mayor Stephen,

Greetings!

The Bachelor of Science in Civil Engineering (BSCE) curriculum in the Philippines requires civil engineering students to develop a practice-based design or research which incorporates the various aspects of a typical engineering undertaking. At Central Philippine University (CPU), Iloilo City, Service Learning (SL) is integrated in this program by requiring all students to conduct a community-oriented design project (CODP) over a period of two semesters.

CE 4131 (Civil Engineering Project I) and [illegible] Project II) are subjects taken by senior BSCE students of CPU. These courses are gear[illegible] community development projects or industry re[illegible] engineering faculty adviser to undertake a [illegible] such as water supply system, public market, [illegible] among others.

This CODP activity requires the stude[illegible] defense this semester and a final project stud[illegible] students have to focus on the problems and co[illegible] the proposal is approved, they could now pro[illegible] application of their civil engineering knowledg[illegible] details will be refined during the fina[illegible] project s[illegible] considering the fact that they are made by students [illegible] of advisers, we hope that the students can come up with a satisfactory project study. [illegible] completed project study will be given to the partner community.

Republic of the Philippines
[illegible]
CITY OF PASSI
Atty. STEPHEN A. PALMARES, CPA
City Mayor
Landline [illegible]
Telefax [illegible]
Smart No. [illegible]
Globe No. [illegible]
E-mail [illegible]

If you are interested in this endeavor, please inform us of your priority projects (in its conceptual stage) of which we could be of assistance through Mr. Frederick Anton Bascoguin [illegible] reach him through mobile phone number at [illegible] or email at frederickanton.bascoguin.17@cpu.edu.ph. The completed project study will be beneficial both to the students as well as the partner community in a sense that (a) the students will have the chance to work on real community projects and apply their civil engineering knowledge as well as understand the value of community service and (b) a priority project of the partner community will have its preliminary design which can be referred to in future project proposals.

Looking forward to a successful partnership with your community.

Thank you.

Yours truly,

ENGR. MARY EARL DARYL A. GRIO
Chairperson, Civil Engineering Department

ENGR. DANY C. MOLINA
Dean, College of Engineering

c/o Engr. M. [illegible]

New City Hall

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY, PHILIPPINES
Tel Nos (033) 329 1971 (to79) local 1082
Fax No (033) 320 3004
CIVIL ENGINEERING DEPARTMENT

Date: March 7, 2022

Engr. Mary Jean L. Quiling
Office of the City Planning & Development. Coordinator
Passi City Local Government Unit
Passi City, Iloilo

Dear Sir/Madam:

Warm Greetings!

We, the 4th year Civil Engineering students of Central Philippine University, in partial fulfillment of the requirements for the completion of our course, Bachelor of Science in Civil Engineering, are currently conducting a project study entitled "Proposed Design of the New Four-Storey City Hall at Passi, Iloilo".

Right now, we are on the process of gathering data to be utilized in the design phase of our study under the implementation stage of our subject CE 4231 (Civil Engineering Project II). This is where our approved project study methodologies are carried out to achieve the project study objectives.

In lieu to this, we would like to ask permission from your good office to allow us to request a copy of the **Land Use Map and Slope Map of Passi City.** Rest assured that the use of these data are purely academics only and not for other purposes that might jeopardize your good intentions to help us.

Thank you so much and we hope that we will have a positive response from your good office. If you have any question, you can reach me Frederick Anton B. Bascoguin, at my mobile number 09935351497 or my email address, frederickanton.bascoguin-17@cpu.edu.ph.

Yours truly,

Doreen Rose B. Avance
Frederick Anton B. Bascoguin
Karl Cristian P. Daquil
Von Mauric R. Marcos
Louise Elaine V. Tan

Noted by:

Engr. Shevanee Ruth De la Cruz
Project Study Coordinator

Engr. John Lorenz Tuala
Project Study Adviser

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY, PHILIPPINES
Tel Nos (033) 329 1971 (to79) local 1082
Fax No (033) 320 3004
CIVIL ENGINEERING DEPARTMENT

Date: February 14, 2023

HON. STEPHEN A. PALMARES
City Mayor
Passi City, Iloilo

Dear Mayor Stephen:

Warm Greetings!

The 4th year students at CPU College of Engineering, Department of Civil Engineering are now in the implementation stage of the project study course CE 4231 (Civil Engineering Project II). It is in this stage and course that our approved project study methodologies are carried out to achieve the project study objectives. For the information concerning the proposal stage in the course CE 4131 (Civil Engineering Project I), the letter received by your good office last September 11, 2022 asking for your priority projects in the city is attached for your reference.

Our approved project study title is "Proposed Design of New Four Storey City Hall at Passi City, Iloilo". The following are the team members involved in this project study:

Doreen Rose Avance, Frederick Anton Bascoguin, Karl Cristian Daquil, Von Mauric Marcos, Louise Elaine Tan

In our study, the scope of work will include the detailed design of the proposed new city hall in Passi City , Iloilo.The site development, structural, architectural, electrical, plumbing, and fire exit plans must all be included in the design.

On this regard, we would like to inform your good office to allow us to conduct the following: Geotechnical Investigation report (Standard Penetration Test) of the site to determine soil capacity, collecting of soil samples that will involve digging two (2) 10 meters deep borehole in order for us to collect at most 10 - 20 kilograms of soil for analysis. We would like to conduct these activities on February 13-19, in Brgy. Sablogon, Passi City, Iloilo, which has been designated as the proposed project's location. Moreover, it is highly appreciated if any representative from your good office will accompany us during the conduct of our stated activities.

We are hoping for your fast and kind consideration. Please feel free to contact any of the undersigned if you have any questions or clarifications. Thank you very much.

Yours truly,

Bascoguin, Frederick Anton
09456196155
(Globe)
frederickanton.bascoguin-17@cpu.edu.ph

Daquil, Karl Cristian
09291027125 (Smart)
karlcristian.daquil-19@cpu.edu.ph

Marcos, Von Mauric
09615581161 (Smart)
vonmauric.marcos-17@cpu.edu.ph

Noted by:

Engr. Shevanee Ruth De la Cruz
Project Study Coordinator

Engr. John Lorenz Tuala
Project Study Adviser

THE CITY ENGINEER OFFICE
DATE 2/14/23
TIME 10:40
BY
PASSI CITY

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY, PHILIPPINES
Tel Nos (033) 329 1971 (to79) local 1082
Fax No (033) 320 3004
CIVIL ENGINEERING DEPARTMENT

CERTIFICATION OF APPROVED ARCHITECTURAL DESIGN

This is to certify that Local Government of Passi City headed by Mayor Palmares and Engr. Ituriaga, Head of the City Engineer, approves the proposed architectural design of the following:

Avance, Doreen Rose
Bascoguin, Frederick Anton
Daquil, Karl Cristian
Marcos, Von Mauric
Tan, Louise Elaine

in their project study entitled "PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL IN PASSI CITY, ILOILO."

Mayor Atty. Stephen A. Palmares, CPA
City of Passi
Passi City, Iloilo

Engr. Moises A. Ituriaga
City Engineer
Passi City, Iloilo

Republic of the Philippines
Province of Iloilo
CITY OF PASSI

Office of the City Engineer

CERTIFICATE OF APPEARANCE

TO WHOM IT MAY CONCERN:

This is to certify that ______________________________

of ____________________ has appeared and conducted business with this office

on ____________________

Purpose: ____

____

ENGR. MOISES A. ITURIAGA
City Engineer I

COLLEGE OF ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
Jaro, Iloilo City, Philippines
Tel No: 63 (33) 3291971 loc 1084

ADVISER ENDORSEMENT FORM
Project Study / Special Problem Proposal Presentation

Date: January 16, 2023

Engr. Dany C. Molina
Dean
College of Engineering
Central Philippine University
Iloilo City

Dear ENGR. DANY C. MOLINA

I am pleased to endorse the proposal study of GROUP 4/ Doreen Rose Avance, Frederick Anton Bascoguin, Karl Cristian Daquil, Von Mauric Marcos, Louise Elaine Tan entitled PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL AT PASSI CITY, ILOILO for examination/defense.
I have carefully checked and examined the document and *they/she/he* will be ready to present *their/her/his* proposal on January 21, 2023.

Sincerely yours,

Tuala
ENGR. JOHN LORENZ S. TUALA
Adviser

Recommending Approval:
01/16/23
ENGR. BABYLOU GENOVEZA NAVA
Subject Coordinator

ENGR. MARY EARL DARYL A. GRIO
Department Head

Approved:

ENGR. DANY C. MOLINA
Dean

===

Schedule of Proposal Defense (to be filled up by the Course Coordinator)

Team/Individual Name: Group 4/Doreen Rose Avance, Frederick Anton Bascoguin, Karl Cristian Daquil, Von Mauric Marcos, Louise Elaine Tan   Course: Bachelor of Science in Civil Engineering

Title: PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL AT PASSI CITY, ILOILO

Date: JANUARY 21, 2023   Place: ________

Panelists:

ENGR. MARY EARL DARYL A. GRIO
ENGR. LINIE ROSE D. SANTACERA
ENGR. PETER JOHN B. ABAYGAR

COLLEGE OF ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
Jaro, Iloilo City, Philippines
Tel No: 63 (33) 3291971 loc 1084

ADVISER ENDORSEMENT FORM
Approval of Final Proposal Paper

Date: February 7, 2023

Engr. Dany C. Molina
Dean
College of Engineering
Central Philippine University
Iloilo City

Dear ENGR. DANY C. MOLINA

I am pleased to endorse the final proposal paper of GROUP 4/ Doreen Rose Avance, Frederick Anton Bascoguin, Karl Cristian Daquil, Von Mauric Marcos, Lousie Elaine Tan entitled PROPOSED DESIGN OF NEW FOUR STOREY CITYHALL AT PASSI CITY, ILOILO for approval.
They/She/He have/has carefully done the revisions and thoroughly edited the paper based on the comments and suggestions of the panel during the proposal presentation.

Sincerely yours,

ENGR. JOHN LORENZ S. TUALA
Adviser

Recommending Approval:

02/21/23
ENGR. BABYLOU GENOVEZA NAVA
Subject Coordinator

ENGR. MARY EARL DARYL A. GRIO
Department Head

Approved:
ENGR. DANY C. MOLINA
Dean

Approval of Final Proposal Paper (to be accomplished by the student(s))
Team / Individual Name: Group 4/ Doreen Rose Avance, Frederick Anton Bascoguin, Karl Cristian Daquil, Von Mauric Marcos, Louise Elaine Tan Course: Bachelor of Science in Civil Engineering
Title: PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL IN PASSI CITY, ILOILO
Panelists:

Name	Signature	Date
ENGR. MARY EARL DARYL A. GRIO		02-20-23
ENGR. LINIE ROSE D. SANTACERA		02-19-23
ENGR. PETER JOHN B. ABAYGAR		02-15-23

COLLEGE OF ENGINEERING
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Tel Nos (033) 329 1971 (to79) local 1082
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CIVIL ENGINEERING DEPARTMENT

ADVISER ENDORSEMENT FORM
Project Study Final Presentation

May 22, 2023

ENGR. DANY C. MOLINA
Dean, College of Engineering
Central Philippine University
Iloilo City

Dear Engr. Molina,

I am pleased to endorse the proposal study of ***HALL O'FRAMERS*** entitled ***PROPOSED DESIGN OF FOUR STOREY CITY HALL AT PASSI CITY*** for final proposal defense.

I have carefully checked and examined the document and they will present their study on TBA.
The individual names of the team members are as follows:

Avance, Doreen Rose B.
Bascoguin, Frederick Anton B.
Daquil, Karl Cristian P.
Marcos, Von Mauric R.
Tan, Louise Elaine V.

Sincerely yours,

Engr. John Lorenz S. Tuala
Project Study Adviser

Recommending Approval:

Engr. Shevanee ... Dela Cruz
Subject Coordinator

Engr. Mary Earl Daryl A. Grio
Department Head

Approved:

Engr. Dany C. Molina
Dean

Schedule of Proposal Defense (to be filled up by the Course Coordinator)
Team/Individual Name: GROUP 4 HALL O'FRAMERS Course: BSCE
Title: PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL AT PASSI CITY
Date: TBA Place: TBA
Panelists:
Engr. Mary Earl Daryl A. Grio
Engr. Peter John Abaygar
Engr. Linie Rose D. Santacera

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY, PHILIPPINES
Tel Nos (033) 329 1971 (to79) local 1082
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CIVIL ENGINEERING DEPARTMENT

FORM FOR PARENT'S (GUARDIAN'S) PERMISSION AND AGREEMENT

Date: January 31, 2023

TO WHOM IT MAY CONCERN:

I have given my son/daughter Doreen Rose B. Avance permission to join the onsite research/project study data collection activities on March to May 2023 in connection with their proposed project study in the subject CE 4231 – Civil Engineering Project II.

I realize the risks connected with the aforesaid activities, but I have given my son/daughter permission to join them because of the benefits that she/he will derive from this experience which constitutes an essential part of his/her educational training. I shall not hold Central Philippine University or his/her faculty advisers responsible for any untoward incident that may arise on account of his/her own fault or negligence or of force majeure and of causes purely accidental, fortuitous, or beyond the control of his/her faculty advisers.

02-1-2023 SIGNED: ______________________
(Date) (Parent or Guardian)

FEB 01 2023
ILOILO CITY, PHILIPPINES

ATTY. ... CAMPOSAGRADO
MCLE Compliance No. ...-0005597/4-14-2025

DOC NO. 35
PAGE NO. 02
BOOK NO. 1
SERIES OF 2023

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY, PHILIPPINES
Tel Nos (033) 329 1971 (to79) local 1082
Fax No (033) 320 3004
CIVIL ENGINEERING DEPARTMENT

FORM FOR PARENT'S (GUARDIAN'S) PERMISSION AND AGREEMENT

Date: January 29, 2023

TO WHOM IT MAY CONCERN:

I have given my son FREDERICK ANTON B. BASCOGUIN permission to join the onsite research/project study data collection activities on March to May 2023 in connection with their proposed project study in the subject CE 4231 – Civil Engineering Project II.

I realize the risks connected with the aforesaid activities, but I have given my son permission to join them because of the benefits that he will derive from this experience which constitutes an essential part of his educational training. I shall not hold Central Philippine University or his faculty advisers responsible for any untoward incident that may arise on account of his own fault or negligence or of force majeure and of causes purely accidental, fortuitous, or beyond the control of his faculty advisers.

January 29, 2023
(Date)

SIGNED: JEREMIAS F. BASCOGUIN
(Parent or Guardian)

SUBSCRIBED AND SWORN TO
BEFORE ME THIS ______ DAY OF
03 FEB 2023 IN THE CITY AND PROVINCE
OF ILOILO PHILIPPINES.

DENNIS D. JUANON
NOTARY PUBLIC
UNTIL DECEMBER 31, 2023
NOTARIAL COMMISSION NO. 46
2ND FLR. A.F. LOPEZ BLDG., IZNART ST., ILOILO CITY
IBP NO. 253697/12-27-2022/ PASIG CITY
PTR NO. 8081553/01-03-2023/ILOILO CITY
ROLL NO. 26173-MCLE NO. VII-0002371

DOC. NO: 93
PAGE NO: 10
BOOK NO: III
SERIES OF 2023

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY, PHILIPPINES
Tel Nos (033) 329 1971 (to79) local 1082
Fax No (033) 320 3004
CIVIL ENGINEERING DEPARTMENT

FORM FOR PARENT'S (GUARDIAN'S) PERMISSION AND AGREEMENT

Date: January 27, 2023

TO WHOM IT MAY CONCERN:

I have given my son/daughter KARL CRISTIAN P. DAQUIL permission to join the onsite research/project study data collection activities on March to May 2023 in connection with their proposed project study in the subject CE 4231 – Civil Engineering Project II.

I realize the risks connected with the aforesaid activities, but I have given my son/daughter permission to join them because of the benefits that she/he will derive from this experience which constitutes an essential part of his/her educational training. I shall not hold Central Philippine University or his/her faculty advisers responsible for any untoward incident that may arise on account of his/her own fault or negligence or of force majeure and of causes purely accidental, fortuitous, or beyond the control of his/her faculty advisers.

January 27, 2023
(Date)

SIGNED: CRISTINO P. DAQUIL
(Parent or Guardian)

SUBSCRIBED AND SWORN TO
BEFO[illegible] DAY OF
3 [illegible] 2023 [illegible] CITY AND PROVINCE
OF ILOILO PHILIPPINES.

DOC. NO.: 91
PAGE NO.: 10
BOOK NO.: [illegible]
SERIES OF 20 23

DENNIS D. JUANON
NOTARY PUBLIC
UNTIL DECEMBER 31, 2023
NOTARIAL COMMISSION NO. 46
2ND FLR. A.F. LOPEZ BLDG., IZNART ST., ILOILO CITY
IBP NO. 253697 / 12-27-2022/ PASIG CITY
PTR NO. 8081358/01-03-2023/ILOILO CITY
ROLL NO. 26173-MCLEE NO. VII-0023917

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY, PHILIPPINES
Tel Nos (033) 329 1971 (to79) local 1082
Fax No (033) 320 3004
CIVIL ENGINEERING DEPARTMENT

FORM FOR PARENT'S (GUARDIAN'S) PERMISSION AND AGREEMENT

Date: January 31, 2023

TO WHOM IT MAY CONCERN:

I have given my son **VON MAURIC R. MARCOS** permission to join the onsite research/project study data collection activities on February to May 2023 in connection with their proposed project study in the subject CE 4231 – Civil Engineering Project II.

I realize the risks connected with the aforesaid activities, but I have given my son permission to join them because of the benefits that he will derive from this experience which constitutes an essential part of his educational training. I shall not hold Central Philippine University or his faculty advisers responsible for any untoward incident that may arise on account of his own fault or negligence or of force majeure and of causes purely accidental, fortuitous, or beyond the control of his/her faculty advisers.

January 31, 2023
(Date)

SIGNED: MA. MELANIE R. MARCOS
(Parent or Guardian)

SUBSCRIBED AND SWORN TO
BEFORE ME THIS ______ DAY OF
0 3 FEB 2023 IN THE CITY AND PROVINCE
OF ILOILO PHILIPPINES.

DENNIS D. JUANON
NOTARY PUBLIC
UNTIL DECEMBER 31, 2023
NOTARIAL COMMISSION NO. 46
2ND FLR. A.F. LOPEZ BLDG., IZNART ST., ILOILO CITY
IBP NO. 253697/12-27-2022/ PASIG CITY
PTR NO. 8081858/01-03-2023/ILOILO CITY
ROLL NO. 26173-MCLE NO. VII-0023917

DOC. NO: 92
PAGE NO: 20
BOOK NO: III
SERIES OF 20 23

COLLEGE of ENGINEERING
CENTRAL PHILIPPINE UNIVERSITY
ILOILO CITY, PHILIPPINES
Tel Nos (033) 329 1971 (to79) local 1082
Fax No (033) 320 3004
CIVIL ENGINEERING DEPARTMENT

FORM FOR PARENT'S (GUARDIAN'S) PERMISSION AND AGREEMENT

Date: January 30, 2023

TO WHOM IT MAY CONCERN:

I have given my son/daughter **LOUISE ELAINE V. TAN** permission to join the onsite research/project study data collection activities on March to May 2022 in connection with their proposed project study in the subject CE 4231 – Civil Engineering Project II.

I realize the risks connected with the aforesaid activities, but I have given my son/daughter permission to join them because of the benefits that she/he will derive from this experience which constitutes an essential part of his/her educational training. I shall not hold Central Philippine University or his/her faculty advisers responsible for any untoward incident that may arise on account of his/her own fault or negligence or of force majeure and of causes purely accidental, fortuitous, or beyond the control of his/her faculty advisers.

January 30, 2023
(Date)

SIGNED: **LALAINE V.TAN**
(Parent or Guardian)

REPUBLIC OF THE PHILIPPINES)
CITY OF ILOILO) S. S.
x---x

BEFORE ME, on this FEB 01 2023 day of February 2023, at Iloilo City, Philippines, personally appeared **LALAINE V. TAN** known to me to be the same person who executed and signed in my presence, the foregoing Waiver & Declaration, which consists of two (2) pages, including this page where the acknowledgment is written, duly signed by her instrumental witnesses on each page hereof, and she acknowledged to me that the same is her free and voluntary act and deed.

LALAINE V. TAN presented to me his/her Government Identification Card No. 06041601101 as competent evidence of identity under the 2004 Rules on Notarial Practice, as amended.

WITNESS MY HAND AND SEAL.

ATTY [illegible] G GARCIA
[illegible]

Doc. No. 341
Page No. 73
Book No.; 1
Series of 2023.

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AS OF JULY 1, 2022 - SEPTEMBER 30, 2022

	OFFICE	PERMANENT							CO-TERM					ELECTED			TEMPORARY			TOTAL FILED	UNFILED POSITION			TOTAL NO. PLANTILLA POSITION
		IST		2ND		DEPT HEAD			IST		2ND			2ND			IST				IST	2ND		
		M	F	M	F	M	F	TOTAL	M	F	M	F	TOTAL	M	F	TOTAL	M	F	TOTAL				TOTAL	
1	Office of the City Mayor	13	18		4			35	1	1	26	6	34	1		1	1		1	71				
2	Proj. Monitoring Section	1	2					3	1				1							4				
3	Motorpool Section	49	3	3				55												55				
4	Population Section	3	1		3			7												7				
5	Public Utilities Section	19	4	3				26									1		1	27				
6	Public Employment Service Section	1	2		1			4												4				
7	Office of the Human Resource & Dev't	6	9		4		1	20												20				
	Office of the City Business Permits & Lic.	7	8		1	1		17												17				
9	Office of the City Tourism	2	4		1		1	8												8				
10	Office of the City Information	11	8		2			21				1	1							22				
11	Office of the City General Services	20	11	3	1		1	36												36				
12	Office of the City Economic Ent. & Mgt	30	17	1	1	1		50												50				
13	Slaughterhouse Section	22	6		1			29												29				
14	Office of the Sangguniang Panlungsod	11	11	1	10		1	34	4	1			5	11	1	12				51				
15	Office of the City Planning & Dev't Coord	6	10	2	3		1	22												22				
16	Office of the City Budget	11	17	1	7	1		37												37				
17	Office of the Accountant	4	11	2	7		1	25												25				
18	Office of the City Treasurer	17	22	3	14	1		57												57				
19	Office of the City Health	4	38	4	15		1	62												62				
20	Office of the City Assessor	6	14	2	5	1		28												28				
21	Office of the City Registrar	10	7	1	3		1	22												22				
	Office of the City Engineer	25	6	8	7	1		47												47				
23	Office of the City Agriculturist	9	4	7	10		1	31												31				
24	Office of the City Environment &Nat. Res	9	4	3			1	17												17				
25	Office of the City Social Welfare and Dev't	1	5		4		1	11												11				
26	Office of the City Administrater	2	6					8												8				
27	Office of the City Legal	3	7		1			11			1		1							12				
28	Passi City College		3	8	13			24												24				
29	Office of the City Waste Management	2	1			1		4												4				
30	Office of the City Sports and Dev't.	8	4			1		13												13				
31	Office of the Local Econ. Dev't & Invest. Prom	2	4		1			7												7				
32	Office of the City DRRM	5					1	6												6				
	TOTAL	319	267	52	119	8	12	777	6	2	27	7	42	12	1	13	2		2	834				

APPENDIX B
BUDGET

WORKING BUDGET (ESTIMATION)

PARTICULAR	***DESCRIPTION***	***AMOUNT***
	FARE	₱ 2,500.00
SITE INVESTIGATION INTERVIEW	LABOR FEE	₱ 1,500.00
SOIL SAMPLE COLLECTION	ARCHITECT PROFESSIONAL FEE	₱ 5,000.00
ARCHITECTURAL PLANS	ELECTRICAL ENGINEER PROFESSIONAL FEE	₱ 1,700.00
ELECTRICAL PLANS	MASTER PLUMBER PROFESSIONAL FEE	₱ 1,100.00
PLUMBING PLANS	BOND PAPER	₱ 1,000.00
	PLAGIARISM SCAN	₱ 800.00
	GRAMMARIAN CHECKING FEE	₱ 1,100.00
DOCUMENTATION	HARDBOUND	₱ 2,500.00
	RESEARCH MANUAL	₱ 250.00
	OTHERS	₱ 1,500.00
MISCELLANEOUS	TOTAL:	₱ 18,450.00

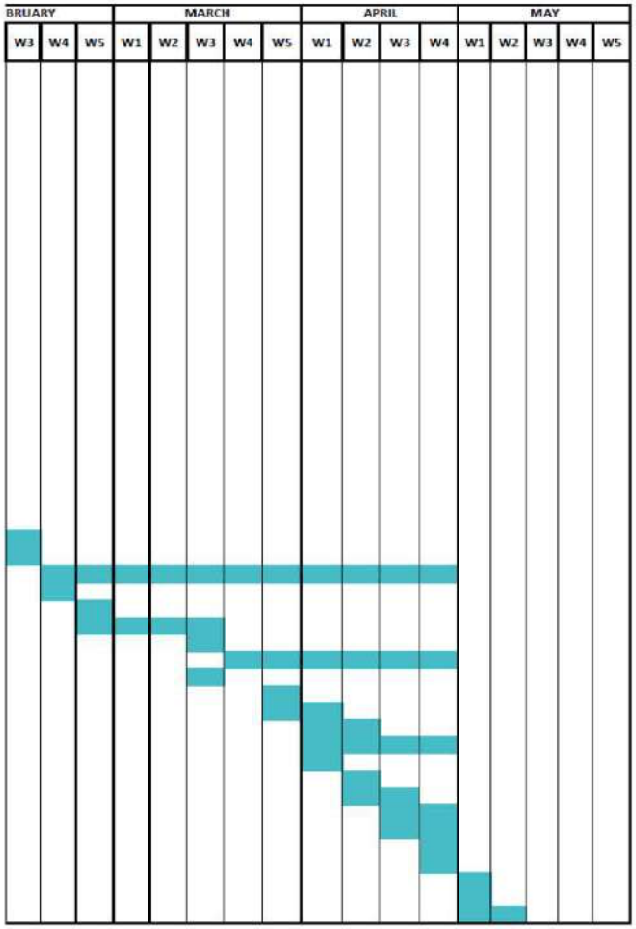
APPENDIX C
WORK SCHEDULE

ACTIVITIES	TIME			AUGUST					SEPTEMBER					OCTOBER					NOVEMBER					DECEMBER					JANUARY					FE	
	Start	Finish	Duration (days)	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5	W1	W2	W3	W4	W5	W1	W2
Class Orientation	August 22, 2022	August 22, 2022	1				🟧																												
Brainstorming Meeting	August 22, 2022	August 29, 2022	7					🟧																											
Sending Out Letter of Priority Projects	August 29, 2022	September 9, 2022	11						🟧	🟧																									
Creating of Concept Papers	September 9, 2022	September 18, 2022	9							🟧	🟧	🟧																							
Reviewing of Concept Papers	Septemebr 19, 2022	September 18, 2022	4									🟧																							
Revision and Submission of Concept Papers	Septemebr 23, 2022	October 8, 2022	15									🟧	🟧	🟧	🟧																				
Site Visit	October 26, 2022	October 26, 2022	1														🟧																		
Discussion for Chapter 1	October 25, 2022	October 25, 2022	1														🟧																		
Making and Submission of Chapter 1	October 25, 2022	November 4, 2022	10														🟧	🟧	🟧																
Consulation for Chapter 1 (Course Coordinator)	Novemeber 8, 2022	November 8, 2022	1																	🟧															
Revision of Chapter 1	Novemeber 8, 2022	December 23, 2022	45																	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧								
Discussion for Chapter 2	October 19, 2023	October 19, 2023	1													🟧																			
Making and Submission of Chapter 2	November 4, 2022	November 11, 2022	7																🟧	🟧															
Consulation for Chapter 2 (Course Coordinator)	Novemeber 8, 2022	November 24, 2022	1																			🟧													
Revsion of Chapter 2	November 14, 2022	December 23, 2022	39																		🟧	🟧	🟧	🟧	🟧	🟧	🟧								
Discussion for Chapter 3	November 23, 2022	November 23, 2022	1																			🟧													
Site Visit (Additional Questioning)	November 21, 2022	November 21, 2022	1																			🟧													
Making and Submission of Chapter 3	November 14, 2022	November 25, 2022	11																		🟧	🟧													
Consulation for Chapter 3 (Adviser)	December 5, 2022	December 23, 2022	18																						🟧	🟧	🟧								
Submission of the Revised Chapters 1, 2, and 3	December 16, 2022	December 23, 2022	7																							🟧	🟧								
Making of Proposal Presentation for Defense	December 26, 2022	January 18, 2023	10																									🟦	🟦	🟦	🟦				
Proposal Presenation Defense	January 21, 2023	January 21, 2023	1																												🟦				
Revision of the Document and Consulation with the Adviser After the Proposal Defense	January 24, 2023	January 31, 2023	7																													🟦	🟦		
Submission of the Revised Document	February 3, 2023	February 3, 2023	1																															🟦	
Site Visit for the Month of January	January 25, 2023	January 25, 2023	1																													🟦			
Discussion for Chapter 4	January 30, 2023	January 30, 2023	1																														🟦		
Making and Submission of Chapter 4	January 30, 2023	February 13, 2023	14																														🟦	🟦	🟦
Consultation for Chapter 4 (Adviser)	February 13, 2023	February 17, 2023	4																																
Revision of Chapter 4	February 20, 2023	April 24, 2023	63																																
Site Visit for the Month of Febuary	February 22, 2023	February 22, 2023	1																																
Discussion for Chapter 5	February 27, 2023	February 27, 2023	1																																
Making and Submission of Chapter 5	February 27, 2023	March 13, 2023	14																																
Consultation for Chapter 5 (Adviser)	March 13, 2023	March 17, 2023	4																																
Revision of Chapter 5	March 20, 2023	April 24, 2023	35																																
Site Visit for the Month of March	March 15, 2023	March 15, 2023	1																																
Discussion for Chapter 6	March 27, 2023	March 27, 2023	1																																
Making and Submission of Chapter 6	March 27, 2023	April 3, 2023	7																																
Consultation for Chapter 6 (Adviser)	April 3, 2023	April 9, 2023	6																																
Revision of Chapter 6	April 3, 2023	April 24, 2023	21																																
Site Visit for the Month of April	April 5, 2023	April 5, 2023	1																																
Discussion for Chapter 7	April 10, 2023	April 10, 2023	1																																
Making and Submission of Chapter 7	April 10, 2023	April 17, 2023	7																																
Consultation for Chapter 7 (Adviser)	April 17, 2023	April 23, 2023	6																																
Revision of Chapter 7	April 17, 2023	April 24, 2023	7																																
Submission of the Revised Chapters 4, 5, 6, and	April 24, 2023	April 24, 2023	1																																
Final Defense	April 28, 2023	April 28, 2023	1																																
Revision of the Document and Consulation with the Adviser After theFinal Defense	May 1, 2023	May 5, 2023	4																																
Submission of Revised and Hardbound Docume	May 1, 2023	May 10, 2023	8																																

LEGEND:

PENDING ACTIVITIES 🟦

DONE ACTIVITIES 🟧


BRUARY
MARCH
APRIL
MAY
W3 W4 W5 W1 W2 W3 W4 W5 W1 W2 W3 W4 W1 W2 W3 W4 W5

APPENDIX D
SERVICES OF THE OFFICES AND THE DAILY RATE OF PEOPLE

SERVICES OFFERED BY THE CITY ACCOUNTANT'S OFFICE

The City Accounting Office is tasked for the processing of payrolls and disbursement vouchers, Issuance of Certification of Philhealth Membership, Certification of Net Take Home Pay, Inquiries of Salary Deductions and Loan Balances, preparation of Financial Reports and accountant's advice for all checks for payment of all expenses and deliver accountant's advice to concerned banks, assessment of payment for enrollment of Passi City College students & signing clearance of students.

A. PROCESSING OF CLAIMS

To look after the use and disposition of assets of the City Government and determine its liabilities from claims, examinations are undertaken by the City Accountant to determine that all necessary documents of vouchers/claims are submitted.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit Disbursement Voucher with supporting documents for evaluation as to validity, propriety and completeness.	a. Approved Obligation Request b. Approved Purchased Request c. Approved Price Quotation/Bid d. Accomplished Abstract of Canvass/Bid e. Approved Purchased Order f. Accomplished Acceptance and Inspection Report g. Accomplished Post-Qualification Report (Phil-GEPS)	15 minutes	**RHEA L. DERIADA** Administrative Officer IV **GLENN A. PADERNAL** Administrative Officer III **JOSE JONATHAN P. CERBAS** Administrative Assistant III **EMY CONNIE D. TEJERESO** Administrative Assistant II
2. Wait for the processing and the release of examined disbursement voucher	Disbursement voucher with complete supporting documents	5 minutes	**ROCHILLE D. PALOMO, CPA** City Accountant I **CYRIL P. MALOCO, CPA** Supervising Administrative Officer
Accomplished Client feedback form and submit it to the Information Officer or Human Resource & Management Personnel on duty at the front desk of Passi City Hall			
TOTAL RESPONSE TIME PER VOUCHER : 20 Minutes			

B. ISSUANCE OF CERTICATE OF NET TAKE HOME PAY

Employees shall secure form from the City Accounting Office the Certificate of Net Take Home Pay for whatever legal purpose it may serve them best.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Request for the certificate of Net take Home Pay	a. Request Slip	5 minutes	**LORENZO PABILONA, III** Administrative Officer II
2. Wait for the processing and the release of certificate of Net take Home Pay	Verification of payroll of concerned person requesting for net pay and prepare certificate of Net take Home Pay and signed by the City Accountant.	5 minutes	**LORENZO PABILONA, III** Administrative Officer II **ROCHILLE D. PALOMO, CPA** City Accountant I
Accomplished Client feedback form and submit it to the Information Officer or Human Resource & Management Personnel on duty at the front desk of Passi City Hall			
TOTAL RESPONSE TIME: 10 Minutes			

C. PREPARATION OF ACCOUNTANT'S ADVICE

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit checks signed by the City Treasurer and Local Chief Executive/ City Administrator/ City Vice Mayor with corresponding Disbursement Voucher	a. Check with complete details	5 minutes	**MILDRED P. PAGAYON** Administrative Aide III **CYRIL P. MALOCO, CPA** Supervising Administrative Officer **ROCHILLE D. PALOMO, CPA** City Accountant I
2. Wait for the preparation and signature of Accountant's Advice	a. Accountant's Advice with complete details	5 minutes	**MILDRED P. PAGAYON** Administrative Aide III **CYRIL P. MALOCO, CPA** Supervising Administrative Officer **ROCHILLE D. PALOMO, CPA** City Accountant I

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
3. Deliver Accountant's Advice to concerned banks by authorized representative	a. Signed Accountant's Advice	15 minutes	**MILDRED P. PAGAYON** Administrative Aide III **ROBERTO P. CARGASON** Administrative Aide III **WILLY BOY DE LOS SANTOS** Administrative Aide III (Driver)
	a. Accountant's Advice with complete details	5 minutes	**MILDRED P. PAGAYON** Administrative Aide III **CYRIL P. MALOCO, CPA** Supervising Administrative Officer **ROCHILLE D. PALOMO, CPA** City Accountant I
Accomplished Client feedback form and submit it to the Information Officer or Human Resource & Management Personnel on duty at the front desk of Passi City Hall			
TOTAL RESPONSE TIME : 30 Minutes			

D. PASSI CITY COLLEGE ASSESSMENT OF PAYMENT FOR ENROLLMENT OF STUDENTS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Assessment of Payment for enrollment	a. Registration Form approved by College Registrar and Acting College President	5 minutes	**MARY JOY P. LORCA** Administrative Assistant I **ROCHILLE D. PALOMO, CPA** City Accountant I
2. Signing of clearance	a. Clearance for verification of account balances	5 minutes	**MARY JOY P. LORCA** Administrative Assistant I **ROCHILLE D. PALOMO, CPA** City Accountant I
Accomplished Client feedback form and submit it to the Information Officer or Human Resource & Management Personnel on duty at the front desk of Passi City Hall			
TOTAL RESPONSE TIME PER VOUCHER : 5 Minutes			

SERVICES OFFERED BY THE CITY ADMINISTRATOR'S OFFICE

A. APPROVAL OF FINANCIAL/MEDICAL/BURIAL ASSISTANCE FOR INDIGENTS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit the requirements to the person In-Charge.	Certificate of Indigency, Medical Certificate/Medical Abstract, Certificate of Confinement, Hospital Bill, Death Certificate.		**LILY P. PALMARES MA. ELSIE PILARCO**
2. In-charge person will review and record the documents.		8 minutes	**LILY P. PALMARES MA. ELSIE PILARCO**
3. Head of Office/Authorized Person will sign the complete documents.		15 minutes	**ATTY. STEPHEN A. PALMARES, CPA, BENIFREDOP.MATUCAN**
4. The approved documents will be released for submission to the Office of the DSWD.		3 minutes	**LILY P. PALMARES MA. ELSIE PILARCO**
TOTAL RESPONSE TIME: 26 minutes			

B. APPROVAL OF LABORATORY ASSISTANCE FOR INDIGENTS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Present the required documents to the person-in-charge.	Brgy. Indigency & Laboratory Request		**LEODELINE P. PANIZALES & MAE DELA PEÑA**
2. In-charge person will check and attach certification and record the documents to be approved by the Authorized Person.		15 minutes	**LEODELINE P. PANIZALES & MAE DELA PEÑA**
3. Head of Office/Authorized Person will sign the Certification.		15 minutes	**ATTY. STEPHEN A. PALMARES, & BENIFREDO P. MATUCAN**
4. Release the approved documents to be brought to the assigned medical laboratory.		3 minutes	**LEODELINE P. PANIZALES & MAE DELA PEÑA**
TOTAL RESPONSE TIME: 33 minutes			

C. APPROVAL OF TRIP TICKETS AND VALE SLIP

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit the filled-up Vale Slip and Trip Tickets to the person-in-charge one day before or 30 mins. Before the trip.	(For travel outside the City) Travel Order and Vale Slip and Trip Ticket.		**LEZA S. CERBAS** **MAE A. DELA PEÑA** **ANABELLE C. AGAPITO**
2. Person-in-charge will check the balance of fuel in the tank in order to evaluate the number of liters to be issued, (depending on the purposed/ destination of travel) and will record the documents.		5 minutes	**LEZA S. CERBAS** **MAE A. DELA PEÑA** **ANABELLE C. AGAPITO**
3. Head of Office/Authorized Person will approve the requested Vale Slip and Trip Ticket.		15 minutes	**ATTY. STEPHEN A. PALMARES, CPA** **DEOEL P. PADILLA** **MARBEN PANERIO**
4. Person-in-charge- release the approved Vale Slip and Trip Ticket to be brought to the authorized gasoline station.		3 minutes	**LEZA S. CERBAS** **MAE A. DELA PEÑA** **ANABELLE C. AGAPITO**
TOTAL RESPONSE TIME: 23 minutes			

D. APPROVAL OF VOUCHER FOR REGULAR RECURRING ADMINISTRATIVE EXPENSES

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit the complete documents to the person-in-charge.	OBR, Voucher and Billing Statement.		**LILY P. PALMARES** **LEZA S. CERBAS**
2. Check, scrutinize and record the complete documents.		20 minutes	**LILY P. PALMARES** **LEZA S. CERBAS**
3. The head of Office will evaluate the documents before signing.		10 minutes	**ATTY. STEPHEN A. PALMARES** **DEOEL P. PADILLA**
4. Release the approved documents.			**LILY P. PALMARES** **LEZA S. CERBAS**
TOTAL RESPONSE TIME: 33 minutes			

E. APPROVAL OF DOCUMENTS FOR PROCUREMENT OF GOODS, INFRASTRUCTURE AND SERVICES (Php 300,000.00 AND BELOW)

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit the complete documents to the person-in-charge.	OBR, PR, Voucher, NOA, NTP, Receipt/Charge Invoice, Contract of Agreement, BAC Resolution, Abstract, RIS & Acceptance.		**CARMEN P. DAGUM** **& MENCHIE P. DOLAR**
2. The person-in-charge will review, scrutinize and record the complete documents submitted.		15 minutes	**CARMEN P. DAGUM** **MENCHIE P. DOLAR** **MARIA NELVA P. JARELL**
3. Head of Office will sign the documents submitted.		10 minutes	**ATTY. STEPHEN A. PALMARES** **DEOEL P. PADILLA** **BENIFREDO P. MATUCAN**
4. Release the approved documents.		3 minutes	**CARMEN P. DAGUM** **MENCHIE P. DOLAR**
TOTAL RESPONSE TIME: 33 minutes			

OFFICE OF THE CITY ASSESSOR
SERVICE PLEDGE

The Office of the City Assessor shares a deep commitment to serve all taxpayers and real property owner of the City of Passi to deliver quality services and to provide assessment and appraisal of real property for taxation purposes without fear or favor a most equitable, efficient, effective, just and fair manner.

The office provides the basic services like assessment of lands, buildings and machineries, the preparation of Sketch Plan and Barangay Map Plans of the City of Passi, Vicinity Maps and other transactions related to tax mapping, appraisal and assessment operations. Conducts field verification if necessary. Regularly conducts ocular inspection of new building, machinery and equipment to update assessment records and to determine the prevailing market value in the City of Passi.

ASSESSMENT OF REAL PROPERTIES

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. SUBDIVISION	Approved SD Plan Subdivision Agreement Current Tax Receipt Sworn Statement Php 300.00 for Inspection fee per lot	2-10 sublots – 2 days 11-20 sublots – 5 days 21 sublots up – 10 days	**ASSESSMENT RECORDS MANAGEMENT DIVISION**
2. Consolidation/ Subdivision	Approved SD Plan Subdivision Agreement Current Tax Receipt Sworn Statement Php 300.00 for Inspection fee per lot	2-10 sublots - 2 days 11-20 sublots – 5 days 21 sublots up – 10 days	**ASSESSMENT RECORDS MANAGEMENT DIVISION**
3. Alienable and Disposable	Approved Plan Certification from CENRO 10 years back taxes Php 300.00 for Inspection fee per lot	2-10 sublots - 2 days 11-20 sublots - 5 days 21 sublots up - 10 days	**ASSESSMENT RECORDS MANAGEMENT DIVISION**
4. Reclassification / Reassessment	Letter request from the lot owner Current Tax Receipt Sworn Statement Php 300.00 for Inspection fee per lot	5 days per lot and after ocular inspection if the location of the property is more than 10 kilometers from the City Hall 2 days per lot and after ocular inspection if the location of the property is less than 10 kilometers from the City Hall	**ASSESSMENT RECORDS MANAGEMENT DIVISION**

ISSUANCE OF TAX DECLARATION

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Owner's Copy-Simple Transfer	a. Photo Copy of Title (bring original) orcertified true copy from ROD b. Current tax receipt c. Sworn Statement Approved SD Plan	2 days if Tax Declaration to be transferred is less than 10 5 days if Tax Declaration to be transferred is less than 15 hour if CTC is less than 10 3 hours if more than 20	ASSESSMENT RECORDS MANAGEMENT DIVISION
2. Certified True Copy	a Current Tax b. Sworn Statement c. Php 200.00 per copy		ASSESSMENT RECORDS MANAGEMENT DIVISION

ISSUANCE OF CERTIFICATION TO ASSESSMENT RECORDS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Certification of Improvement or no improvement	Php 150.00 per lot	hour if there is no improvement or with 5 improvements 2 hours if there is no landholding or with 5 landholdings 3 hours if there is more than 5 landholdings	ASSESSMENT RECORDS MANAGEMENT DIVISION
2. Certificate of Real Properties/ Aggregate Landholding	Php 150.00 per lot		ASSESSMENT RECORDS MANAGEMENT DIVISION
3. A. Sketch Plan B. Vicinity Map	Php 200.00 Php 250.00	2 hours	ASSESSMENT RECORDS MANAGEMENT DIVISION TAX MAPPING DIVISION
4. RESEARCH FEE	Php 100.00 per lot	30 minutes	ASSESSMENT RECORDS MANAGEMENT DIVISION

SERVICES OFFERED BY THE CITY BUDGET OFFICE

The Office of the City Budget provides the City Mayor, members of the Sangguniang Panlungsod and other officials such technical assistance and financial data which may be needed in budget process. It also provides the city with efficient and progressive organization for fiscal administration particularly in budgeting services.

A. ANNUAL/SUPPLEMENTAL BUDGET

Submits annual budget for authorization to the Sangguniang Panlungsod on October 16 every year, complete and accurate. Prepare one Supplemental Budget in every quarter and submit the same to Sangguniang Panlungsod for review and approval.

B. ISSUANCE OF QUARTERLY ALLOTMENT RELEASE ORDER

This service of the City Budget Office is to keep track the balance of allotment of different offices of the City of Passi and automatically inform them of the remaining budget for every quarter. The issuance of the quarterly allotment release order (ARO) is given every three months on the first week of every quarter.

C. BUDGET CONTROL

PROCESSING OF OBLIGATION REQUEST

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit doccuments	Obligation Request with pertinent papers attached: For Travel – (Cash Advance) OBR, Voucher, Travel Order, Appendix A, Communication, Authority to cash advance (Reimbursement) OBR, Voucher, Appendix B, Appearance, Ticket & RER For Supplies – OBR, Voucher, PR, PPMP For regular monthly bills – OBR, Voucher, Billing Statement & Official Receipt for reimbursement For Financial/Burial Assistance – OBR, Voucher, Brgy. Indigency, Certificate of Eligibility, Medical Certificate/Death Certificate For Payroll Job Order – OBR, Voucher, Job Contract, Program of Expenditure, Labor Payroll, Accomplishment Report & DTR For Payroll Regular – OBR, Voucher and Payroll For Development projects – OBR, Voucher, Program of Works & Project Statement	5 minutes	**JUNGERIN A. PALMA** for recording **KAREN A. COLLADO** for checking and review

2.	Doccuments will be forwarded to action officer or assigned personnel for checking/review to determine appropriation		10 minutes	
3.	Action Officer/Assigned Personnel will check if there is an available fund and posts Obligation request to logbook and assigns control number. If there is no available fund, it will be return back to the office concerned.		5 minutes	
4.	Action Officer/Assigned Personnel will record and affix initial		5 minutes	
5.	City Budget Officer I will certify existence of appropriation		5 minutes	AZUCENA C. TORILLA
6.	Releasing of documents to the client or to the Office of the City Treasurer.			
	Total processing time: 30 minutes			

Action Officer/Assigned Personnel	**Assigned Offices**
Rowena P. Alejano	City Mayor/Local School Board
Ryne P. Castellano	Local School Board
Ofelia B. Paguidian	Passi City College/Market/Slaughterhouse/Bus Terminal

Joean C. Pasit	City Treasurer/Assessor/Office of the Sangguniang Panlungsod/Special Appopriation/Business and Licensing Office
Maria Salome P. Dilag	City Agriculture/Social Welfare and Development
Margie C. Camacho	City Information/Motorpool/BJMP/PNP/Fire
Efren P. Pineda	City Planning & Dev't. Coor./Gen. Services/Court/CENRO/Auditor
Shem C. Lico	City Administrator/Health/Registrar/HRDO
Alma M. Limogmog	City Accounting/Budget/Tourism
Alona Ann D. Padios	City Legal/Public Utilities/Beautification
Dinah P. Diala	City Engineer
Karen A. Collado	5%/20%/Continuing

D. THE REVIEW AND ENDORSEMENT OF BARANGAY BUDGET (ANNUAL/SUPPLEMENTAL)

The City Budget is tasked to assist barangay in the preparation of the annual budget to ensure compliance with statutory contractual obligation and budgetary requirements prior to review and approval of the Sangguniang Panlungsod. Conducts preliminary review of 51 Barangay budget 1 hour upon submission of Barangay Treasurer.

Upon approval of the Barangay budget, the City Budget Office shall furnish the copies to the Sangguniang Barangay and City Accounting Office.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit Barangay Budget for review and evaluation	Annual Barangay Budget a. Transmittal Letter of the Barangay Secretary b. Budget Message of the Punong Barangay c. The Authorized Expenditures Program for the Budget or Appropriation Ordinance d. Budget of Expenditures and sources of Financing e. Barangay Development Plan or Barangay Investment Plan	1 day	**AZUCENA TORILLA** City Budget Officer I **ENGR. MARY JEAN QUILING** CPDC I **PAQUITO J. ESTANDARTE JR.** City Treasurer I **ROCHILLE D. PALOMO** City Accountant I
2. Wait for the review and recommendation of the Sangguniang Panlungsod			**Sangguniang Panlungsod**

SERVICES OFFERED BY THE OFFICE OF THE CITY ENGINEER

The Office of the City Engineer is in –charge of infrastructure and public works. Aside from engineering services, it also conducts surveys, technical supervision and management of the 51 Barangays that rebounds to the proper implementation of the projects of the LGU.

A. PREPARATION OF PROGRAM OF WORKS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Present your letter request for the preparation of POW/ Plan to the Administrative Section to be forwarded to the City Engineer and Infra -Planning Section.	Letter request stating project title, source of fund and amount of the project with signature/ approval of the City Mayor/City Administrator	5 Minutes	**KRISTEL DAWN P. PALMARES** **JULIA S. CIA** **FE P. AGUILAR**
2. Coordinate with Planning Section for schedule of site inspection, survey and data gathering.	Letter request received by the Office of the City Engineer.	10-15 minutes	**ENGR. ILDEFONSO NOLI S. MOSQUERA** **VICTOR AGUILAR** **ARNOLD PABIONA** **LEO JARUDA** **SAMSON PADRE-E**
Note: Preparation of Program of Works will take 4- 5 days to finish due to actual site inspection survey of the area and data gathering			

3. Ask your Project Engineer of the Program of Works funded by your Brgy . IRA for your signatory on approval.			**ENGR. MARYANN TAGAYTAYAN** **ROLANDO PALOMADO** **ENGR. SHENIBETH SERAFICO** **ENGR. ANDREA A. BELARMA**
4. Return to the Office of the City Engineer and get your approved Program of Works noted by the City Mayor.		10 minutes	**LALYN PALOMARIA** **ENGR.AGNESHOPEPALMARES**
5. Coordinate with the Infra Planning Section of your approved Program of Works funded by the City IRA.		10 minutes	**LALYN PALOMARIA** **ENGR.AGNESHOPEPALMARES**

B. PROCESS DELIVERY AND CLAIMS OF MATERIALS FOR VERTICAL AND HORIZONTAL PROJECTS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
BRGY. IRA 1. Request inspection of the delivery of materials.	Letter request for inspection of materials a. Voucher b. Inspection Report c. Requisition & Issuance Slip d. Acceptance & Inspection Report e. Charge Invoice f. BID Documents g. PR h. POW i. OB/R (Additional documents for One Job Contract Projects) j. Certificate of Project completion	1-5 weeks (site inspection of project as to quality assurance).	**KRISTEL DAWN P. PALMARES** **LALYN PALOMARIA** **ENGR. DIADEMA PILARTA** **ENGR. ALDRIN AYALIN** **ENGR. EDMUND PAMA** **(For Electrical Materials)** **ENGR. RICHARD DERIADA** **ENGR. ELBERN B. PADIOS**
	k. Certificate of Payment l. Certificate of Acceptance m. Statement of Work Accomp. n. Pictures (before, during and after) o. PERT. CPM p. Time Elapsed q. Letter request for inspection of COA.		

2. Coordinate with the respective Engineer concerned for approval of supporting documents.		5-10 minutes	**ENGR. ALDRIN AYALIN** **ENGR. EDMUND PAMA** **ENGR. DIADEMA PILARTA** **ENGR. AGNES HOPE PALMARES** **ENGR. MOISES ITURIAGA**
3. Return to the office of the City Engineer, Administrative Section for follow up of documents submitted to Accounting.			

C. PROCESS CERTIFICATE OF OCCUPANCY FOR BUSINESS PERMITS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Secure Certificate of Occupancy (Business)	Present Approved Zoning Clearance for private applicants and market clearance for market vendors	15 minutes	**EUFEMIA P. AGUJITAS** **ENGR. ILDEFONSO NOLI S. MOSQUERA**
	Note: Zoning Clearance Exemted for Market Vendors		
2. Request for Inspection of Electrical Installation (Private)	For New Applicants please provide As-Built Electrical Plan	10 minutes	**ENGR. ELBERN PADIOS** **ENGR. RICHARD Q. DERIADA**
3. Submit application for Assessment	For New Applicant only	15 minutes	**ENGR. ILDEFONSO NOLI S. MOSQUERA**
4. Request for Inspection of Structure	Application form with Picture of building	1 day	**ENGR. ILDEFONSO NOLI S. MOSQUERA**
5. Secure approved permit	Application form w/ complete requirements	15 minutes	**ENGR. MOISES A. ITURIAGA**

D. HOW TO SECURE PERMITS RELATIVE TO PD 1096 OR NATIONAL BUILDING CODE OF THE PHILIPPINES SUCH AS BUILDING, ELECTRICAL, SANITARY/PLUMBING, MECHANICAL, ELECTRONICS AND OTHER ANCILLARY PERMITS AND ITS ACCESSORY. (BUILDING PERMIT)

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Secure Application Forms and Requirements		5 minutes	EUFEMIA P. AGUJITAS ENGR. ILDEFONSO NOLI S. MOSQUERA
2. Fill up/accomplish the Application Forms and comply all the requirements and submit to the office of the Building Official		25 minutes	EUFEMIA P. AGUJITAS ENGR. ILDEFONSO NOLI S. MOSQUERA
3. Wait for the schedule of inspection		2 days	ENGR. ILDEFONSO NOLI S. MOSQUERA
4. Comply the Lacking Documents *(if documents are not complete)*	If completed As to the completeness of documents	5 minutes	For Land Use and Zoning, Plumbing/ Sanitary, Architectural, Structural, Line and Grade: ENGR. ILDEFONSO NOLI S. MOSQUERA Electrical: ENGR. RICHARD Q. DERIADA Mechanical: ENGR. PEPITO S. PALMARES Electronics: ENGR. LIRA P. LADIGOHON ENGR. EUFEMIA P. AGUJITAS
5. Pay the assessed payments at the Office of the City Treasurer	Present Official Receipt		ENGR. ILDEFONSO NOLI S. MOSQUERA

6. Return the OR to the Building Official		15 minutes	EUFEMIA P. AGUJITAS
7. Bring the Application Form and Plans together with the complete required documents to the Bureau of Fire Protection and secure the Fire Safety Clearance.		5 minutes	ENGR. MOISES A. ITURIAGA
8. Return the documents to the office of the Building Official with Fire Safety Clearance for approval of Permit.		10 minutes	ENGR. MOISES A. ITURIAGA
9. Receive the Approval Permit		15 minutes	EUFEMIA P. AGUJITAS ENGR. ILDEFONSO NOLI S. MOSQUERA

E. PROCESSING OF NICHE CLEARANCE

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Request inspection of area	Death Certificate	1/2 day	EUFEMIA P. AGUJITAS
2. Assessment/ Evaluation	Certification Fee / P 242.00	15 minutes	ENGR. ILDEFONSO NOLI S. MOSQUERA
3. Issuance of Niche Clearance	Official Receipt	30 minutes	ENGR. MOISES A. ITURIAGA

SERVICES OFFERED BY THE OFFICE OF THE CITY GENERAL SERVICES

Delivery of janitorial services, maintenance services of the City Hall Building and its premises, and other public services such as the Passi Public Cemetery, update registrations and insurance of all motor vehicles owned by the City Government of Passi; maintenance and safeguard inventories and records of real properties owned by the City Government and Procurement of Goods and Services/Infrastructures Project based on R.A. 9184.

A. HOW TO SECURE "PAHANUGOT" FOR EXHUMATION OF NICHES IN THE PUBLIC CEMETERY

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Verify the records of payment	Official Receipts	5 minutes	ELYN P. MELLIZA
2. Request yellow card for payment before exhumation	Death certificate and burial fee of P100.00	3 minutes	ELYN P. MELLIZA
3. Request documents (PAHANUGOT)	Exhumation Fee – P100.00	1 minute	ELYN P. MELLIZA
4. For signature of PAHANUGOT a. Payor b. GSO	a. if not a payor – authorization from payor	1 day 1 minute	GSO
5. Return yellow card			G S O
6. Submit copy of Pahanugot	Pahanugot	1 minute	1 – CHO (Sanitation)/ 1 - Cemetery Caretaker

B. HOW TO UPDATE/VERIFY PAYMENT FOR RENTAL OF NICHES

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Verify records (Yellow Card)	Official Receipts	3 minutes	ELYN P. MELLIZA
2. Request yellow card for payment to CTO for Rental	Official Receipts		GSO CTO
3. Return Yellow Card		5 minute	CGSO
Approximate processing Time: 1 day and 23 minutes			

C. PROCUREMENT OF OFFICE SUPPLIES, EQUIPMENT & PROJECTS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Receive approved PR & OBR	PR & OBR	5 minutes	VERGINIA F. PAGAYON
2. Submit PR/OBR for signature and approval			Admin./CMO/Budget Office
3. Submit copy of approved PR/OBR to COA		15 minutes	VERGINIA F. PAGAYON
4. Submit approved PR / OBR for Mode of Procurement		15 minutes	BAC/CGSO
Approximate processing Time: 35 minutes (Excluding A. Signature of City Mayor)			

D. DELIVERY/ACCEPTANCE OF OFFICE SUPPLIES, MATERIALS AND EQUIPMENTS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Receives Contract / NOA/NTP	Approved Contract	1 minute	**JOHNALIE S. CUBITA**
2. Inform Supplier of Delivery Schedule			**JOHNALIE S. CUBITA**
3. Receives Delivery a. Office Supplies & Equipment b. Materials	Delivery Receipt/Charge Invoice	10 minute	**RITCHE CERBAS** **ROLANDO PAMPLONA, II**
4. Accept & Inspect delivery	Acceptance and Inspection Report	10 minute	**RICARDO P. PACIENTE** **JOHNALIE S. CUBITA**
5. Issue Delivery to end user	Requisition and Issue Slip	20 minute	**MA. IRENE GRACE P. BALBON**
6. Submit Acceptance and Inspection Report to COA		within 24 hrs.	**JOHNALIE S. CUBITA**
7. Prepare necessary documents - ARE for equipment - Property custodian slip - Stock card - Property card		15 minutes	**NEDIE P. PALMA** **ELYN P. MELLIZA**
8. Prepare Disbursement Voucher for payment and submit to Accounting Office		25 minutes	**JHONA MAE E. MORENO**
Approximate processing Time: 3 days, 1 hr. & 36 minutes (Excluding A. Signature of City Mayor)			

SERVICES OFFERED BY THE OFFICE OF THE CITY MAYOR

The Office of the Mayor exercises executive direction, control, supervision and management of government affairs. It aims to provide able leadership in planning, programming, coordination and implementation of development projects and activities of different offices, departments and agencies, including those of the private sectors when public interest is involved in order to promote progress and well-being of the people in an atmosphere of peace and security.

As the center of all transactions in the local government unit of Passi, the Office of the Mayor ensures the delivery of basic services to its constituents. It is a venue of meetings and conferences pertaining to various issues and concerns including different sectors of the community. It is also the venue of civil wedding ceremonies officiated by the mayor himself. The office issues permits, clearances, certifications, referrals, endorsements and recommendation to different concerned individuals and entities. It issues executive orders, office orders, administrative orders and memoranda to ensure that officials and employees faithfully discharge their duties and functions.

The city headed by the mayor, sponsors the local scholarship program offered to poor but deserving students who are bonafide residents of the city. Financial assistance is also given to NGO's that promote physical, historical and cultural developments of the city through programs and activities related thereto.

As the nerve of the entire local government machinery of the City of Passi, this office sets the policies and overall direction of the local governance in terms of development thrusts and priorities in coordination with and supported by the different departments and line agencies.

A. ISSUANCE OF MAYOR'S CLEARANCE, JOB RECOMMENDATIONS AND CERTIFICATIONS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit documents for evaluation/ verification and preparation of mayor's clearance, recommendation and certification	a. Barangay Clearance b. Residence Certificate c. Police Clearance d. Court Clearance e. Resume or Biodata (for job recommendation)	15 minutes	Administrative Officer III
2. Pay the required fee at the Office of the City Treasurer	Order of Payment	5 minutes	City Treasurer's Office Personnel
3. Return to the Mayor's Office for signature of Executive Assistant or the processing and release of clearance, recommendation or certification	Official Receipt	5 minutes	Administrative Officer III
Total Response Time : 25 minutes			

B. LETTER REQUEST

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit letter request for approval of the City Mayor	Request Letter	3 minutes	Administrative Officer V
2. Approved request is referred/indorsed to concerned officer	Request Letter	3 minutes	Administrative Officer V
3. Inform the Mayor's Office of the action taken	Letter	1 10 minutes	Administrative Officer V
Total Response Time : 18 minutes			

C. ISSUANCE OF MAYOR'S PERMIT - Special Recruitment Activity (SRA), Social Activities (live bond, pool party etc.)

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit letter request for approval	Request Letter	3 minutes	Administrative Officer V
2. Prepare Mayor's Permit for signature of the Mayor and conformity of the Chief of Police	Mayor's Permit	10 minutes	Computer Operator
3. Pay the required fee at the Office of the City Treasurer	Order of Payment	5 minutes	City Treasurer's Office Personnel
4. Return to Mayor's Office for release of permit	Official Receipt	3 minutes	Administrative Officer V

D. APPROVAL OF VOUCHERS AND OTHER DOCUMENTS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit documents	Documents	2 minutes	Administrative Officer III
2. Waits for evaluation and verification	Documents	5 minutes	Administrative Officer III
3. Waits for approval	Documents	20 minutes	City Mayor or City Administrator
4. Return to Mayor's Office for release of permit	Official Receipt	3 minutes	Administrative Officer V
Total Response Time : 27 minutes			

SERVICES OFFERED BY THE OFFICE OF THE CITY PLANNING AND DEVELOPMENT COORDINATOR

The Office of the City Planning and Development Coordinator is responsible in promoting people's participation in Development Planning with the City; exercise supervision and control over the SECRETARIAT of the development council and exercise such other powers and perform such other duties and functions prescribed by law (e.g. RA 7160) and ordinances.

A. ISSUANCE OF CERTIFICATE OF ZONING TO BUSINESS ESTABLISHMENTS

Business/owners operators must secure Zoning Certificate as requirements for business permits. Zoning Administrator issues approve Zoning Certificate if it conforms with zoning regulations of the City.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Person In-Charge receives required documents from client	**Application Form** a. Lease Contract between the lessor and the lessee. b. Business Name Registration with DTI for sole proprietorship c. Articles in Incorporation or Partnership d. National Grains Authority License in Case of Dealer of Rice. e. Bureau of Food and Drug Administration in case of Drug Store/Bakery. f. Accreditation Certificate issued by DTI in case of Auto Repair Shop, Electronics, Radio and Electrical Equipments. g. Real Estate Broker's License issued by DTI in case of Real Estate Broker. h. Department of Labor Employment in case Recruitment Agency.	10 minutes	**JOEL P. HOLLERO** Zoning Inspector I **ENGR. MARY JEAN L. QUILING** CPDC I/ Zoning Administrator **EMILY DADOR** Senior Administrative Assistant I

	i. Central Bank Authority in case of Banking Institution. j. Pest Control License issued by the Fertilizer and Insecticide in case of Pest Control. k. Video gram Permit issued by the video gram Regulatory Board in case of Video Rental Services. l. Occupancy permit and ownership case of Real Estate Lessor. m. Future Commodity Merchant/Broker's License issued by the Securities and Exchange Commission Application Form n. PCSUIA (National License) for those operating Security Agency. o. Department of Environment and National Resources Clearance in case of Mining. p. LTO Franchising and Regulatory Board in case of Rent-a-Car and Transport Services.		

	q. License to Operate – Firearms and Explosive units (Camp Crame) r. Department of Transportation and Communication (DOTC) in case of Messengerial and Courier Services. s. Energy Regulatory Board (ERB) in case of LPG t. National Telecommunication Commission (NTC) in case of Telecommunications. u. Barangay Clearance v. Other Documents Request to submit **For new Business:** Conduct inspection and verification of the business. After verification of the business, the CPDC sign the business zoning clearance **For Old Business:** Evaluate and sign the business zoning clearance		
2. Person-In-Charge interview and evaluate the application for together with the submitted documents		Depending on the business location	**Engr. Mary Jean L. Quiling** CPDC I/ Zoning Administrator **Joel P. Hollero** Zoning Inspector I
3. Person-In-Charge releases the approved business zoning clearance		5 minutes	**Nora L. Sotomil** Administrative Aide VI **Emily Dador** Senior Administrative Assistant I

B. PROCESSING OF APPROVAL FOR DEVELOPMENT OF SUBDIVISION PROJECTS

In accordance with Section 4 of P.D. 957 as its implementing rules and regulations, as amended by Executive Order No. 648 dated 07 February 1981 and further amended E.O. No. 90 dated 15 December 1986, owners/developers shall apply for approval for development of subdivision project

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Person-In-Charge receives required documents from client	Notarized Application Form A. Simple Subdivision a. 3 sets of the following documents duly signs and sealed by Licensed Architect/Engineer ➢ Site Development Plan showing the proposed lay-out ➢ Vicinity Map b. Certified True Copy of Title(s), tax declaration(s), Deed of Sale/Memorandum of Agreement if the Title is not registered in the name of the applicant c. Certification as to Zoning Classification d. Tax Clearance Receipt e. Tax Declaration Receipt	10 minutes	**ENGR. MARY JEAN L. QUILING** CPDC I/Zoning Administrator **JOEL P. HOLLERO** Zoning Inspector I **EMILY DADOR** Senior Administrative Assistant I

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Person-In-Charge receives required documents from client	B. Complex Subdivision a. 4 sets of the following documents duly signed and sealed by Licensed Architect/Engineer ➢ Site Development Plan showing the proposed lay-out (Schematic Plans) ➢ Topographic Plan ➢ Vicinity Map with a minimum of two (2) km radius from the periphery of the proposed project to existing community facilities such as churches, schools, markets, hospital, transportation lines, drugstores, etc. b. Certificate True Copy of Title(s), Tax Declaration(s), (Right to Use) Intent to Sell from Lot Owner c. Clearance to conversion of property from agricultural land/pasture land to residential use from DAR		**ENGR. MARY JEAN L. QUILING** CPDC I/Zoning Administrator

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
	d. Zoning Certification e. Letter of endorsement of the project from the Local Government. Notarized Application Form C. Final Approval Subdivision The following documents duly signed and sealed by a Licensed Architect/Engineer: a. One copy of Topographic Map of Site b. Three copies of Site Development c. Three copies of Road (Geometric and Structural) Design Plan ➢ Profile showing the vertical control designed grade, curve elements and all information needed for construction ➢ Typical roadway section showing relatives dimension and slopes of payment, gutter, sidewalls shoulders, benching and others.		ENGR. MARY JEAN L. QUILING CPDC I/ZONING Administrator

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
	➢ Details of roadway showing the required thickness of pavement, sub-grade treatment and sub-base course on those course on the design analysis ➢ Details of roadway miscellaneous structures such as curb, and gutter (barrier, mountable and drop) slope protection wall and retaining wall, if any. d. Three copies of Storm Drainage and Sewer System ➢ Profile showing the hydraulic gradients and properties of the main lines including structures in relation with the road grade line ➢ Details of Drainage and miscellaneous structures such as various types and manhole catch basin inlets (curb, gutter and drop), culverts and channel linings		

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
	e. Three copies of Water System Lay-out and Details f. Three copies of Site Grading Plan Two copies of Project Study for Projects having an area of one (1) hectare and above the following financial attachments: 1. Audited Assets and Liabilities/Income Statement 2. Income Tax Return (for last 3 years) 3. Certification of Registration with SEC 4. Articles of Incorporation by- laws and Implementing Amendment, Specification, Bill of Materials and Cost estimate.		
2. Person In-Charge Evaluates lot plans and other Requirements		10 minutes	ENGR. MARY JEAN L. QUILING CPDC I/Zoning Administration

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
3. Conduct site inspection and Prepare Site Inspection Report		Depending on the location of the project	**JOEL P. HOLLERO** Zoning Inspector I
4. Issuance of Zoning Certification Fee	Zoning Certification Fee (250.00/ has)		City Treasurer's Staff
5. Submission to the Office of the Sangguniang Panlungsod for Approval	Official Receipt for Subdivision Approval fee	Three (3) regular Session 15 minutes	Office of the Sangguniang Panlungsod Staff **ENGR. MARY JEAN L. QUILING** CPDC I/Zoning Administration
6. Processing of subdivision approval Order of Payment for Release	Official Receipt for Subdivision Approval fee	\ \	**JOEL P. HOLLERO** Zoning Inspector I
7. Process Notice of Approval		Upon signed	**CITY MAYOR**
8. Release approved Documents	Official Receipt	5 minutes	**NORA L. SOTOMIL** Administrative Aide VI **EMILY DADOR** Senior Administrative Assistant I

C. ISSUANCE OF ZONING CLEARANCE FOR BUILDING CONSTRUCTION

All owners/developers shall secure Locational Clearance from the Zoning Administrator prior to conducting any activity of construction of their property/land.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Person-In-Charge receives required Documents from client	a. Duly accomplished and notarized application form b. Written proof of applicant's right over the project site (Land Title/Affidavit of Consent) c. Vicinity Map Site Development Map d. Bill of Materials e. Specification f. Tax Clearance g. Zoning fee	25 minutes	**ENGR. MARY JEAN L. QUILING** CPDC I/Zoning Administrator **Joel P. Hollero** Zoning Inspector I
2. Evaluation of plans and location of the Project		15 minutes	**ENGR. MARY JEAN L. QUILING** CPDC I/Zoning Administrator
3. Approval of Locational Clearance			**ENGR. MARY JEAN L. QUILING** CPDC I/Zoning Administrator
4. Prepares Order of Payment	Official Receipt for Locational Clearance Fee (as per estimated cost of construction)	15 minutes	**JOEL P. HOLLERO** ZONING INSPECTOR I **EMILY DADOR** Senior Administrative Assistant I
5. Release approved documents	Official Receipt	5 minutes	**NORA L. SOTOMIL** Administrative Aide VI
			EMILY DADOR Senior Administrative Assistant I

SERVICES OFFERED BY THE OFFICE OF THE CITY TREASURER

The Office of the City Treasurer has the principal duties of collecting and receiving all monies due or accruing to the City. The City Treasurer a mandated by law to take charge of Treasurer's Office and perform the duties provided for under Book II of R.A. 7160 as follows:

* Advice the Mayor, the Sanggunian and other local government and national officials concerned regarding disposition of local government funds and on such other matters relative to public finance;

* Takes custody and exercise proper management of the funds of the local government;

* Takes charge of the disbursement of the local government funds and such other funds the custody of which may be entrusted to him;

* Exercise such other powers and perform such other duties and functions as may be prescribed by law or ordinance

SERVICES OFFERED BY CASH RECEIPTS AND DISBURSEMENT SECTION

A. ISSUANCE AND RELEASE OF CHECK

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client presents to person in-charge	Approved voucher and supporting documents	2 minutes	IMELPA P. WARQUEZ
2. Person in-charge issues check		2 minutes	IMELPA P. WARQUEZ JOY S. DAYOT
3. City Treasurer/Asst. City Treasurer signs the issued check		2 minutes	PAQUITO J. ESTANDARTE, JR. CRISTINO P. DAQUIL
4. Person in-charge forwards the check to the Office of the City Mayor/City Administrator for signature		2 minutes	IMELPA P. WARQUEZ ROWENA P. CEBALLOS GUILLERMA S. PALMARES
Office of the City Accountant prepares Accountant's Advice on Local Check Disbursement and delivers it to the bank			

5. Client pays contractor's tax at the collection window	Payment of fee	2 minutes 2 minutes 2 minutes	NILO BLASICO Admin. Assistant MARK ALLAIN PILARCO RCC I
6. Client issues O.R. and affixes signature to the voucher and logbook & receives check	CTC/Identification Card for validation or Official Receipt for acknowledgment with SPA	2 minutes	ROWENA P. CEBALLOS Guillerma S. Palmares
TOTAL PROCESSING TIME: 12 Minutes excluding the approval and signature of the City Mayor/City Administrator and advice of the City Accounting Department			

B. CASH DISBURSEMENT

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client visits disbursement window 1, 2 or 3 and presents Cedula and/ or ID	CTC or Identification Card	2 minutes	EMILY M. PADILLA MILROSE P. PARRENO ANGIE L. JAGORIN
2. Client Affixes signature to the payroll		1 minute	
3. Disbursing Officer releases cash to the client		1 minute	EMILY M. PADILLA MILROSE P. PARRENO ANGIE L. JAGORIN
TOTAL PROCESSING TIME: 4 Minutes			

SERVICES OFFERED BY LAND TAX SECTION

A. ISSUANCE OF REAL PROPERTY TAX RECEIPT/RPU

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client visits window 2, 4 or 5 and presents documents	Present any of the following: 1. Previous official receipt 2. Title of the property 3. Tax Declaration 4. Deed of Sale/Donation/ Adjudication, etc.	2 minutes	**NILO P. BLASICO** **MARK ANTHONY DAYOT**
2. Revenue Collector verifies, computes and confirms amount of tax to be paid		4 minutes	**NILO P. BLASICO** **MARK ANTHONY DAYOT**
3. Revenue Collector issues Official Receipt		1 minute	**NILO P. BLASICO** **MARK ANTHONY DAYOT**
4. Issuance of Official Receipt		2 minutes	**NILO P. BLASICO** **MARK ANTHONY DAYOT** **NOVEL P. HANDA**
5. Client pays and receives OfficialReceipt		2 minutes	**NILO P. BLASICO** **MARK ANTHONY DAYOT**
TOTAL PROCESSING TIME: 10 Minutes			

B. ISSUANCE OF TRANSFER TAX CERTIFICATE

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client visits window 2, 4 or 5 and presents documents	Present the following documents: 1. Deed of Sale/Adjudication/ Donation, Agreement of partition, etc. 2. Tax Declaration 3. Title to the property 4. Photocopy of Tax Receipt	2 minutes	REYNAFE P. BOSQUE SUSAN A. VILLALOBOS
2. Person in-charge verifies, computes and confirms amount of transfer tax to be paid			SUSAN A. VILLALOBOS
3. Revenue Collector issues Official Receipt and receives payment from client; prepares Transfer Tax Certificate		3 minutes	NILO P. BLASICO MARK ANTHONY DAYOT CHARLYN E. PAUYA
4. City Treasurer/Asst. City Treasurer signs the Transfer Tax Certificate		2 minutes	PAQUITO J. ESTANDARTE, JR. CRISTINO P. DAQUIL
5. Client affixes signature to logbook and receives Transfer Tax Certificate		2 minutes	CHARLYN E. PAUYA
TOTAL PROCESSING TIME: 18 Minutes			

C. ISSUANCE OF TAX CLEARANCE AND OFFICE CERTIFICATION

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client visits window2, 3, 4 or 5 and presents documents	Present any of the following: 1. Official Receipt on Land Tax payment 2. Tax Declaration 3. Title 4. Letter of Consent/Affidavit, etc.	2 minutes	NILO P. BLASICO MARK ALLAIN PILARCO
2. Revenue Collector verifies tax payment		2 minutes	NILO P. BLASICO MARK ALLAIN PILARCO
3. Client pays Certification fee		2 minutes	NILO P. BLASICO MARK ALLAIN PILARCO
4. Person in-charge prepares Certification and have it signed by City Treasurer/Asst. City Treasurer			REYNAFE P. BOSQUE CRISTINO P. DAQUIL
5. Client affixes signature to logbook and receives Clearance/Certification		2 minutes	NILO P. BLASICO MARK ALLAIN PILARCO
TOTAL PROCESSING TIME: 16 Minutes			

D. ISSUANCE OF RECEIPT ON MISCELLANEOUS FEES

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client visits window 2, 3, 4 or 5 and fill-up request form	Payment of any of the following: 1. Community Tax Certificate 2. Police Clearance 3. Service fee 4. Cemetery fee 5. Certification fee, etc.	1 minute	NILO P. BLASICO MARK ALLAIN PILARCO
2. Revenue Collector issues receipt		2 minutes	NILO P. BLASICO
3. Client pays and receives Official Receipt		2 minutes	NILO P. BLASICO
TOTAL PROCESSING TIME: 5 Minutes			

SERVICES OFFERED BY PUBLIC UTILITIES SECTION

A. PAYMENT OF VARIOUS MISCELLANEOUS FEES

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
ON PAYMENT OF MARKET FEES 1. Client approaches PUS Collector and expresses intent to pay		1 minute	**All PUS Collectors**
2. Person in-charge verifies document/ record of stall and electric bill and issues Official Receipt	Present previous official receipts	2 minutes	**All PUS Collectors**
3. Client pays and receives O.R.		2 minutes	**All PUS Collectors**
TOTAL PROCESSING TIME: 5 Minutes			

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
ON PAYMENT OF SPACE OCCUPIED & ENTRANCE FEE 1. Revenue Collector issues cash ticket to market occupant/ Vendor		1 minute	All PUS Collectors
2. Revenue Collector receives payment		2 minutes	All PUS Collectors
TOTAL PROCESSING TIME: 3 Minutes			

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
ON PAYMENT OF SLAUGHTERHOUSE FEES 1. Client submits required documents to Revenue Collector	Certificate of Ownership/Transfer	2 minutes	Assigned Revenue Collector
2. Revenue Collector verifies documents and cowlicks	Weigh Slip with Official Receipt as proof of payment	15 minutes	Assigned Revenue Collector
3. Revenue Collector issues Official Receipt and receives payment		2 minutes	Assigned Revenue Collector
4. Client receives Official Receipt		1 minute	Assigned Revenue Collector
TOTAL PROCESSING TIME: 20 Minutes			

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
ON PAYMENT OF LIVESTOCK/ OKSYON MARKET FEES 1. Client submits required documents to Revenue Collector	Barangay Certification as to Ownership	2 minutes	Assigned Revenue Collector
2. Revenue Collector verifies documents and cowlicks	Facsimile of cowlicks	5 minutes	Assigned Revenue Collector
3. Revenue Collector receives payment and issues Official Receipt and issue Certificate of Ownership	Weigh slip with Official Receipt as proof of payment	10 minutes	Assigned Revenue Collector
4. Client pays and receives O.R. and Certificate of Ownership	Certificate of Ownership of Large Cattle, if previously branded	3 minutes	Assigned Revenue
TOTAL PROCESSING TIME: **20 Minutes**			

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
ON PAYMENT OF BUS TERMINAL FEES 1. Revenue Collector issues cash ticket to Bus driver/conductor		2 minutes	All PUS Collectors
2. Revenue Collector receives payment		2 minutes	All PUS Collectors
TOTAL PROCESSING TIME: **4 Minutes**			

NOTE: There is a change of schedule of **Revenue Collection Clerk assigned every two (2) months.**

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
ON PAYMENT OF TUITION AND MISCELLANEOUS FEES OF PASSI CITY COLLEGE 1. Client visits window 1	Statement of Account/ previous receipt or Request for Payment	1 minute	JEANELYN P. PALOMO
2. Revenue Collector issues Official Receipt		2 minutes	JEANELYN P. PALOMO
3. Client pays and receives Official Receipt		2 minutes	JEANELYN P. PALOMO
TOTAL PROCESSING TIME: 5 minutes			

For signing of PCC clearance:

1. Client visits window 1	PCC Clearance Form	1 minute	JEANELYN P. PALOMO
2. City Treasurer/Asst. City Treasurer signs the clearance		2 minutes	City Treasurer/ Asst. City Treasurer
3. Client receives the signed Clearance		1 minute	JEANELYN P. PALOMO
TOTAL PROCESSING TIME: 4 Minutes			

SERVICES OFFERED BY BUSINESS TAX & MISCELLANEOUS SECTION

A. ASSESSMENT AND COMPUTATION OF BUSINESS TAX

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client presents required documents for verification	1. Filled-up application form 2. Brgy. Clearance 3. Tax Clearance 4. Certificate of Occupancy 5. Environmental Clearance 6. Market Certification (for Market occupants only) 7. Cert. of Zoning (for business outside of market only)	3 minutes	LITA P. SALCEDO
2. Person in-charge assesses and computes business tax and fees		3 minutes	EREMELITO C. DARROCA MA. DAZA P. PENALVER GLORIA LEZ P. PABLICO
3. Client receives assessment and other pertaining documents and secures Community Tax Cert.	Statement of Account/ Assessment	2 minutes	MAE P. BROWN
4. Client visits window 1 or 2; Revenue Collector issues Official Receipt and receives payment	Assessment Form & supporting documents	3 minutes	ARLEEN A. SAYCO KENNYMARIEP.SOMOSERA
5. Client proceeds to get Health Clearance, Police Clearance, Fire Clearance from respective offices		2 minutes	
6. Client submits documents for signature of City Treasurer/ Asst. City Treasurer		2 minutes	City Treasurer/ Asst. City Treasurer
7. Client affixes signature to logbook, receives documents and proceeds to BPLO			Person Incharge
TOTAL PROCESSING TIME: 15 Minutes			

B. PAYMENT OF MISCELLANEOUS FEES

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client visits window 1 or 2 and expresses intent	Payment of any of the following: 1. Community Tax Certificate 2. Franchise Tax 3. Annual Fixed Tax 4. Traffic Violation 5. Filing fee, CTC of birth, marriage and death certificate, etc.	1 minute	MAE P. BROWN MAE P. BROWN ARLENE A. SAYCO
2. Revenue Collector issues official receipt and receives payment		2 minutes	NILO P. BLASICO MARK ANTHONY DAYOT
3. Client pays corresponding amount and receives receipt		2 minutes	NILO P. BLASICO MARK ANTHONY DAYOT
TOTAL PROCESSING TIME: 5 Minutes			

SERVICES OFFERED BY TREASURY OPERATION & REVIEW SECTION

A. PROCESSING OF OBLIGATION REQUEST /PURCHASE REQUEST (from Budget Office)

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Present ObR's/Purchase Request	Obligation Request/PR, etc.	3 minutes	JEFFRY Q. JUNDANTE
2. Records ObR for verificationof availability of fund		10 minutes	MELLA ROSE F. BASBANO ROSELYN P. PENAFLORIDA JEFFRY Q. JUNDANTE
3. Releases ObR to GSO/Accounting Office		7 minutes	Jeffry Q. Jundante
TOTAL PROCESSING TIME: 20 Minutes			

B. PROCESSING OF VOUCHERS (from Accounting Office)

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Presents voucher	Voucher	3 minutes	JEFFRY Q. JUNDANTE
2. Reviews and takes up JEV		7 minutes	MELLA ROSE F. BASBANO ROSELYN P. PENAFLORIDA JEFFRY Q. JUNDANTE
3. City Treasurer/Asst. City Treasurer signs the certificate of availability of fund		5 minutes	PAQUITO J. ESTANDARTE, JR. CRISTINO P. DAQUIL
4. Releases voucher to Mayor's Office		5 minutes	JEFFRY Q. JUNDANTE

TOTAL PROCESSING TIME: 20 Minutes

SERVICES OFFERED BY ADMINISTRATIVE MANAGEMENT & RECORDS SECTION

A. PROCESSING OF CLEARANCES, FRANCHISE, BUSINESS LICENSES, LOANS AND OTHER DOCUMENTS

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. For review of the correctness of documents and affix initial		5 minutes	MA. LUZ P. PACHICA NOVEL HANDA
2. For approval of the City Treasurer/ Asst. City Treasurer		5 minutes	PAQUITO J. ESTANDARTE, JR. CRISTINO P. DAQUIL
3. Personnel in-charge releases documents to clients and affix signature to logbook		5 minutes	MA. LUZ P. PACHICA NOVEL HANDA

TOTAL PROCESSING TIME: 12 MINUTES

A. Releasing of Financial Assistance

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Client visits window 1	Identification Card and Cedula	2 minutes	JEANELYN P. PALOMO
2. Personnel verifies completeness and validity of documents		2 minutes	CRISTINO P. DAQUIL
3. Client affixes signature to voucher and logbook and receives cash		2 minutes	NORMA P. SANTANDER

TOTAL PROCESSING TIME: 6 Minutes

SERVICES OFFERED BY THE OFFICE OF THE CITY LEGAL OFFICER

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
Client visits legal office for queries, or legal opinions	Receives and records endorsements, resolutions, complaints, queries, inter office communications and other related matters;	5 to 15 minutes	CRISLIN EMBOLTURA ROGER B. PACINO
	Sends legal documents thru proper and official couriers;	15 to 30minutes	CRISLIN EMBOLTURA ROGER B. PACINO
	Relays information, notices of meetings/hearings and vital messages to the City Legal Officer;	10 to 20 minutes	CRISLIN EMBOLTURA ROGER B. PACINO
	Refers to the staff concerned, or directly refer to the City Legal Officer any complaints, queries involving questions of law for proper dispositions;	5 to 15 minutes	CRISLIN EMBOLTURA
	Renders legal opinion, queries and clarifications, personally or thru other channels, to the person concerned, Office of the City Mayor, Office of the Sangguniang Panlungsod, Office of the Department Heads, employees or to constituents of the City of Passi;	30 minutes to 3 days	ATTY. QUINTIN O. MAGSICO, JR.

	Assists the City Legal Officer in developing plans and strategies, which are relevant to the programs and projects related to legal mandate of the office;	10 to 30 days	CRISLIN EMBOLTURA
	Assists the City Legal Officer in protecting human rights and prosecuting any violation and protect the constituents particularly during man-made or natural disaster and calamities;	60 min to 1 day	CRISLIN EMBOLTURA
	Draft and render legal opinions when requested to do so by the City Legal Officer;	1 hour to 1day	CRISLIN EMBOLTURA
	Draft legal documents when requested to do so by the Office of the City Mayor, Office of the Sangguniang Panlungsod and other Offices of the City Government of Passi	1 to 5 days	ATTY. QUINTIN O. MAGSICO, JR.
	Represent the City Government of Passi in all criminal and civil actions or special proceedings in court and other quasi-judicial bodies;	30 min to 3 hours	ATTY. QUINTIN O. MAGSICO, JR.

	Investigates or cause the investigation of any Local Official or employee for administrative neglect or misconduct and recommends appropriate action to the Office of the City Mayor;	30 min to 5 days	ATTY. QUINTIN O. MAGSICO, JR.
	Develop plans and strategies, related to legal services which the office is mandated;	10 to 30 days	ATTY. QUINTIN O. MAGSICO, JR.
	Protects and promotes human rights and prosecutes any violation thereof.	60 min to 1 day	ATTY. QUINTIN O. MAGSICO, JR.

SERVICES OFFERED BY THE OFFICE OF THE HUMAN RESOURCE AND DEVELOPMENT

The Human Resource Management focuses on personnel administration of the city government of Passi City, Iloilo develop and administer policies and programs leading to effective organization, qualified and competent employees, equitable treatment, advancement opportunities and job security. It assists the Local Chief Executive and the Sanggunian in the development, formulation and execution of policies, rules and regulations in all areas of personnel management in accordance with Civil Service Laws and Rules. Develops a sound personnel records management and implements a comprehensive and balanced development program designed to raise the level of efficiency, effectiveness and morale of employees.

A. PROCESSING OF APPLICATION FOR LEAVE

Permanent, Temporary, Casual, Contractual and Elective City Government Officials and Employees are entitled to vacation, sick, and other leave privileges.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Fill up request form		2 minutes	201-In-Charge
2. Fill up Application for Leave Form and have it approved by your supervisor	2 copies of Application for Leave Form (CSC Form No. 6, Revised 1984)	3 minutes	201-In-Charge
3. Submit the accomplished form for processing to the 201 In-Charge. Supervising Administrative Officer or Administrative Assistant II in the absence of the latter, reviews and approves the computation on the application for Leave	Medical Certificate of sick leave exceeding 5 days or upon required of the department head Clearance from Money or Property Accountability if leave will last for 30 calendar days or more	30 minutes	201-In-Charge
4. Get Approved Application for Leave		2 minutes	201-In-Charge
TOTAL PROCESSING TIME: 37 Minutes excluding the approval of the City Mayor			
Accomplish Client Feedback Form and drop at designated drop box in front of the Office of the City Treasurer at Passi City Hall.			

B. ISSUANCE OF SERVICE RECORD, CERTIFICATE OF EMPLOYMENT AND OTHER PERSONNEL RECORDS

The city government employees and former employees if not more than 10 years separated from the Local Government Unit may request the HRMO for copies of service records, certificate of employment and other certifications and personnel records.

These are usually required for salary loans and other forms of loans, credit card applications, step increments/promotion, retirement and terminal leave purposes and other purposes not mention herein.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Fill up requested form		3 minutes	**JESSICA P. PALMARES** Administrative Assistant IV
2. Wait for the printing and signing of records		7 minutes	**JESSICA P. PALMARES** Administrative Assistant IV
3. Get record		2 minutes	201-In-Charge
Accomplish Client Feedback Form and drop at designated drop box in front of the Office of the City Treasurer at Passi City Hall.			

C. ISSUANCE OF APPOINTMENT PAPERS OF NEWLY HIRED AND PROMOTED PERSONNEL

Appointment papers for newly hired employees, promoted employees and renewal of appointment for temporary, casual and contractual employees are prepared by the Administrative Assistant IV.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Get requirements from City Government Department Head I	Original copy of Authenticated Certificate of Eligibility/Rating/ License Bio-data with (2) 2x2 ID picture Transcript of Records (Certified True Copy) Diploma (Certified True Copy) Medical Certificate Blood Test Neuro-Psychiatric Test Drug Test Chest X-ray Urinalysis Marriage Contract (if Married) NBI Clearance Mayor's Clearance Birth Certificate	10 minutes	**LA-ARNI P. TRABADO** OIC-HRDO
2. Submit all required documents and duly accomplished form to the 201 In-Charge for verification		7 minutes	201 In-Charge
3. Wait for the preparation of appointment forms and other supporting documents		1 hour	**JESSICA P. PALMARES** Administrative Assistant IV
4. Go to your Supervisor for the signing of the Position Description Form	Position Description Form (PDF)	30 minutes	Concerned Supervisor

5. Submit to the Office of the City Mayor for signing	Appointment Papers	5 minutes	City Mayor
6. Get approved appointment		2 minutes	201 In-charge
TOTAL PROCESSING TIME: 1 Hour and 54 Minutes			
Accomplish Client Feedback Form and drop at designated drop box in front of the Office of the City Treasurer at Passi City Hall.			

FILING OF COMPLAINTS ON CITY EMPLOYEES

HOW TO AVAIL OF THE SERVICE

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit letter of complaint or filled-out complaint form	Attend to the complaint's grievance or provide complaint form	5 – 30 minutes	Frontline Personnel
	Record the complaint in the logbook	3 – 5 minutes	
	Inform the client that HRDO will revert to the client within 1 day	1 day	
	Submit the complaint form to the HRDO Head	1 – 2 minutes	
	Inform the personnel about the complaint against him/her	30 minutes to 1 hour	HRDO Head and Assistant HRDO

	Schedule a meeting between the complainant and the concerned personnel	10– 20 minutes	
2. Decide whether to file a case or resolve the issue and move for amicable settlement			
3a. If the complaint decides to file a case			
	Refer the case to the Grievance/ Administrative for further review of the case	30 minutes	HRDO Head and Assistant HRDO
	Grievance works on due-process procedure	Depends on the Committee's action	Ethics Committee
	Decision of the Grievance/ Administrativeon the case, pending resolution.	Depends on the Committee's action	Ethics Committee
4b. If the complainant decides on amicable settlement			
	Accomplish the Complaint Settlement Agreement document	20 – 30 minutes	HRDO Head
	Declare the case closed		HRDO Head

SERVICES OFFERED BY THE OFFICE OF THE SANGGUNIANG PANLUNGSOD

THE LEGISLATIVE ENACTMENT SERVICES

The Services:

The Sangguniang Panlungsod under RA 7160 is authorized to approve legislative measures for public purposes such as:

1. Issuance of authority to construct/install Cell Site (CS);
2. Issuance of resolution to bury remains of dead persons in Private Cemetery (PC);
3. Issuance of legislative endorsement for the issuance of Environmental Compliance Certificate (ECC) to DENR;
4. Accreditation of Non-Government Organizations (NGO's);
5. Land Conversion
   a) When the land ceases to be economically feasible and sound agricultural purposes determined by the Department of Agriculture;
   b) Where the land shall have substantially greater economic value for residential, commercial or industrial purposes as determined by the Sanggunian (Section 20 R.A. 7160);
6. Issuance of legislative resolutions for the approval of simple, complex subdivisions and establishment of private cemeteries within the City of Passi;
7. Issuance of legislative resolution as one of the requirements for the acquisition of building permit;
8. Issuance of an ordinance for the approval of franchise for tricycle operators;
9. Issuance of a resolution indorsing to the LTFRB the application for franchise for the operation of a Public Utility Jeep/Bus (PUJ/B);
10. Issuance of legislative resolution for the accreditation of Cooperatives/POs/NGOs operating in the City of Passi;
11. Issuance of an ordinance for the temporary closure of streets;
12. Issuance of an ordinance for the naming, renaming of schools, streets, barangays, hospitals and other public structures;
13. Issuance of certification from the SP Secretary;
14. Administrative action on administrative complaint against Barangay Officials.

PLEASE FOLLOW THESE STEPS	YOU WILL NEED TO PRESENT	IT WILL TAKE YOU	PLEASE APPROACH
1. Submit requirements for review	**Letter Requests for Legislative action of the following:** **1. Cellsite** a. Tax Declaration of the proposed site and title b. Affidavit of undertaking c. Structural blue print of the antennae d. City Environment and Natural Resources Office Assessment and Recommendation Report e. Department of Health Certification f. Air Transportation Office Clearance g. Barangay Resolution endorsing the proposed cellsite, minutes of the public hearing, and attendance sheet h. Neighbors' consent within 50 meter radius from the proposed cellsite	2 City Council Sessions	**ERSA L. CHAVEZ** Board Secretary III

	2. Accreditation of NGO's and PO's (5 copies of each of the following) a. Letter of application b. Duly accomplished Application form c. Board Resolution signifying intention for accreditation for the purpose of membership in the Local SpecialBodies d. Certificate of Registration (SEC/CDA) e. List of current officers and members f. Financial Statement of the immediately preceding year; g. Annual Accomplishment report of the immediately preceding year **Environmental Compliance Certificate (ECC)** a. Locational Clearance from Housing and Land Use Regulatory Board (HLURB)		**JULIETA C. PALMA** Sr. Adm. Asst. I **ERSA L. CHAVEZ** Board Secretary III

	b. Initial Environmental Examination Report c. City Environment and Natural Resources Office Assessment and Recommendation Report d. Brgy. Resolution endorsing the project, minutes of the public hearing and attendance sheet. **Private Cemetery** a. Request Letter b. Title or Tax declaration of the property c. Architectural drawing d. Barangay Resolution endorsing the putting up of private cemetery e. Sanitary Permit f. Certification by the CPDCO with regards to the proposed site location g. Certification by the City Engr. that the design of the proposed structures conforms to the National Building Code of the Philippines		**ERSA L. CHAVEZ** Board Secretary III

	Conversion of Lands a. Request Letter b. Title or Tax Declaration of the Property c. Title of the Property d. Certification from DAR/DA e. Endorsement from the City Assessor f. Brgy. Resolution endorsing the proposed conversion	2 City Council Sessions	**JULIETA C. PALMA** Sr. Adm. Asst. I **TERESITA T. PRUDENTE** Board Secretary V
	Simple Subdivision/Complex Subdivision a. Indorsement from the Zoning Administrator by the HLURB that the proponent had satisfactorily complied all the requirements set by the HLURB	2 City Council Sessions	**JULIETA C. PALMA** Sr. Adm. Asst. I
	Temporary closure of street a. Letter request endorsing the ustification as to the temporary closure	2 City Council Sessions	**RONA P. FERNANDEZ** Administrative Officer IV
	Building Permit a. Indorsement from the City Engr. and CENROv	2 City Council Sessions	**RONA P. FERNANDEZ** Administrative Officer IV

	Indorsement to LTFRB a. Letter request specifying the route and distance in kms. from the City Proper to its destination and photocopy of OR/CR. **Naming/Renaming of Streets, School, Barangays and other Public Structures** a. Justification **For School** a. Barangay Resolution b. Indorsement of Local School Board **For Barangays** a. Barangay Resolution b. Minutes of the Public Hearing duly supported by attendance sheet **Other Public Structures** a. Indorsement from Concerned Office **SP Secretary Certification** a. Indorsement from CLGOO **Administrative Complaints Against Barangay** a. Letter complaint against any local elective official verified or under oath containing the following:	2 City Council Sessions 2 minutes	**JULIETA C. PALMA** Sr. Adm. Asst. I **RONA P. FERNANDEZ** Administrative Officer IV **RONA P. FERNANDEZ** Administrative Officer IV **TERESITA T. PRUDENTE** Board Secretary V **MARIA RAZIEL P. BELONIO** Board Secretary IV **REA P. PASCUA** LLSO IV **MRS. LEA P. PALMARES** SP Secretary **ERSA L. CHAVEZ** Board Secretary III

	a.1. Full name and address of the complainant; a.2. Full name and address of the respondent as well as his position and office; a.3. A narration of the relevant and material facts which shows the acts or omissions allegedly committed by the respondent. Documentary evidence and sworn statements or affidavits of witnesses, if any, should be attached as annexes; a.4. A certification by the complaint that no other administrative action or complaint against the same party involving the same acts or omission and issues, has been filed before any agency or administrative body quasi-judicial functions.		**TERESITA T. PRUDENTE** Board Secretary V **MARIA RAZIEL P. BELONIO** Board Secretary IV **REA P. PASCUA** LLSO IV
2. Wait for legislative actions: Application letter will be placed in the Order of Business under Communications for		2 City Council Sessions	**RONA P. FERNANDEZ** Administrative Officer IV

referral to the proper committee/s. The committee/s will conduct public hearing/ committee hearing and will render committee report/s. A favorable endorsement of the committee/s follows the filing of the draft resolution for the first reading. Wait for the approval of the resolution the second and third reading Wait for the Resolution endorsement/accreditation to be signed by the Vice Mayor and the City Council Members and attested by the secretary and approved by the Mayor. Get approved resolution MOTORCYCLE FRANCHISE			

1. Submit the following requirements for review	**For Renewal** a. Endorsement from the Office of Permits and Licenses Section that the operation had complied the requirements b. Barangay Clearance c. Official Receipt d. Certification from their respective association **For Transfer:** a. Deed of Absolute Sale/Donation	2 City Council Sessions 3 minutes	**JULIETA C. PALMA** Senior Adm. Asst. I
2. Attend Committee meeting		1 hour	
3. Wait for the review and approval of the Committee on Transportation & Communication & approval of ordinance			
4. Get approved ordinance			**JULIETA C. PALMA** Senior Adm. Asst. I
ISSUANCE OF CERTIFIED TRUE COPIES OF CITY COUNCIL DOCUMENTS AND CERTIFICATION OF SP SECRETARY			**RONA P. FERNANDEZ** Admi. Officer IV
1. Submit request letter	Request Letter	3 minutes	**AILYN MAE P. BROWN** Legislative Officer III
2. Wait for the documents to be researched and get order of payment	P100.00 per page-photocopy	15 minutes	
3. Get documents	Official receipt	1 minute	**RONA P. FERNANDEZ** Admi. Officer IV

No.	Office Name:	Daily Rate of People
1.	Office of the City Mayor	30
2.	Project Monitoring Section	
3.	Motor Pool Section	
4.	Population Section	
5.	Public Utilities Section	
6.	Public Employment Service Section	
7.	Office of the Resource and Development	75
8.	Office of the Business Permit and Licensing	
9.	Office of the City Tourism	
10.	Office of the City Information	
11.	Office of the City General Services	36
12.	Office of the City Economic Enterprise and Management	
13.	Slaughterhouse Section	
14.	Office of the Sangguniang Panlungsod	15.
15.	Office of the City Planning and Development Coordinator	10 + 25 = 35
16.	Office of the City Budget	50
17.	Office of the Accountant	5
18.	Office of the City Treasurer	
19.	Office of the City Health	
20.	Office of the City Assessor	
21.	Office of the City Registrar	
22.	Office of the City Engineer	30

23.	Office of the City Agriculture	
24.	Office of the City Environment and Natural Resources	
25.	Office of the City Social Welfare and Development	
26.	Office of the City Administrator	90
27.	Office of the City Legal	
28.	Passi City College	
29.	Office of the City Waste Management	
30.	Office of the City Sports and Development	
31.	Office of the City Local Economic Development and Investment Promotion	
32.	Office of the City DRRM	

APPENDIX E
COMPUTATIONS FOR OFFICE OVERCROWDING/ UNDERCROWDING

F2 | =IF(D2<4,"OVERCROWDED","UNCROWDED")

	A	B	C	D	E	F
1	OFFICE	No. of EMPLOYEES PER OFFICE	AREA	AREA PER EMPLOYEE	STANDARD AREA PER EMPLOYEE	REMARKS
2	City Mayor	35	208.226675	5.949333571	4	UNCROWDED
3	Project Monitoring Section	3				
4	Motor Pool Section	55				
5	Population Section	7				
6	Public Utilities Section	26				
7	Public Employment Service Section	4				
8	Resource and Development	20				
9	Business Permit and Licensing	17				
10	City Tourism	8				
11	City Information	21				
12	City General Services	36	95.25	2.645833333	4	OVERCROWDED
13	City Economic Enterprise and Management	50				
14	Slaughterhouse Section	29				
15	Sangguniang Panlungsod	34	97.425911	2.865467971	4	OVERCROWDED
16	Planning and Development Coordinator	22	131.25	5.965909091	4	UNCROWDED
17	City Budget	37	104.252754	2.817642	4	OVERCROWDED
18	Accountant	25	85.5	3.42	4	OVERCROWDED
19	City Treasurer	57	158.521	2.781070175	4	OVERCROWDED
20	City Health	62				
21	City Assessor	28	107.336438	3.833444214	4	OVERCROWDED
22	City Registrar	22				
23	City Engineer	47	190.646827	4.056315468	4	UNCROWDED
24	City Agriculture	31				
25	City Environment and Natural Resources	17				
26	City Social Welfare and Development	11				
27	City Administrator	8	125.998755	15.74984438	4	UNCROWDED
28	City Legal	11	32.4	2.945454545	4	OVERCROWDED
29	Passi City College	24				
30	City Waste Management	4				
31	City Sports and Development	13				
32	City Local Economic Development and Investment Promotion	7				
33	City DRRM	6				
34						

APPENDIX F
BILL OF QUANTITIES AND DETAILED ESTIMATES

Project : **PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL IN PASSI CITY, ILOILO**
Location : Brgy. Sablogon, Passi City, Iloilo
Owner : City of Passi

BILL OF QUANTITIES

ITEM NO	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	**GENERAL PROVISIONS**				
1.1	Billboard/Signboard	2	ea.	1,400.00	2,800.00
1.2	Mobilization/ Demobilazation	1	l.s.	500,000.00	500,000.00
1.3	Occupational Safety and Health	15	mos.	15,000.00	225,000.00
1.4	Layouting/Staking	4,000	sq. m	100.00	400,000.00
	Sub-Total 1			**₱516,500.00**	**₱1,127,800.00**
2	**FACILITIES FOR ENGINEER**				
2.1	Provision of the Office for the Enginee	4,000	sq.m	25.00	100,000.00
2.2	Maintenance of the Office for the Engi	15	mos.	10,000.00	150,000.00
	Sub-Total 2			**₱10,025.00**	**₱250,000.00**
3	**EARTH WORKS**				
3.1	Excavation	2,000	cu.m	1,200.00	2,400,000.00
3.2	Clearing and Grubbing	4,000	sq. m	50.00	200,000.00
3.3	Embankment from Borrow	1,500	cu.m	400.00	600,000.00
3.4	Embankment from Excavation	1,000	cu.m	300.00	300,000.00
3.5	Gravel Bedding	2,000	cu.m	1,200.00	2,400,000.00
	Sub-Total 3			**₱3,150.00**	**₱5,900,000.00**
4	**CONCRETE WORKS**				
4.1	Concrete Works for Footing	350	cu.m	4,266.89	1,493,410.00
4.2	Concrete Works for Slab on Fill	191	cu.m	4,735.81	904,540.00
4.3	Concrete Works for Suspended Slab	575	cu.m	4,356.75	2,505,130.00
4.4	Concrete Works for Column	313	cu.m	4,396.55	1,376,120.00
4.5	Concrete Works for Girder	560	cu.m	4,270.50	2,391,480.00
4.6	Concrete Works for Beam	111	cu.m	4,240.54	470,700.00
4.7	Concrete Works for Stair	17	cu.m	7,708.24	131,040.00
	Sub-Total 4			**₱33,975.27**	**₱9,272,420.00**
5	**FORMWORKS**				
5.1	Cocolumber 2x4x10	3,344	pcs.	280	936,320.00
5.2	Plywood 1/2"x4'x8'	2,695	pcs.	775	2,088,625.00
5.3	Nails	440	kg	80.00	35,200.00
5.4	Tie Wire # 16	505	kg	65.00	32,825.00
	Sub-Total 5			**₱1,200.00**	**₱3,092,970.00**
6	**STEEL BARS**				
6.1	Reinforcing Steel Bars, 25 mm dia x 6	3,576	pcs.	820.00	2,932,320.00
6.2	Reinforcing Steel Bars, 20 mm dia x 6	2,418	pcs.	530.00	1,281,540.00
6.3	Reinforcing Steel Bars, 16 mm dia x 7	7,506	pcs.	450.00	3,377,700.00
6.4	Reinforcing Steel Bars, 16 mm dia x 6	2,418	pcs.	350.00	846,300.00
6.5	Reinforcing Steel Bars, 12 mm dia x 7	2,000	pcs.	220.00	440,000.00
6.6	Reinforcing Steel Bars, 12 mm dia x 6	5,734	pcs.	200.00	1,146,800.00
6.7	Reinforcing Steel Bars, 10 mm dia x 6	894	pcs.	185.00	165,390.00
6.8	Tie Wire	1,000	kg	65.00	65,000.00
6.9	Square Bar	56	l.m.	1,850.00	103,600.00
6.10	Tubular Post	25	l.m.	1,000.00	25,000.00
	Sub-Total 6			**₱3,100.00**	**₱10,383,650.00**
7	**MASONRY**				
7.1	Concrete Hollow Block 4"	46,745	pcs.	15.00	701,175.00
7.2	Concrete Hollow Block 6"	41,125	pcs.	20.00	822,500.00
7.3	Sand	476	cu.m	1,300.00	618,800.00
7.4	Cement	8,641	bags	270.00	2,333,070.00
	Sub-Total 7			**₱1,605.00**	**₱4,475,545.00**
8	**FINISHING WORKS**				
8.1	Plastering Works	7,030	sq.m	148.19	1,041,800.00
	Sub-Total 8			**₱148.19**	**₱1,041,800.00**
9	**WINDOWS**				
9.1	Aluminum Sliding Window with Fixed	186	sq. m	5,000	930,000.00
9.2	Aluminum Sliding Window 1.3m x 1.2	42	sq. m	5,410	227,220.00
9.3	Aluminum Fixed Window 1.3m x 1.2n	25	sq. m	2,500	62,500.00
9.4	Aluminum Fixed Window 2.4m x 1.2n	150	sq. m	2,500	375,000.00

9.5	Aluminum Fixed Window 1.2m x 3.0n	20	sq. m	2,500	50,000.00
9.6	Aluminum Sliding Window 5.5m x 1.2	60	sq. m	5,410	324,600.00
9.7	Aluminum Fixed Window 11.4m x 3.0	35	sq. m	2,500	87,500.00
	Sub-Total 9			**₱25,820.00**	**₱2,056,820.00**
10	**DOORS**				
10.1	Glass Aluminum Double Door with Fi	67	pcs.	6,500.00	435,500.00
10.2	Glass Aluminum Single Door	10	pcs.	6,500.00	65,000.00
10.3	Panel Door with Fixed Glass	225	pcs.	3,000.00	675,000.00
10.4	PVC Type Door with Louvers	21	pcs.	1,500.00	31,500.00
	Sub-Total 10			**₱17,500.00**	**₱1,207,000.00**
11	**TILE WORKS**				
11.1	Glazed Tiles 60x60cm	20,580	pcs.	190.00	3,910,200.00
11.2	Unglazed Tiles 20x30cm	28,140	pcs.	50.00	1,407,000.00
11.3	Tile Adhesive	1,000	pcs.	390.00	390,000.00
11.4	Spacers	250	cu.m	450.00	112,500.00
11.5	Grouting	500	bag	78.00	39,000.00
	Sub-Total 11			**₱1,158.00**	**₱5,858,700.00**
12	**ROOFING WORKS**				
12.1	C-Purlins 50mm x 100mm x 2mm	1,800	l.m.	712.00	1,281,600.00
12.2	Angle Bar 100x100x5	110	l.m.	3,500.00	385,000.00
12.3	Angle Bar 90x90x5	15	l.m.	2,900.00	43,500.00
12.4	Corrugated Roof	1,700	sq. m	420.00	714,000.00
12.5	Welding Rod	50	pack	660.00	33,000.00
12.6	Rivets	20	box	300.00	6,000.00
	Sub-Total 12			**₱8,492.00**	**₱2,463,100.00**
13	**PAINTING WORKS**				
13.1	Concrete Neutralizer	220	gal	500.00	110,000.00
13.2	Concret Putty	3,450	kg	660.00	2,277,000.00
13.3	Paint Primer Solvent	220	gal	750.50	165,110.00
13.4	Paint Latex Gloss	220	gal	672.50	147,950.00
13.6	Metal Primer	950	gal	500.00	475,000.00
13.7	Paint Thinner	450	gal	350.00	157,500.00
13.8	Enamel Paint	950	gal	680.00	646,000.00
	Sub-Total 13			**₱4,113.00**	**₱3,978,560.00**
14	**ELECTRICAL WORKS**				
14.1	Lighting Outlet	108	pcs.	150.00	16,200.00
14.2	Convenience Outlet (Flush Type)	211	pcs.	200.00	42,200.00
14.3	Air Conditioning Outlet	80	pcs.	160.00	12,800.00
14.4	One Gang Switch (Flush Type)	40	pcs.	60.00	2,400.00
14.5	Two Gang Switch (Flush Type)	30	pcs.	100.00	3,000.00
14.6	Three Gang Switch (Flush Type)	35	pcs.	150.00	5,250.00
14.7	Three Way Switch (Flush Type)	25	pcs.	200.00	5,000.00
14.8	Convenience Outlet Line	1,321	l.m.	60.00	79,260.00
14.9	Lighting Outlet Line	2,245	l.m.	100.00	224,500.00
14.10	6" Parabolic Light Fixture	520	ea.	400.00	208,000.00
14.11	Decorative Chandelier	67	ea.	5,000.00	335,000.00
14.12	6" x 48" Led Blade Suspended Light F	15	ea.	500.00	7,500.00
14.13	Airconditioning Unit Inverter (Wall Mou	40	ea.	25,000.00	1,000,000.00
14.14	Airconditioning Unit Inverter (Standing	30	ea.	70,000.00	2,100,000.00
14.15	PVC pipe for Electrical Wiring	3,541	l.m.	75.00	265,575.00
	Sub-Total 14			**₱102,155.00**	**₱4,306,685.00**
15	**CEILING WORK**				
15.1	Gypsum Board 4' x 8' x 9mm (moistur	2,290	sheet	520.00	1,190,800.00
15.2	Metal Furring	1,295	pcs.	176.00	227,920.00
15.3	Toks Screw	20,000	pcs.	2.00	40,000.00
15.4	Insect Screen	200	sheet	150.00	30,000.00
	Sub-Total 15			**₱848.00**	**₱1,488,720.00**
16	**PLUMBING WORK**				
16.1	Water Closet	26	pcs.	5,827.00	151,502.00

16.2	Urinals	8	pcs.	4,175.00	33,400.00
16.3	Sink	22	pcs.	1,550.00	34,100.00
16.4	Floor Drain	11	pcs.	250.00	2,750.00
16.5	Faucet	22	pcs.	250.00	5,500.00
16.6	Sanitary Pipe Line	146	l.m.	500.00	73,000.00
16.7	Storm Drain Line	180	l.m.	500.00	90,000.00
16.8	Angle Pipe	415	pcs.	100.00	41,500.00
16.9	Pipe Sealant	100	pcs.	75.00	7,500.00
16.10	Catch Basin	15	l.s.	25,000.00	375,000.00
16.11	Septic Tank	1	l.s.	100,000.00	100,000.00
	Sub-Total 16			**₱138,227.00**	**₱914,252.00**
TOTAL MATERIAL COST					**₱57,818,022.00**
LABOR COST (40% OF MATERIAL COST)					**₱23,127,208.80**
EQUIPMENT COST (40% OF MATERIAL COST)					**₱23,127,208.80**
TOTAL COST (TC) (MATERIAL + LABOR + EQUIPMENT)					**₱104,072,439.59**
OVERHEAD, CONTINGENCIES, & MISCELLANEOUS (OCM) EXPENSES (10% OF TC)					**₱10,407,243.96**
CONTRACTOR'S PROFIT (CP) (8% OF TC)					**₱8,325,795.17**
VALUE ADDED TAX (VAT) (5% OF TC + OCM + CP)					**₱6,140,273.94**
TOTAL PROJECT COST					**₱128,945,752.66**

Project : **PROPOSED DESIGN OF NEW FOUR STOREY CITY HALL IN PASSI CITY, ILOILO**
Location : Brgy. Sablogon, Passi City, Iloilo
Owner : City of Passi

DETAILED ESTIMATES

ITEM NO	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	**GENERAL PROVISIONS**				
1.1	Billboard	2	each	1,400.00	2,800.00
1.2	Mobilization/ Demobilazation	1	l.s.	500,000.00	500,000.00
1.3	OSH Equipment	15	mos.	15,000.00	225,000.00
1.4	Layouting/Staking	4,000	sq. m	100.00	400,000.00
	Sub-Total 1			**₱516,500.00**	**₱1,127,800.00**
2	**FACILITIES FOR ENGINEER**				
2.1	Provision	4,000	sq.m	25.00	100,000.00
2.2	Power, Water, Illumination, Misc.	15	m.o	10,000.00	150,000.00
	Sub-Total 2			**₱10,025.00**	**₱250,000.00**
3	**EARTH WORKS**				
3.1	Clearing and Grubbing	4,000	sq. m	50.00	200,000.00
3.2	Excavation	2,000	cu.m	1,200.00	2,400,000.00
3.3	Embankment from Borrow	1,500	cu.m	400.00	600,000.00
3.4	Backfilling & Compaction	1,000	cu.m	300.00	300,000.00
3.5	Gravel Bedding	2,000	cu.m	1,200.00	2,400,000.00
	Sub-Total 3			**₱3,150.00**	**₱5,900,000.00**
4	**CONCRETE WORKS**				
	Reinforced Concrete Strength at 28 days (28 Mpa)				
4.1	GROUND FLOOR				
4.1.1	Footing				
4.1.1.1	Cement	3,133	bags	270.00	845,910.00
4.1.1.2	Sand	175	cu.m	1,300.00	227,500.00
4.1.1.3	Gravel	350	cu.m	1,200.00	420,000.00
4.1.2	Column				
4.1.2.1	Cement	843	bags	270.00	227,610.00
4.1.2.2	Sand	47	cu.m	1,300.00	61,100.00
4.1.2.3	Gravel	95	cu.m	1,200.00	114,000.00
4.2	SECOND FLOOR				
4.2.1	Column				
4.2.1.1	Cement	681	bags	270.00	183,870.00
4.2.1.2	Sand	38	cu.m	1,300.00	49,400.00
4.2.1.3	Gravel	76	cu.m	1,200.00	91,200.00
4.2.2	Girder				
4.2.2.1	Cement	1,678	bags	270.00	453,060.00
4.2.2.2	Sand	93	cu.m	1,300.00	120,900.00
4.2.2.3	Gravel	186	cu.m	1,200.00	223,200.00
4.2.3	Beams				
4.2.3.1	Cement	330	bags	270.00	89,100.00
4.2.3.2	Sand	18	cu.m	1,300.00	23,400.00
4.2.3.3	Gravel	37	cu.m	1,200.00	44,400.00
4.3	THIRD FLOOR				
4.3.1	Column				
4.3.1.1	Cement	681	bags	270.00	183,870.00
4.3.1.2	Sand	38	cu.m	1,300.00	49,400.00
4.3.1.3	Gravel	76	cu.m	1,200.00	91,200.00
4.3.2	Girder				
4.3.2.1	Cement	1,678	bags	270.00	453,060.00
4.3.2.2	Sand	93	cu.m	1,300.00	120,900.00
4.3.2.3	Gravel	186	cu.m	1,200.00	223,200.00
4.3.3	Beams				
4.3.3.1	Cement	330	bags	270.00	89,100.00
4.3.3.2	Sand	18	cu.m	1,300.00	23,400.00
4.3.3.3	Gravel	37	cu.m	1,200.00	44,400.00
4.4	FOURTH FLOOR				

4.4.1	Column				
4.4.1.1	Cement	681	bags	270.00	183,870.00
4.4.1.2	Sand	38	cu.m	1,300.00	49,400.00
4.4.1.3	Gravel	76	cu.m	1,200.00	91,200.00
4.4.2	Girder				
4.4.2.1	Cement	1,678	bags	270.00	453,060.00
4.4.2.2	Sand	93	cu.m	1,300.00	120,900.00
4.4.2.3	Gravel	186	cu.m	1,200.00	223,200.00
4.4.3	Beams				
4.4.3.1	Cement	330	bags	270.00	89,100.00
4.4.3.2	Sand	18	cu.m	1,300.00	23,400.00
4.4.3.3	Gravel	37	cu.m	1,200.00	44,400.00
	Reinforced Concrete Strength at 28 days (21 Mpa)				
4.5	GROUND FLOOR				
4.5.1	Slab on Fill				
4.5.1.1	Cement	1,902	bags	270.00	513,540.00
4.5.1.2	Sand	106	cu.m	1,300.00	137,800.00
4.5.1.3	Gravel	211	cu.m	1,200.00	253,200.00
4.5.2	Stairs				
4.5.2.1	Cement	84	bags	270.00	22,680.00
4.5.2.2	Sand	6	cu.m	1,300.00	7,800.00
4.5.1.3	Gravel	11	cu.m	1,200.00	13,200.00
4.6	SECOND FLOOR				
4.6.1	Suspended Slab				
4.6.1.1	Cement	1,805	bags	270.00	487,350.00
4.6.1.2	Sand	103	cu.m	1,300.00	133,900.00
4.6.1.3	Gravel	205	cu.m	1,200.00	246,000.00
4.6.2	Stairs				
4.6.2.1	Cement	84	bags	270.00	22,680.00
4.6.2.2	Sand	6	cu.m	1,300.00	7,800.00
4.6.2.3	Gravel	11	cu.m	1,200.00	13,200.00
4.7	THIRD FLOOR				
4.7.1	Suspended Slab				
4.7.1.1	Cement	1,722	bags	270.00	464,940.00
4.7.1.2	Sand	96	cu.m	1,300.00	124,800.00
4.7.1.3	Gravel	191	cu.m	1,200.00	229,200.00
4.7.2	Stairs				
4.7.2.1	Cement	84	bags	270.00	22,680.00
4.7.2.2	Sand	6	cu.m	1,300.00	7,800.00
4.7.2.3	Gravel	11	cu.m	1,200.00	13,200.00
4.8	FOURTH FLOOR				
4.8.1	Suspended Slab				
4.8.1.1	Cement	1,722	bags	270.00	464,940.00
4.8.1.2	Sand	96	cu.m	1,300.00	124,800.00
4.8.1.3	Gravel	191	cu.m	1,200.00	229,200.00
	Sub-Total 4			**₱49,860.00**	**₱9,272,420.00**
5	**FORMWORKS**				
5.1	GROUND FLOOR				
5.1.1	Column				
5.1.1.1	Cocolumber 2x4x10	74	pc	280	20,720.00
5.1.1.2	Plywood 1/2"x4'x8'	75	pc	775	58,125.00
5.1.1.3	Nails	15	kg	80.00	1,200.00
5.1.1.4	Tie Wire # 16	20	kg	65.00	1,300.00
5.1.2	Stairs				
5.1.2.1	Cocolumber 2x4x10	16	pc	280	4,480.00
5.1.2.2	Plywood 1/2"x4'x8'	5	pc	775	3,875.00
5.1.2.3	Nails	1	kg	80.00	80.00
5.1.2.4	Tie Wire # 16	1	kg	65.00	65.00
5.2	SECOND FLOOR				
5.2.1	Beams				

5.2.1.1	Cocolumber 2x4x10	145	pc	280	40,600.00
5.2.1.2	Plywood 1/2"x4'x8'	95	pc	775	73,625.00
5.2.1.3	Nails	20	kg	80.00	1,600.00
5.2.1.4	Tie Wire # 16	25	kg	65.00	1,625.00
5.2.2	Column				
5.2.2.1	Cocolumber 2x4x10	76	pc	280	21,280.00
5.2.2.2	Plywood 1/2"x4'x8'	58	pc	775	44,950.00
5.2.2.3	Nails	10	kg	80.00	800.00
5.2.2.4	Tie Wire # 16	15	kg	65.00	975.00
5.2.3	Suspended Slab				
5.2.3.1	Cocolumber 2x4x10	450	pc	280	126,000.00
5.2.3.2	Plywood 1/2"x4'x8'	386	pc	775	299,150.00
5.2.3.3	Nails	60	kg	80.00	4,800.00
5.2.3.4	Tie Wire # 16	65	kg	65.00	4,225.00
5.2.4	Girder				
5.2.4.1	Cocolumber 2x4x10	425	pc	280	119,000.00
5.2.4.2	Plywood 1/2"x4'x8'	345	pc	775	267,375.00
5.2.4.3	Nails	55	kg	80.00	4,400.00
5.2.4.4	Tie Wire # 16	60	kg	65.00	3,900.00
5.2.5	Stairs				
5.2.5.1	Cocolumber 2x4x10	16	pc	280	4,480.00
5.2.5.2	Plywood 1/2"x4'x8'	5	pc	775	3,875.00
5.2.5.3	Nails	1	kg	80.00	80.00
5.2.5.4	Tie Wire # 16	1	kg	65.00	65.00
5.3	THIRD FLOOR				
5.3.1	Beams				
5.3.1.1	Cocolumber 2x4x10	145	pc	280	40,600.00
5.3.1.2	Plywood 1/2"x4'x8'	95	pc	775	73,625.00
5.3.1.3	Nails	20	kg	80.00	1,600.00
5.3.1.4	Tie Wire # 16	25	kg	65.00	1,625.00
5.3.2	Column				
5.3.2.1	Cocolumber 2x4x10	67	pc	280	18,760.00
5.3.2.2	Plywood 1/2"x4'x8'	58	pc	775	44,950.00
5.3.2.3	Nails	10	kg	80.00	800.00
5.3.2.4	Tie Wire # 16	15	kg	65.00	975.00
5.3.3	Suspended Slab				
5.3.3.1	Cocolumber 2x4x10	450	pc	280	126,000.00
5.3.3.2	Plywood 1/2"x4'x8'	370	pc	775	286,750.00
5.3.3.3	Nails	55	kg	80.00	4,400.00
5.3.3.4	Tie Wire # 16	60	kg	65.00	3,900.00
5.3.4	Girder				
5.3.4.1	Cocolumber 2x4x10	425	pc	280	119,000.00
5.3.4.2	Plywood 1/2"x4'x8'	345	pc	775	267,375.00
5.3.4.3	Nails	55	kg	80.00	4,400.00
5.3.4.4	Tie Wire # 16	60	kg	65.00	3,900.00
5.3.5	Stairs				
5.3.5.1	Cocolumber 2x4x10	16	pc	280	4,480.00
5.3.5.2	Plywood 1/2"x4'x8'	5	pc	775	3,875.00
5.3.5.3	Nails	1	kg	80.00	80.00
5.3.5.4	Tie Wire # 16	1	kg	65.00	65.00
5.4	FOURTH FLOOR				
5.4.1	Beams				
5.4.1.1	Cocolumber 2x4x10	145	pc	280	40,600.00
5.4.1.2	Plywood 1/2"x4'x8'	95	pc	775	73,625.00
5.4.1.3	Nails	20	kg	80.00	1,600.00
5.4.1.4	Tie Wire	25	kg	65.00	1,625.00
5.4.2	Column				
5.4.2.1	Cocolumber 2x4x10	67	pc	280	18,760.00
5.4.2.2	Plywood 1/2"x4'x8'	58	pc	775	44,950.00
5.4.2.3	Nails	10	kg	80.00	800.00

5.4.2.4	Tie Wire # 16	15	kg	65.00	975.00
5.4.3	Suspended Slab				
5.4.3.1	Cocolumber 2x4x10	450	pc	280	126,000.00
5.4.3.2	Plywood 1/2"x4'x8'	370	pc	775	286,750.00
5.4.3.3	Nails	55	kg	80.00	4,400.00
5.4.3.4	Tie Wire # 16	60	kg	65.00	3,900.00
5.4.4	Girder				
5.4.4.1	Cocolumber 2x4x10	425	pc	280	119,000.00
5.4.4.2	Plywood 1/2"x4'x8'	345	pc	775	267,375.00
5.4.4.3	Nails	55	kg	80.00	4,400.00
5.4.4.4	Tie Wire # 16	60	kg	65.00	3,900.00
	Sub-Total 5			**₱19,200.00**	**₱3,118,470.00**
6	**REINFORCING STEEL BAR**				
	MAIN BARS				
	GROUND FLOOR				
	Column 25 mm dia x 6	924	pc	820.00	757,680.00
	Footing 20 mm dia x 6	2,418	pc	530.00	1,281,540.00
	Slab on Fill 12 mm dia x 7.5	2,000	pc	220.00	440,000.00
	Stairs 16 mm dia x 7.5	39	pc	450.00	17,550.00
	SECOND FLOOR				
	Suspended Slab 16 mm dia x 7.5	1,993	pc	450.00	896,850.00
	Girder 16 mm dia x 7.5	340	pc	450.00	153,000.00
	Beam 16 mm dia x 7.5	130	pc	450.00	58,500.00
	Column 25 mm dia x 6	924	pc	820.00	757,680.00
	Stairs 16 mm dia x 7.5	39	pc	450.00	17,550.00
	THIRD FLOOR				
	Suspended Slab 16 mm dia x 7.5	1,993	pc	450.00	896,850.00
	Girder 16 mm dia x 7.5	340	pc	450.00	153,000.00
	Beam 16 mm dia x 7.5	130	pc	450.00	58,500.00
	Column 25 mm dia x 6	864	pc	820.00	708,480.00
	Stairs 16 mm dia x 7.5	39	pc	450.00	17,550.00
	FOURTH FLOOR				
	Suspended Slab 16 mm dia x 7.5	1,993	pc	450.00	896,850.00
	Girders 16 mm dia x 7.5	340	pc	450.00	153,000.00
	Beam 16 mm dia x 7.5	130	pc	450.00	58,500.00
	Column 25 mm dia x 6	864	pc	820.00	708,480.00
	LATERAL AND STIRRUPS BARS, TRANSVERSE AND NOSING BARS				
	GROUND FLOOR				
	Column 10 mm dia x 6	216	pc	185.00	39,960.00
	Stairs 12 mm dia x 6	10	pc	200.00	2,000.00
	Stairs 10 mm dia x 6	7	pc	185.00	1,295.00
	SECOND FLOOR				
	Girder 12 mm dia x 6	71	pc	200.00	14,200.00
	Beam 12 mm dia x 6	169	pc	200.00	33,800.00
	Stairs 12 mm dia x 6	10	pc	200.00	2,000.00
	Stairs 10 mm dia x 6	7	pc	185.00	1,295.00
	Column 10 mm dia x 6	216	pc	185.00	39,960.00
	THIRD FLOOR				
	Girder 12 mm dia x 6	71	pc	200.00	14,200.00
	Beam 12 mm dia x 6	169	pc	200.00	33,800.00
	Column 10 mm dia x 6	231	pc	185.00	42,735.00
	Stairs 12 mm dia x 6	10	pc	200.00	2,000.00
	Stairs 10 mm dia x 6	7	pc	185.00	1,295.00
	FOURTH FLOOR				
	Girder 12 mm dia x 6	71	pc	200.00	14,200.00
	Beam 12 mm dia x 6	169	pc	200.00	33,800.00
	Column 10 mm dia x 6	231	pc	185.00	42,735.00
	SHRINKAGE AND TEMEPERATURE BAR				
	Footing 16 mm dia x 6	2,418	pc	350.00	846,300.00
	TIE WIRE				

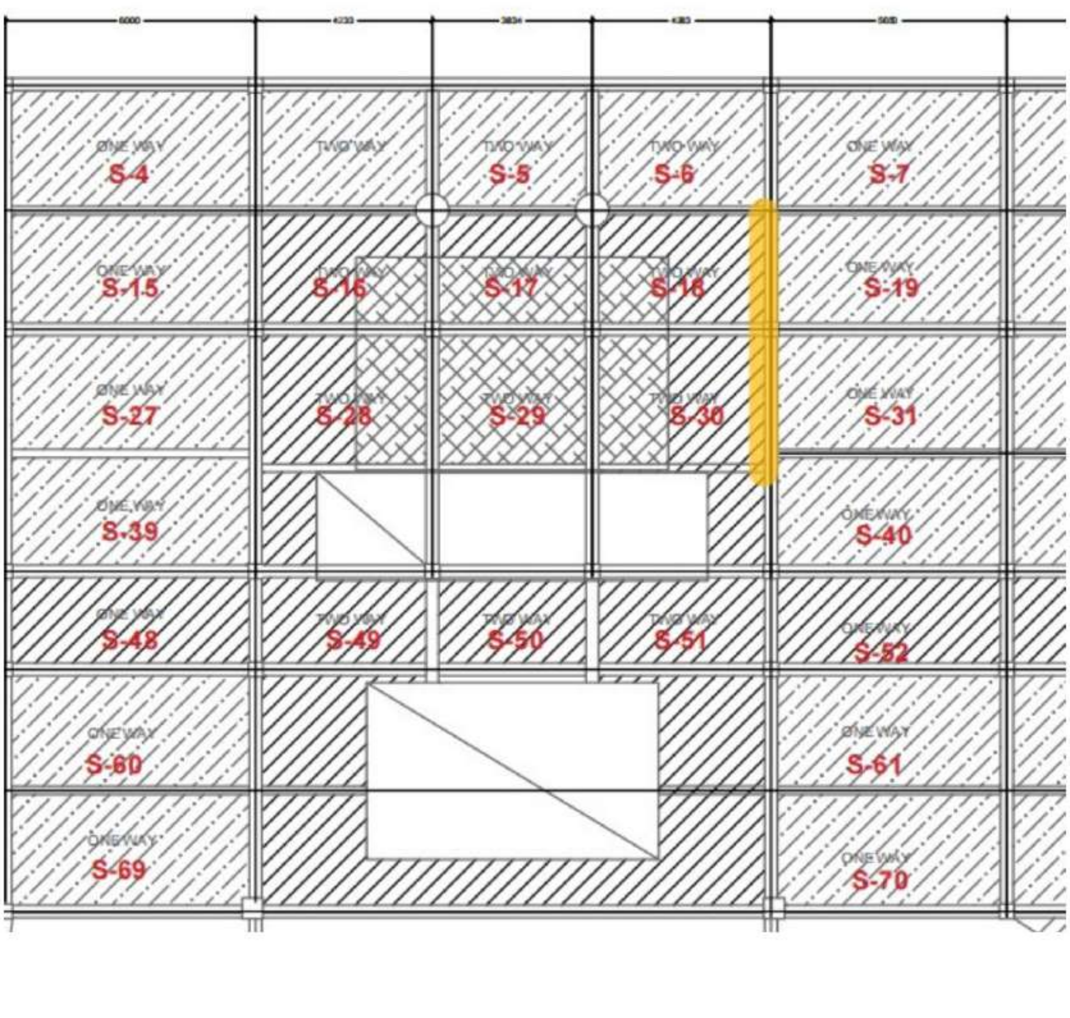
	Tie Wire #16	1,100	kg	65.00	71,500.00
	CHB STEEL BAR				
	GROUND FLOOR				
	CHB 4" 12 mm dia x 6	660	pc	200.00	132,000.00
	CHB 6" 12 mm dia x 6	599	pc	200.00	119,800.00
	SECOND FLOOR				
	CHB 4" 12 mm dia x 6	594	pc	200.00	118,800.00
	CHB 6" 12 mm dia x 6	627	pc	200.00	125,400.00
	THIRD FLOOR				
	CHB 4" 12 mm dia x 6	708	pc	200.00	141,600.00
	CHB 6" 12 mm dia x 6	581	pc	200.00	116,200.00
	FOURTH FLOOR				
	CHB 4" 12 mm dia x 6	705	pc	200.00	141,000.00
	CHB 6" 12 mm dia x 6	540	pc	200.00	108,000.00
	METAL RAILING				
	Square Bar 25mm Ø S/S	56.00	lm	1,850.00	103,600.00
	Tubular Post	25.00	lm	1,000.00	25,000.00
	Sub-Total 6			**₱15,370.00**	**₱10,400,035.00**
7	**MASONRY**				
7.1	GROUND FLOOR CHB LAYING				
7.1.1	Concrete Hollow Block 4"	11,570	pc	15.00	173,550.00
7.1.2	Concrete Hollow Block 6"	10,491	pc	20.00	209,820.00
7.2	SECOND FLOOR CHB LAYING				
7.2.1	Concrete Hollow Block 4"	10,404	pc	15.00	156,060.00
7.2.2	Concrete Hollow Block 6"	10,989	pc	20.00	219,780.00
7.3	THIRD FLOOR CHB LAYING				
7.3.1	Concrete Hollow Block 4"	12,413	pc	15.00	186,195.00
7.3.2	Concrete Hollow Block 6"	10,182	pc	20.00	203,640.00
7.4	FOURTH FLOOR CHB LAYING				
7.4.1	Concrete Hollow Block 4"	12,358	pc	15.00	185,370.00
7.4.2	Concrete Hollow Block 6"	9,463	pc	20.00	189,260.00
7.5	CHB MORTAR FOR GROUND FLOOR				
7.5.1	Sand	147	cu.m	1,300.00	191,100.00
7.5.2	Cement	2,673	bags	270.00	721,710.00
7.6	CHB MORTAR FOR SECOND FLOOR				
7.6.1	Sand	110	cu.m	1,300.00	143,000.00
7.6.2	Cement	2,001	bags	270.00	540,270.00
7.7	CHB MORTAR FOR THIRD FLOOR				
7.7.1	Sand	112	cu.m	1,300.00	145,600.00
7.7.2	Cement	2,029	bags	270.00	547,830.00
7.8	CHB MORTAR FOR FOURTH FLOOR				
7.8.1	Sand	107	cu.m	1,300.00	139,100.00
7.8.2	Cement	1,938	bags	270.00	523,260.00
	Sub-Total 7			**₱6,420.00**	**₱4,475,545.00**
8	**FINISHING WORKS**				
8.1	Sand	170	cu.m	1,300.00	221,000.00
8.2	Cement	3,040	bags	270.00	820,800.00
	Sub-Total 8			**₱1,570.00**	**₱1,041,800.00**
9	**WINDOWS**				
9.1	Aluminum Sliding Window with Fix	186	sq. m	5,000	930,000.00
9.2	Aluminum Sliding Window 1.3m x 1	42	sq. m	5,410	227,220.00
9.3	Aluminum Fixed Window 1.3m x 1.	25	sq. m	2,500	62,500.00
9.4	Aluminum Fixed Window 2.4m x 1.	150	sq. m	2,500	375,000.00
9.5	Aluminum Fixed Window 1.2m x 3.	20	sq. m	2,500	50,000.00
9.6	Aluminum Sliding Window 5.5m x 1	60	sq. m	5,410	324,600.00
9.7	Aluminum Fixed Window 11.4m x 3	35	sq. m	2,500	87,500.00
	Sub-Total 9			**₱25,820.00**	**₱2,056,820.00**
10	**DOORS**				
10.1	Glass Aluminum Double Door with	67	pc	6,500.00	435,500.00
10.2	Glass Aluminum Single Door	10	pc	6,500.00	65,000.00

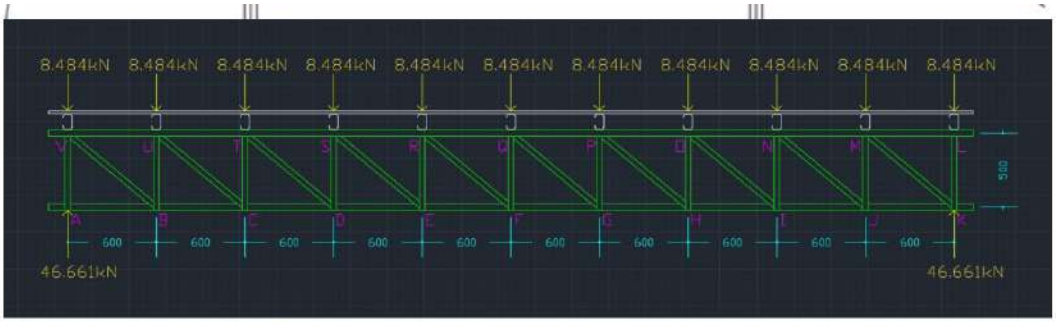
10.3	Panel Door with Fixed Glass	225	pc	3,000.00	675,000.00
10.4	PVC Type Door with Louvers	21	pc	1,500.00	31,500.00
	Sub-Total 10			**₱17,500.00**	**₱1,207,000.00**
11	**TILE WORKS**				
11.1	GLAZED TILES 60x60cm	20,580	pc	190.00	3,910,200.00
11.2	UNGLAZED TILES 20x30cm	28,140	pc	50.00	1,407,000.00
11.3	Tile Adhesive	1,000	bag	390.00	390,000.00
11.4	Spacers	250	pack	450.00	112,500.00
11.5	Grouting	500	bag	78.00	39,000.00
	Sub-Total 11			**₱1,158.00**	**₱5,858,700.00**
12	**ROOFING WORKS**				
12.1	C-Purlins 50mm x 100mm x 2mm	1,800	lm	712.00	1,281,600.00
12.2	Angle Bar 100x100x5	110	lm	3,500.00	385,000.00
12.3	Angle Bar 90x90x5	15	lm	2,900.00	43,500.00
12.4	Corrugated Roof	1,700	sq. m	420.00	714,000.00
12.5	Welding Rod	50	pack	660.00	33,000.00
12.6	Rivets	20	box	300.00	6,000.00
	Sub-Total 12			**₱8,492.00**	**₱2,463,100.00**
13	**PAINTING WORKS**				
13.1	Concrete Neutralizer	220	gal	500.00	110,000.00
13.2	Concret Putty	3,450	kg	660.00	2,277,000.00
13.3	Paint Primer Solvent	220	gal	750.50	165,110.00
13.4	Paint Latex Gloss	220	gal	672.50	147,950.00
	METAL				
13.5	Metal Primer	950	gal	500.00	475,000.00
13.6	Paint Thinner	450	gal	350.00	157,500.00
13.7	Enamel Paint	950	gal	680.00	646,000.00
	Sub-Total 13			**₱4,113.00**	**₱3,978,560.00**
14	**ELECTRICAL WORKS**				
14.1	Lighting Outlet	108	pc	150.00	16,200.00
14.2	Convenience Outlet (Flush Type)	211	pc	200.00	42,200.00
14.3	Air Conditioning Outlet	80	pc	160.00	12,800.00
14.4	One Gang Switch (Flush Type)	40	pc	60.00	2,400.00
14.5	Two Gang Switch (Flush Type)	30	pc	100.00	3,000.00
14.6	Three Gang Switch (Flush Type)	35	pc	150.00	5,250.00
14.7	Three Way Switch (Flush Type)	25	pc	200.00	5,000.00
14.8	Convenience Outlet Line	1321	lm	60.00	79,260.00
14.9	Lighting Outlet Line	2245	lm	100.00	224,500.00
14.10	6" Parabolic Light Fixture	520	each	400.00	208,000.00
14.11	Decorative Chandelier	67	each	5,000.00	335,000.00
14.12	6"x48"Led Blade Suspended Light	15	each	500.00	7,500.00
14.13	Airconditioning Unit Inverter	40	each	25,000.00	1,000,000.00
14.14	Airconditioning Unit Standing	30	each	70,000.00	2,100,000.00
14.15	Ground Floor PVC pipe for Electrica	893	lm	75.00	66,975.00
14.16	Second Floor PVC pipe for Electrica	888	lm	75.00	66,600.00
14.17	Third Floor PVC pipe for Electrical \	879	lm	75.00	65,925.00
14.18	Fourth Floor PVC pipe for Electrical	881	lm	75.00	66,075.00
	Sub-Total 14			**₱102,380.00**	**₱4,306,685.00**
15	**CEILING WORK**				
15.1	Gypsum Board 4' x 8' x 9mm (moist	2,290	sheet	520.00	1,190,800.00
15.2	Metal Furrring	1,295	pc	176.00	227,920.00
15.3	Toks Screw	20,000	pc	2.00	40,000.00
15.4	Insect Screen	200	sheet	150.00	30,000.00
	Sub-Total 15			**₱848.00**	**₱1,488,720.00**
16	**PLUMBING WORK**				
16.1	Water Closet	26	pc	5,827.00	151,502.00
16.2	Urinals	8	pc	4,175.00	33,400.00
16.3	Sink	22	pc	1,550.00	34,100.00
16.4	Floor Drain	11	pc	250.00	2,750.00
16.5	Faucet	22	pc	250.00	5,500.00

16.6	Sanitary Pipe Line	146	lm	500.00	73,000.00
16.7	Storm Drain Line	180	lm	500.00	90,000.00
16.8	Angle Pipe	415	pc	100.00	41,500.00
16.9	Pipe Sealant	100	pc	75.00	7,500.00
16.10	Catch Basin	15	l.s.	25,000.00	375,000.00
16.11	Septic Tank	1	l.s.	100,000.00	100,000.00
	Sub-Total 16			**₱138,227.00**	**₱914,252.00**
TOTAL MATERIAL COST					**₱57,859,907.00**
LABOR COST (40% OF MATERIAL COST)					₱23,143,962.80
EQUIPMENT COST (40% OF MATERIAL COST)					₱23,143,962.80
TOTAL COST (TC) (MATERIAL + LABOR + EQUIPMENT)					**₱104,147,832.60**
OVERHEAD, CONTINGENCIES, & MISCELLANEOUS (OCM) EXPENSES (10% OF TC)					₱10,414,783.26
CONTRACTOR'S PROFIT (CP) (8% OF TC)					₱8,331,826.61
VALUE ADDED TAX (VAT) (5% OF TC + OCM + CP)					₱6,144,722.12
TOTAL PROJECT COST					**₱129,039,164.59**

APPENDIX G
DESIGN AND ANALYSIS OF FLAT PARALLEL TRUSS

Design and Analysis of Flat Parallel Truss





$tan(\theta) = \frac{y}{x} = \frac{0.5\ m}{0.6\ m}$

$\theta := \text{atan}\left(\frac{0.5}{0.6}\right) = 39.806\ °$

Wind Load: $W := 120\ \frac{kg}{m^2} \cdot \left(9.81\ \frac{m}{s^2}\right) = 1.177\ kPa$

Dead Load (Deck Metal Gage 18): $D := 0.14\ kPa$

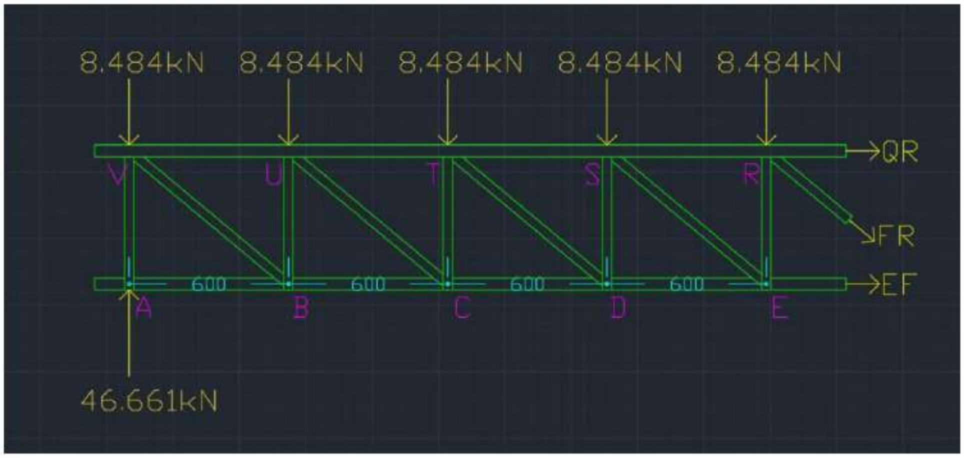
Roof Live Load: $L := 1\ kPa$

Tributary Area:
$A_T := 0.6\ m \cdot 6\ m = 3.6\ m^2$
Concentrated Load: say $w := 1.2 \cdot D + 1.6 \cdot L + 0.5 \cdot W = 2.357\ kPa$

$P := w \cdot A_T = 8.484\ kN$

Reaction: $R := \frac{11 \cdot P}{2} = 46.661\ kN$

Using Method of Section:



$\left[.+up\Sigma F_y=0\right]$

$R-5\cdot P-F_{FR}\cdot sin(\theta)=0$

$F_{FR}:=\dfrac{R-5\cdot P}{\sin(\theta)}=6.626\ kN$ $F_{FR}=6.626\ kN$

$\left[.+cw\Sigma M_A=0\right]$

$0.6\ m\cdot P+1.2\ m\cdot P+1.8\ m\cdot P+2.4\ m\cdot P+0.5\ m\cdot F_{QR}+0.5\ m\cdot\left(F_{FR}\cdot cos(\theta)\right)+2.4\ m\cdot\left(F_{FR}\cdot sin(\theta)\right)=0$

$F_{QR}:=\dfrac{0.6\ m\cdot P+1.2\ m\cdot P+1.8\ m\cdot P+2.4\ m\cdot P+0.5\ m\cdot\left(F_{FR}\cdot\cos(\theta)\right)+2.4\ m\cdot\left(F_{FR}\cdot\sin(\theta)\right)}{-0.5\ m}$

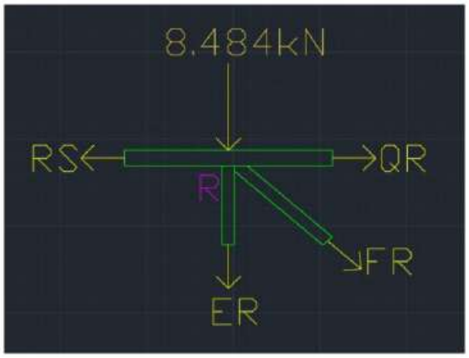
$F_{QR}=-127.256\ kN$

$\left[.+right\Sigma F_x=0\right]$

$F_{QR}+F_{FR}\cdot cos(\theta)+F_{EF}=0$

$F_{EF}:=-\left(F_{QR}+F_{FR}\cdot\cos(\theta)\right)=122.166\ kN$ $F_{EF}=122.166\ kN$

Joint R



$\left[.+up\Sigma F_y=0\right]$

$-P-F_{ER}-F_{FR}\cdot sin(\theta)=0$

$F_{ER}:=-P-F_{FR}\cdot \sin(\theta)=-12.726\ \boldsymbol{kN}$

$F_{ER}=-12.726\ \boldsymbol{kN}$

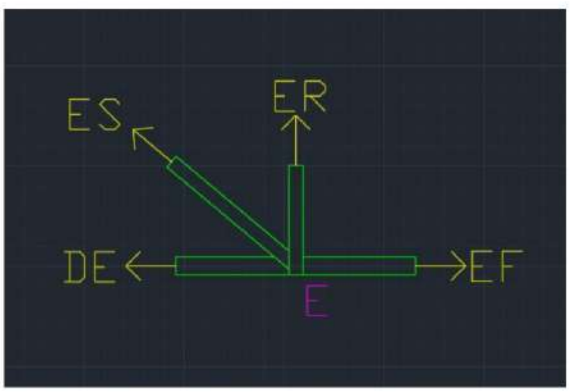
$\left[.+right\Sigma F_x=0\right]$

$-F_{RS}+F_{QR}+F_{FR}\cdot cos(\theta)=0$

$F_{RS}:=F_{QR}+F_{FR}\cdot \cos(\theta)=-122.166\ \boldsymbol{kN}$

$F_{RS}=-122.166\ \boldsymbol{kN}$

Joint E



$\left[.+up\Sigma F_y=0\right]$

$F_{ES}\cdot sin(\theta)+F_{ER}=0$

$F_{ES}:=\dfrac{-F_{ER}}{\sin(\theta)}=19.878\ \boldsymbol{kN}$

$F_{ES}=19.878\ \boldsymbol{kN}$

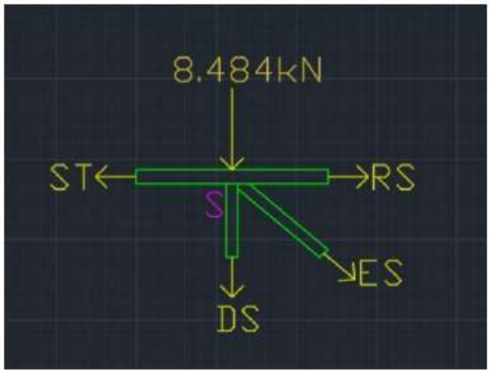
$\left[.+right\Sigma F_x=0\right]$

$-F_{DE}-F_{ES}\cdot cos(\theta)+F_{EF}=0$

$F_{DE}:=-F_{ES}\cdot \cos(\theta)+F_{EF}=106.895\ \boldsymbol{kN}$

$F_{DE}=106.895\ \boldsymbol{kN}$

Joint S



$\left[.+up\Sigma F_y = 0 \right]$

$-P - F_{DS} - F_{ES} \cdot sin(\theta) = 0$

$F_{DS} := -P - F_{ES} \cdot \sin(\theta) = -21.209 \ kN$

$F_{DS} = -21.209 \ kN$

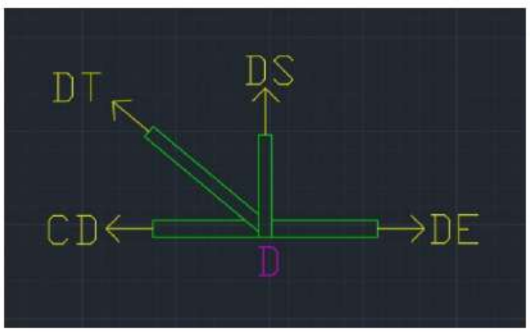
$\left[.+right\Sigma F_x = 0 \right]$

$-F_{ST} + F_{RS} + F_{ES} \cdot cos(\theta) = 0$

$F_{ST} := F_{RS} + F_{ES} \cdot \cos(\theta) = -106.895 \ kN$

$F_{ST} = -106.895 \ kN$

Joint D



$\left[.+up\Sigma F_y = 0 \right]$

$F_{DT} \cdot sin(\theta) + F_{DS} = 0$

$F_{DT} := \dfrac{-F_{DS}}{\sin(\theta)} = 33.13 \ kN$

$F_{DT} = 33.13 \ kN$

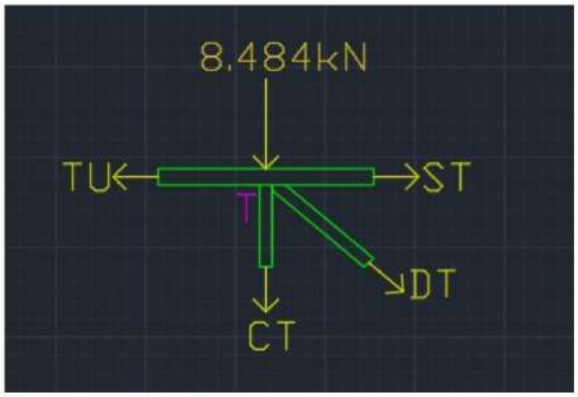
$\left[.+right\Sigma F_x = 0 \right]$

$-F_{CD} - F_{DT} \cdot cos(\theta) + F_{DE} = 0$

$F_{CD} := -F_{DT} \cdot \cos(\theta) + F_{DE} = 81.444 \ kN$

$F_{CD} = 81.444 \ kN$

Joint T



$\left[.+up\Sigma F_y = 0\right]$

$-P - F_{CT} - F_{DT} \cdot sin(\theta) = 0$

$F_{CT} := -P - F_{DT} \cdot \sin(\theta) = -29.693\ kN$

$F_{CT} = -29.693\ kN$

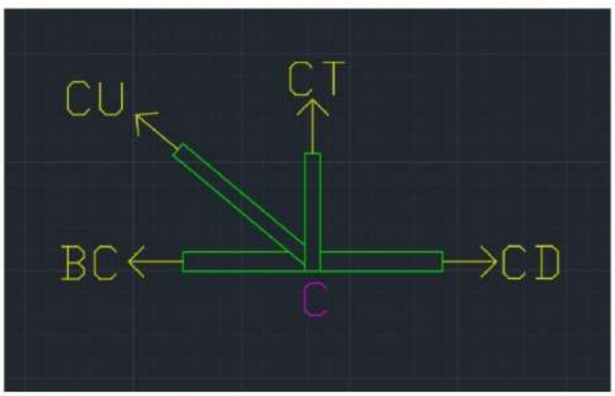
$\left[.+right\Sigma F_x = 0\right]$

$-F_{TU} + F_{ST} + F_{DT} \cdot cos(\theta) = 0$

$F_{TU} := F_{ST} + F_{DT} \cdot \cos(\theta) = -81.444\ kN$

$F_{TU} = -81.444\ kN$

Joint C



$\left[.+up\Sigma F_y = 0\right]$

$F_{CU} \cdot sin(\theta) + F_{CT} = 0$

$F_{CU} := \dfrac{-F_{CT}}{\sin(\theta)} = 46.382\ kN$

$F_{CU} = 46.382\ kN$

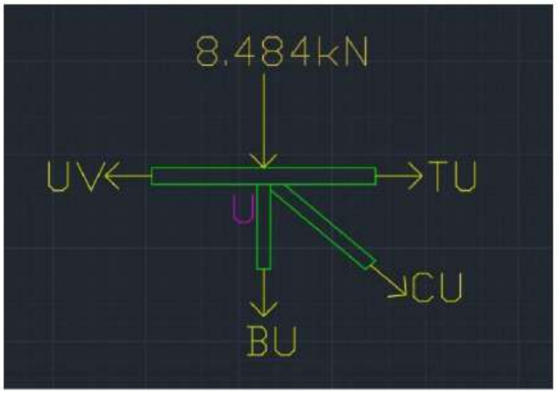
$\left[.+right\Sigma F_x = 0\right]$

$-F_{BC} - F_{CU} \cdot cos(\theta) + F_{CD} = 0$

$F_{BC} := -F_{CU} \cdot \cos(\theta) + F_{CD} = 45.812\ kN$

$F_{BC} = 45.812\ kN$

Joint U



$\left[.+up\Sigma F_y=0\right]$

$-P-F_{BU}-F_{CU}\cdot sin(\theta)=0$

$F_{BU}:=-P-F_{CU}\cdot \sin(\theta)=-38.177\ kN$

$F_{BU}=-38.177\ kN$

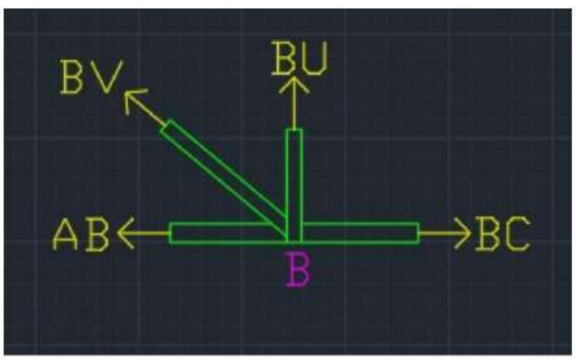
$\left[.+right\Sigma F_x=0\right]$

$-F_{UV}+F_{TU}+F_{CU}\cdot cos(\theta)=0$

$F_{UV}:=F_{TU}+F_{CU}\cdot \cos(\theta)=-45.812\ kN$

$F_{UV}=-45.812\ kN$

Joint B



$\left[.+up\Sigma F_y=0\right]$

$F_{BV}\cdot sin(\theta)+F_{BU}=0$

$F_{BV}:=\dfrac{-F_{BU}}{\sin(\theta)}=59.634\ kN$

$F_{BV}=59.634\ kN$

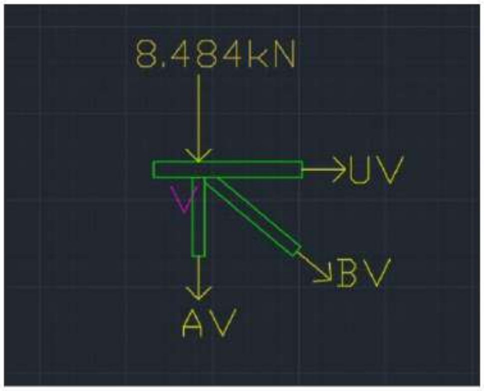
$\left[.+right\Sigma F_x=0\right]$

$-F_{AB}-F_{BV}\cdot cos(\theta)+F_{BC}=0$

$F_{AB}:=-F_{BV}\cdot \cos(\theta)+F_{BC}=0\ kN$

$F_{AB}=0\ kN$

Joint V



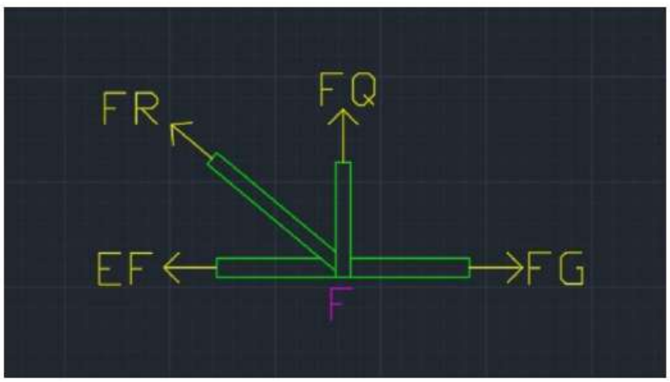
$\left[.+up\Sigma F_y = 0\right]$

$-P - F_{AV} - F_{BV} \cdot sin(\theta) = 0$

$F_{AV} := -P - F_{BV} \cdot \sin(\theta) = -46.661\ kN$

$F_{AV} = -46.661\ kN$

Joint F



$\left[.+up\Sigma F_y = 0\right]$

$F_{FR} \cdot sin(\theta) + F_{FQ} = 0$

$F_{FQ} := -F_{FR} \cdot \sin(\theta) = -4.242\ kN$

$F_{FQ} = -4.242\ kN$

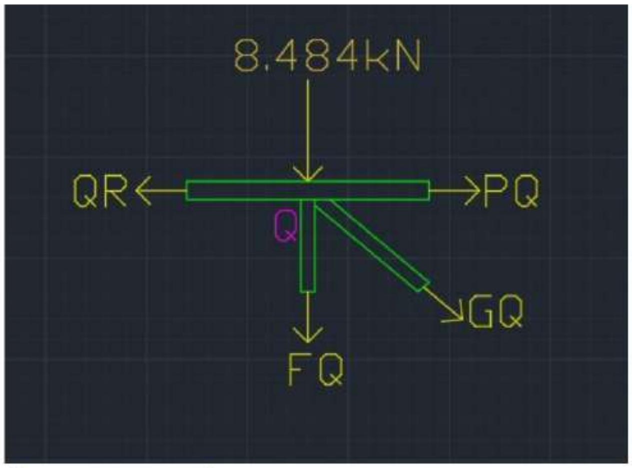
$\left[.+right\Sigma F_x = 0\right]$

$-F_{EF} - F_{FR} \cdot cos(\theta) + F_{FG} = 0$

$F_{FG} := -F_{EF} - F_{FR} \cdot \cos(\theta) = -127.256\ kN$

$F_{FG} = -127.256\ kN$

Joint Q



$\left[.+up\Sigma F_y = 0\right]$

$-P - F_{FQ} - F_{GQ} \cdot sin(\theta) = 0$

$F_{GQ} := \dfrac{-P - F_{FQ}}{\sin(\theta)} = -6.626\ \boldsymbol{kN}$

$F_{GQ} = -6.626\ \boldsymbol{kN}$

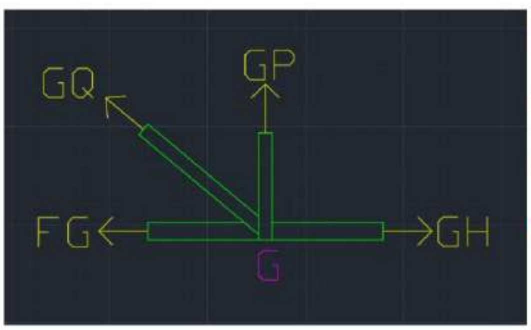
$\left[.+right\Sigma F_x = 0\right]$

$-F_{QR} + F_{PQ} + F_{GQ} \cdot cos(\theta) = 0$

$F_{PQ} := F_{QR} - F_{GQ} \cdot \cos(\theta) = -122.166\ \boldsymbol{kN}$

$F_{PQ} = -122.166\ \boldsymbol{kN}$

Joint G



$\left[.+up\Sigma F_y = 0\right]$

$F_{GQ} \cdot sin(\theta) + F_{GP} = 0$

$F_{GP} := -F_{GQ} \cdot \sin(\theta) = 4.242\ \boldsymbol{kN}$

$F_{GP} = 4.242\ \boldsymbol{kN}$

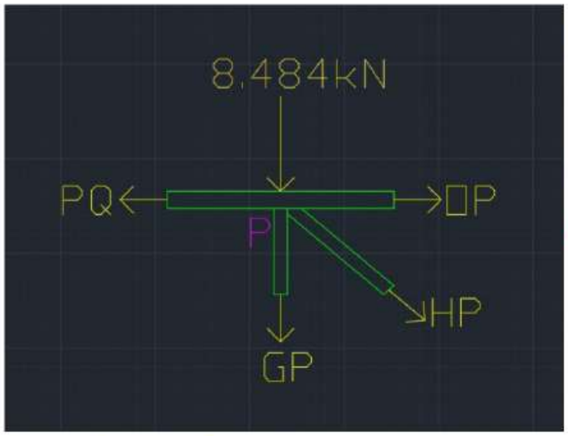
$\left[.+right\Sigma F_x = 0\right]$

$-F_{FG} - F_{GQ} \cdot cos(\theta) + F_{GH} = 0$

$F_{GH} := F_{FG} + F_{GQ} \cdot \cos(\theta) = -132.347\ \boldsymbol{kN}$

$F_{GH} = -132.347\ \boldsymbol{kN}$

Joint P



$\left[. + up\Sigma F_y = 0 \right]$

$-P - F_{GP} - F_{HP} \cdot sin(\theta) = 0$

$F_{HP} := \dfrac{-P - F_{GP}}{\sin(\theta)} = -19.878$ $\boldsymbol{kN}$

$F_{HP} = -19.878$ $\boldsymbol{kN}$

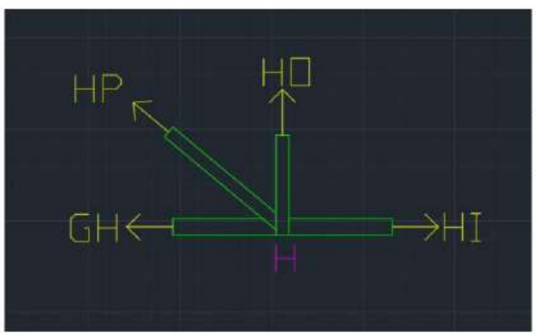
$\left[. + right\Sigma F_x = 0 \right]$

$-F_{PQ} + F_{OP} + F_{HP} \cdot cos(\theta) = 0$

$F_{OP} := F_{PQ} - F_{HP} \cdot \cos(\theta) = -106.895$ $\boldsymbol{kN}$

$F_{OP} = -106.895$ $\boldsymbol{kN}$

Joint H



$\left[. + up\Sigma F_y = 0 \right]$

$F_{HP} \cdot sin(\theta) + F_{HO} = 0$

$F_{HO} := -F_{HP} \cdot \sin(\theta) = 12.726$ $\boldsymbol{kN}$

$F_{HO} = 12.726$ $\boldsymbol{kN}$

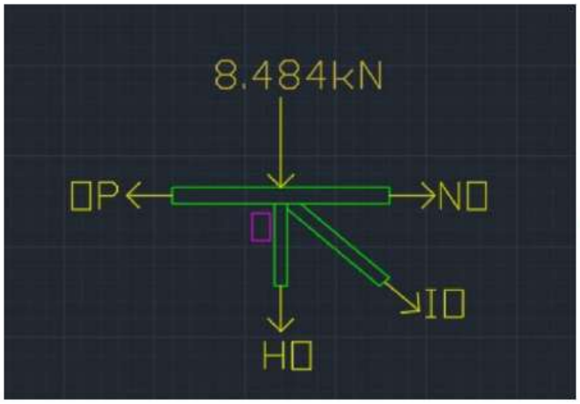
$\left[. + right\Sigma F_x = 0 \right]$

$-F_{GH} - F_{HP} \cdot cos(\theta) + F_{HI} = 0$

$F_{HI} := F_{GH} + F_{HP} \cdot \cos(\theta) = -147.617$ $\boldsymbol{kN}$

$F_{HI} = -147.617$ $\boldsymbol{kN}$

Joint O



$\left[.+up\Sigma F_y=0\right]$

$-P-F_{HO}-F_{IO}\cdot sin(\theta)=0$

$F_{IO}:=\dfrac{-P-F_{HO}}{\sin(\theta)}=-33.13\ \boldsymbol{kN}$

$F_{IO}=-33.13\ \boldsymbol{kN}$

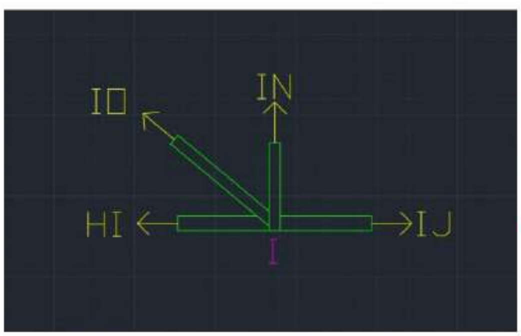
$\left[.+right\Sigma F_x=0\right]$

$-F_{OP}+F_{NO}+F_{IO}\cdot cos(\theta)=0$

$F_{NO}:=F_{OP}-F_{IO}\cdot\cos(\theta)=-81.444\ \boldsymbol{kN}$

$F_{NO}=-81.444\ \boldsymbol{kN}$

Joint I



$\left[.+up\Sigma F_y=0\right]$

$F_{IO}\cdot sin(\theta)+F_{IN}=0$

$F_{IN}:=-F_{IO}\cdot\sin(\theta)=21.209\ \boldsymbol{kN}$

$F_{IN}=21.209\ \boldsymbol{kN}$

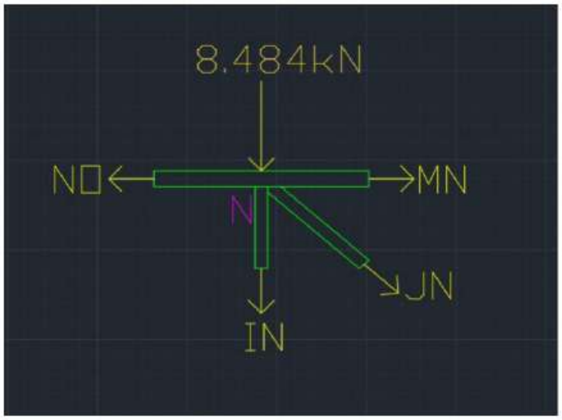
$\left[.+right\Sigma F_x=0\right]$

$-F_{HI}-F_{IO}\cdot cos(\theta)+F_{IJ}=0$

$F_{IJ}:=F_{HI}+F_{IO}\cdot\cos(\theta)=-173.069\ \boldsymbol{kN}$

$F_{IJ}=-173.069\ \boldsymbol{kN}$

Joint N



$$\left[.+up\Sigma F_y=0\right]$$

$$-P-F_{IN}-F_{JN}\cdot sin(\theta)=0$$

$$F_{JN}:=\frac{-P-F_{IN}}{\sin(\theta)}=-46.382\ kN$$

$$F_{JN}=-46.382\ kN$$

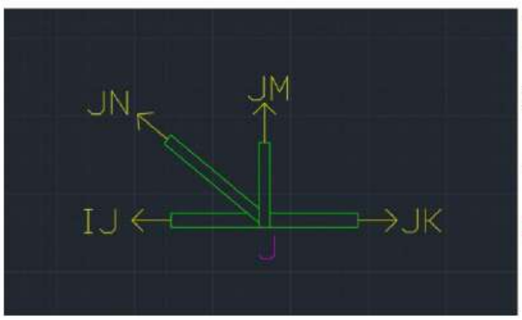
$$\left[.+right\Sigma F_x=0\right]$$

$$-F_{NO}+F_{MN}+F_{JN}\cdot cos(\theta)=0$$

$$F_{MN}:=F_{NO}-F_{JN}\cdot\cos(\theta)=-45.812\ kN$$

$$F_{MN}=-45.812\ kN$$

Joint J



$$\left[.+up\Sigma F_y=0\right]$$

$$F_{JN}\cdot sin(\theta)+F_{JM}=0$$

$$F_{JM}:=-F_{JN}\cdot\sin(\theta)=29.693\ kN$$

$$F_{JM}=29.693\ kN$$

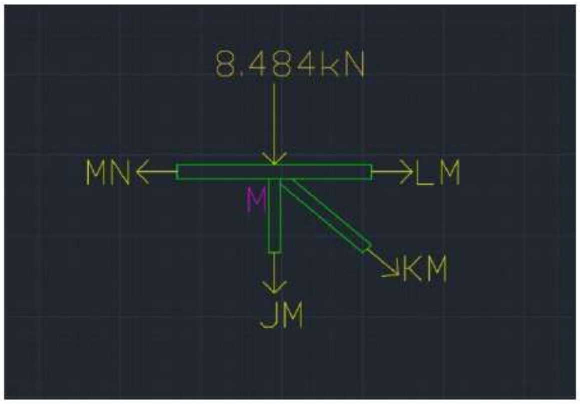
$$\left[.+right\Sigma F_x=0\right]$$

$$-F_{IJ}-F_{JN}\cdot cos(\theta)+F_{JK}=0$$

$$F_{JK}:=F_{IJ}+F_{JN}\cdot\cos(\theta)=-208.7\ kN$$

$$F_{JK}=-208.7\ kN$$

Joint M



$\left[.+up\Sigma F_y=0\right]$

$-P-F_{JM}-F_{KM}\cdot sin(\theta)=0$

$F_{KM}:=\dfrac{-P-F_{JM}}{\sin(\theta)}=-59.634\ \boldsymbol{kN}$

$F_{KM}=-59.634\ \boldsymbol{kN}$

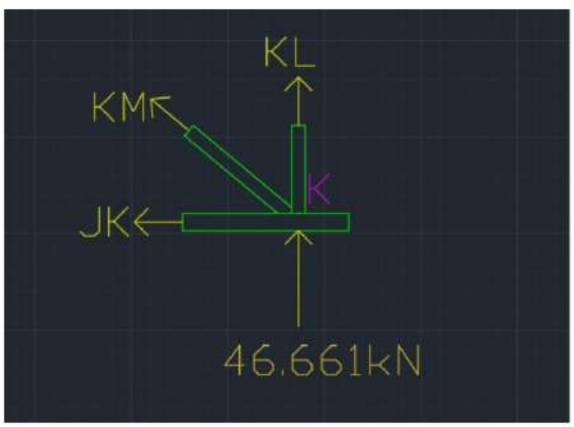
$\left[.+right\Sigma F_x=0\right]$

$-F_{MN}+F_{LM}+F_{KM}\cdot cos(\theta)=0$

$F_{LM}:=F_{MN}-F_{KM}\cdot\cos(\theta)=-7.276\cdot 10^{-14}\ \boldsymbol{kN}$

$F_{LM}:=0\ \boldsymbol{kN}$

Joint K



$\left[.+up\Sigma F_y=0\right]$

$F_{KM}\cdot sin(\theta)+F_{KL}+R=0$

$F_{KL}:=-F_{KM}\cdot\sin(\theta)-R=-8.484\ \boldsymbol{kN}$

$F_{KL}=-8.484\ \boldsymbol{kN}$

Summary of Values:

$F_{AB}=0\ kN$	$F_{CD}=81.444\ kN$	$F_{DT}=33.13\ kN$	$F_{FQ}=-4.242\ kN$
$F_{AV}=-46.661\ kN$	$F_{CT}=-29.693\ kN$	$F_{EF}=122.166\ kN$	$F_{FR}=6.626\ kN$
$F_{BC}=45.812\ kN$	$F_{CU}=46.382\ kN$	$F_{ER}=-12.726\ kN$	$F_{GH}=-132.347\ kN$
$F_{BU}=-38.177\ kN$	$F_{DE}=106.895\ kN$	$F_{ES}=19.878\ kN$	$F_{GQ}=-6.626\ kN$
$F_{BV}=59.634\ kN$	$F_{DS}=-21.209\ kN$	$F_{FG}=-127.256\ kN$	$F_{HI}=-147.617\ kN$

$F_{HO}=12.726\ kN$	$F_{JK}=-208.7\ kN$	$F_{LM}=0\ kN$	$F_{QR}=-127.256\ kN$
$F_{HP}=-19.878\ kN$	$F_{JM}=29.693\ kN$	$F_{MN}=-45.812\ kN$	$F_{RS}=-122.166\ kN$
$F_{IJ}=-173.069\ kN$	$F_{JN}=-46.382\ kN$	$F_{NO}=-81.444\ kN$	$F_{ST}=-106.895\ kN$
$F_{IN}=21.209\ kN$	$F_{KL}=-8.484\ kN$	$F_{OP}=-106.895\ kN$	$F_{TU}=-81.444\ kN$
$F_{IO}=-33.13\ kN$	$F_{KM}=-59.634\ kN$	$F_{PQ}=-122.166\ kN$	$F_{UV}=-45.812\ kN$

Largest Force present in the System:
$F_{JK}=-208.7\ kN$ $\quad F_{EF}=122.166\ kN$

Therefore: $P_c:=F_{JK}=-208.7\ kN$ $\quad P_t:=F_{EF}=122.166\ kN$

List of Sizes: Angle Bars

L25x25x3: $A:=141\ mm^2$	L30x30x3: $A:=171\ mm^2$	L35x35x3: $A:=201\ mm^2$
L25x25x4: $A:=184\ mm^2$	L30x30x4: $A:=224\ mm^2$	L35x35x4: $A:=264\ mm^2$
L25x25x5: $A:=225\ mm^2$	L30x30x5: $A:=275\ mm^2$	L35x35x5: $A:=325\ mm^2$
L40x40x3: $A:=231\ mm^2$	L45x45x3: $A:=261\ mm^2$	L50x50x3: $A:=291\ mm^2$
L40x40x4: $A:=304\ mm^2$	L45x45x4: $A:=344\ mm^2$	L50x50x4: $A:=384\ mm^2$
L40x40x5: $A:=375\ mm^2$	L45x45x5: $A:=425\ mm^2$	L50x50x5: $A:=475\ mm^2$
L60x60x3: $A:=351\ mm^2$	L65x65x3: $A:=381\ mm^2$	L75x75x3: $A:=441\ mm^2$
L60x60x4: $A:=464\ mm^2$	L65xL65x4: $A:=504\ mm^2$	L75xL75x4: $A:=584\ mm^2$
L60x60x5: $A:=575\ mm^2$	L65xL65x5: $A:=625\ mm^2$	L75x75x5: $A:=725\ mm^2$
L90x90x3: $A:=531\ mm^2$	L100x100x3: $A:=591\ mm^2$	L150x150x3: $A:=891$
L90x90x4: $A:=704\ mm^2$	L100xL100x4: $A:=784\ mm^2$	L150x150x4: $A:=1184\ mm^2$
L90x90x5: $A:=875\ mm^2$	L100xL100x5: $A:=975\ mm^2$	L150x150x5: $A:=1475\ mm^2$

Chosen Size of Angle Bar:

For Web Ties: **L90x90x5** $A_1 := 875\ mm^2$

For Top and Bottom Chords: **L100x100x5** $A_2 := 975\ mm^2$

Determining the minimum area that can resist the force P.

$\left[\sigma = \dfrac{P}{A_{cs}}\right]$ where: $F_y := 420\ MPa$ (allowable axial strength of angle bar)

$P_c = -208.7\ kN$ (largest compressive force in the system)

$P_t = 122.166\ kN$ (largest tensile force in the system)

A_{cs} (cross sectional area of the member)

$\sigma_t := 0.6 \cdot F_y = 252\ MPa$

$\sigma_c = F_a = ?$ (To be be Determined through structural steel design)

For members whose design is based on compression force, the slenderness ratio should not exceed $\frac{KL}{r} = 200$, if the limit is exceeded, the allowable stress shall not exceed the following:

A) When $\frac{KL}{r} < C_c$

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}}$$

$$F_a = \left[1 - \frac{(KL/r)^2}{2C_c^2}\right]\frac{F_y}{F.S.}$$

$$F.S. = \frac{5}{3} + \frac{3(KL/r)}{8C_c} - \frac{(KL/r)^3}{8C_c^3}$$

B) When $\frac{KL}{r} > C_c$

$$F_a = \frac{12\pi^2 E}{23\left(\frac{KL}{r}\right)^2}$$

K = effective length factor

r = minimum radius of gyration

$$r = \sqrt{\frac{I_{min}}{A}}$$

Theoretical Values of K:

a) Both ends are fixed:
   K = 0.5

b) Both ends are hinged:
   K = 1.0

c) One end is hinged and the other is fixed
   K = 0.7

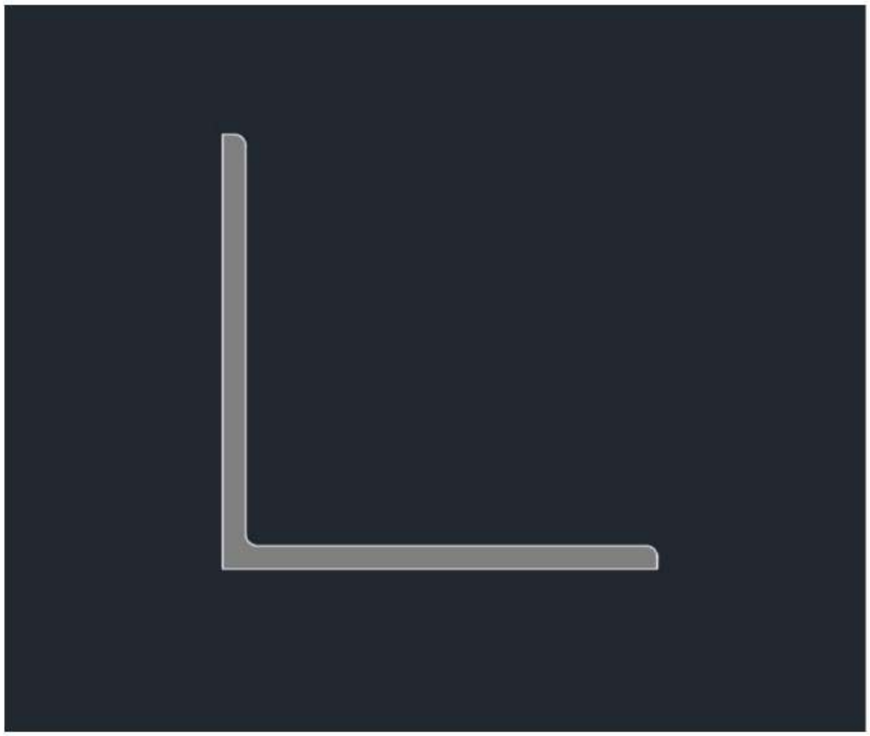
d) One is fixed and the other end is free:
   K = 2.0

Since the joints are welded, then both ends are fixed: $K := 0.5$

$$L := \sqrt[2]{(0.6\ \mathbf{m})^2 + (0.5\ \mathbf{m})^2} = 0.781\ \mathbf{m}$$

Section: L100x100x5: $b := 100\ \mathbf{mm}$ $h := 100\ \mathbf{mm}$ $t := 5\ \mathbf{mm}$ $E := 200\ \mathbf{GPa}$

$$A_T := t \cdot (b - t) + t \cdot (h - t) + t^2 = 975\ \mathbf{mm}^2$$



$A_T \cdot y_c = \Sigma_X (a_i \cdot y_i)$ (Using Varignon's Theorem)

$$\Sigma_X a_i y_i := \frac{t^2\ (b - t)}{2} + \frac{t \cdot h^2}{2} = 26187.5\ \mathbf{mm}^3$$

$$y_c := \frac{\Sigma_X a_i y_i}{A_T} = 26.859\ \mathbf{mm}$$

$A_T \cdot x_c = \Sigma_Y (a_i \cdot x_i)$ (Using Varignon's Theorem)

$$\Sigma_Y a_i x_i := \frac{t^2\ (h - t)}{2} + \frac{t \cdot b^2}{2} = 26187.5\ \mathbf{mm}^3$$

$$x_c := \frac{\Sigma_X a_i y_i}{A_T} = 26.859\ \mathbf{mm}$$

Moment of Inertia taken from the x-axis:

$$I_x := \frac{(b-t)\cdot t^3}{12} + \frac{t\cdot h^3}{12} + (b-t)\cdot t\cdot\left(y_c - \frac{t}{2}\right)^2 + t\cdot h\cdot\left(\frac{h}{2} - y_c\right)^2 = \left(9.673\cdot 10^5\right)\ \boldsymbol{mm}^4$$

Moment of Inertia taken from the y-axis:

$$I_y := \frac{(h-t)\cdot t^3}{12} + \frac{t\cdot b^3}{12} + (h-t)\cdot t\cdot\left(x_c - \frac{t}{2}\right)^2 + t\cdot b\cdot\left(\frac{b}{2} - x_c\right)^2 = \left(9.673\cdot 10^5\right)\ \boldsymbol{mm}^4$$

Radius of Gyrations: Choose the minimum

$$r_x := \sqrt[2]{\frac{I_x}{A_T}} = 31.497\ \boldsymbol{mm} \qquad r_y := \sqrt[2]{\frac{I_y}{A_T}} = 31.497\ \boldsymbol{mm}$$

$$r := r_x \qquad r := r_y$$

Slenderness Ratios: Choose the greater of the two

$$R_x := \frac{K\cdot L}{r_x} = 12.398 \qquad R_y := \frac{K\cdot L}{r_y} = 12.398$$

Comparing whichever becomes greater between R_x and R_y to C_c.

$$C_c := \sqrt[2]{\frac{2\cdot\pi^2\cdot E}{F_y}} = 96.952$$

A.) When $\frac{KL}{r} < C_c$

$$F_a = \left(1 - \frac{\left(\frac{KL}{r}\right)^2}{2\cdot C_c^{\ 2}}\right)\cdot\frac{F_y}{FS} \qquad FS := \frac{5}{3} + \frac{3\cdot\left(\frac{K\cdot L}{r}\right)}{8\cdot C_c} - \frac{\left(\frac{K\cdot L}{r}\right)^3}{8\cdot C_c^{\ 3}}$$

B.) When $\frac{KL}{r} > C_c$

$$F_a := \frac{12\cdot\pi^2\cdot E}{23\cdot\left(\frac{K\cdot L}{r}\right)^2}$$

Since $\frac{KL}{r} < C_c$: Use (A)

$$FS := \frac{5}{3} + \frac{3 \cdot \left(\frac{K \cdot L}{r}\right)}{8 \cdot C_c} - \frac{\left(\frac{K \cdot L}{r}\right)^3}{8 \cdot {C_c}^3} = 1.7143612097$$

$$F_a := \left(1 - \frac{\left(\frac{K \cdot L}{r}\right)^2}{2 \cdot {C_c}^2}\right) \cdot \frac{F_y}{FS} = 242.986\ \boldsymbol{MPa}$$

Therefore: $\sigma_c := F_a = 242.986\ \boldsymbol{MPa}$

Determining the minimum area that can resist the force P.

$\left[\sigma = \frac{P}{A_{cs}}\right]$ where: $F_y := 420\ \boldsymbol{MPa}$ (allowable axial strength of angle bar)

$P_c = -208.7\ \boldsymbol{kN}$ (largest compressive force in the system)
$P_t = 122.166\ \boldsymbol{kN}$ (largest tensile force in the system)
A_{cs} (cross sectional area of the member)

$\sigma_t := 0.6 \cdot F_y = 252\ \boldsymbol{MPa}$ (Tensile Stress)
$\sigma_c := F_a = 242.986\ \boldsymbol{MPa}$ (Compressive Stress)

Chosen Size of Angle Bar:
For Web Ties: **L90x90x5** $A_1 := 875\ \boldsymbol{mm}^2$
For Top and Bottom Chords: **L100x100x5** $A_2 := 975\ \boldsymbol{mm}^2$

Comparing the value of A_T to A_t and A_c:

$$A_t := \frac{P_t}{\sigma_t} = 484.786\ \boldsymbol{mm}^2$$

$$A_c := \frac{-1 \cdot P_c}{\sigma_c} = 858.899\ \boldsymbol{mm}^2$$

Therefore:
L90x90x5: **Passed**
L100x100x5: **Passed**

APPENDIX H
DESIGN OF STRUCTURAL COLUMNS

Project Title: Proposed Design of New 4 Storey CityHall at Passi City, Iloilo

Design Phase: Column Design Axial only

A. Material Properties and Design Factors:

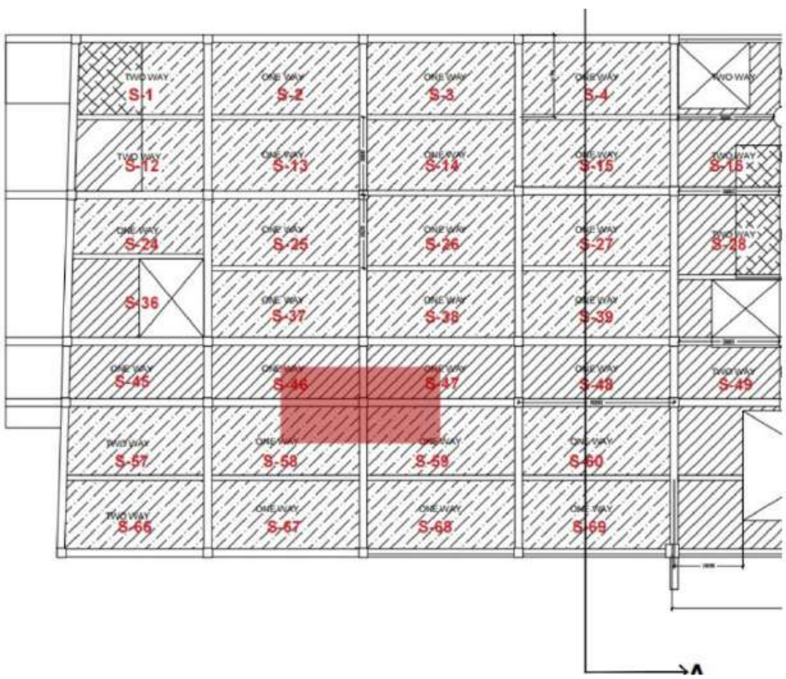
$f_y := 415\ MPa$ $\qquad dia_{main} := 16\ mm$ $\qquad db_{ties} := 10\ mm$

$f'c := 28\ MPa$ $\qquad \varphi := 0.02$ $\qquad c_c := 75\ mm$

$\phi_{lateral} := 0.65$ $\qquad \phi_{spiral} := 0.75$

Case 1:

FBD 1:



Tributary Area and Girder Lengths:

Girder Length: $\quad L_g := 2 \cdot 3\ m + 1176.5\ mm + 1450\ mm = 8.627\ m$

Tributary Area:

$$A_1 := 6\ m \cdot 1176.5\ mm = 7.059\ m^2$$

$A_2 := 6\ m \cdot 1450\ mm = 8.7\ m^2$

$A_t := 6\ m \cdot (1176.5\ mm + 1450\ mm) = 15.759\ m^2$

Factored Column Load: Thru Approximate Method Using Tributary Area

a. Dead Loads:

Beam Self Weight: $W_{D1} := 23.6\ \dfrac{kN}{m^3} \cdot (50\ cm \cdot 70\ cm) \cdot L_g = 71.255\ kN$

Weight of Slab: $W_{D2} := 23.6\ \dfrac{kN}{m^3} \cdot (150\ mm) \cdot (A_t) = 55.787\ kN$

Mechanical Ducts: $W_{D3} := 0.20\ kPa \cdot (A_t) = 3.152\ kN$

Floor Finish: $W_{D4} := 1.34\ kPa \cdot (A_t) = 21.117\ kN$

Suspended Steel Channel: $W_{D5} := 0.1\ kPa \cdot (A_t) = 1.576\ kN$

Walls: $W_{D6} := 3.17 \cdot kPa \cdot (4\ m - 150\ mm - 700\ mm) \cdot 6\ m = 59.913\ kN$

Total Dead Loads: $P_{DT} := W_{D1} + W_{D2} + W_{D3} + W_{D4} + W_{D5} + W_{D6} = 212.79951\ kN$

b. Live Loads:

Hallway: $W_{L1} := 4.8\ kPa \cdot (A_1) = 33.883\ kN$

Office: $W_{L2} := 2.4\ kPa \cdot (A_2) = 20.88\ kN$

Total Live Loads: $P_{LT} := W_{L1} + W_{L2} = 54.7632\ kN$

Point Loads From Roof: $P_{roof} := 46.661\ kN$

$Pu := 4 \cdot 1.1 \cdot (1.2 \cdot P_{DT} + 1.6 \cdot P_{LT}) + 2 \cdot P_{roof} = 1602.436\ kN$

Design Proper:

$$P_o = 0.85 \cdot f'c \cdot (A_g - A_{st}) + f_y \cdot A_{st}$$
$$\phi \cdot Pn = \phi \cdot (0.8) \cdot Po$$
$$\phi \cdot Pn = \phi \cdot (0.8) \cdot (0.85 \cdot f'c\,(A_g - A_{st}) + f_y \cdot A_{st})$$
$$\phi \cdot Pn = \phi \cdot (0.8) \cdot (0.85 \cdot f'c\,(A_g - \varphi \cdot A_g) + f_y \cdot \varphi_g \cdot A_g)$$
$$\phi \cdot Pn = Pu$$
$$A_g := \frac{Pu}{\phi_{lateral} \cdot (0.8) \cdot (0.85 \cdot f'c \cdot (1 - \varphi) + \varphi \cdot f_y)} = 97445.242\ mm^2$$

$a := \sqrt[2]{A_g} = 312.162\ mm$

$a := 500\ mm$

$A_g := a^2 = 250000\ mm^2$

$A_{st} := 0.02\ A_g = 5000\ mm^2$

$db := 25\ mm$

$$n_{rsb} := \frac{A_{st}}{0.25 \cdot \pi \cdot db^2} = 10.186$$

Design of Ties:

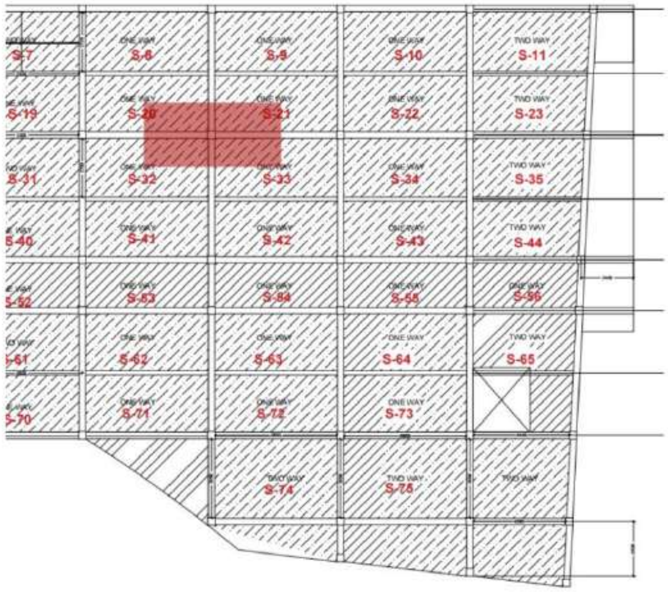
Spacing of Lateral Ties: shall not Exceed the following:

$16\ db = 400\ mm$

$48 \cdot db_{ties} = 480\ mm$

$a = 500\ mm$

Case 2:



Tributary Area and Girder Lengths:

Girder Length: $L_g := 2 \cdot 3\ m + 2 \cdot 1.5\ m = 9\ m$

Tributary Area:

$$A_1 := 6\ m \cdot 1.5\ m = 9\ m^2$$

$$A_2 := 6\ m \cdot 1.5\ m = 9\ m^2$$

$$A_t := 6\ m \cdot (3\ m) = 18\ m^2$$

Factored Column Load: Thru Approximate Method Using Tributary Area

a. Dead Loads:

Beam Self Weight: $W_{D1} := 23.6\ \dfrac{kN}{m^3} \cdot (50\ cm \cdot 70\ cm) \cdot L_g = 74.34\ kN$

Weight of Slab: $W_{D2} := 23.6\ \dfrac{kN}{m^3} \cdot (150\ mm) \cdot (A_t) = 63.72\ kN$

Mechanical Ducts: $W_{D3} := 0.20\ kPa \cdot (A_t) = 3.6\ kN$

Floor Finish: $W_{D4} := 1.34\ kPa \cdot (A_t) = 24.12\ kN$

Suspended Steel Channel: $W_{D5} := 0.1\ \boldsymbol{kPa} \cdot (A_t) = 1.8\ \boldsymbol{kN}$

Walls: $W_{D6} := 3.17 \cdot \boldsymbol{kPa} \cdot (4\ \boldsymbol{m} - 150\ \boldsymbol{mm} - 700\ \boldsymbol{mm}) \cdot 6\ \boldsymbol{m} = 59.913\ \boldsymbol{kN}$

Total Dead Loads: $P_{DT} := W_{D1} + W_{D2} + W_{D3} + W_{D4} + W_{D5} + W_{D6} = 227.493\ \boldsymbol{kN}$

b. Live Loads:

Office: $W_{L1} := 2.4\ \boldsymbol{kPa} \cdot (A_t) = 43.2\ \boldsymbol{kN}$

Total Live Loads: $P_{LT} := W_{L1} = 43.2\ \boldsymbol{kN}$

Point Loads From Roof: $P_{roof} := 46.661\ \boldsymbol{kN}$

$$Pu := 4 \cdot 1.1 \cdot (1.2 \cdot P_{DT} + 1.6 \cdot P_{LT}) + 2 \cdot P_{roof} = 1598.613\ \boldsymbol{kN}$$

Design Proper:

$$P_o = 0.85 \cdot f'c \cdot (A_g - A_{st}) + f_y \cdot A_{st}$$
$$\phi \cdot Pn = \phi \cdot (0.8) \cdot Po$$
$$\phi \cdot Pn = \phi \cdot (0.8) \cdot (0.85 \cdot f'c\,(A_g - A_{st}) + f_y \cdot A_{st})$$
$$\phi \cdot Pn = \phi \cdot (0.8) \cdot (0.85 \cdot f'c\,(A_g - \varphi \cdot A_g) + f_y \cdot \varphi_g \cdot A_g)$$
$$\phi \cdot Pn = Pu$$
$$A_g := \frac{Pu}{\phi_{lateral} \cdot (0.8) \cdot (0.85 \cdot f'c \cdot (1 - \varphi) + \varphi \cdot f_y)} = 97212.745\ \boldsymbol{mm}^2$$

$$a := \sqrt[2]{A_g} = 311.79\ \boldsymbol{mm}$$

$$a := 500\ \boldsymbol{mm}$$

$$A_g := a^2 = 250000\ \boldsymbol{mm}^2$$

$$A_{st} := 0.02\ A_g = 5000\ \boldsymbol{mm}^2$$

$$db := 25\ \boldsymbol{mm}$$

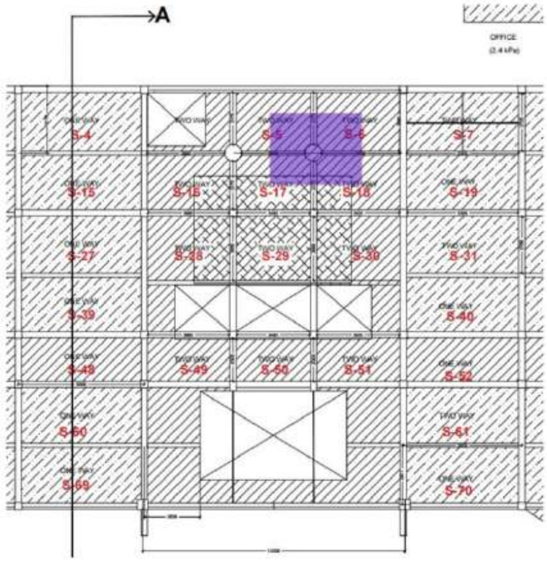
$$n_{rsb} := \frac{A_{st}}{0.25 \cdot \pi \cdot db^2} = 10.186$$

Design of Ties:

Spacing of Lateral Ties: shall not Exceed the following:

$16\ db = 400\ \boldsymbol{mm}$ $\quad a = 500\ \boldsymbol{mm}$ $\quad 48 \cdot db_{ties} = 480\ \boldsymbol{mm}$

Case 3: Spiral Two Way



Tributary Area and Girder Lengths:

Girder Length: $$L_g := \frac{3000\ mm}{2} + \frac{2850\ mm}{2} + \frac{4290\ mm}{2} + \frac{3834\ mm}{2} = 6.987\ m$$

Tributary Area:

$$A_1 := \left(\frac{3000\ mm}{2}\right) \cdot \left(\frac{4290\ mm + 3834\ mm}{2}\right) = 6.093\ m^2$$

$$A_2 := \left(\frac{2850\ mm}{2}\right) \cdot \left(\frac{4290\ mm + 3834\ mm}{2}\right) = 5.788\ m^2$$

$$A_t := \left(\frac{3000\ mm + 2850\ mm}{2}\right) \cdot \left(\frac{4290\ mm + 3834\ mm}{2}\right) = 11.881\ m^2$$

Factored Column Load: Thru Approximate Method Using Tributary Area

a. Dead Loads:

Beam Self Weight: $W_{D1} := 23.6\ \frac{kN}{m^3} \cdot (50\ cm \cdot 70\ cm) \cdot L_g = 57.713\ kN$

Weight of Slab: $W_{D2} := 23.6\ \frac{kN}{m^3} \cdot (150\ mm) \cdot (A_t) = 42.06\ kN$

Mechanical Ducts: $W_{D3} := 0.20\ kPa \cdot (A_t) = 2.376\ kN$

Floor Finish: $W_{D4} := 1.34\ kPa \cdot (A_t) = 15.921\ kN$

Suspended Steel Channel: $W_{D5} := 0.1\ kPa \cdot (A_t) = 1.188\ kN$

Walls: $W_{D6} := 3.17 \cdot kPa \cdot (4\ m - 150\ mm - 700\ mm) \cdot 6\ m = 59.913\ kN$

Total Dead Loads: $P_{DT} := W_{D1} + W_{D2} + W_{D3} + W_{D4} + W_{D5} + W_{D6} = 179.171013\ kN$

b. Live Loads:

Hallway: $W_{L1} := 4.8\ kPa \cdot (A_t) = 57.03\ kN$

Total Live Loads: $P_{LT} := W_{L1} = 57.03048\ kN$

Point Loads From Roof: $P_{roof} := 46.661\ kN$

$Pu := 4 \cdot 1.1 \cdot (1.2 \cdot P_{DT} + 1.6 \cdot P_{LT}) + 2 \cdot P_{roof} = 1440.84\ kN$

Design Proper:

$$P_o = 0.85 \cdot f'c \cdot (A_g - A_{st}) + f_y \cdot A_{st}$$
$$\phi \cdot Pn = \phi \cdot (0.85) \cdot Po$$
$$\phi \cdot Pn = \phi \cdot (0.85) \cdot (0.85 \cdot f'c\,(A_g - A_{st}) + f_y \cdot A_{st})$$
$$\phi \cdot Pn = \phi \cdot (0.85) \cdot (0.85 \cdot f'c\,(A_g - \varphi \cdot A_g) + f_y \cdot \varphi_g \cdot A_g)$$
$$\phi \cdot Pn = Pu$$
$$A_g := \frac{Pu}{\phi_{spiral} \cdot (0.85) \cdot (0.85 \cdot f'c \cdot (1 - \varphi) + \varphi \cdot f_y)} = 71469.151\ mm^2$$

$$a := \sqrt[2]{\frac{4 \cdot A_g}{\pi}} = 301.6576693\ mm$$

$a := 500\ mm$

$$A_g := 0.25 \cdot \pi \cdot a^2 = (1.963 \cdot 10^5)\ mm^2$$

$$A_{st} := 0.02\ A_g = 3926.991\ mm^2$$

$db := 25\ mm$

$$n_{rsb} := \frac{A_{st}}{0.25 \cdot \pi \cdot db^2} = 8$$

Design of Ties:

Spacing of Lateral Ties: shall not Exceed the following:

$16\ db = 400\ mm$ $\quad 48 \cdot db_{ties} = 480\ mm$ $\quad a = 500\ mm$

Final Dimension: **600mmx600mm**
Reinforcement: 12-25mm Bars

Checking Clear Spacing:

$n := 4$ $c_c := 75\ mm$ $d_b := 25\ mm$ $b := 600\ mm$

$$Spacing_{Clear} := \frac{b - 2 \cdot c_c - d_b}{n - 1} - db = 116.667\ mm$$

Note: Actual Clear Spacing is Less than 150 mm no need for internal ties

Checking Minimum Clear Spacing for Columns:

$Spacing_{Clearmin1} := 40\ mm$

$Spacing_{Clearmin2} := 1.5 \cdot d_b = 37.5\ mm$

$d_{aggr} := 40\ mm$

$$Spacing_{Clearmin3} := \frac{4}{3} \cdot d_{aggr} = 53.333\ mm$$

Note: Actual Clear Spacing is More than the Minimum Clear Spacing Requirement

Summary of Results:

Dimensions of Columns to Withstand Axial Loads: **500mmx500mm**
Steel Reinforcing Bars: **10-25mm bars**

Dimension of Columns to Withstand Both Axial Loads: **600mmx600mm**
Steel Reinforcing Bars: **12-25mm Bars**

APPENDIX I
EARTHQUAKE DESIGN AND ANALYSIS OF COLUMNS

Earthquake Analysis of the Proposed Design of New Four Storey City Hall at Passi City, Iloilo

Material Properties:

$$\gamma_c := 23.6\ \frac{kN}{m^3}$$

Dimensions:

Girder Length: $L_g := 69421\ mm + 11 \cdot \left(\frac{2898\ mm + 2353\ mm}{2}\right) + 2 \cdot \left(\frac{2353\ mm}{2}\right) = 100.6545\ m$

Slab Area:

Hallway: $A_1 := (L_g - 2541\ mm - 2325\ mm) \cdot \left(\frac{2353\ mm}{2}\right) + (4233\ mm + 4283\ mm) \cdot \left(\frac{2898\ mm}{2}\right) = 125.035\ m^2$

Office: $A_2 := (L_g - 2541\ mm - 2325\ mm - 12350\ mm) \cdot \left(\frac{2898\ mm}{2}\right) = 120.90239\ m^2$

Total Floor Tributary Area: $A_t := A_1 + A_2 = 245.93724\ m^2$

Floor Loads:

a. Dead Loads:

Beam Self Weight: $W_{D1} := 23.6\ \frac{kN}{m^3} \cdot (50\ cm \cdot 70\ cm) \cdot L_g = 831.40617\ kN$

Weight of Slab: $W_{D2} := 23.6\ \frac{kN}{m^3} \cdot (150\ mm) \cdot (A_t) = 870.61783\ kN$

Mechanical Ducts: $W_{D3} := 0.20\ kPa \cdot (A_t) = 49.18745\ kN$

Floor Finish: $W_{D4} := 1.34\ kPa \cdot (A_t) = 329.5559\ kN$

Suspended Steel Channel: $W_{D5} := 0.1\ kPa \cdot (A_t) = 24.59372\ kN$

Walls: $W_{D6} := 3.17 \cdot kPa \cdot (4\ m - 150\ mm - 700\ mm) \cdot 6\ m = 59.913\ kN$

Total Dead Loads:

$$P_{DT} := 1.2 \cdot (W_{D1} + W_{D2} + W_{D3} + W_{D4} + W_{D5} + W_{D6}) = 2598.3288925\ kN$$

b. Live Loads:

Hallway: $W_{L1} := 4.8\ kPa \cdot (A_1) = 600.1673\ kN$

Office: $W_{L2} := 2.4\ kPa \cdot (A_2) = 290.16573\ kN$

Total Live Loads: $P_{LT} := 1.2\ (W_{L1} + W_{L2}) = 1068.3996336\ kN$

$W_u := (1.2 \cdot P_{DT} + 0.25 \cdot P_{LT}) = 3385.095\ kN$

Loads per Floor:

2nd Floor: $W_{u2} := W_u = 3385.095\ kN$

3rd Floor: $W_{u3} := W_u = 3385.095\ kN$

4th Floor: $W_{u4} := W_u = 3385.095\ kN$

Total Weight of All Floors: $W_T := 3 \cdot W_u = 10155.284\ kN$

Earthquake Constants:

$I := 1.5$ $d := 30.8\ km$ Seismic Source A: More than 10km in distance

$z := 0.4$ $R := 8.5$ Soilt Type: D, Stiff Soil

$N_a := 1.0$ $C_a := 0.44 \cdot N_a = 0.44$ $C_t := 0.0731$ Concrete Frame

$N_v := 1.0$ $C_v := 0.64 \cdot N_v = 0.64$ $h_n := 12\ m$

Design Proper:

$T := C_t \cdot \left(\frac{h_n}{1\ m}\right)^{\frac{3}{4}} = 0.47131$ $T < 0.7$ Ft=0

$$V := \frac{C_v \cdot I}{R \cdot T} \cdot W_T = 2433.5543940996\ kN$$

$$V_{max} := \frac{2.5 \cdot C_a \cdot I}{R} \cdot W_T = 1971.32\ kN$$

$$V_{min} := 0.11 \cdot C_a \cdot I \cdot W_T = 737.274\ kN$$

$$V_{z4} := \frac{0.8 \cdot z \cdot N_v \cdot I}{R} \cdot W_T = 573.475\ kN$$

Base Shear per Floor:

a. 4th Level:

$h_{x4} := 12\ m$

$W_{u4} \cdot h_{x4} = 40621.13495\ kN \cdot m$

b. 3rd Level:

$h_{x3} := 8\ m$

$W_{u3} \cdot h_{x3} = 27080.75664\ kN \cdot m$

c. 2nd Level:

$h_{x2} := 4\ m$

$W_{u2} \cdot h_{x2} = 13540.37832\ kN \cdot m$

$W_i h_i := W_{u2} \cdot h_{x2} + W_{u3} \cdot h_{x3} + W_{u4} \cdot h_{x4} = 81242.26991\ kN \cdot m$

Shears:

2nd Level: $\dfrac{\left(W_{u2} \cdot h_{x2}\right)}{W_i h_i} \cdot V_{max} = 328.5533\ kN$

3rd Level: $\dfrac{\left(W_{u3} \cdot h_{x3}\right)}{W_i h_i} \cdot V_{max} = 657.10659\ kN$

4th Level: $\dfrac{\left(W_{u4} \cdot h_{x4}\right)}{W_i h_i} \cdot V_{max} = 985.65989\ kN$

Seismic Design of Columns:

Other data:

$D := 4 \cdot 212.79951\ kN + 2 \cdot \left(46.661\ kN\right)$ $\qquad L := 54.7632\ kN$

Zone 4

$C_a = 0.44$

$I = 1.5$

$\rho := 1.0$

$f_1 := 1.0$

$E_h := V_{max} = 1971.31978\ kN$

$E_v := 0.5 \cdot C_a \cdot I \cdot \left(D\right) = 311.69161\ kN$

$E := \rho \cdot E_h + E_v = 2283.0114\ kN$

Earthquake Load Combinations:

Combination (1): $1.2D + 1.0E + f_1 L$

Combination (2): $0.9D + 1.0E + 1.6H$

Earthquake Loads: $E = \rho E_h + E_v$

$E = \rho E_h + 0.5C_a ID$

Combination (1): $1.2D + 1.0(\rho E_h + 0.5C_a ID) + 0.5L$

Combination (2): $0.9D \pm 1.0(\rho E_h + 0.5C_a ID)$

Combination 1:

$$P_{c1} := 1.2 \cdot (D) + E + 0.5 \cdot (L) = 3443.81705\ kN$$

*if seismic loads and gravity loads are in the same direction

Combination 2a:

$$P_{c2a} := 0.9 \cdot (D) + E = 3133.07943\ kN$$

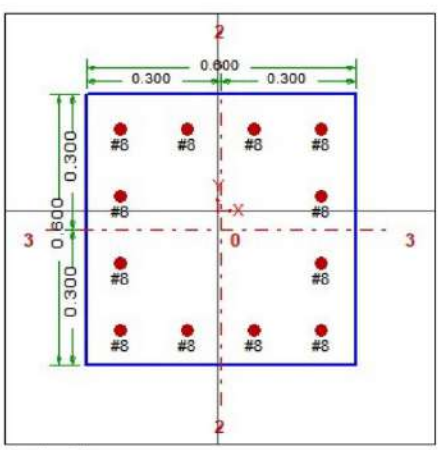
Combination 2b:

$$P_{c2b} := 0.9 \cdot (D) - E = -1432.94336\ kN$$

*if seismic loads and gravity loads are in the opposite direction

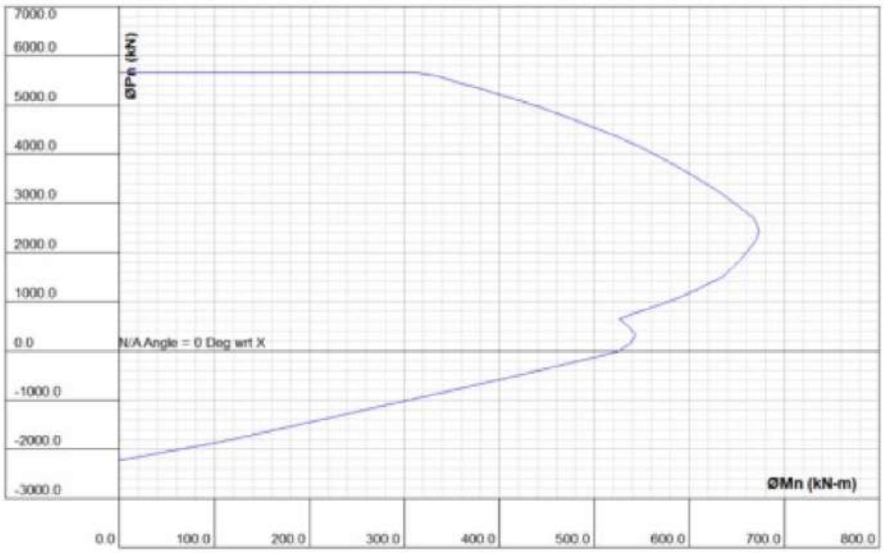
Test Section:

600mm by 600mm section with 12-25mm steel bar main reinforcements

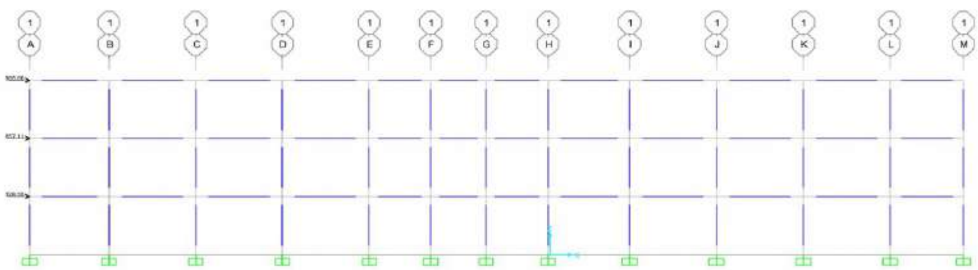


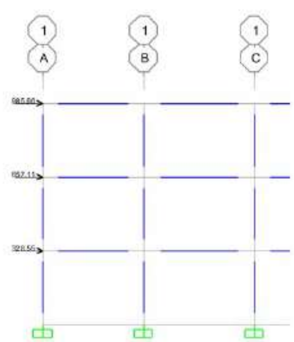
Section Diagram

Section PM Diagram:



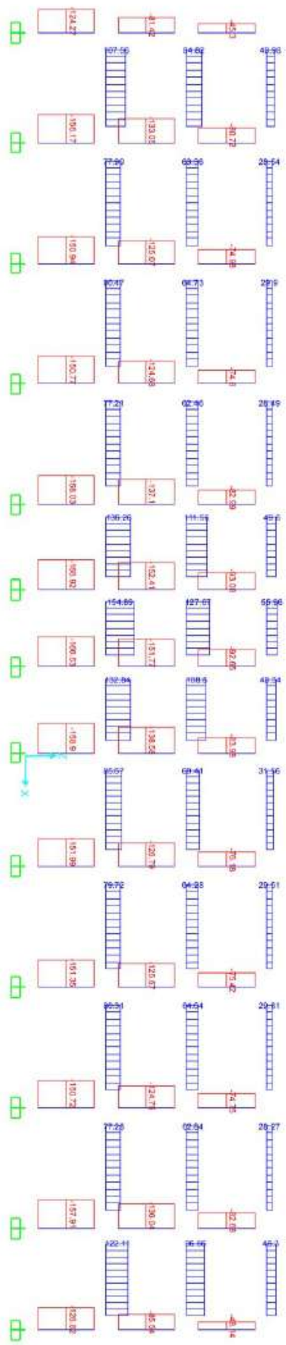
Base Shear Interaction on the Most Stressed Frame:



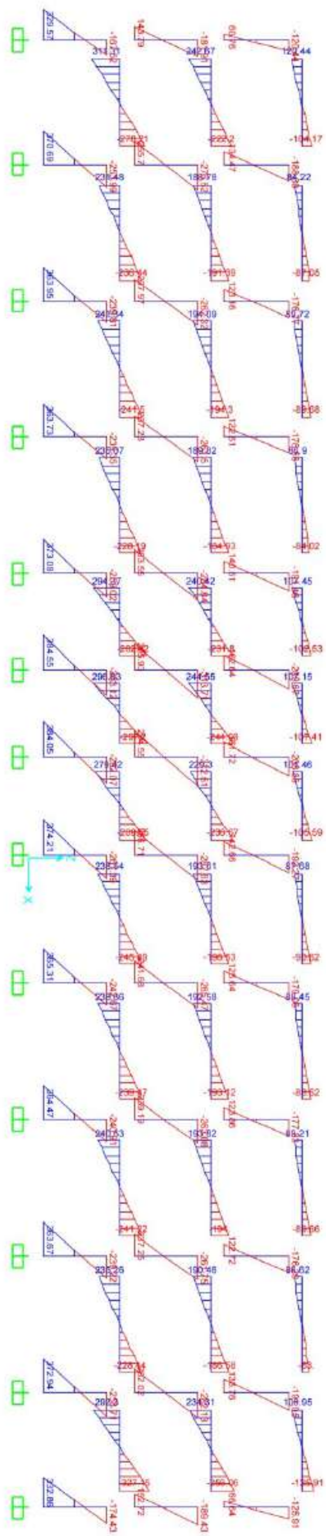


Max Moment and Shear: Design Moment and Shear:

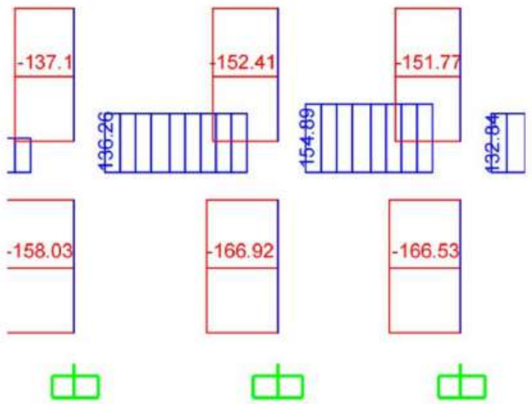
Shear Diagram:



Moment Diagram



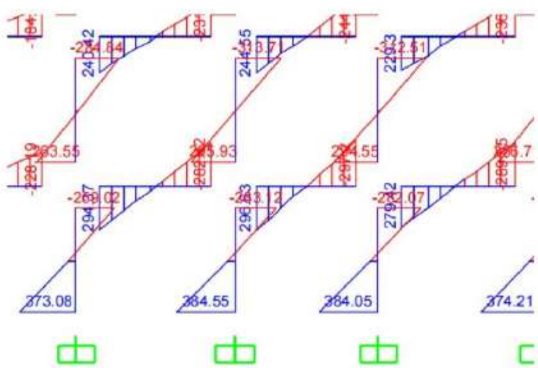
Max Shear and Moment:

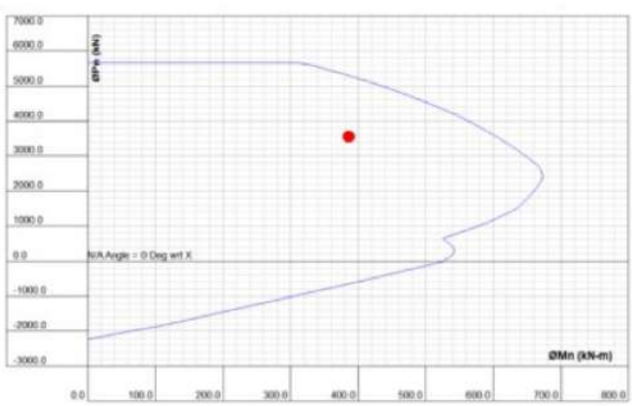


$V_{max} := -166.92\ kN$

$M_{max} := 384.55\ kN \cdot m$

$P_{max} := P_{c1} = 3443.81705\ kN$





Section Loads Within Design
Enveloped the Section
Passed

APPENDIX J
ONE-WAY AND TWO-WAY SLAB DESIGN

MANUAL COMPUTATION OF STRUCTURAL PLANS

Given Material Properties:

$f'_c := 21\ MPa$ $f_y := 420\ MPa$ $\gamma_c := 23.6\ \frac{kN}{m^3}$ $d_b := 16\ mm$ $c_c := 20\ mm$

Superimposed Dead Load: $\lambda := 1.0$ Normal Weight Concrete)

Mechanical Duct Allowance: $D_1 := 0.20\ kPa$

Plaster on Tile or Concrete: $D_2 := 0.24\ kPa$

Suspended Steel Channel System: $D_3 := 0.10\ kPa$

Ceramic or Quarry Tile (20mm) on 25mm Mortar Bed: $D_4 := 1.10\ kPa$

100mm Medium Density Concrete Masonry Units (Fully Grouted):

$D_5 := 2.69\ kPa + 2 \cdot 0.24\ kPa = 3.17\ kPa$

Self-weight Dead Load:

$D_{sw} = \gamma_c \cdot h$

Live Load:

Office: $L_1 := 2.4\ kPa$

Restroom: $L_2 := 2.4\ kPa$

Storage: $L_3 := 6.0\ kPa$

Hallway: $L_4 := 4.8\ kPa$

ONE WAY SLABS

1. Minimum Slab Thickness:

One end continuous:

$l := 3175\ mm$ $h_{min} := \frac{l}{24} = 132.292\ mm$

Both end continuous:

$l := 3000\ mm$ $h_{min} := \frac{l}{28} = 107.143\ mm$

Cantilever:

$l := 1485\ mm$ $h_{min} := \frac{l}{10} = 148.5\ mm$

For Slabs; Use the thickness

$h_{min} := 148.5\ mm$ Or say $h := 150\ mm$

Thus, $\boxed{h = 150\ mm}$

Note that the Cantilever Slab will have a separate design from Non-Cantilever Slabs.

Girder Thickness: $h_g := 700\ mm$

Slab Thickness: $h = 150\ mm$

Floor to Floor Height: $H := 4\ m$

Wall Height: $h_w := H - h_g - h = 3150\ mm$

2. Loads:

Superimposed Dead Load: $D_{sdl} := D_1 + D_2 + D_3 + D_4 = 1.64\ \dfrac{kN}{m^2}$

Self-weight Dead Load: $D_{sw} := \gamma_c \cdot h = 3.54\ \dfrac{kN}{m^2}$

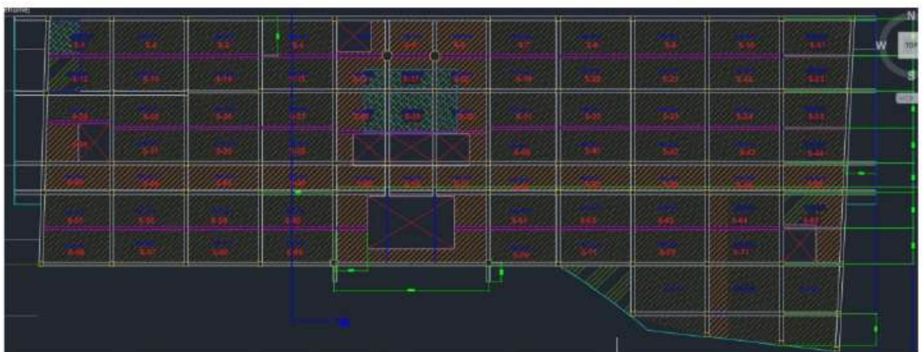
Total Dead Load: $DL := D_{sdl} + D_{sw} + D_5 = 8.35\ \dfrac{kN}{m^2}$

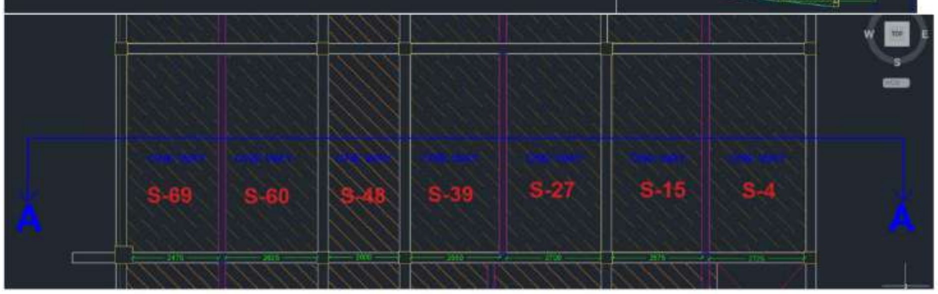
Service Live Load: $LL := L_3 = 6\ \dfrac{kN}{m^2}$ (L_3 Governs)

3. USD Load Combination:

$$U := 1.2 \cdot DL + 1.6 \cdot LL = 19.62\ \frac{kN}{m^2}$$

$$w_u := 1.2 \cdot \left(\left(D_1 + D_2 + D_3 + D_4\right) \cdot 1\ m + D_5 \cdot h_w\right) + 1.6 \cdot \left(LL \cdot 1\ m\right) = 23.551\ \frac{kN}{m}$$





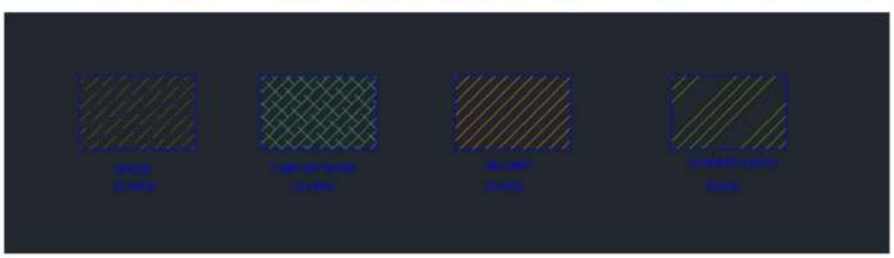


Table 406.5.2 Approximate Moments for Non-Prestressed Continuous Beams and One-Way Slabs

Moment	Location	Condition	M_u
Positive	End span	Discontinuous end integral with support	$w_u \ell_n^2/14$
		Discontinuous end unrestrained	$w_u \ell_n^2/11$
	Interior spans	All	$w_u \ell_n^2/16$
Negative[1]	Interior face of exterior support	Member built Integrally with supporting spandrel beam	$w_u \ell_n^2/24$
		Member built integrally with supporting column	$w_u \ell_n^2/16$
	Exterior face of first interior support	Two spans	$w_u \ell_n^2/9$
		More than two spans	$w_u \ell_n^2/10$
	Face of Other supports	All	$w_u \ell_n^2/11$
	Face of all supports satisfying (a) or (b)	a) Slabs with spans not exceeding 3m. b) Beams where ratio of sum of column stiffnesses to beam stiffness exceeds 8 at each end of span	$w_u \ell_n^2/12$

[1] To calculate negative moments, ℓ_n shall be the average of the adjacent clear span lengths.

4. Maximum Moment and Shear:

Given: $l_{n1} := 2475\ mm$ $l_{n2} := 2625\ mm$ $l_{n3} := 2000\ mm$ $l_{n4} := 2550\ mm$
$l_{n5} := 2700\ mm$ $l_{n6} := 2575\ mm$ $l_{n7} := 2725\ mm$

$$w_u = 23.551\ \frac{kN}{m}$$

Important Note: Since none of the slab spans have exceeded a length of 3 m; then the negative moment in all location will be $M_{neg} = \frac{w_u \cdot l_n^2}{12}$

For Slab S-69:

$$M_{pos} := \frac{w_u \cdot l_{n1}^2}{14} = 10.304\ kN \cdot m$$

$$M_{neg1} := \frac{w_u \cdot l_{n1}^2}{12} = 12.022\ kN \cdot m$$

$$M_{neg2} := \frac{w_u \cdot \left(\frac{l_{n1} + l_{n2}}{2}\right)^2}{12} = 12.761\ kN \cdot m$$

For Slab S-60:

$$M_{pos} := \frac{w_u \cdot l_{n2}^2}{16} = 10.142\ kN \cdot m$$

$$M_{neg1} := \frac{w_u \cdot \left(\frac{l_{n1} + l_{n2}}{2}\right)^2}{12} = 12.761\ kN \cdot m$$

$$M_{neg2} := \frac{w_u \cdot \left(\frac{l_{n2} + l_{n3}}{2}\right)^2}{12} = 10.495\ kN \cdot m$$

For Slab S-48:

$$M_{pos} := \frac{w_u \cdot l_{n3}^2}{16} = 5.888\ kN \cdot m$$

$$M_{neg1} := \frac{w_u \cdot \left(\frac{l_{n2} + l_{n3}}{2}\right)^2}{12} = 10.495\ kN \cdot m$$

$$M_{neg2} := \frac{w_u \cdot \left(\frac{l_{n3} + l_{n4}}{2}\right)^2}{12} = 10.157\ kN \cdot m$$

For Slab S-39:

$$M_{pos} := \frac{w_u \cdot {l_{n4}}^2}{16} = 9.571\ kN \cdot m$$

$$M_{neg1} := \frac{w_u \cdot \left(\frac{l_{n3} + l_{n4}}{2}\right)^2}{12} = 10.157\ kN \cdot m$$

$$M_{neg2} := \frac{w_u \cdot \left(\frac{l_{n4} + l_{n5}}{2}\right)^2}{12} = 13.523\ kN \cdot m$$

For Slab S-27:

$$M_{pos} := \frac{w_u \cdot {l_{n5}}^2}{16} = 10.73\ kN \cdot m$$

$$M_{neg1} := \frac{w_u \cdot \left(\frac{l_{n4} + l_{n5}}{2}\right)^2}{12} = 13.523\ kN \cdot m$$

$$M_{neg2} := \frac{w_u \cdot \left(\frac{l_{n5} + l_{n6}}{2}\right)^2}{12} = 13.652\ kN \cdot m$$

For Slab S-15:

$$M_{pos} := \frac{w_u \cdot {l_{n6}}^2}{16} = 9.76\ kN \cdot m$$

$$M_{neg1} := \frac{w_u \cdot \left(\frac{l_{n5} + l_{n6}}{2}\right)^2}{12} = 13.652\ kN \cdot m$$

$$M_{neg2} := \frac{w_u \cdot \left(\frac{l_{n6} + l_{n7}}{2}\right)^2}{12} = 13.782\ kN \cdot m$$

For Slab S-4:

$$M_{pos} := \frac{w_u \cdot {l_{n7}}^2}{14} = 12.491\ kN \cdot m$$

$$M_{neg1} := \frac{w_u \cdot \left(\frac{l_{n6} + l_{n7}}{2}\right)^2}{12} = 13.782\ kN \cdot m$$

$$M_{neg2} := \frac{w_u \cdot {l_{n7}}^2}{12} = 14.573\ kN \cdot m$$

Since the largest Positive and Negative Moments are
$M_{pos} := 12.491\ kN \cdot m$ and $M_{neg} := 14.573\ kN \cdot m$, respectively.

Therefore:

$M_{Pmax} := M_{pos} = 12.491\ kN \cdot m$

$M_{Nmax} := M_{neg} = 14.573\ kN \cdot m$

Interior Face of First Support from the Left:

$$V := \frac{w_u \cdot l_{n1}}{2} = 29.144\ kN$$

Exterior Face of First Interior Support from the Left:

$$V := \frac{1.15 \cdot w_u \cdot \left(\frac{l_{n1} + l_{n2}}{2}\right)}{2} = 34.531\ kN$$

Interior Face of First Interior Support from the Left:

$$V := \frac{w_u \cdot \left(\frac{l_{n1} + l_{n2}}{2}\right)}{2} = 30.027\ kN$$

Faces of the Third Support from the Left:

$$V := \frac{w_u \cdot \left(\frac{l_{n2} + l_{n3}}{2}\right)}{2} = 27.23\ kN$$

Faces of the Fourth Support from the Left:

$$V := \frac{w_u \cdot \left(\frac{l_{n3} + l_{n4}}{2}\right)}{2} = 26.789\ kN$$

Faces of the Fifth Support from the Left:

$$V := \frac{w_u \cdot \left(\frac{l_{n4} + l_{n5}}{2}\right)}{2} = 30.91\ kN$$

Faces of the Sixth Support from the Left:

$$V := \frac{w_u \cdot \left(\frac{l_{n5} + l_{n6}}{2}\right)}{2} = 31.057\ kN$$

Interior Face of First Interior Support from the Right:

$$V := \frac{w_u \cdot \left(\frac{l_{n6} + l_{n7}}{2}\right)}{2} = 31.205\ kN$$

Exterior Face of First Interior Support from the Right:

$$V := \frac{1.15 \cdot w_u \cdot \left(\frac{l_{n6} + l_{n7}}{2}\right)}{2} = 35.885\ kN$$

Interior Face of First Support from the Left:

$$V := \frac{w_u \cdot l_{n7}}{2} = 32.088\ kN$$

Since the largest Shear is $V := 35.885\ kN$

Therefore:

$V_{max} := V = 35.885\ kN$

Maximum Moments and Shear

$M_{Pmax} = 12.491\ kN \cdot m$ $\qquad$ $M_{Nmax} = 14.573\ kN \cdot m$

$V_{max} = 35.885\ kN$ $\quad , \quad$ $V_u := V_{max}$

5. Flexural Design:(Flexural Design for Slab is Assumed to be Tension-Controlled).

Given:

$M_{Pmax} = 12.491\ kN \cdot m$ $\qquad$ $M_{Nmax} = 14.573\ kN \cdot m$

$V_{max} = 35.885\ \frac{1}{m} \cdot kN \cdot m$ $\qquad$ $\beta_1 := 0.85 \qquad (f'_c \le 28\ MPa)$

$d := h - c_c - \frac{1}{2} \cdot d_b = 122\ mm$ $\qquad$ $\phi := 0.90$

For Positive Reinforcement: $\quad M_u := M_{Pmax} = 12.491\ kN \cdot m$

$$M_u = \phi \cdot 0.85 \cdot f'_c \cdot \beta_1 \cdot c \cdot \left(d - \frac{\beta_1 \cdot c}{2}\right) \cdot 1\ m$$

$$\left(0.425 \cdot f'_c \cdot {\beta_1}^2\right) \cdot c^2 - 0.85 \cdot f'_c \cdot \beta_1 \cdot d \cdot c + \frac{M_u}{\phi} = 0$$

$$A := 0.425 \cdot f'_c \cdot {\beta_1}^2 \cdot 1\ m$$

$$B := -0.85 \cdot f'_c \cdot \beta_1 \cdot d \cdot 1\ m$$

$$C := \frac{M_u}{\phi}$$

$$c_1 := \frac{-B + \sqrt[2]{B^2 - 4 \cdot A \cdot C}}{2 \cdot A} = 279.354 \ \mathbf{mm}$$

$$c_2 := \frac{-B - \sqrt[2]{B^2 - 4 \cdot A \cdot C}}{2 \cdot A} = 7.705 \ \mathbf{mm}$$

Use $c := c_2 = 7.705 \ \mathbf{mm}$

Check if Tension-Controlled assumption is correct:

$$f_s := 600 \ \mathbf{MPa} \cdot \frac{d - c}{c} = 8900.744 \ \mathbf{MPa}$$

Since $f_y < f_s < 1000 \ MPa$

Tension - Controlled

Solving for Actual A_s *:*

$$\rho_{min1} := \frac{1.4}{f_y} \ \mathbf{MPa} = 0.0033333333$$

$$\rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1 \ \mathbf{MPa}}}{4 \cdot f_y} = 0.0027277236$$

$$\rho_{act} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_u}{0.85 \cdot \phi \cdot f'_c \cdot (1 \ \mathbf{m}) \cdot d^2}} \right) = 0.0022814003$$

Since $\rho_{act} < \rho_{min2} < \rho_{min1}$

Use $\rho := \rho_{min1}$

$$A_s := \rho \cdot 1 \ \mathbf{m} \cdot d = 406.667 \ \mathbf{mm}^2 \qquad As := \rho \cdot d = 406.667 \ \frac{\mathbf{mm}^2}{\mathbf{m}}$$

Solving for number of bars and the spacing:

$$n := \frac{A_s}{\frac{\pi}{4} \cdot {d_b}^2} = 2.023 \qquad n := 3 \text{ bars}$$

$$s_{act} := \frac{1000 \ \mathbf{mm}}{n} = 333.333 \ \mathbf{mm} \qquad \text{Say } s := 200 \ \mathbf{mm}$$

$$s_{max1} := 3 \cdot h = 450 \ \mathbf{mm}$$

$$s_{max2} := 450 \ \mathbf{mm}$$

$s = 200 \ \mathbf{mm}$ $\qquad n := \frac{1000 \ \mathbf{mm}}{s} = 5$ $\qquad n = 5$ per meter strip

For Negative Reinforcement: $M_u := M_{Nmax} = 14.573\ kN \cdot m$

$$M_u = \phi \cdot 0.85 \cdot f'_c \cdot \beta_1 \cdot c \cdot \left(d - \frac{\beta_1 \cdot c}{2}\right) \cdot 1\ m$$

$$\left(0.425 \cdot f'_c \cdot \beta_1^{\ 2}\right) \cdot c^2 - 0.85 \cdot f'_c \cdot \beta_1 \cdot d \cdot c + \frac{M_u}{\phi} = 0$$

$$A := 0.425 \cdot f'_c \cdot \beta_1^{\ 2} \cdot 1\ m$$

$$B := -0.85 \cdot f'_c \cdot \beta_1 \cdot d \cdot 1\ m$$

$$C := \frac{M_u}{\phi}$$

$$c_1 := \frac{-B + \sqrt[2]{B^2 - 4 \cdot A \cdot C}}{2 \cdot A} = 278.027\ mm$$

$$c_2 := \frac{-B - \sqrt[2]{B^2 - 4 \cdot A \cdot C}}{2 \cdot A} = 9.032\ mm$$

Use $c := c_2 = 9.032\ mm$

Check if Tension-Controlled assumption is correct:

$$f_s := 600\ MPa \cdot \frac{d - c}{c} = \left(7.505 \cdot 10^3\right)\ MPa$$

Since $f_y < f_s < 1000\ MPa$

Tension - Controlled

Solving for Actual A_s*:*

$$\rho_{min1} := \frac{1.4}{f_y}\ MPa = 0.0033333333$$

$$\rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} = 0.0027277236$$

$$\rho_{act} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_u}{0.85 \cdot \phi \cdot f'_c \cdot (1\ m) \cdot d^2}}\right) = 0.0026743692$$

Since $\rho_{act} < \rho_{min2} < \rho_{min1}$

Use $\rho := \rho_{min1}$

$A_s := \rho \cdot 1\ m \cdot d = 406.667\ mm^2$ or $As := \rho \cdot d = 406.667\ \frac{mm^2}{m}$

Solving for number of bars and the spacing:

$$n := \frac{A_s}{\frac{\pi}{4} \cdot {d_b}^2} = 2.023$$ $n := 3$ bars

$$s_{act} := \frac{1000\ mm}{n} = 333.333\ mm$$ Say $s := 200\ mm$

$$s_{max1} := 3 \cdot h = 450\ mm$$

$$s_{max2} := 450\ mm$$

$s = 200\ mm$ $\quad n := \frac{1000\ mm}{s} = 5$ $\quad n = 5$ per meter strip

7. Shrinkage and Temperature Reinforcement:

$$A_g := 1\ m \cdot h = 150000\ mm^2$$

$$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = 270\ mm^2$$

$$A_{st2} := 0.0014 \cdot A_g = 210\ mm^2$$

$$A_{st} := A_{st1}$$

Using 12mm reinforcement bars: $d_{st} := 12\ mm$

$$A_{bs} := \frac{\pi}{4} \cdot {d_{st}}^2 = 113.097\ mm^2$$

$$n := \frac{A_{st}}{A_{bs}} = 2.387$$ Say $n := 3$

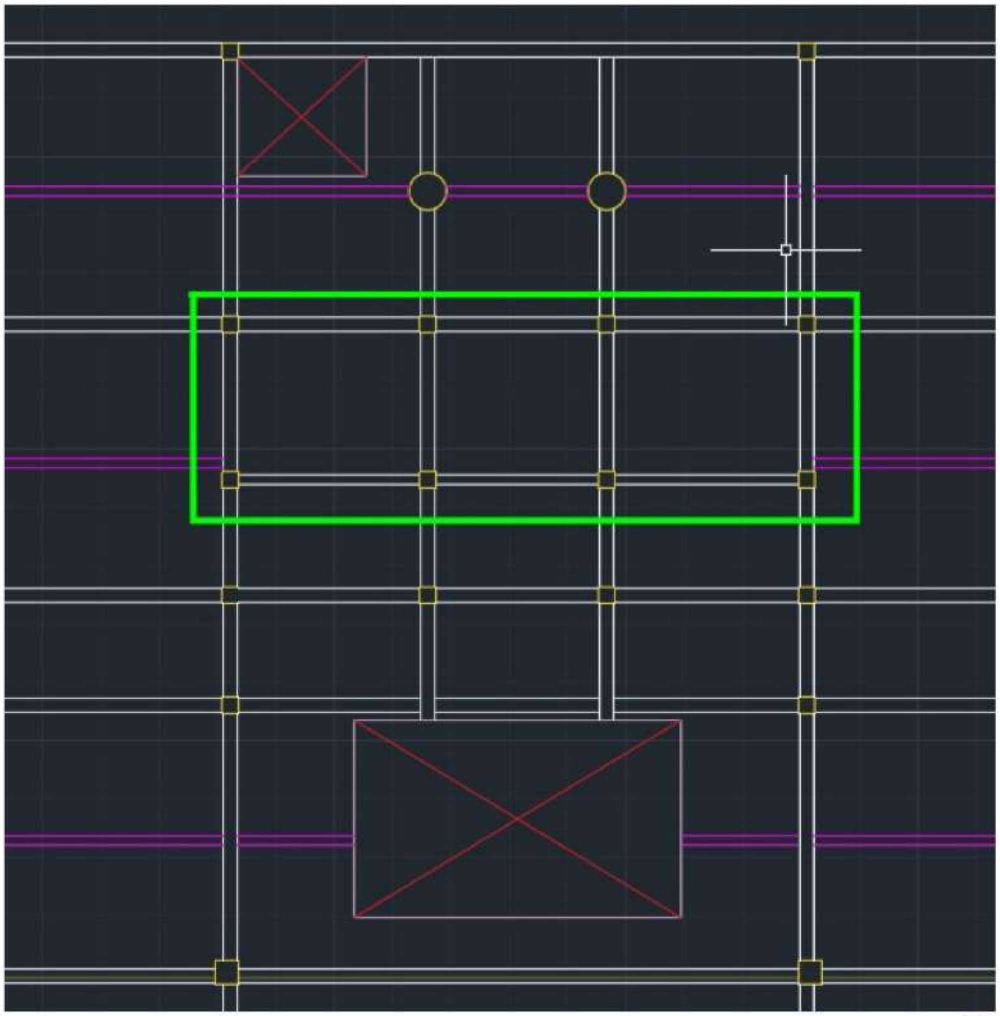
$$s_{stmax1} := 450\ mm$$

$$s_{stmax2} := 5 \cdot h = 750\ mm$$

$$s_{st} := \frac{1000\ mm}{n} = 333.333\ mm$$ Say $s := 200\ mm$

$s = 200\ mm$ $\quad n := \frac{1000\ mm}{s} = 5$ $\quad n = 5$ per meter strip

DESIGN OF TWO WAY SLABS



Given: Total Factored DL: $w_D := 1.2 \cdot \left(\left(D_1 + D_2 + D_3 + D_4 \right) \cdot 1\ m + D_5 \cdot h_w \right) = 13.951\ \frac{kN}{m}$

Total Factored Live Load: $w_L := \left(1.6 \cdot L_3 \right) \cdot 1\ m = 9.6\ \frac{kN}{m}$ (L_3 Governs)

$w_u := 1.2 \cdot \left(\left(D_1 + D_2 + D_3 + D_4 \right) \cdot 1\ m + D_5 \cdot h_w \right) + 1.6 \cdot \left(LL \cdot 1\ m \right) = 23.551\ \frac{kN}{m}$

$\phi := 0.90 \quad A_b := \frac{\pi}{4} \cdot {d_b}^2 = 201.062\ mm^2$

1. Given Dimensions:

$h := 150\ mm \quad d_b := 16\ mm \quad c_c := 20\ mm \quad d := h - c_c - \frac{1}{2} \cdot d_b = 122\ mm$

Slab S-28

Middle Strip (Interior Negative Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3885\ mm$

$m' := \frac{l_a}{l_b} = 0.785$ Case Number: **8** $\quad m_1 := 0.75 \quad m_2 := 0.80 \quad C_{a1Neg} := 0.061 \quad C_{a2Neg} := 0.055$

$$C_{aNeg} := \frac{C_{a2Neg} - C_{a1Neg}}{m_2 - m_1} \left(m' - m_1\right) + C_{a1Neg} = 0.05679$$

Moment: $M_{uaNeg1} := C_{aNeg} \cdot w_u \cdot {l_a}^2 = 12.442\ kN \cdot m$

$$\boxed{M_{uaNeg1} = 12.442\ kN \cdot m}$$

Middle Strip (Exterior Negative Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3885\ mm$

Moment: $M_{uaNeg2} := \frac{1}{3} \cdot M_{uaNeg1}$

$$\boxed{M_{uaNeg2} = 4.147\ kN \cdot m}$$

Middle Strip (Positive Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3885\ mm$

$m_{DL} := \frac{l_a}{l_b} = 0.785$ Case Number: **8** $\quad m_{1DL} := 0.75 \quad m_{2DL} := 0.80 \quad C_{aDL1Pos} := 0.036 \quad C_{aDL2Pos} := 0.032$

$$C_{aDLPos} := \frac{C_{aDL2Pos} - C_{aDL1Pos}}{m_{2DL} - m_{1DL}} \left(m_{DL} - m_{1DL}\right) + C_{aDL1Pos} = 0.03319$$

$m_{LL} := \frac{l_a}{l_b} = 0.785$ Case Number: **8** $\quad m_{1LL} := 0.75 \quad m_{2LL} := 0.80 \quad C_{aLL1Pos} := 0.049 \quad C_{aLL2Pos} := 0.044$

$$C_{aLLPos} := \frac{C_{aLL2Pos} - C_{aLL1Pos}}{m_{2LL} - m_{1LL}} \left(m_{LL} - m_{1LL}\right) + C_{aLL1Pos} = 0.04549$$

Moment: $M_{uaPos} := C_{aDLPos} \cdot w_D \cdot {l_a}^2 + C_{aLLPos} \cdot w_L \cdot {l_a}^2 = 8.371\ kN \cdot m$

$$\boxed{M_{uaPos} = 8.371\ kN \cdot m}$$

Middle Strip (Negative Moment)- Long Span: $l_a := 3050\ mm \quad l_b := 3885\ mm$

$m' := \frac{l_a}{l_b} = 0.785$ Case Number: **8** $\quad m_1 := 0.75 \quad m_2 := 0.80 \quad C_{b1Neg} := 0.036 \quad C_{b2Neg} := 0.041$

$$C_{bNeg} := \frac{C_{b2Neg} - C_{b1Neg}}{m_2 - m_1} \left(m' - m_1\right) + C_{b1Neg} = 0.04$$

Moment: $M_{ubNeg} := C_{bNeg} \cdot w_u \cdot {l_b}^2 = 14.043\ kN \cdot m$

$$\boxed{M_{ubNeg} = 14.043\ kN \cdot m}$$

Middle Strip (Positive Moment)- Long Span: $l_a := 3050\ mm \quad l_b := 3885\ mm$

$m_{DL} := \frac{l_a}{l_b} = 0.785$ Case Number: **8** $\quad m_{1DL} := 0.75 \quad m_{2DL} := 0.80$

$C_{bDL1Pos} := 0.013 \quad C_{bDL2Pos} := 0.015$

$$C_{bDLPos} := \frac{C_{bDL2Pos} - C_{bDL1Pos}}{m_{2DL} - m_{1DL}} \left(m_{DL} - m_{1DL}\right) + C_{bDL1Pos} = 0.0144$$

$m_{LL} := \frac{l_a}{l_b} = 0.785$ Case Number: **8** $\quad m_{1LL} := 0.75 \quad m_{2LL} := 0.80$

$C_{bLL1Pos} := 0.016 \quad C_{bLL2Pos} := 0.019$

$$C_{bLLPos} := \frac{C_{bLL2Pos} - C_{bLL1Pos}}{m_{2LL} - m_{1LL}} \left(m_{LL} - m_{1LL}\right) + C_{bLL1Pos} = 0.018$$

Moment: $\quad M_{ubPos} := C_{bDLPos} \cdot w_D \cdot {l_b}^2 + C_{bLLPos} \cdot w_L \cdot {l_b}^2 = 5.656\ kN \cdot m$

$$\boxed{M_{ubPos} = 5.656\ kN \cdot m}$$

Flexural Design of Slab S-28:

$$\rho_{min1} := \frac{1.4}{f_y} \cdot MPa = 0.0033333333$$

$$\rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} = 0.0027277236$$

$$\rho_{aNeg1} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaNeg1}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.002$$

$$\rho_{aNeg2} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaNeg2}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 7.437 \cdot 10^{-4}$$

$$\rho_{aPos} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaPos}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.002$$

$$\rho_{bNeg} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{ubNeg}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.003$$

$$\rho_{bPos} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{ubPos}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.001$$

Use $\rho := \rho_{min1}$ for all indicated portion of the middle strip:

Steel Area, A_s

$A_s := \rho \cdot 1\ m \cdot d = 406.667\ mm^2$ or $As := \rho \cdot d = 406.667\ \frac{mm^2}{m}$

Number of Bars, n

$n := \frac{A_s}{A_b} = 2.023$ or $n := 3$

Spacing, s

$s := \frac{1000\ mm}{n} = 0.333\ m$ Say $s := 200\ mm$ $n := \frac{1000\ mm}{s} = 5$

$s_{max1} := 3 \cdot h = 450\ mm$

Thus, $s = 200\ mm$ $n = 5$ per meter strip

$s_{max2} := 450\ mm$

Shrinkage and Temperature Reinforcement:

$A_g := 1\ m \cdot h = 150000\ mm^2$

$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = 270\ mm^2$

$A_{st2} := 0.0014 \cdot A_g = 210\ mm^2$

$A_{st} := A_{st1}$

Using 12mm reinforcement bars: $d_{st} := 12\ mm$

$A_{bs} := \frac{\pi}{4} \cdot {d_{st}}^2 = 113.097\ mm^2$

$n := \frac{A_{st}}{A_{bs}} = 2.387$ Say $n := 3$

$s_{stmax1} := 450\ mm$

$s_{stmax2} := 5 \cdot h = 750\ mm$

$s_{st} := \frac{1000\ mm}{n} = 333.333\ mm$ Say $s'_{st} := 200\ mm$ $n := \frac{1000\ mm}{s'_{st}} = 5$

Thus, $s'_{st} = 200\ mm$ $n = 5$ per meter strip

Slab S-29

Middle Strip (Interior Negative Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3485\ mm$

$m' := \frac{l_a}{l_b} = 0.875$ Case Number: **8** $\quad m_1 := 0.85 \quad m_2 := 0.90 \quad C_{a1Neg} := 0.049 \quad C_{a2Neg} := 0.043$

$$C_{aNeg} := \frac{C_{a2Neg} - C_{a1Neg}}{m_2 - m_1} \left(m' - m_1\right) + C_{a1Neg} = 0.04598$$

Moment: $\quad M_{uaNeg1} := C_{aNeg} \cdot w_u \cdot l_a^{\ 2} = 10.073\ kN \cdot m$

$M_{uaNeg1} = 10.073\ kN \cdot m$

Middle Strip (Exterior Negative Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3885\ mm$

Moment: $\quad M_{uaNeg2} := \frac{1}{3} \cdot M_{uaNeg1}$

$M_{uaNeg2} = 3.358\ kN \cdot m$

Middle Strip (Positive Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3485\ mm$

$m_{DL} := \frac{l_a}{l_b} = 0.875$ Case Number: **8** $\quad m_{1DL} := 0.85 \quad m_{2DL} := 0.90 \quad C_{aDL1Pos} := 0.029 \quad C_{aDL2Pos} := 0.025$

$$C_{aDLPos} := \frac{C_{aDL2Pos} - C_{aDL1Pos}}{m_{2DL} - m_{1DL}} \left(m_{DL} - m_{1DL}\right) + C_{aDL1Pos} = 0.02699$$

$m_{LL} := \frac{l_a}{l_b} = 0.875$ Case Number: **8** $\quad m_{1LL} := 0.85 \quad m_{2LL} := 0.90 \quad C_{aLL1Pos} := 0.040 \quad C_{aLL2Pos} := 0.035$

$$C_{aLLPos} := \frac{C_{aLL2Pos} - C_{aLL1Pos}}{m_{2LL} - m_{1LL}} \left(m_{LL} - m_{1LL}\right) + C_{aLL1Pos} = 0.03748$$

Moment: $\quad M_{uaPos} := C_{aDLPos} \cdot w_D \cdot l_a^{\ 2} + C_{aLLPos} \cdot w_L \cdot l_a^{\ 2} = 6.849\ kN \cdot m$

$M_{uaPos} = 6.849\ kN \cdot m$

Middle Strip (Negative Moment)- Long Span: $l_a := 3050\ mm \quad l_b := 3485\ mm$

$m' := \frac{l_a}{l_b} = 0.875$ Case Number: **8** $\quad m_1 := 0.85 \quad m_2 := 0.90 \quad C_{b1Neg} := 0.046 \quad C_{b2Neg} := 0.052$

$$C_{bNeg} := \frac{C_{b2Neg} - C_{b1Neg}}{m_2 - m_1} \left(m' - m_1\right) + C_{b1Neg} = 0.049$$

Moment: $\quad M_{ubNeg} := C_{bNeg} \cdot w_u \cdot l_b^{\ 2} = 14.021\ kN \cdot m$

$M_{ubNeg} = 14.021\ kN \cdot m$

Middle Strip (Positive Moment)- Long Span: $l_a := 3050\ mm \quad l_b := 3485\ mm$

$m_{DL} := \frac{l_a}{l_b} = 0.875$ Case Number: **8** $\quad m_{1DL} := 0.85 \quad m_{2DL} := 0.90$

$C_{bDL1Pos} := 0.017 \quad C_{bDL2Pos} := 0.019$

$$C_{bDLPos} := \frac{C_{bDL2Pos} - C_{bDL1Pos}}{m_{2DL} - m_{1DL}} \left(m_{DL} - m_{1DL}\right) + C_{bDL1Pos} = 0.01801$$

$m_{LL} := \frac{l_a}{l_b} = 0.875$ Case Number: **8** $\quad m_{1LL} := 0.85 \quad m_{2LL} := 0.90$

$C_{bLL1Pos} := 0.022 \quad C_{bLL2Pos} := 0.024$

$$C_{bLLPos} := \frac{C_{bLL2Pos} - C_{bLL1Pos}}{m_{2LL} - m_{1LL}} \left(m_{LL} - m_{1LL}\right) + C_{bLL1Pos} = 0.023$$

Moment: $\quad M_{ubPos} := C_{bDLPos} \cdot w_D \cdot {l_b}^2 + C_{bLLPos} \cdot w_L \cdot {l_b}^2 = 5.734\ kN \cdot m$

$\boxed{M_{ubPos} = 5.734\ kN \cdot m}$

Flexural Design of Slab S-29:

$$\rho_{min1} := \frac{1.4}{f_y} \cdot MPa = 0.0033333333$$

$$\rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} = 0.0027277236$$

$$\rho_{aNeg1} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaNeg1}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.002$$

$$\rho_{aNeg2} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaNeg2}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 6.01 \cdot 10^{-4}$$

$$\rho_{aPos} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaPos}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.001$$

$$\rho_{bNeg} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{ubNeg}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.003$$

$$\rho_{bPos} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{ubPos}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.001$$

Use $\rho := \rho_{min1}$ for all indicated portion of the middle strip:

Steel Area, A_s

$A_s := \rho \cdot 1\ m \cdot d = 406.667\ mm^2$ or $As := \rho \cdot d = 406.667\ \dfrac{mm^2}{m}$

Number of Bars, n

$n := \dfrac{A_s}{A_b} = 2.023$ or $n := 3$

Spacing, s

$s := \dfrac{1000\ mm}{n} = 0.333\ m$ Say $s := 200\ mm$ $n := \dfrac{1000\ mm}{s} = 5$

$s_{max1} := 3 \cdot h = 450\ mm$

Thus, $s = 200\ mm$ $n = 5$ per meter strip

$s_{max2} := 450\ mm$

Shrinkage and Temperature Reinforcement:

$A_g := 1\ m \cdot h = 150000\ mm^2$

$A_{st1} := \dfrac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = 270\ mm^2$

$A_{st2} := 0.0014 \cdot A_g = 210\ mm^2$

$A_{st} := A_{st1}$

Using 12mm reinforcement bars: $d_{st} := 12\ mm$

$A_{bs} := \dfrac{\pi}{4} \cdot {d_{st}}^2 = 113.097\ mm^2$

$n := \dfrac{A_{st}}{A_{bs}} = 2.387$ Say $n := 3$

$s_{stmax1} := 450\ mm$

$s_{stmax2} := 5 \cdot h = 750\ mm$

$s_{st} := \dfrac{1000\ mm}{n} = 333.333\ mm$ Say $s'_{st} := 200\ mm$ $n := \dfrac{1000\ mm}{s'_{st}} = 5$

Thus, $s'_{st} = 200\ mm$ $n = 5$ per meter strip

Slab S-30

Middle Strip (Interior Negative Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3935\ mm$

$m_1 := 0.75 \qquad m_2 := 0.80$

$m' := \frac{l_a}{l_b} = 0.775$ Case Number: **8** $\quad C_{a1Neg} := 0.061 \qquad C_{a2Neg} := 0.055$

$$C_{aNeg} := \frac{C_{a2Neg} - C_{a1Neg}}{m_2 - m_1} \left(m' - m_1\right) + C_{a1Neg} = 0.05799$$

Moment: $\quad M_{uaNeg1} := C_{aNeg} \cdot w_u \cdot {l_a}^2 = 12.704\ kN \cdot m$

$M_{uaNeg1} = 12.704\ kN \cdot m$

Middle Strip (Exterior Negative Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3935\ mm$

Moment: $\quad M_{uaNeg2} := \frac{1}{3} \cdot M_{uaNeg1}$

$M_{uaNeg2} = 4.235\ kN \cdot m$

Middle Strip (Positive Moment)- Short Span: $l_a := 3050\ mm \quad l_b := 3935\ mm$

$m_{DL} := \frac{l_a}{l_b} = 0.775$ Case Number: **8** $\quad m_{1DL} := 0.75 \qquad m_{2DL} := 0.80$

$C_{aDL1Pos} := 0.036 \qquad C_{aDL2Pos} := 0.032$

$$C_{aDLPos} := \frac{C_{aDL2Pos} - C_{aDL1Pos}}{m_{2DL} - m_{1DL}} \left(m_{DL} - m_{1DL}\right) + C_{aDL1Pos} = 0.03399$$

$m_{LL} := \frac{l_a}{l_b} = 0.775$ Case Number: **8** $\quad m_{1LL} := 0.75 \qquad m_{2LL} := 0.80$

$C_{aLL1Pos} := 0.049 \qquad C_{aLL2Pos} := 0.044$

$$C_{aLLPos} := \frac{C_{aLL2Pos} - C_{aLL1Pos}}{m_{2LL} - m_{1LL}} \left(m_{LL} - m_{1LL}\right) + C_{aLL1Pos} = 0.04649$$

Moment: $\quad M_{uaPos} := C_{aDLPos} \cdot w_D \cdot {l_a}^2 + C_{aLLPos} \cdot w_L \cdot {l_a}^2 = 8.563\ kN \cdot m$

$M_{uaPos} = 8.563\ kN \cdot m$

Middle Strip (Negative Moment)- Long Span: $l_a := 3050\ mm \quad l_b := 3935\ mm$

$m_1 := 0.75 \qquad m_2 := 0.80$

$m' := \frac{l_a}{l_b} = 0.775$ Case Number: **8** $\quad C_{b1Neg} := 0.036 \qquad C_{b2Neg} := 0.041$

$$C_{bNeg} := \frac{C_{b2Neg} - C_{b1Neg}}{m_2 - m_1} \left(m' - m_1\right) + C_{b1Neg} = 0.039$$

Moment: $\quad M_{ubNeg} := C_{bNeg} \cdot w_u \cdot {l_b}^2 = 14.043\ kN \cdot m$

$M_{ubNeg} = 14.043\ kN \cdot m$

Middle Strip (Positive Moment)- Long Span: $l_a := 3050\ mm \quad l_b := 3935\ mm$

$m_{DL} := \frac{l_a}{l_b} = 0.775$ Case Number: **8** $\quad m_{1DL} := 0.75 \quad m_{2DL} := 0.80$

$C_{bDL1Pos} := 0.013 \quad C_{bDL2Pos} := 0.015$

$$C_{bDLPos} := \frac{C_{bDL2Pos} - C_{bDL1Pos}}{m_{2DL} - m_{1DL}} \left(m_{DL} - m_{1DL}\right) + C_{bDL1Pos} = 0.014$$

$m_{LL} := \frac{l_a}{l_b} = 0.775$ Case Number: **8** $\quad m_{1LL} := 0.75 \quad m_{2LL} := 0.80$

$C_{bLL1Pos} := 0.016 \quad C_{bLL2Pos} := 0.019$

$$C_{bLLPos} := \frac{C_{bLL2Pos} - C_{bLL1Pos}}{m_{2LL} - m_{1LL}} \left(m_{LL} - m_{1LL}\right) + C_{bLL1Pos} = 0.018$$

Moment: $\quad M_{ubPos} := C_{bDLPos} \cdot w_D \cdot {l_b}^2 + C_{bLLPos} \cdot w_L \cdot {l_b}^2 = 5.627\ kN \cdot m$

$$M_{ubPos} = 5.627\ kN \cdot m$$

Flexural Design of Slab S-30:

$$\rho_{min1} := \frac{1.4}{f_y} \cdot MPa = 0.0033333333$$

$$\rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} = 0.0027277236$$

$$\rho_{aNeg1} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaNeg1}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.002$$

$$\rho_{aNeg2} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaNeg2}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 7.595 \cdot 10^{-4}$$

$$\rho_{aPos} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uaPos}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.002$$

$$\rho_{bNeg} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{ubNeg}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.003$$

$$\rho_{bPos} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{ubPos}}{0.85 \cdot \phi \cdot f'_c \cdot 1\ m \cdot d^2}}\right) = 0.001$$

Use $\rho := \rho_{min1}$ for all indicated portion of the middle strip:

Steel Area, A_s

$A_s := \rho \cdot 1\ m \cdot d = 406.667\ mm^2$ or $As := \rho \cdot d = 406.667\ \frac{mm^2}{m}$

Number of Bars, n

$n := \frac{A_s}{A_b} = 2.023$ or $n := 3$

Spacing, s

$s := \frac{1000\ mm}{n} = 0.333\ m$ Say $s := 200\ mm$ $n := \frac{1000\ mm}{s} = 5$

$s_{max1} := 3 \cdot h = 450\ mm$

Thus, $s = 200\ mm$ $n = 5$ per meter strip

$s_{max2} := 450\ mm$

Shrinkage and Temperature Reinforcement:

$A_g := 1\ m \cdot h = 150000\ mm^2$

$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = 270\ mm^2$

$A_{st2} := 0.0014 \cdot A_g = 210\ mm^2$

$A_{st} := A_{st1}$

Using 12mm reinforcement bars: $d_{st} := 12\ mm$

$s_{stmax1} := 450\ mm$

$A_{bs} := \frac{\pi}{4} \cdot {d_{st}}^2 = 113.097\ mm^2$

$s_{stmax2} := 5 \cdot h = 750\ mm$

$n := \frac{A_{st}}{A_{bs}} = 2.387$ Say $n := 3$

$s_{st} := \frac{1000\ mm}{n} = 333.333\ mm$ Say $s'_{st} := 200\ mm$ $n := \frac{1000\ mm}{s'_{st}} = 5$

Thus, $s'_{st} = 200\ mm$ $n = 5$ per meter strip

Summary of Slab Design:

One Way:

Slab Thickness: $h = 150\ mm$

Number of Top Main Bars per meter Strip: $n := 5$ -16mm

Spacing of Top Main Bars: $s := 200\ mm$

Number of Bottom Main Bars per meter Strip: $n := 5$ -16mm

Spacing of Bottom Main Bars: $s := 200\ mm$

Number of Shrinkage and Temperature Bars: $n := 5$ -12mm

Spacing of Shrinkage and Temperature Bars: $s := 200\ mm$

Two Way:

Slab Thickness: $h = 150\ mm$

Number of Top Main Bars at Column Strip - Short Span: $n := 5$ -16mm

Number of Top Main Bars at Column Strip - Long Span: $n := 5$ -16mm

Number of Bottom Main Bars at Middle Strip - Short Span: $n := 5$ -16mm

Number of Bottom Main Bars at Middle Strip - Long Span: $n := 5$ - 16mm

Spacing for All Main Bars: $s := 200\ mm$

Number of Shrinkage and Temperature Bars Both Ways: $n := 5$ -12mm

Spacing of Shrinkage and Temperature Bars Both Ways: $s := 200\ mm$

APPENDIX K
BEAM DESIGN

Project Title: Proposed Design of New 4 Storey CityHall at Passi City, Iloilo

Design Phase: Beam Design

Material Properties:

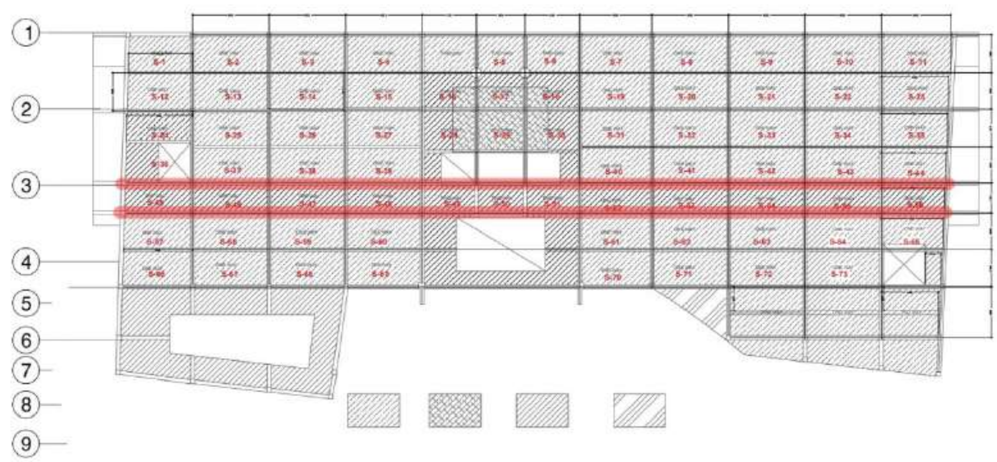
$f_y := 420\ MPa$

$f'c := 28\ MPa$

$\beta_1 := 0.85 - \frac{0.05}{7}\left(\frac{f'c}{1\ MPa} - 28\right) = 0.85$

Case 1: Girders Along the Hallway

FBD 1:



Beam/Girder Dimensions:

$b := 500\ mm$
$h := 700\ mm$
$c_c := 70\ mm$

Reinforcements:

$\phi_{main} := 16\ mm$ $\quad$ $n_{main} := 10$

Design Proper of Beam (Flexure Design):

A. Check if beam is DRB (2015 Provisions):

$d := h - c_c - \frac{1}{2} \cdot \phi_{main} = 622\ mm$

$A_{sactual} := n_{main} \cdot \frac{\pi}{4} \cdot (\phi_{main})^2 = 2010.619\ mm^2$

$spacing := \frac{b}{n_{main}} = 50\ mm$

$c_{max} := \frac{3}{7} \cdot d = 266.571\ mm$

$a_{max} := \beta_1 \cdot c_{max} = 226.586\ mm$

$0.85 \cdot f'_c \cdot a \cdot b = A_s \cdot f_y$

$A_{smax} := \frac{0.85 \cdot f'c \cdot a_{max} \cdot b}{f_y} = 6419.929\ mm^2$

if Asmax>Asactual, beam is SRB

B. Analysis of the Beam:

$C = T$

$0.85\ f'c \cdot a \cdot b = As \cdot f_y$

$a := \frac{A_{sactual} \cdot f_y}{0.85 \cdot f'c \cdot b} = 70.963\ mm$

$c := \frac{a}{\beta_1} = 83.486\ mm$

$f_s := 600\ MPa \cdot \left(\frac{d-c}{c}\right) = 3870.215\ MPa$

fs>1000Mpa, phi is = 0.90,
and is tension controlled

$\phi := 0.90$

$A_{smin1} := \frac{1.4\ MPa}{f_y} \cdot b \cdot d = 1036.667\ mm^2$

$A_{smin2} := \frac{\sqrt[2]{f'c \cdot 1\ MPa}}{4\ f_y} \cdot b \cdot d = 979.558\ mm^2$

$M_n := A_{sactual} \cdot f_y \cdot \left(d - \frac{a}{2}\right) = 495.291\ kN \cdot m$

$M_u := \phi \cdot M_n = 445.762\ kN \cdot m$

C. Computation of Factored Serciveablity Loads of the beam:

Given Values and Properties of the Case:

$W_1 := \frac{2353}{2} \cdot mm = 1.177\ m$

$W_2 := \frac{2898}{2}\ mm = 1.449\ m$

Dead Loads:

Beam Self Weight: $DL_1 := b \cdot h \cdot \left(23.6\ \frac{kN}{m^3}\right) = 8.26\ \frac{kN}{m}$

Walls: $DL_2 := 3.17\ kPa \cdot (4\ m - 150\ mm - h) = 9.986\ \frac{kN}{m}$

Mechanical Ducts: $DL_3 := 0.20\ kPa \cdot (W_1 + W_2) = 0.525\ \frac{kN}{m}$

Floor Finish: $DL_4 := 1.34\ kPa \cdot (W_1 + W_2) = 3.518\ \frac{kN}{m}$

Suspended Steel Channel: $DL_5 := 0.10\ kPa \cdot (W_1 + W_2) = 0.263\ \frac{kN}{m}$

Slab weight: $DL_6 := 23.6\ \frac{kN}{m^3} \cdot (W_1 + W_2)\ (150\ mm) = 9.294\ \frac{kN}{m}$

$$DL_{total} := DL_1 + DL_2 + DL_3 + DL_4 + DL_5 + DL_6 = 31.846\ \frac{kN}{m}$$

Live Loads:

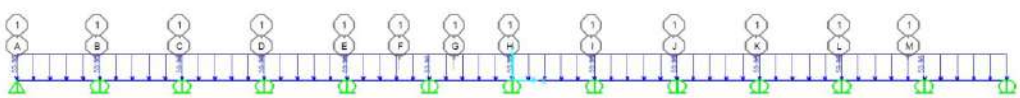
Hallway: $LL_1 := 4.8\ kPa \cdot (W_2) = 6.955\ \frac{kN}{m}$

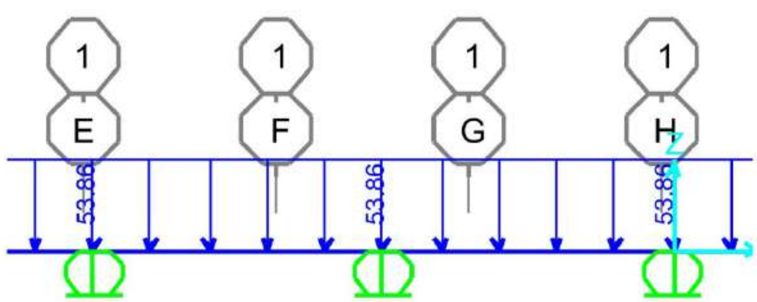
Office: $LL_2 := 2.4\ kPa \cdot (W_1) = 2.824\ \frac{kN}{m}$

$$LL_{total} := LL_1 + LL_2 = 9.779\ \frac{kN}{m}$$

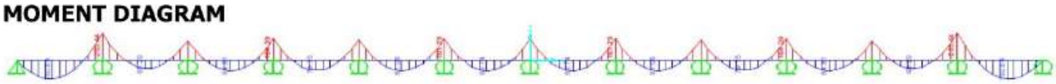
$$W_u := 1.2 \cdot (DL_{total}) + 1.6 \cdot (LL_{total}) = 53.861\ \frac{kN}{m}$$

LOAD DIAGRAM:

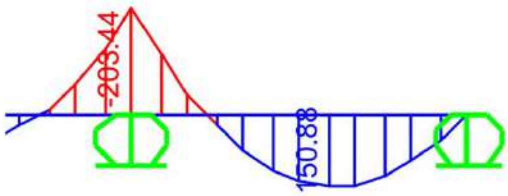




MOMENT DIAGRAM



MAX MOMENTS:



$$M_{uact1} := -203.44\ kN \cdot m$$

$$M_{uact2} := 150.88\ kN \cdot m$$

MAX MOMENTS USING APPROXIMATION NSCP:

Positive Moment:

$$M_{u1} := W_u \cdot \frac{(5.774\ m)^2}{14} = 128.262\ kN \cdot m$$

$$M_{u2} := W_u \cdot \frac{(6\ m)^2}{16} = 121.187\ kN \cdot m$$

Negative Moment:

$$M_{u3} := -W_u \cdot \frac{\left(\frac{5.774\ m + 6\ m}{2}\right)^2}{10} = -186.664\ kN \cdot m$$

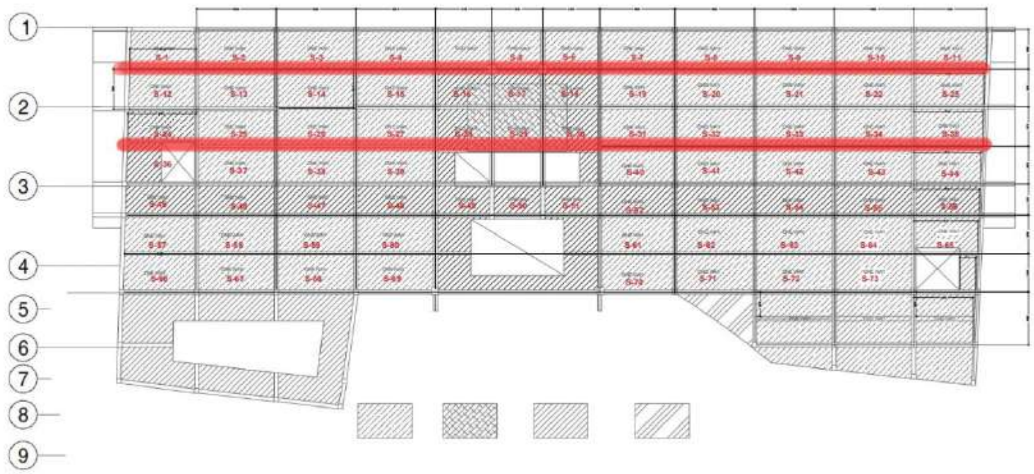
$$M_{u4} := -W_u \cdot \frac{(6\ m)^2}{11} = -176.272\ kN \cdot m$$

$$M_u = 445.762\ kN \cdot m$$

Mu act is <Mu beam design is safe

Case 2: Beams along the Hallway top portion, mostly carries office loads :

FBD 2:



Beam Dimensions:

$b := 350\ mm$
$h := 550\ mm$
$c_c := 70\ mm$

Reinforcements:

$\phi_{main} := 16\ mm$ $\qquad n_{main} := 8$

Design Proper of Beam (Flexure Design):

A. Check if beam is DRB:

$$d := h - c_c - \frac{1}{2} \cdot \phi_{main} = 472\ mm$$

$$A_{sactual} := n_{main} \cdot \frac{\pi}{4} \cdot \left(\phi_{main}\right)^2 = 1608.495\ mm^2$$

$$spacing := \frac{b}{n_{main}} = 43.75\ mm$$

$$c_{max} := \frac{3}{7} \cdot d = 202.286\ mm$$

$a_{max} := \beta_1 \cdot c_{max} = 171.943\ mm$

$0.85 \cdot f'_c \cdot a \cdot b = A_s \cdot f_y$

$$A_{smax} := \frac{0.85 \cdot f'c \cdot a_{max} \cdot b}{f_y} = 3410.2\ mm^2$$

if Asmax>Asactual, beam is SRB

B. Analysis of the Beam:

$C = T$

$0.85\ f'c \cdot a \cdot b = As \cdot f_y$

$$a := \frac{A_{sactual} \cdot f_y}{0.85 \cdot f'c \cdot b} = 81.101\ mm$$

$$c := \frac{a}{\beta_1} = 95.412\ mm$$

$$f_s := 600\ MPa \cdot \left(\frac{d-c}{c}\right) = 2368.165\ MPa$$

fs>1000Mpa, phi is = 0.90, and is tension controlled

$\phi := 0.90$

$$A_{smin1} := \frac{1.4\ MPa}{f_y} \cdot b \cdot d = 550.667\ mm^2$$

$$A_{smin2} := \frac{\sqrt[2]{f'c \cdot 1\ MPa}}{4\ f_y} \cdot b \cdot d = 520.331\ mm^2$$

$$M_n := A_{sactual} \cdot f_y \cdot \left(d - \frac{a}{2}\right) = 291.474\ kN \cdot m$$

$$M_u := \phi \cdot M_n = 262.326\ kN \cdot m$$

Given Values and Properties on One-Way Slab End Beams:

$L := 6\ m$ $\quad W_1 := \frac{3000}{2} \cdot mm = 1.5\ m$ $\quad W_2 := \frac{2850}{2}\ mm = 1.425\ m$

Dead Loads:

Beam Self Weight: $DL_1 := b \cdot h \cdot \left(23.6\ \frac{kN}{m^3}\right) = 4.543\ \frac{kN}{m}$

Walls: $DL_2 := 3.17\ kPa \cdot (4\ m - 150\ mm - h) = 10.461\ \frac{kN}{m}$

Mechanical Ducts: $DL_3 := 0.20\ kPa \cdot (W_1 + W_2) = 0.585\ \frac{kN}{m}$

Floor Finish: $DL_4 := 1.34\ kPa \cdot (W_1 + W_2) = 3.92\ \frac{kN}{m}$

Suspended Steel Channel: $DL_5 := 0.10\ kPa \cdot (W_1 + W_2) = 0.293\ \frac{kN}{m}$

Slab weight: $DL_6 := 23.6\ \frac{kN}{m^3} \cdot (W_1 + W_2)\ (150\ mm) = 10.355\ \frac{kN}{m}$

$$DL_{total} := DL_1 + DL_2 + DL_3 + DL_4 + DL_5 + DL_6 = 30.156\ \frac{kN}{m}$$

Live Loads:

Office: $LL_2 := 2.4\ kPa \cdot (W_1 + W_2) = 7.02\ \frac{kN}{m}$

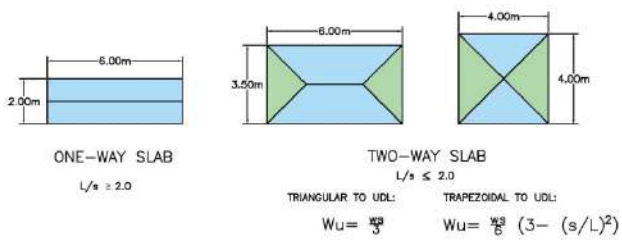
$$LL_{total} := LL_2 = 7.02\ \frac{kN}{m}$$

$$W_{u1} := 1.2 \cdot (DL_{total}) + 1.6 \cdot (LL_{total}) = 47.419\ \frac{kN}{m}$$

Given Values and Properties For Two-Way Slab Middle Beams:

$L := 4\ m \qquad s := 3\ m$

Referrence for two way slab load computation:



Dead Loads:

Beam Self Weight: $DL_1 := b \cdot h \cdot \left(23.6\ \frac{kN}{m^3}\right) = 4.543\ \frac{kN}{m}$

Walls: $DL_2 := 3.17\ kPa \cdot (4\ m - 150\ mm - h) = 10.461\ \frac{kN}{m}$

Mechanical Ducts: $DL_3 := 0.20\ kPa \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 0.488\ \frac{kN}{m}$

Floor Finish: $DL_4 := 1.34\ kPa \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 3.266\ \frac{kN}{m}$

Suspended Steel Channel: $DL_5 := 0.10\ kPa \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 0.244\ \frac{kN}{m}$

Slab weight: $DL_6 := 23.6\ \frac{kN}{m^3} \cdot (150\ mm) \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 8.629\ \frac{kN}{m}$

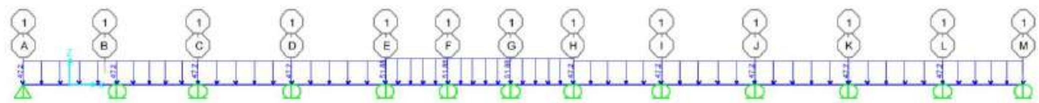
$$DL_{total} := DL_1 + DL_2 + DL_3 + DL_4 + DL_5 + DL_6 = 27.63\ \frac{kN}{m}$$

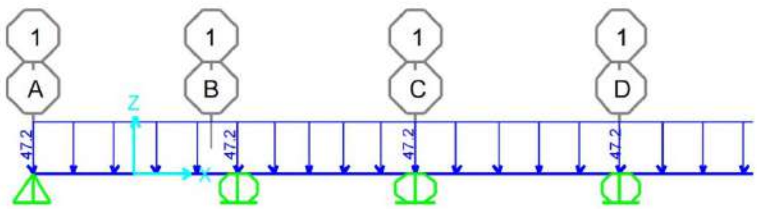
Live Loads:

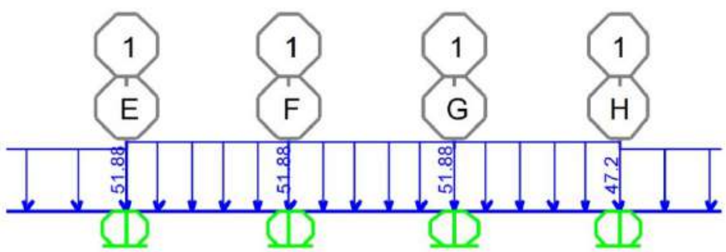
Hallway: $LL_2 := 4.8\ kPa \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 11.7\ \frac{kN}{m}$ $\quad LL_{total} := LL_2 = 11.7\ \frac{kN}{m}$

$$W_{u2} := 1.2 \cdot (DL_{total}) + 1.6 \cdot (LL_{total}) = 51.876\ \frac{kN}{m}$$

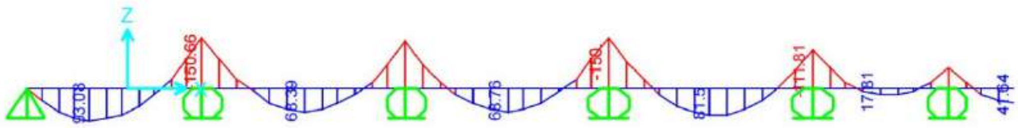
LOAD DIAGRAM:

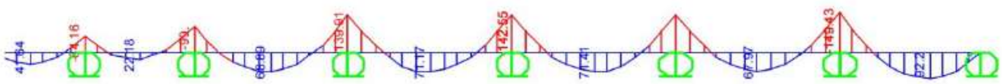




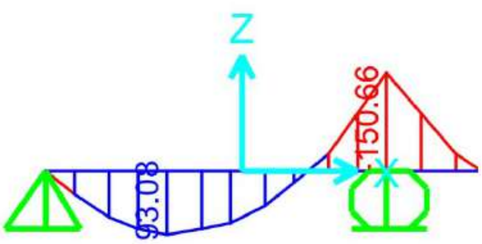


MOMENT DIAGRAM:





MAX MOMENTS:



$M_{uact1} := -150.66\ kN \cdot m$

$M_{uact2} := 93.08\ kN \cdot m$

MAX MOMENTS USING APPROXIMATION NSCP:

Positive Moment:

$$M_{u1} := W_{u1} \cdot \frac{(5.204\ m)^2}{14} = 91.727\ kN \cdot m$$

$$M_{u2} := W_{u1} \cdot \frac{(6\ m)^2}{16} = 106.692\ kN \cdot m$$

$$M_{u3} := W_{u2} \cdot \frac{(4\ m)^2}{16} = 51.876\ kN \cdot m$$

Negative Moment:

$$M_{u3} := -W_{u1} \cdot \frac{\left(\frac{5.204\ m + 6\ m}{2}\right)^2}{10} = -148.811\ kN \cdot m$$

$$M_{u4} := -W_{u1} \cdot \frac{(6\ m)^2}{11} = -155.188\ kN \cdot m$$

$M_u = 262.326\ kN \cdot m$

Mu act is <Mu beam design is safe

Case 3: gridlines 1&3, office x office girder:

FBD 3:

Beam/Girder Dimensions:

$b := 500\ mm$
$h := 700\ mm$
$c_c := 70\ mm$

Reinforcements:

$\phi_{main} := 16\ mm$ $\qquad n_{main} := 10$

Design Proper of Beam (Flexure Design):

A. Check if beam is DRB

$$d := h - c_c - \frac{1}{2} \cdot \phi_{main} = 622\ mm$$

$$A_{sactual} := n_{main} \cdot \frac{\pi}{4} \cdot (\phi_{main})^2 = 2010.619\ mm^2$$

$$spacing := \frac{b}{n_{main}} = 50\ mm$$

$$c_{max} := \frac{3}{7} \cdot d = 266.571\ mm$$

$a_{max} := \beta_1 \cdot c_{max} = 226.586\ mm$

$0.85 \cdot f'_c \cdot a \cdot b = A_s \cdot f_y$

$A_{smax} := \dfrac{0.85 \cdot f'c \cdot a_{max} \cdot b}{f_y} = 6419.929\ mm^2$

if Asmax>Asactual, beam is SRB

B. Analysis of the Beam:

$C = T$

$0.85\ f'c \cdot a \cdot b = As \cdot f_y$

$a := \dfrac{A_{sactual} \cdot f_y}{0.85 \cdot f'c \cdot b} = 70.963\ mm$

$c := \dfrac{a}{\beta_1} = 83.486\ mm$

$f_s := 600\ MPa \cdot \left(\dfrac{d-c}{c}\right) = 3870.215\ MPa$

fs>1000Mpa, phi is = 0.90, and is tension controlled

$\phi := 0.90$

$A_{smin1} := \dfrac{1.4\ MPa}{f_y} \cdot b \cdot d = \left(1.037 \cdot 10^3\right)\ mm^2$

$A_{smin2} := \dfrac{\sqrt[2]{f'c \cdot 1\ MPa}}{4\ f_y} \cdot b \cdot d = 979.558\ mm^2$

$M_n := A_{sactual} \cdot f_y \cdot \left(d - \dfrac{a}{2}\right) = 495.291\ kN \cdot m$

$M_u := \phi \cdot M_n = 445.762\ kN \cdot m$

Given Values and Properties on One-Way Slab End Beams:

$L := 6\ m$ $\qquad W_1 := \dfrac{3000}{2} \cdot mm = 1.5\ m$ $\qquad W_2 := \dfrac{2825}{2}\ mm = 1.413\ m$

Dead Loads:

Beam Self Weight: $DL_1 := b \cdot h \cdot \left(23.6\ \dfrac{kN}{m^3}\right) = 8.26\ \dfrac{kN}{m}$

Walls: $DL_2 := 3.17\ kPa \cdot (4\ m - 150\ mm - h) = 9.986\ \dfrac{kN}{m}$

Mechanical Ducts: $DL_3 := 0.20\ kPa \cdot (W_1 + W_2) = 0.583\ \dfrac{kN}{m}$

Floor Finish: $DL_4 := 1.34\ kPa \cdot (W_1 + W_2) = 3.903\ \dfrac{kN}{m}$

Suspended Steel Channel: $DL_5 := 0.10\ kPa \cdot (W_1 + W_2) = 0.291\ \dfrac{kN}{m}$

Slab weight: $DL_6 := 23.6\ \frac{kN}{m^3} \cdot (W_1 + W_2)\ (150\ mm) = 10.31\ \frac{kN}{m}$

$$DL_{total} := DL_1 + DL_2 + DL_3 + DL_4 + DL_5 + DL_6 = 33.332\ \frac{kN}{m}$$

Live Loads:

Office: $LL_2 := 2.4\ kPa \cdot (W_1 + W_2) = 6.99\ \frac{kN}{m}$

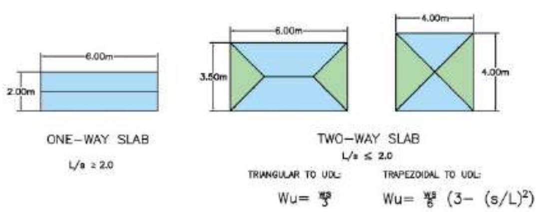
$$LL_{total} := LL_2 = 6.99\ \frac{kN}{m}$$

$$W_{u1} := 1.2 \cdot (DL_{total}) + 1.6 \cdot (LL_{total}) = 51.183\ \frac{kN}{m}$$

Given Values and Properties For Two-Way Slab Middle Beams:

$L := 4\ m$ $\quad s := 3\ m$

Referrence for two way slab load computation:



Dead Loads:

Beam Self Weight: $DL_1 := b \cdot h \cdot \left(23.6\ \frac{kN}{m^3}\right) = 8.26\ \frac{kN}{m}$

Walls: $DL_2 := 3.17\ kPa \cdot (4\ m - 150\ mm - h) = 9.986\ \frac{kN}{m}$

Mechanical Ducts: $DL_3 := 0.20\ kPa \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 0.488\ \frac{kN}{m}$

Floor Finish: $DL_4 := 1.34\ kPa \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 3.266\ \frac{kN}{m}$

Suspended Steel Channel: $DL_5 := 0.10\ kPa \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 0.244\ \frac{kN}{m}$

Slab weight: $DL_6 := 23.6\ \frac{kN}{m^3} \cdot (150\ mm) \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 8.629\ \frac{kN}{m}$

$$DL_{total} := DL_1 + DL_2 + DL_3 + DL_4 + DL_5 + DL_6 = 30.872\ \frac{kN}{m}$$

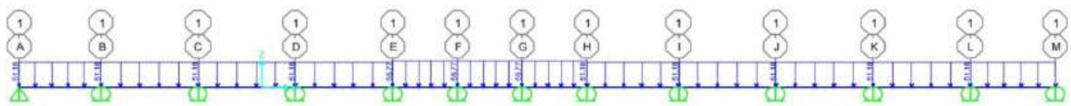
Live Loads:

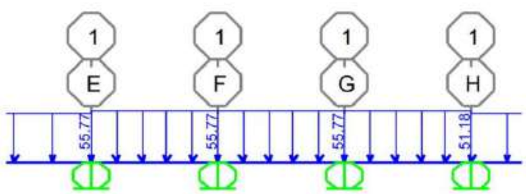
Hallway: $$LL_2 := 4.8\ kPa \cdot 2 \cdot \left(\frac{s}{6}\right) \cdot \left(3 - \left(\frac{s}{L}\right)^2\right) = 11.7\ \frac{kN}{m}$$

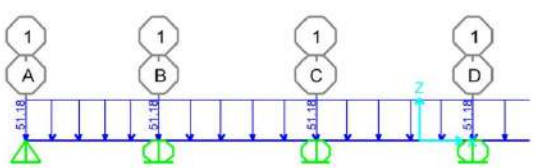
$$LL_{total} := LL_2 = 11.7\ \frac{kN}{m}$$

$$W_{u2} := 1.2 \cdot \left(DL_{total}\right) + 1.6 \cdot \left(LL_{total}\right) = 55.766\ \frac{kN}{m}$$

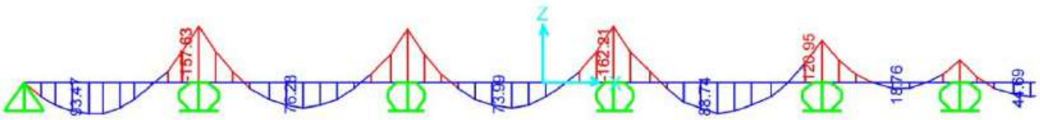
LOADING DIAGRAM:

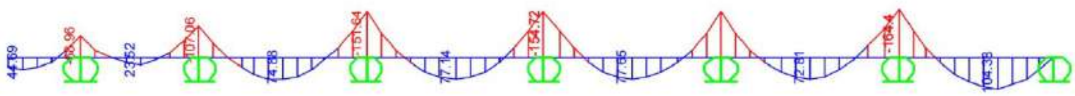




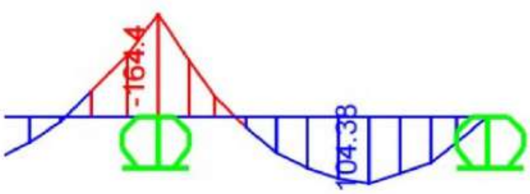


MOMENT DIAGRAM:





MAX MOMENTS:



$$M_{uact1} := -164.4\ kN \cdot m$$

$$M_{uact2} := 104.38\ kN \cdot m$$

MAX MOMENTS USING APPROXIMATION NSCP:

Positive Moment:

$$M_{u1} := W_{u1} \cdot \frac{(5.265\ m)^2}{14} = 101.343\ kN \cdot m$$

$$M_{u2} := W_{u1} \cdot \frac{(6\ m)^2}{16} = 115.161\ kN \cdot m$$

$$M_{u3} := W_{u2} \cdot \frac{(4\ m)^2}{16} = 55.766\ kN \cdot m$$

Negative Moment:

$$M_{u3} := -W_{u1} \cdot \frac{\left(\frac{5.265\ m + 6\ m}{2}\right)^2}{10} = -162.377\ kN \cdot m$$

$$M_{u4} := -W_{u1} \cdot \frac{(6\ m)^2}{11} = -167.507\ kN \cdot m$$

$$M_u = 445.762\ kN \cdot m$$

Mu act is <Mu beam design is safe

Design Proper of Beam
(Shear)

Material Properties:

$f'_c := 28\ MPa$ $\quad f_y := 420\ MPa$ $\quad f_{yt} := 275\ MPa$ $\quad \beta_1 := 0.85 - \frac{0.05}{7} \cdot \left(\frac{f'_c}{1\ MPa} - 28\right) = 0.85$

$\lambda := 1.0$

Dimensions:

$b_g := 500\ mm$ $\quad h_g := 700\ mm$ $\quad c_c := 70\ mm$ $\quad d_b := 16\ mm$ $\quad d_s := 10\ mm$ $\quad \phi := 0.75$

$b := 350\ mm$ $\quad h := 550\ mm$ $\quad L := 6\ m$

$d_g := h_g - c_c - \frac{d_b}{2} = 622\ mm$ $\quad d := h - c_c - \frac{d_b}{2} = 472\ mm$

$A_v := 2 \cdot \left(\frac{\pi}{4} \cdot d_s^{\ 2}\right) = 157.08\ mm^2$

Case 1 Gridline 3&4 Girders along the Hallway

Load: $\quad w_u := W_{u1} = 53.861\ \frac{kN}{m}$

$V_u := d_g \cdot w_u = 33.501\ kN$

$V_c := 0.17 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} \cdot b_g \cdot d_g = 279.762\ kN$

$\phi V_c := \phi \cdot V_c = 209.82131\ kN$

$0.5 \cdot \phi V_c = 104.911\ kN$ $\quad$ Since $V_u < 0.5 \cdot \phi V_c$, beam section is capable to carry required shear. (Or use smax)

$s_{max} := \frac{d_g}{2} = 311\ mm$ $\quad$ say $s := 300\ mm$

Case 2 Gridlines 0&2, beams along the Hallway top portion:

Load: $\quad w_u := W_{u2} = 47.419\ \frac{kN}{m}$

$V_u := d \cdot w_u = 22.382\ kN$

$V_c := 0.17 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} \cdot b \cdot d = 148.607\ kN$

$\phi V_c := \phi \cdot V_c = 111.45492\ kN$

$0.5 \cdot \phi V_c = 55.727\ kN$ $\quad$ Since $V_u < 0.5 \cdot \phi V_c$, beam section is capable to carry required shear. (Or use smax)

$s_{max} := \frac{d}{2} = 236\ mm$ $\quad$ say $s := 225\ mm$

Case 3 Gridlines 1&3, office x office girder:

Load: $w_u := W_{u3} = 51.183\ \frac{kN}{m}$

$V_u := d_g \cdot w_u = 31.836\ kN$

$V_c := 0.17 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} \cdot b_g \cdot d_g = 279.762\ kN$

$\phi V_c := \phi \cdot V_c = 209.82131\ kN$

$0.5 \cdot \phi V_c = 104.911\ kN$ Since $V_u < 0.5 \cdot \phi V_c$, beam section is capable to carry required shear. (Or use smax)

$s_{max} := \frac{d_g}{2} = 311\ mm$ say $s := 300\ mm$

Case 4 S2way slab hall way x hall way girder

Load: $w_u := W_{u4} = 55.766\ \frac{kN}{m}$

$V_u := d_g \cdot w_u = 34.687\ kN$

$V_c := 0.17 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} \cdot b_g \cdot d_g = 279.762\ kN$

$\phi V_c := \phi \cdot V_c = 209.82131\ kN$

$0.5 \cdot \phi V_c = 104.911\ kN$ Since $V_u < 0.5 \cdot \phi V_c$, beam section is capable to carry required shear. (Or use smax)

$s_{max} := \frac{d_g}{2} = 311\ mm$ say $s := 300\ mm$

Case 5 S2way slab hall way x hall way beam

Load: $w_u := W_{u5} = 51.876\ \frac{kN}{m}$

$V_u := d \cdot w_u = 24.486\ kN$

$V_c := 0.17 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} \cdot b \cdot d = 148.607\ kN$

$\phi V_c := \phi \cdot V_c = 111.45492\ kN$

$0.5 \cdot \phi V_c = 55.727\ kN$ Since $V_u < 0.5 \cdot \phi V_c$, beam section is capable to carry required shear. (Or use smax)

$s_{max} := \frac{d}{2} = 236\ mm$ say $s := 225\ mm$

Summary for Shear:

Stirrup Spacing for Girders: $s_g := 300\ mm$

Stirrup Spacing for Beams: $s_b := 225\ mm$

APPENDIX L
DESGIN OF FOOTING

Design of Reinforced Concrete □nterior Square Footing

<u>Given:</u>

Reinforced Concrete Density: $\gamma_{rc} := 23.6 \ \frac{kN}{m^3}$

Soil Unit Weight: $\gamma_s := 15.61 \ \frac{kN}{m^3}$

Concrete Strength: $f'_c := 28 \ MPa$

Reinforced Yield Strength: $f_y := 420 \ MPa$

Unfactored Axial Dead Load: $P_D := 239.26644 \ kN \cdot (1.1) \cdot (3) = 789.57925 \ kN$

Unfactored Axial Live Load: $P_L := 105.588 \ kN \cdot (1.1) \cdot (3) = 348.4404 \ kN$

Unfactored Weight from Ground Floor: $w := 8.35 \ kPa + 6 \ kPa = 14.35 \ kPa$

Square Column Width: $a_1 := 600 \ mm \quad a_2 := 600 \ mm$

Reinforcement Diameter: $d_b := 20 \ mm$

Concrete Cover: $c_c := 75 \ mm$

Concrete Modification Factor: $\lambda := 1.0$

Depth of Footing's Base Measured from Ground Line: $D_f := 1.5 \ m$

Assumption: $h := 400 \ mm$

$q_a := 138.049 \ kPa$

$q_a = W_c + W_s + W_D + W_L + w$

Footing Weight, $W_c := \gamma_{rc} \cdot h = 9.44 \ kPa$

Weight of Soil Above the Footing, $W_s := \gamma_s \cdot (D_f - h) = 17.171 \ kPa$

Service Dead Loads, $W_D = \frac{P_D}{B^2}$

Service Live Loads, $W_L = \frac{P_L}{B^2}$

$$q_a = \gamma_{rc} \cdot h + \gamma_s (D_f - h) + \frac{P_D + P_L}{B^2} + w$$

$$B := \sqrt[2]{\frac{P_D + P_L}{q_a - \gamma_{rc} \cdot h - \gamma_s \cdot (D_f - h) - w}} = 3.42367 \ m$$

$B = 3423.67163 \ mm$ say $B := 3500 \ mm$

$$d := h - \frac{d_b}{2} - c_c = 315 \ mm$$

Punching Perimeter: $b_o := 2 \cdot (a_1 + d) + 2 \cdot (a_2 + d) = 3.66 \ m$

Thickness Required for Two-Way Shear: $\phi := 0.75 \quad \beta_c := \frac{a_2}{a_1} = 1 \quad \alpha_s := 40$

$V_u = 0.75 \cdot V_c$

Where:

$V_u = v_u \cdot \left(B^2 - \left(a_1 + d\right) \cdot \left(a_2 + d\right)\right) \qquad v_u := \frac{1.2 \cdot P_D + 1.6 \cdot P_L}{B^2} = 122.85712\ kPa$

$V_u := v_u \cdot \left(B^2 - \left(a_1 + d\right) \cdot \left(a_2 + d\right)\right) = 1402.14069\ kN$

$V_c = 0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.33 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 1.7462\ MPa$ (Governing Formula)

$V_c = 0.17 \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.17 \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.6987\ MPa$

$V_c = 0.083 \cdot \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.083 \cdot \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.3904\ MPa$

$V_u = \phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}\right)$

$d_{req} := \frac{V_u}{\phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 292.52049\ mm$

$h_{req} := d_{req} + \frac{d_b}{2} + c_c = 377.52\ mm \qquad h = 400\ mm$

$h > h_{req}$ (Footing Thickness is Acceptable)

Thickness Required for One-Way Shear:

$d := h - \frac{d_b}{2} - c_c = 315\ mm$

$V_{u1} := v_u \cdot B \cdot \left(\frac{B}{2} - \frac{a_1}{2} - d\right) = 488.04992\ kN \qquad V_{u2} := v_u \cdot B \cdot \left(\frac{B}{2} - \frac{a_2}{2} - d\right) = 488.04992\ kN$

$V_u := V_{u1} = 488.04992\ kN$

$d_{req} := \frac{V_u}{\phi \cdot \left(0.17 \cdot \lambda \cdot B \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 206.68407\ mm$

$h_{req} := d_{req} + \frac{d_b}{2} + c_c = 291.68407\ mm \qquad h = 400\ mm$

$h > h_{req}$ (Footing Thickness is Acceptable)

Therefore:

By rounding up to the nearest 50mm:

$h = 400\ mm$ (Footing Thickness)

$B := \sqrt[2]{\frac{P_D + P_L}{q_a - \gamma_{rc} \cdot h - \gamma_s \cdot \left(D_f - h\right) - w}} = 3423.67163\ mm$

By rounding up to the nearest 100mm:

$B := 3500\ mm$ (Footing Width)

Flexure Design of Square Footing:

Given:

Footing Thickness: $h=400\ mm$

Footing Width: $B=3500\ mm$

Concrete Strength: $f'_c := 28\ MPa$

Reinforced Yield Strength: $f_y := 420\ MPa$

Unfactored Axial Dead Load: $P_D := 239.26644\ kN \cdot (1.1) \cdot (3) = 789.57925\ kN$

Unfactored Axial Live Load: $P_L := 105.588\ kN \cdot (1.1) \cdot (3) = 348.4404\ kN$

Square Column Width: $a_1 = 600\ mm \quad a_2 = 600\ mm$

Reinforcement Diameter: $d_b := 20\ mm$

Concrete Cover: $c_c := 75\ mm$

Concrete Modification Factor: $\lambda := 1.0$

Design Factor: $\phi := 0.90$

- Taking the Critical Section at the face of the Column

Cantilever Length:

$$l_{u1} := \frac{B}{2} - \frac{a_1}{2} = 1450\ mm \quad l_{u2} := \frac{B}{2} - \frac{a_2}{2} = 1450\ mm$$

Governing Cantilever Length: $l_u := l_{u1} = 1450\ mm$

Design Moment:

$$q_u := \frac{1.2 \cdot P_D + 1.6 \cdot P_L}{B^2} = 122.85712\ kPa$$

$$w_u := q_u \cdot B = 429.99993\ \frac{kN}{m}$$

$$M_u := \frac{w_u \cdot {l_u}^2}{2} = 452.03742\ kN \cdot m$$

$$d := h - \frac{d_b}{2} - c_c = 315\ mm$$

$$\rho := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_u}{0.85 \cdot \phi \cdot f'_c \cdot B \cdot d^2}}\right) = 0.003554956539$$

Steel Area:

$$As := \rho \cdot B \cdot d = 3919.33958\ mm^2$$

$$A_{smin1} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} \cdot B \cdot d = 3472.5486\ mm^2$$

$$A_{smin2} := \frac{1.4\ MPa}{f_y} \cdot B \cdot d = 3675\ mm^2$$

Governing Steel Area: $A_s := As = 3919.33958\ mm^2$

Quantity:

$$n = \frac{A_s}{A_b}$$

$$A_b := \frac{\pi}{4} \cdot d_b^{\,2} = 314.15927\ mm^2$$

$$A_s = 3919.33958\ mm^2$$

Therefore:

$$n := \frac{A_s}{A_b} = 12.47565$$

$n := 13$ pieces of 20-mm reinforcement bars both Ways.

Spacing:

$$s := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 256.15385\ mm$$

$s := 150\ mm$

$s_{max1} := 3 \cdot h = 1200\ mm$

$s_{max2} := 450\ mm$

$s = 150\ mm \qquad n := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s} = 22.2 \qquad n := 23$

Shrinkage and Temperature Reinforcement:

$$A_g := B \cdot h = 1400000\ mm^2$$

$$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = 2520\ mm^2$$

$$A_{st2} := 0.0014 \cdot A_g = 1960\ mm^2$$

$$A_{st} := A_{st1}$$

Using 16mm reinforcement bars: $d_{st} := 16\ mm$

$$A_{bs} := \frac{\pi}{4} \cdot d_{st}^{\,2} = 201.06193\ mm^2$$

$s_{stmax1} := 450\ mm$

$s_{stmax2} := 5 \cdot h = 2000\ mm$

$n_{st} := \frac{A_{st}}{A_{bs}} = 12.53345 \qquad n_{st} := 13$

$$s_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_{st}}{2}\right)}{n_{st}} = 256.46154\ mm$$

$s_{st} := 150\ mm \qquad n_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_{st}}{2}\right)}{s_{st}} = 22.22667 \qquad n_{st} := 23$

Summary of the Design:

Size of Footing, BxB: $B = 3.5\ m \quad B = 3.5\ m$
Height of Footing: $h = 400\ mm$
Size of Main Reinforcements: $d_b = 20\ mm$
Size of Shrinkage and Temperature Bars: $d_{st} = 16\ mm$

Number of Main Reinforcement Bars Both Ways: $n = 23 \quad (20\ mm\phi)$
Adapted Spacing of Main Reinforcement Bars Both Ways: $s = 150\ mm$

Number of Shrinkage and Temperature Reinforcement Bars Both Ways: $n_{st} = 23 \quad (16\ mm\phi)$
Adapted Spacing of Shrinkage and Temperature Reinforcement Bars Both Ways: $s_{st} = 150\ mm$

Design of Reinforced Concrete Edge Square Footing

Given:

Reinforced Concrete Density: $\gamma_{rc} := 23.6 \dfrac{kN}{m^3}$

Soil Unit Weight: $\gamma_s := 15.61 \dfrac{kN}{m^3}$

Concrete Strength: $f'_c := 28\ MPa$

Reinforced Yield Strength: $f_y := 420\ MPa$

Unfactored Axial Dead Load: $P_D := 146.7096\ kN \cdot (1.16) \cdot (3) = 510.54941\ kN$

Unfactored Axial Live Load: $P_L := 73.053\ kN \cdot (1.16) \cdot (3) = 254.22444\ kN$

Weight from Ground Floor: $w := 8.35\ kPa + 6\ kPa = 14.35\ kPa$

Square Column Width: $a_1 := 600\ mm \quad a_2 := 600\ mm$

Reinforcement Diameter: $d_b := 20\ mm$

Concrete Cover: $c_c := 75\ mm$

Concrete Modification Factor: $\lambda := 1.0$

Depth of Footing's Base Measured from Ground Line: $D_f := 1.5\ m$

Assumption: $h := 350\ mm$

$q_a := 138.049\ kPa$

$q_a = W_c + W_s + W_D + W_L + w$

Footing Weight, $W_c := \gamma_{rc} \cdot h = 8.26\ kPa$

Weight of Soil Above the Footing, $W_s := \gamma_s \cdot (D_f - h) = 17.9515\ kPa$

Service Dead Loads, $W_D = \dfrac{P_D}{B^2}$

Service Live Loads, $W_L = \dfrac{P_L}{B^2}$

$$q_a = \gamma_{rc} \cdot h + \gamma_s (D_f - h) + \frac{P_D + P_L}{B^2} + w$$

$$B := \sqrt[2]{\frac{P_D + P_L}{q_a - \gamma_{rc} \cdot h - \gamma_s \cdot (D_f - h) - w}} = 2.80086\ m$$

$B = 2800.86417\ mm$ say $B := 2900\ mm$

$$d := h - \frac{d_b}{2} - c_c = 265\ mm$$

Punching Perimeter: $b_o := 2 \cdot (a_1 + d) + 2 \cdot (a_2 + d) = 3.46\ m$

Thickness Required for Two-Way Shear: $\phi := 0.75 \quad \beta_c := \dfrac{a_2}{a_1} = 1 \quad \alpha_s := 40$

$$V_u = 0.75 \cdot V_c$$

Where:

$$V_u = v_u \cdot \left(B^2 - \left(a_1 + d\right) \cdot \left(a_2 + d\right)\right) \qquad v_u := \frac{1.2 \cdot P_D + 1.6 \cdot P_L}{B^2} = 121.21503\ kPa$$

$$V_u := v_u \cdot \left(B^2 - \left(a_1 + d\right) \cdot \left(a_2 + d\right)\right) = 928.72228\ kN$$

$V_c = 0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.33 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 1.7462\ MPa$ (Governing Formula)

$V_c = 0.17 \cdot \left(1 + \dfrac{2}{\beta_c}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.17 \cdot \left(1 + \dfrac{2}{\beta_c}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.6987\ MPa$

$V_c = 0.083 \cdot \left(2 + \dfrac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.083 \cdot \left(2 + \dfrac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.2239\ MPa$

$$V_u = \phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}\right)$$

$$d_{req} := \frac{V_u}{\phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 204.9536\ mm$$

$h_{req} := d_{req} + \dfrac{d_b}{2} + c_c = 289.954\ mm \qquad h = 350\ mm$

$h > h_{req}$ (Footing Thickness is Acceptable)

Thickness Required for One-Way Shear:

$$d := h - \frac{d_b}{2} - c_c = 265\ mm$$

$V_{u1} := v_u \cdot B \cdot \left(\dfrac{B}{2} - \dfrac{a_1}{2} - d\right) = 311.09837\ kN \qquad V_{u2} := v_u \cdot B \cdot \left(\dfrac{B}{2} - \dfrac{a_2}{2} - d\right) = 311.09837\ kN$

$$V_u := V_{u1} = 311.09837\ kN$$

$$d_{req} := \frac{V_u}{\phi \cdot \left(0.17 \cdot \lambda \cdot B \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 159.00491\ mm$$

$h_{req} := d_{req} + \dfrac{d_b}{2} + c_c = 244.00491\ mm \qquad h = 350\ mm$

$h > h_{req}$ (Footing Thickness is Acceptable)

Therefore:

By rounding up to the nearest 50mm:

$h := 350\ mm$ (Footing Thickness)

$$B := \sqrt[2]{\frac{P_D + P_L}{q_a - \gamma_{rc} \cdot h - \gamma_s \cdot \left(D_f - h\right) - w}} = 2800.86417\ mm$$

By rounding up to the nearest 100mm:

$B := 2900\ mm$ (Footing Width)

Flexure Design of Square Footing:

Given:

Footing Thickness: $h = 350\ mm$

Footing Width: $B = 2900\ mm$

Concrete Strength: $f'_c := 28\ MPa$

Reinforced Yield Strength: $f_y := 420\ MPa$

Unfactored Axial Dead Load: $P_D := 146.7096\ kN \cdot (1.16) \cdot (3) = 510.54941\ kN$

Unfactored Axial Live Load: $P_L := 73.053\ kN \cdot (1.16) \cdot (3) = 254.22444\ kN$

Square Column Width: $a_1 = 600\ mm \quad a_2 = 600\ mm$

Reinforcement Diameter: $d_b := 20\ mm$

Concrete Cover: $c_c := 75\ mm$

Concrete Modification Factor: $\lambda := 1.0$

Design Factor: $\phi := 0.90$

- Taking the Critical Section at the face of the Column

Cantilever Length:

$$l_{u1} := \frac{B}{2} - \frac{a_1}{2} = 1150\ mm \quad l_{u2} := \frac{B}{2} - \frac{a_2}{2} = 1150\ mm$$

Governing Cantilever Length: $l_u := l_{u1} = 1150\ mm$

Design Moment:

$$q_u := \frac{1.2 \cdot P_D + 1.6 \cdot P_L}{B^2} = 121.21503\ kPa$$

$$w_u := q_u \cdot B = 351.52358\ \frac{kN}{m}$$

$$M_u := \frac{w_u \cdot {l_u}^2}{2} = 232.44497\ kN \cdot m$$

$$d := h - \frac{d_b}{2} - c_c = 265\ mm$$

$$\rho := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_u}{0.85 \cdot \phi \cdot f'_c \cdot B \cdot d^2}}\right) = 0.0031045691$$

Steel Area:

$$As := \rho \cdot B \cdot d = 2385.86135\ mm^2$$

$$A_{smin1} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} \cdot B \cdot d = 2420.54748\ mm^2$$

$$A_{smin2} := \frac{1.4\ MPa}{f_y} \cdot B \cdot d = 2561.66667\ mm^2$$

Governing Steel Area: $A_s := A_{smin2} = 2561.66667\ mm^2$

Quantity:

$$n = \frac{A_s}{A_b}$$

$$A_b := \frac{\pi}{4} \cdot d_b^{\,2} = 314.15927\ mm^2$$

$$A_s = 2561.66667\ mm^2$$

Therefore:

$$n := \frac{A_s}{A_b} = 8.15404$$

$n := 9$ pieces of 20-mm reinforcement bars both Ways.

Spacing:

$$s := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 303.33333\ mm \qquad s_{max1} := 3 \cdot h = 1050\ mm$$

$$s_{max2} := 450\ mm$$

$$s := 150\ mm \qquad n := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s} = 18.2 \qquad n := 19$$

Shrinkage and Temperature Reinforcement:

$$A_g := B \cdot h = 1015000\ mm^2$$

$$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = 1827\ mm^2$$

$$A_{st2} := 0.0014 \cdot A_g = 1421\ mm^2$$

$$A_{st} := A_{st1}$$

Using 16 mm reinforcement bars: $d_{st} := 16\ mm$

$$A_{bs} := \frac{\pi}{4} \cdot d_{st}^{\,2} = 201.06193\ mm^2$$

$$n_{st} := \frac{A_{st}}{A_{bs}} = 9.08675 \qquad n_{st} := 10 \qquad s_{stmax1} := 450\ mm$$

$$s_{stmax2} := 5 \cdot h = 1750\ mm$$

$$s_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_{st}}{2}\right)}{n_{st}} = 273.4\ mm$$

$$s_{st} := 150\ mm \qquad n_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_{st}}{2}\right)}{s_{st}} = 18.22667 \qquad n_{st} := 19$$

Summary of the Design:

Size of Footing, BxB: $B = 2.9\ m \quad B = 2.9\ m$
Height of Footing: $h = 350\ mm$
Size of Main Reinforcements: $d_b = 20\ mm$
Size of Shrinkage and Temperature Bars: $d_{st} = 16\ mm$

Number of Main Reinforcement Bars Both Ways: $n = 19 \quad (20\ mm\phi)$
Adapted Spacing of Main Reinforcement Bars Both Ways: $s = 150\ mm$

Number of Shrinkage and Temperature Reinforcement Bars Both Ways: $n_{st} = 19 \quad (16\ mm\phi)$
Adapted Spacing of Shrinkage and Temperature Reinforcement Bars Both Ways: $s = 150\ mm$

Design of Reinforced Concrete Corner Square Footing

Given:

Reinforced Concrete Density: $\gamma_{rc} := 23.6 \dfrac{kN}{m^3}$

Soil Unit Weight: $\gamma_s := 15.61 \dfrac{kN}{m^3}$

Concrete Strength: $f'_c := 28\ MPa$

Reinforced Yield Strength: $f_y := 420\ MPa$

Unfactored Axial Dead Load: $P_D := 122.24\ kN \cdot (1.33) \cdot (3) = 487.7376\ kN$

Unfactored Axial Live Load: $P_L := 9.82422\ kN \cdot (1.33) \cdot (3) = 39.19864\ kN$

Weight from Ground Floor: $w := 8.35\ kPa + 6\ kPa = 14.35\ kPa$

Square Column Width: $a_1 := 600\ mm \quad a_2 := 600\ mm$

Reinforcement Diameter: $d_b := 20\ mm$

Concrete Cover: $c_c := 75\ mm$

Concrete Modification Factor: $\lambda := 1.0$

Depth of Footing's Base Measured from Ground Line: $D_f := 1.5\ m$

Assumption: $h := 300\ mm$

$q_a := 138.049\ kPa$

$q_a = W_c + W_s + W_D + W_L + w$

Footing Weight, $W_c := \gamma_{rc} \cdot h = 7.08\ kPa$

Weight of Soil Above the Footing, $W_s := \gamma_s \cdot \left(D_f - h\right) = 18.732\ kPa$

Service Dead Loads, $W_D = \dfrac{P_D}{B^2}$

Service Live Loads, $W_L = \dfrac{P_L}{B^2}$

$$q_a = \gamma_{rc} \cdot h + \gamma_s \left(D_f - h\right) + \frac{P_D + P_L}{B^2} + w$$

$$B := \sqrt[2]{\frac{P_D + P_L}{q_a - \gamma_{rc} \cdot h - \gamma_s \cdot \left(D_f - h\right) - w}} = 2.32015\ m$$

$B = 2320.15246\ mm$ say $B := 2400\ mm$

$$d := h - \frac{d_b}{2} - c_c = 215\ mm$$

Punching Perimeter: $b_o := 2 \cdot \left(a_1 + d\right) + 2 \cdot \left(a_2 + d\right) = 3.26\ m$

Thickness Required for Two-Way Shear: $\phi := 0.75 \quad \beta_c := \frac{a_2}{a_1} = 1 \quad \alpha_s := 40$

$V_u = 0.75 \cdot V_c$

Where:

$V_u = v_u \cdot \left(B^2 - (a_1 + d) \cdot (a_2 + d)\right) \qquad v_u := \frac{1.2 \cdot P_D + 1.6 \cdot P_L}{B^2} = 112.50051\ kPa$

$V_u := v_u \cdot \left(B^2 - (a_1 + d) \cdot (a_2 + d)\right) = 573.27729\ kN$

$V_c = 0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.33 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 1.7462\ MPa$ (Governing Formula)

$V_c = 0.17 \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.17 \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.6987\ MPa$

$V_c = 0.083 \cdot \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.083 \cdot \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.037\ MP$

$V_u = \phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}\right)$

$d_{req} := \frac{V_u}{\phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 134.27431\ mm$

$h_{req} := d_{req} + \frac{d_b}{2} + c_c = 219.274\ mm \qquad h = 300\ mm$

$h > h_{req}$ (Footing Thickness is Acceptable)

Thickness Required for One-Way Shear:

$d := h - \frac{d_b}{2} - c_c = 215\ mm$

$V_{u1} := v_u \cdot B \cdot \left(\frac{B}{2} - \frac{a_1}{2} - d\right) = 184.95084\ kN \qquad V_{u2} := v_u \cdot B \cdot \left(\frac{B}{2} - \frac{a_2}{2} - d\right) = 184.95084\ kN$

$V_u := V_{u1} = 184.95084\ kN$

$d_{req} := \frac{V_u}{\phi \cdot \left(0.17 \cdot \lambda \cdot B \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 114.22361\ mm$

$h_{req} := d_{req} + \frac{d_b}{2} + c_c = 199.22361\ mm \qquad h = 300\ mm$

$h > h_{req}$ (Footing Thickness is Acceptable)

Therefore:

By rounding up to the nearest 50mm:

$h := 300\ mm$ (Footing Thickness)

$$B := \sqrt[2]{\frac{P_D + P_L}{q_a - \gamma_{rc} \cdot h - \gamma_s \cdot (D_f - h) - w}} = 2320.15246\ mm$$

By rounding up to the nearest 100mm:

$B := 2400\ mm$ (Footing Width)

Flexure Design of Square Footing:

Given:

Footing Thickness: $h = 300\ mm$

Footing Width: $B = 2400\ mm$

Concrete Strength: $f'_c := 28\ MPa$

Reinforced Yield Strength: $f_y := 420\ MPa$

Unfactored Axial Dead Load: $P_D := 122.24\ kN \cdot (1.33) \cdot (3) = 487.7376\ kN$

Unfactored Axial Live Load: $P_L := 9.82422\ kN \cdot (1.33) \cdot (3) = 39.19864\ kN$

Square Column Width: $a_1 = 600\ mm \quad a_2 = 600\ mm$

Reinforcement Diameter: $d_b := 20\ mm$

Concrete Cover: $c_c := 75\ mm$

Concrete Modification Factor: $\lambda := 1.0$

Design Factor: $\phi := 0.90$

- Taking the Critical Section at the face of the Column

Cantilever Length:

$l_{u1} := \dfrac{B}{2} - \dfrac{a_1}{2} = 900\ mm \quad l_{u2} := \dfrac{B}{2} - \dfrac{a_2}{2} = 900\ mm$

Governing Cantilever Length: $l_u := l_{u1} = 900\ mm$

Design Moment:

$$q_u := \frac{1.2 \cdot P_D + 1.6 \cdot P_L}{B^2} = 112.50051\ kPa$$

$$w_u := q_u \cdot B = 270.00123\ \frac{kN}{m}$$

$$M_u := \frac{w_u \cdot {l_u}^2}{2} = 109.3505\ kN \cdot m$$

$$d := h - \frac{d_b}{2} - c_c = 215\ mm$$

$$\rho := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_u}{0.85 \cdot \phi \cdot f'_c \cdot B \cdot d^2}}\right) = 0.00267052578$$

Steel Area:

$$As := \rho \cdot B \cdot d = 1377.9913\ mm^2$$

$$A_{smin1} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} \cdot B \cdot d = 1625.24723\ mm^2$$

$$A_{smin2} := \frac{1.4\ MPa}{f_y} \cdot B \cdot d = 1720\ mm^2$$

Governing Steel Area: $A_s := A_{smin2} = 1720\ mm^2$

Quantity:

$$n = \frac{A_s}{A_b}$$

$$A_b := \frac{\pi}{4} \cdot d_b^{\ 2} = 314.15927\ mm^2$$

$$A_s = 1720\ mm^2$$

Therefore:

$$n := \frac{A_s}{A_b} = 5.47493$$

$n := 6$ pieces of 20-mm reinforcement bars both Ways.

Spacing:

$$s := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 371.66667\ mm$$ Say $s := 150\ mm$

$s := 150\ mm$ $$n := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s} = 14.86667$$ $n := 15$

$$s_{max1} := 3 \cdot h = 900\ mm$$

$$s_{max2} := 450\ mm$$

$s = 150\ mm$ $n = 15$

Shrinkage and Temperature Reinforcement:

$$A_g := B \cdot h = 720000\ mm^2$$

$$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = 1296\ mm^2$$

$$A_{st2} := 0.0014 \cdot A_g = 1008\ mm^2$$

$$A_{st} := A_{st1}$$

Using 16mm reinforcement bars: $d_{st} := 16\ mm$

$$A_{bs} := \frac{\pi}{4} \cdot d_{st}^{\ 2} = 201.06193\ mm^2$$

$$n_{st} := \frac{A_{st}}{A_{bs}} = 6.44578$$ $n_{st} := 7$

$$s_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_{st}}{2}\right)}{n_{st}} = 319.14286\ mm$$

$$s_{stmax1} := 450\ mm$$

$$s_{stmax2} := 5 \cdot h = 1500\ mm$$

$s_{st} := 150\ mm$ $$n_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_{st}}{2}\right)}{s_{st}} = 14.89333$$ $n_{st} := 15$

Summary of the Design:

Size of Footing, BxB: $B = 2.4\ m \quad B = 2.4\ m$
Height of Footing: $h = 300\ mm$
Size of Main Reinforcements: $d_b = 20\ mm$
Size of Shrinkage and Temperature Bars: $d_{st} = 16\ mm$

Number of Main Reinforcement Bars Both Ways: $n = 15 \quad (20\ mm\phi)$
Spacing of Main Reinforcement Bars Both Ways: $s = 150\ mm$

Number of Shrinkage and Temperature Reinforcement Bars Both Ways: $n_{st} = 15 \quad (16\ mm\phi)$
Spacing of Shrinkage and Temperature Reinforcement Bars Both Ways: $s_{st} = 150\ mm$

Design of Reinforced Concrete Interior Circular Footing

Given:

Reinforced Concrete Density: $\gamma_{rc} := 23.6 \ \frac{kN}{m^3}$

Soil Unit Weight: $\gamma_s := 15.61 \ \frac{kN}{m^3}$

Concrete Strength: $f'_c := 28 \ MPa$

Reinforced Yield Strength: $f_y := 420 \ MPa$

Unfactored Axial Dead Load: $P_D := 239.26644 \ kN \cdot (1.1) \cdot (3) = 789.579 \ kN$

Unfactored Axial Live Load: $P_L := 105.588 \ kN \cdot (1.1) \cdot (3) = 348.44 \ kN$

Unfactored Weight from Ground Floor: $w := 8.35 \ kPa + 6 \ kPa = 14.35 \ kPa$

Circular Column Diameter: $R_C := 500 \ mm$

Reinforcement Diameter: $d_b := 20 \ mm$

Concrete Cover: $c_c := 75 \ mm$

Concrete Modification Factor: $\lambda := 1.0$

Depth of Footing's Base Measured from Ground Line: $D_f := 1.5 \ m$

Assumption: $h := 500 \ mm$

$q_a := 138.049 \ kPa$

$q_a = W_c + W_s + W_D + W_L + w$

Footing Weight, $W_c := \gamma_{rc} \cdot h = 11.8 \ kPa$

Weight of Soil Above the Footing, $W_s := \gamma_s \cdot (D_f - h) = 15.61 \ kPa$

Service Dead Loads, $W_D = \frac{P_D}{B^2}$

Service Live Loads, $W_L = \frac{P_L}{B^2}$

$$q_a = \gamma_{rc} \cdot h + \gamma_s (D_f - h) + \frac{P_D + P_L}{B^2} + w$$

$$B := \sqrt[2]{\frac{P_D + P_L}{q_a - \gamma_{rc} \cdot h - \gamma_s \cdot (D_f - h) - w}} = 3.438 \ m$$

$B = 3437.847 \ mm$ say $B := 3500 \ mm$

$$d := h - \frac{d_b}{2} - c_c = 415 \ mm$$

Punching Perimeter: $b_o := \pi \cdot (R_C + d) = (2.875 \cdot 10^3) \ mm$

Thickness Required for Two-Way Shear: $\phi := 0.75 \quad \beta_c := \frac{R_C}{R_C} = 1 \quad \alpha_s := 40$

$V_u = 0.75 \cdot V_c$

Where:

$$V_u = v_u \cdot \left(B^2 - \frac{\pi}{4} \cdot (R_c + d)^2\right) \qquad v_u := \frac{1.2 \cdot P_D + 1.6 \cdot P_L}{B^2} = 122.857\ kPa$$

$$V_u := v_u \cdot \left(B^2 - \frac{\pi}{4} \cdot (R_C + d)^2\right) = 1424.214\ kN$$

$V_c = 0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.33 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 1.746\ MPa$ (Governing Formula)

$V_c = 0.17 \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.17 \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.6987\ MPa$

$V_c = 0.083 \cdot \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$; $V_c := 0.083 \cdot \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 3.4147\ MPa$

$$V_u = \phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}\right)$$

$$d_{req} := \frac{V_u}{\phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 378.312\ mm$$

$$h_{req} := d_{req} + \frac{d_b}{2} + c_c = 463.312\ mm \qquad h = 500\ mm$$

$h > h_{req}$ (Footing Thickness is Acceptable)

Thickness Required for One-Way Shear:

$$d := h - \frac{d_b}{2} - c_c = 415\ mm$$

$$V_u := v_u \cdot B \cdot \left(\frac{B}{2} - \frac{R_C}{2} - d\right) = 466.55\ kN$$

$$d_{req} := \frac{V_u}{\phi \cdot \left(0.17 \cdot \lambda \cdot B \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 197.579\ mm$$

$$h_{req} := d_{req} + \frac{d_b}{2} + c_c = 282.579\ mm \quad h = 500\ mm$$

$h > h_{req}$ (Footing Thickness is Acceptable)

Therefore:

By rounding up to the nearest 50mm:

$h := 500\ mm$ (Footing Thickness)

$$B := \sqrt[2]{\frac{P_D + P_L}{q_a - \gamma_{rc} \cdot h - \gamma_s \cdot (D_f - h) - w}} = 3437.847\ mm$$

By rounding up to the nearest 100mm:

$B := 3500\ mm$ (Footing Width)

Flexure Design of Circular Footing:

Given:

Footing Thickness: $h = 500\ mm$

Footing Width: $B = 3500\ mm$

Concrete Strength: $f'_c := 28\ MPa$

Reinforced Yield Strength: $f_y := 420\ MPa$

Unfactored Axial Dead Load: $P_D := 239.26644\ kN \cdot (1.1) \cdot (3) = 789.579\ kN$

Unfactored Axial Live Load: $P_L := 105.588\ kN \cdot (1.1) \cdot (3) = 348.44\ kN$

Circular Column Diameter: $R_C := 500\ mm$

Reinforcement Diameter: $d_b := 20\ mm$

Concrete Cover: $c_c := 75\ mm$

Concrete Modification Factor: $\lambda := 1.0$

Design Factor: $\phi := 0.90$

- Taking the Critical Section at the face of the Column

Cantilever Length:

$$l_{u1} := \frac{B}{2} - \frac{R_C}{2} = 1500\ mm$$

Governing Cantilever Length: $l_u := l_{u1} = 1500\ mm$

Design Moment:

$$q_u := \frac{1.2 \cdot P_D + 1.6 \cdot P_L}{B^2} = 122.857\ kPa$$

$$w_u := q_u \cdot B = 430\ \frac{kN}{m}$$

$$M_u := \frac{w_u \cdot l_u^{\ 2}}{2} = 483.75\ kN \cdot m$$

$$d := h - \frac{d_b}{2} - c_c = 415\ mm$$

$$\rho := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_u}{0.85 \cdot \phi \cdot f'_c \cdot B \cdot d^2}}\right) = 0.002164407952$$

Steel Area:

$$As := \rho \cdot B \cdot d = 3143.803\ mm^2$$

$$A_{smin1} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} \cdot B \cdot d = 4574.945\ mm^2$$

$$A_{smin2} := \frac{1.4\ MPa}{f_y} \cdot B \cdot d = 4841.667\ mm^2$$

Governing Steel Area: $A_s := A_{smin2} = 4841.667\ mm^2$

Quantity:

$$n = \frac{A_s}{A_b}$$

$$A_b := \frac{\pi}{4} \cdot d_b^{\ 2} = 314.159\ mm^2$$

$$A_s = 4841.667\ mm^2$$

Therefore:

$$n := \frac{A_s}{A_b} = 15.412$$

$n := 16$ pieces of 20-mm reinforcement bars both Ways.

Spacing:

$$s := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 208.125\ mm$$

$s := 150\ mm$

$$s_{max1} := 3 \cdot h = \left(1.5 \cdot 10^3\right)\ mm$$

$$s_{max2} := 450\ mm$$

$s = 150\ mm$ $\qquad n := \dfrac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s} = 22.2$ $\qquad n := 23$

Shrinkage and Temperature Reinforcement:

$$A_g := B \cdot h = 1750000\ mm^2$$

$$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = 3150\ mm^2$$

$$A_{st2} := 0.0014 \cdot A_g = \left(2.45 \cdot 10^3\right)\ mm^2$$

$$A_{st} := A_{st1}$$

Using 16mm reinforcement bars: $d_{st} := 16\ mm$

$$A_{bs} := \frac{\pi}{4} \cdot {d_{st}}^2 = 201.062\ mm^2$$

$$s_{stmax1} := 450\ mm$$

$$s_{stmax2} := 5 \cdot h = 2500\ mm$$

$$n := \frac{A_{st}}{A_{bs}} = 15.667 \qquad n := 16$$

$$s_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 208.125\ mm$$

$$s_{st} := 150\ mm \qquad n_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s_{st}} = 22.2 \qquad n_{st} := 23$$

Summary of the Design:

Size of Footing, BxB: $B = 3.5\ m \quad B = 3.5\ m$
Height of Footing: $h = 500\ mm$
Size of Main Reinforcements: $d_b = 20\ mm$
Size of Shrinkage and Temperature Bars: $d_{st} = 16\ mm$

Number of Main Reinforcement Bars Both Ways: $n = 16 \quad (20\ mm\phi)$
Spacing of Main Reinforcement Bars Both Ways: $s = 150\ mm$

Number of Shrinkage and Temperature Reinforcement Bars Both Ways: $n_{st} = 23 \quad (16\ mm\phi)$
Spacing of Shrinkage and Temperature Reinforcement Bars Both Ways: $s_{st} = 150\ mm$

Design of Reinforced Concrete Combined Footing

Given:

Reinforced Concrete Density: $\gamma_{rc} := 23.6 \ \frac{kN}{m^3}$

Soil Unit Weight: $\gamma_s := 15.61 \ \frac{kN}{m^3}$

Concrete Strength: $f'_c := 28 \ MPa$

Soil Unit Weight: $\gamma_c := 15.61 \ \frac{kN}{m^3}$

Concrete Unit Weight: $23.6 \ \frac{kN}{m^3}$

Reinforced Yield Strength: $f_y := 420 \ MPa$

Unfactored Axial Dead Load at Column 1: $P_{D1} := 239.26644 \ kN \cdot (1.1) \cdot (3) = 789.579 \ kN$

Unfactored Axial Live Load at Column 1: $P_{L1} := 105.588 \ kN \cdot (1.1) \cdot (3) = 348.44 \ kN$

Unfactored Axial Dead Load at Column 2: $P_{D2} := 239.26644 \ kN \cdot (1.1) \cdot (3) = 789.579 \ kN$

Unfactored Axial Live Load at Column 2: $P_{L2} := 105.588 \ kN \cdot (1.1) \cdot (3) = 348.44 \ kN$

Weight from Ground Floor: $w := 8.35 \ kPa + 6 \ kPa = 14.35 \ kPa$

Column Dimension: $a_1 := 600 \ mm \quad a_2 := 600 \ mm$

Reinforcement Diameter: $d_b := 20 \ mm$

Concrete Cover: $c_c := 75 \ mm$

Concrete Modification Factor: $\lambda := 1.0$

Depth of Footing's Base Measured from Ground Line: $D_f := 1.5 \ m$

Allowable Bearing Pressure: $q_a := 138.049 \ kPa$

Distance Center to Center between the Columns: $l := 2500 \ mm$

Closest Distance of Column's Side from the Edge of Footing: $k := 1000 \ mm$

Assumption: $h := 400 \ mm \quad d := h - c_c - 0.5 \ d_b = 315 \ mm$

Shear Reduction Factor: $\phi := 0.75$

$$P_1 := P_{D1} + P_{L1} = 1138.01965 \ kN$$

$$P_2 := P_{D2} + P_{L2} = 1138.01965 \ kN$$

$$P_u := 1.2 \cdot (P_{D1} + P_{D2}) + 1.6 \cdot (P_{L1} + P_{L2}) = 3009.999 \ kN$$

$$R := P_1 + P_2 = (2.276 \cdot 10^3) \ kN$$

$$q_a = \gamma_c \cdot h + \gamma_s (D_f - h) + \frac{P_1 + P_2}{A_f}$$

$$A_f := \frac{P_1 + P_2}{q_a - \gamma_c \cdot h - \gamma_s \cdot (D_f - h)} = 19.855 \ m^2$$

$\left[\Sigma M_\tau = 0\right] \quad x \cdot R = l \cdot P_2$

$$x := \frac{l \cdot P_2}{R} = 1.25\ m$$

$$L := 2 \cdot \left(k + 0.5 \cdot a_2 + x\right) = 5.1\ m \qquad L = 5100\ mm$$

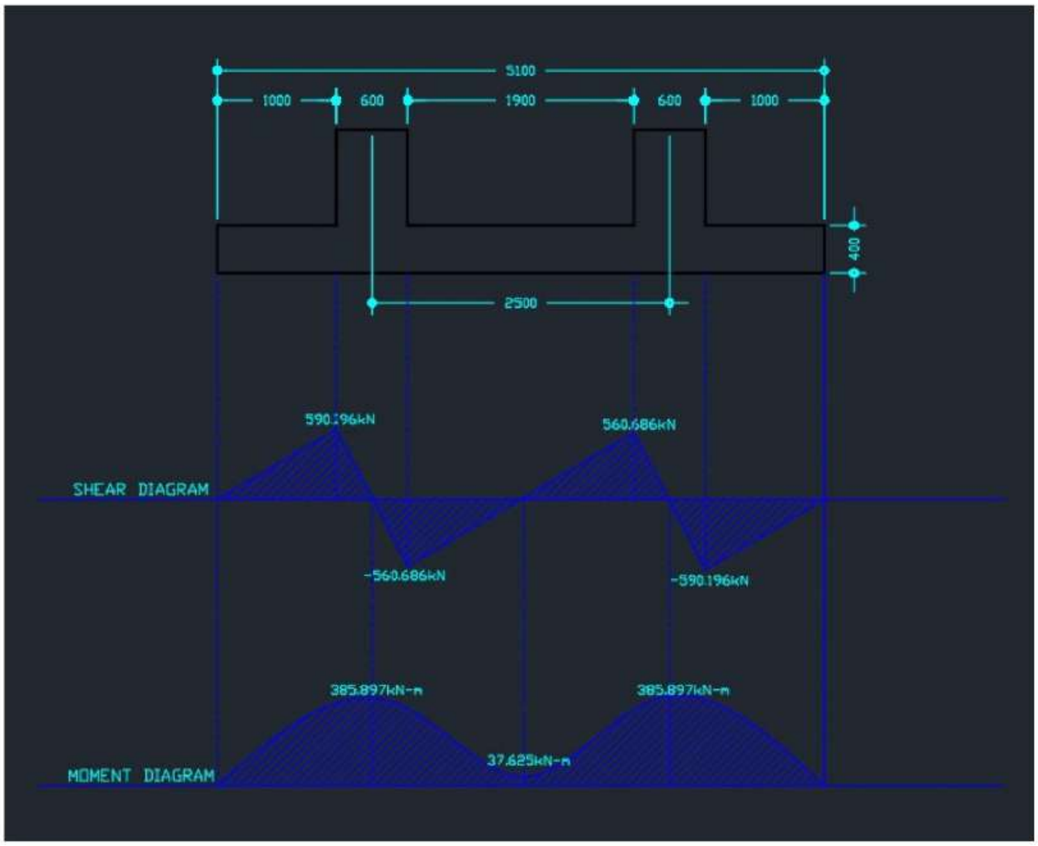
$$B := \frac{\left(P_1 + P_2\right)}{\left(q_a - \gamma_c \cdot h - \gamma_s \cdot \left(D_f - h\right)\right) \cdot L} = 3893.105\ mm \qquad \text{Say} \quad B := 3900\ mm$$

$$P_{u1} := 1.2 \cdot P_{D1} + 1.6 \cdot P_{L1} = \left(1.505 \cdot 10^3\right)\ kN$$

$$P_{u2} := 1.2 \cdot P_{D2} + 1.6 \cdot P_{L2} = \left(1.505 \cdot 10^3\right)\ kN \qquad A_{act} := B \cdot L = 19.89\ m^2$$

$$P_u := P_{u1} + P_{u2} = \left(3.01 \cdot 10^3\right)\ kN$$

$$q_u := \frac{P_u}{A_{act}} = 151.332\ kPa \qquad \omega := q_u \cdot B = 590.19598\ \frac{kN}{m}$$



$V_1 := \omega \cdot k = 590.196\ kN$
$V_2 := V_1 - P_{u1} + \omega \cdot a_2 = -560.686\ kN$
$V_3 := V_2 + \omega \cdot (l - a_2) = 560.686\ kN$
$V_4 := V_3 - P_{u2} + \omega \cdot a_2 = -590.196\ kN$
$V_5 := V_4 + \omega \cdot k = (1.164 \cdot 10^{-13})\ kN$ $\qquad V_5 := 0\ kN$

Therefore, $V_{max} := V_1 = 590.196\ kN$

Thickness Required for One Way Shear:

$$\frac{V_{max}}{0.5 \cdot (l - a_2)} = \frac{V_u}{0.5 \cdot (l - a_2) - d}$$

$$V_u := \frac{(0.5\ (l - a_2) - d) \cdot V_{max}}{0.5 \cdot (l - a_2)} = 394.499\ kN$$

$$d_{req} := \frac{V_u}{\phi \cdot \left(0.17 \cdot \lambda \cdot B \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 149.931\ mm$$

$$h_{req} := d_{req} + c_c + \frac{d_b}{2} = 234.931\ mm \qquad h = 400\ mm$$

Since $h > h_{req}$, Footing Thickness is Acceptable.

Thickness Required for Two Way Shear: $\phi := 0.75$ $\quad \beta_c := \frac{a_2}{a_1} = 1$ $\quad \alpha_s := 40$

Punching Perimeter: $b_o := 2 \cdot (a_1 + d) + 2 \cdot (a_2 + d) = 3.66\ m$
$V_u = 0.75 \cdot V_c$
where:
$V_c = 0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$ $\qquad V_c := 0.33 \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 1.746\ MPa$ (Governing Formula)

$V_c = 0.17 \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$ $\qquad V_c := 0.17 \cdot \left(1 + \frac{2}{\beta_c}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.699\ MPa$

$V_c = 0.083 \cdot \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}$ $\qquad V_c := 0.083 \cdot \left(2 + \frac{\alpha_s \cdot d}{b_o}\right) \cdot \lambda \cdot \sqrt[2]{f'_c \cdot 1\ MPa} = 2.39\ MPa$

Left Column

$V_u = \phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}\right)$

$$V_{uleft} := P_{u1} - q_u \cdot (a_1 + d) \cdot (a_2 + d) = (1.378 \cdot 10^3)\ kN$$

$$d_{req} := \frac{V_{uleft}}{\phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 287.547\ mm$$

$$h_{req} := d_{req} + \frac{d_b}{2} + c_c = 372.547\ mm \qquad h = 400\ mm$$

Since $h > h_{req}$, Footing Thickness is Acceptable.

Right Column

$$V_u = \phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot d_{req} \cdot \sqrt[2]{f'_c}\right)$$

$$V_{uright} := P_{u2} - q_u \cdot (a_1 + d) \cdot (a_2 + d) = \left(1.378 \cdot 10^3\right)\ kN$$

$$d_{req} := \frac{V_{uright}}{\phi \cdot \left(0.33 \cdot \lambda \cdot b_o \cdot \sqrt[2]{f'_c \cdot 1\ MPa}\right)} = 287.547\ mm$$

$$h_{req} := d_{req} + 0.5 \cdot d_b + c_c = 372.547\ mm \qquad h = 400\ mm$$

Since $h > h_{req}$, Footing Thickness is Acceptable.

Design of Longitudinal Steel

Computing the Locations of Maximum Moment

$$\frac{x_1}{V_1} = \frac{a_2}{V_1 - V_2} \qquad x_1 := \frac{a_2 \cdot V_1}{V_1 - V_2} = 307.692\ mm \qquad x_2 := a_2 - x_1 = 292.308\ mm$$

$$\frac{x_3}{V_2} = \frac{l - a_2}{V_3 - V_2} \qquad x_3 := \frac{-(l - a_2) \cdot V_2}{V_3 - V_2} = 950\ mm \qquad x_4 := (l - a_2) - x_3 = 950\ mm$$

$$\frac{x_5}{V_3} = \frac{a_2}{V_3 - V_4} \qquad x_5 := \frac{a_2 \cdot V_3}{V_3 - V_4} = 292.308\ mm \qquad x_6 := a_2 - x_5 = 307.692\ mm$$

$$M_1 := \frac{1}{2} \cdot (k + x_1) \cdot V_1 = 385.897\ kN \cdot m$$

$$M_2 := M_1 + \frac{1}{2} \cdot (x_2 + x_3) \cdot V_2 = 37.625\ kN \cdot m$$

$$M_3 := M_2 + \frac{1}{2} \cdot (x_4 + x_5) \cdot V_3 = 385.897\ kN \cdot m$$

$$M_4 := M_3 + \frac{1}{2} \cdot (x_6 + k) \cdot V_4 = \left(1.164 \cdot 10^{-13}\right)\ kN \cdot m \qquad M_4 := 0\ kN \cdot m$$

Maximum Positive Moment: $M_{uPmax} := M_1 = 385.897\ kN \cdot m$

Maximum Negative Moment: $M_{uNmax} := M_1 = 385.897\ kN \cdot m$

Since there is no negative moment, we assume the magnitude of positive moment to be the value of the negative moment.

Reinforcements at Positive Moment: Short Span

$$\rho_{act} := \frac{0.85 \cdot f'_c}{f_y} \cdot \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uPmax}}{0.85 \cdot \phi \cdot f'_c \cdot B \cdot d^2}}\right) = 0.0032594856$$

$$\rho_{min1} := \frac{1.4}{f_y} \cdot 1\ MPa = 0.0033333333 \qquad \rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} = 0.0031497039$$

Use $\rho := \rho_{min1} = 0.0033333333$

$A_s := \rho \cdot B \cdot d = (4.095 \cdot 10^3)\ mm^2$ $\qquad A_b := \frac{\pi}{4} \cdot {d_b}^2 = 314.159\ mm^2$

$n := \frac{A_s}{A_b} = 13.035$ Say $n := 14$ - 20mm rebars

$s := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 266.429\ mm$ $\qquad s_{max1} := 3 \cdot h = 1200\ mm$ $\qquad s_{max2} := 450\ mm$

$s_{ps} := 150\ mm$ $\qquad n := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s_{ps}} = 24.867$ $\qquad n_{ps} := 25$

Reinforcements at Negative Moment: Short Span

$$\rho_{act} := \frac{0.85 \cdot f'_c}{f_y} \cdot \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uNmax}}{0.85 \cdot \phi \cdot f'_c \cdot B \cdot d^2}}\right) = 0.0032594856$$

$\rho_{min1} := \frac{1.4}{f_y} \cdot 1\ MPa = 0.0033333333$ $\qquad \rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} = 0.0031497039$

Use $\rho := \rho_{min1} = 0.0033333333$

$A_s := \rho \cdot B \cdot d = (4.095 \cdot 10^3)\ mm^2$ $\qquad A_b := \frac{\pi}{4} \cdot {d_b}^2 = 314.159\ mm^2$

$n := \frac{A_s}{A_b} = 13.035$ Say $n := 14$ - 20mm rebars

$s := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 266.429\ mm$ $\qquad s_{max1} := 3 \cdot h = 1200\ mm$ $\qquad s_{max2} := 450\ mm$

$s_{ns} := 150\ mm$ $\qquad n := \frac{B - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s_{ns}} = 24.867$ $\qquad n_{ns} := 25$

Shrinkage and Temperature Reinforcement: Short Span

$$A_g := B \cdot h = 1560000\ mm^2$$

$$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = \left(2.808 \cdot 10^3\right)\ mm^2$$

$$A_{st2} := 0.0014 \cdot A_g = \left(2.184 \cdot 10^3\right)\ mm^2$$

$$A_{st} := A_{st1}$$

Using 16mm reinforcement bars: $d_{st} := 16\ mm$

$$A_{bs} := \frac{\pi}{4} \cdot {d_{st}}^2 = 201.062\ mm^2$$

$n_{st} := \dfrac{A_{st}}{A_{bs}} = 13.966$ Say $n_{st} := 14$ -20mm rebars

$$s_{st} := \frac{B - 2 \cdot c_c - 2 \cdot \left(\dfrac{d_{st}}{2}\right)}{n_{st}} = 266.714\ mm$$

$$s_{stmax1} := 450\ mm$$

$$s_{stmax2} := 5 \cdot h = 2000\ mm$$

$s_{sst} := 150\ mm$ $\quad n := \dfrac{B - 2 \cdot c_c - 2 \cdot \left(\dfrac{d_{st}}{2}\right)}{s_{sst}} = 24.893$ $\quad n_{sst} := 25$

Reinforcements at Positive Moment: Long Span

$$\rho_{act} := \frac{0.85 \cdot f'_c}{f_y} \cdot \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uPmax}}{0.85 \cdot \phi \cdot f'_c \cdot L \cdot d^2}}\right) = 0.0024749073$$

$$\rho_{min1} := \frac{1.4}{f_y} \cdot 1\ MPa = 0.0033333333 \qquad \rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} = 0.0031497039$$

Use $\rho := \rho_{min1} = 0.0033333333$

$$A_s := \rho \cdot L \cdot d = \left(5.355 \cdot 10^3\right)\ mm^2 \qquad A_b := \frac{\pi}{4} \cdot {d_b}^2 = 314.159\ mm^2$$

$n := \dfrac{A_s}{A_b} = 17.045$ Say $n := 18$ - 20mm rebars

$$s_{max1} := 3 \cdot h = 1200\ mm$$

$$s := \frac{L - 2 \cdot c_c - 2 \cdot \left(\dfrac{d_b}{2}\right)}{n} = 273.889\ mm \qquad s_{max2} := 450\ mm$$

$s_{pl} := 150\ mm$ $\quad n := \dfrac{L - 2 \cdot c_c - 2 \cdot \left(\dfrac{d_b}{2}\right)}{s_{pl}} = 32.867$ $\quad n_{pl} := 33$

Reinforcements at Negative Moment: Long Span

$$\rho_{act} := \frac{0.85 \cdot f'_c}{f_y} \cdot \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_{uNmax}}{0.85 \cdot \phi \cdot f'_c \cdot L \cdot d^2}}\right) = 0.0024749073$$

$$\rho_{min1} := \frac{1.4}{f_y} \cdot 1\ MPa = 0.0033333333 \qquad \rho_{min2} := \frac{\sqrt[2]{f'_c \cdot 1\ MPa}}{4 \cdot f_y} = 0.0031497039$$

Use $\rho := \rho_{min1} = 0.0033333333$

$$A_s := \rho \cdot L \cdot d = \left(5.355 \cdot 10^3\right)\ mm^2 \qquad A_b := \frac{\pi}{4} \cdot d_b^{\ 2} = 314.159\ mm^2$$

$n := \dfrac{A_s}{A_b} = 17.045$ Say $n := 18$ - 20mm rebars

$$s := \frac{L - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 273.889\ mm \qquad s_{max1} := 3 \cdot h = 1200\ mm \quad s_{max2} := 450\ mm$$

$$s_{nl} := 150\ mm \qquad n := \frac{L - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s_{nl}} = 32.867 \qquad n_{nl} := 33$$

Shrinkage and Temperature Reinforcement: Long Span

$$A_g := L \cdot h = 2040000\ mm^2$$

$$A_{st1} := \frac{0.0018 \cdot 420\ MPa}{f_y} \cdot A_g = \left(3.672 \cdot 10^3\right)\ mm^2$$

$$A_{st2} := 0.0014 \cdot A_g = \left(2.856 \cdot 10^3\right)\ mm^2$$

$$A_{st} := A_{st1}$$

Using 16mm reinforcement bars: $d_{st} := 16\ mm$

$$A_b := \frac{\pi}{4} \cdot d_{st}^{\ 2} = 201.062\ mm^2 \qquad s_{stmax1} := 450\ mm \quad s_{stmax2} := 5 \cdot h = 2000\ mm$$

$n := \dfrac{A_{st}}{A_b} = 18.263$ Say $n := 17$ - 20mm rebars

$$s_{st} := \frac{L - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{n} = 290\ mm$$

$$s_{lst} := 150\ mm \qquad n := \frac{L - 2 \cdot c_c - 2 \cdot \left(\frac{d_b}{2}\right)}{s_{lst}} = 32.867 \qquad n_{lst} := 33$$

Summary of the Design:

Size of Footing, BxL: $B=3.9\ m \quad L=5.1\ m$
Height of Footing: $h=400\ mm$
Size of Main Reinforcements: $d_b=20\ mm$
Size of Shrinkage and Temperature Bars: $d_{st}=16\ mm$

Number of Top Main Reinforcement Bars at Short Span: $n_{ps}=25 \quad (20\ mm\phi)$
Spacing of Top Main Reinforcement Bars at Short Span: $s_{ps}=150\ mm$
Number of Bottom Main Reinforcement Bars at Short Span: $n_{ns}=25 \quad (20\ mm\phi)$
Spacing of Bottom Main Reinforcement Bars at Short Span: $s_{ns}=150\ mm$
Number of Shrinkage and Temperature Reinforcement Bars at Short Span: $n_{sst}=25 \quad (16\ mm\phi)$
Spacing of Shrinkage and Temperature Reinforcement Bars at Short Span: $s_{sst}=150\ mm$

Number of Top Main Reinforcement Bars at Long Span: $n_{pl}=33 \quad (20\ mm\phi)$
Spacing of Top Main Reinforcement Bars at Long Span: $s_{pl}=150\ mm$
Number of Bottom Main Reinforcement Bars at Long Span: $n_{nl}=33 \quad (20\ mm\phi)$
Spacing of Bottom Main Reinforcement Bars at Long Span: $s_{nl}=150\ mm$
Number of Shrinkage and Temperature Reinforcement Bars at Long Span: $n_{lst}=33 \quad (16\ mm\phi)$
Spacing of Shrinkage and Temperature Reinforcement Bars at Long Span: $s_{lst}=150\ mm$

APPENDIX M
DESIGN OF STAIRS

Design Criteria:

Material Properties:

$f'_c := 28\ MPa$ $\quad f_y := 420\ MPa$ $\quad \gamma_c := 23.6\ \frac{kN}{m^3}$ $\quad \phi := 0.90$

$$\beta_1 := 0.85 - \frac{0.05}{7\ MPa}\left(f'_c - 28\ MPa\right) = 0.85$$

Rebar Size:

$d_b := 16\ mm$ $\quad d_{st} := 12\ mm$ $\quad d_h := 10\ mm$

Service Load:

$LL := 2.4\ kPa$ $\quad LL_M := 0.5\ kPa$

$DL := 1.10\ kPa$ $\quad DL_M := 0.5\ kPa$

Stair Detail:

Tread: $T := 300\ mm$ Concrete Cover: $c_c := 25\ mm$

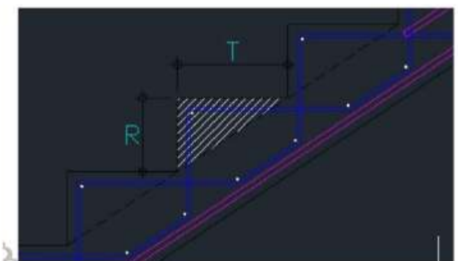
Riser: $R := 160\ mm$

Length: $L_c := 4150\ mm$ Distance between the landings, measured center to center.

Table 407.3.1.1 Minimum Thickness of Solid Non-Prestressed One-Way Slabs

Support condition	Minimum h[1]
Simply supported	$\ell/20$
One end continuous	$\ell/24$
Both ends continuous	$\ell/28$
Cantilever	$\ell/10$

[1] Expression applicable for normal weight concrete and f_y = 420 MPa. For other cases, minimum h shall be modified in accordance with Sections 407.3.1.1.1 through 407.3.1.1.3, as appropriate.



A.) Waist Slab Thickness: $h := \frac{L_c}{20} = 207.5\ mm$ say $h := 210\ mm$

B.) Dead Loads

Weight of Steps: $w_{St} := \frac{1}{2} \cdot R \cdot \gamma_c = 1.888\ kPa$

Weight of Slab: $w_{Sl} := h \cdot \gamma_c \cdot \frac{\sqrt[2]{R^2 + T^2}}{T} = 5.617\ kPa$

Total Dead Load:

$D_T := DL + DL_M + w_{St} + w_{Sl} = 9.105\ kPa$

$D_T = 9.105\ kPa$

C.) Total Live Load: $L_T := LL + LL_M = 2.9\ kPa$

D.) Factored Load

$$w_u := 1.2 \cdot D_T + 1.6\ L_T = 15.566\ kPa$$

$w_u = 15.566\ kPa$ Times $b := 1\ m$ Strip: $W_u := w_u \cdot b = 15.566\ \dfrac{kN}{m}$

E.) Effective Depth

$$d := h - c_c - \frac{d_b}{2} = 177\ mm$$

F.) Factored Maximum Moment

$$M_u := \frac{W_u \cdot L_c^{\ 2}}{8} = 33.51\ kN \cdot m$$

G.) Compute for Required ρ

$$\rho_{act} := \frac{0.85 \cdot f'_c}{f_y} \left(1 - \sqrt[2]{1 - \frac{2 \cdot M_u}{0.85 \cdot \phi \cdot f'_c \cdot b \cdot d^2}} \right) = 0.002904$$

$$\rho_{min} := \frac{1.4\ MPa}{f_y} = 0.003333$$

$$\rho_{max} := \frac{51 \cdot f'_c}{140 \cdot f_y} \cdot \beta_1 = 0.0206429$$

Since $\rho_{min} < \rho_{act} < \rho_{max}$ Use $\rho := \rho_{min}$

$\rho = 0.003$

H.) Reinforcement: A_s

$A_s := \rho \cdot b \cdot d = 590\ mm^2$ $A_{st} := 0.0018 \cdot b \cdot h = 378\ mm^2$

$A_b := \dfrac{\pi}{4} \cdot d_b^{\ 2} = 201.062\ mm^2$ $A'_{st} := \dfrac{\pi}{4} \cdot d_{st}^{\ 2} = 113.097\ mm^2$

For Main Bars: $s_1 := \dfrac{1000\ mm}{\dfrac{A_s}{A_b}} = 340.783\ mm$

$s_2 := 3 \cdot h = 630\ mm$

$s_3 := 450\ mm$

Use: $s := s_1 = 340.783\ mm$ Say $s := 150\ mm$

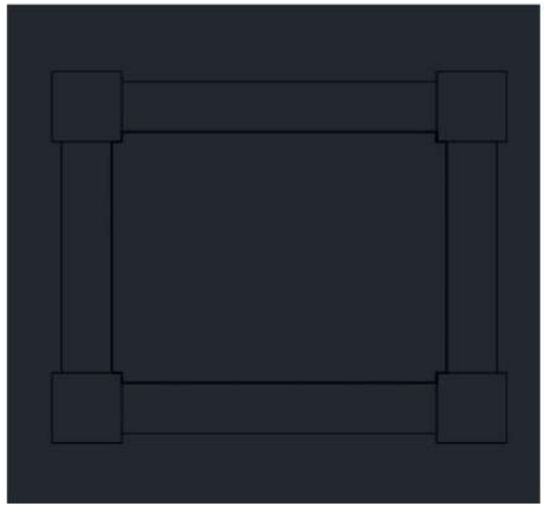
For Temperature Bars: $s_1 := \dfrac{1000\ mm}{\dfrac{A_{st}}{A'_{st}}} = 299.199\ mm$

$s_2 := 5 \cdot h = 1050\ mm$

$s_3 := 450\ mm$

Use: $s' := s_1 = 299.199\ mm$ Say $s' := 170\ mm$

APPENDIX N
DETERMINATION OF THICKNESS OF TWO-WAY SLAB



Thickness of Two Way Slab

Shorter Span: $l_a := 3000\ mm$

Long Span: $l_b := 3835\ mm$

Girder Concrete Strength: $f'_{gc} := 28\ MPa$

Slab Concrete Strength: $f'_{sg} := 21\ MPa$

Steel Yield Strength: $f_y := 420\ MPa$

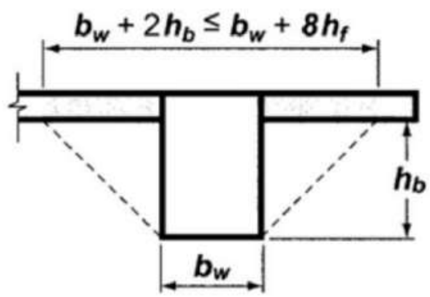
Initial Height of Slab: $h_i := 100\ mm$

Calculating Effective Flange:

$$b_w + h_b \le b_w + 8\ h_f$$

Dimensions:

$$b_w := 500\ mm$$
$$h_b := 700\ mm$$
$$h_f := h_i = 0.1\ m$$



Flange Width:

$$b_{f1} := b_w + 2 \cdot h_b = 1900\ mm$$

$$b_{f2} := b_w + 8 \cdot h_f = 1300\ mm$$

Use $b_f := b_{f2} = 1300\ mm$

Centroid Measured from the Top:

$$\left[A_T \cdot y_t = \Sigma a_i y_i\right]$$

$$A_T := b_f \cdot h_f + b_w \cdot h_b = 480000\ mm^2$$

$$\Sigma a_i y_i := b_f \cdot h_f \cdot \left(\frac{1}{2} \cdot h_f\right) + b_w \cdot h_b \cdot \left(h_f + \frac{1}{2} \cdot h_b\right) = 164000000\ mm^3$$

$$y_t := \frac{\Sigma a_i y_i}{A_T} = 341.667\ mm$$

$$y_t = 341.667\ mm$$

Moment of Inertia of T-Beam :

$$I_{bt} := \frac{b_f \cdot {h_f}^3}{12} + \frac{b_w \cdot {h_b}^3}{12} + b_f \cdot h_f \cdot \left(y_t - \frac{1}{2} \cdot h_f\right)^2 + b_w \cdot h_b \cdot \left(h_f + \frac{1}{2} \cdot h_b - y_t\right)^2 = \left(2.957 \cdot 10^{10}\right)\ mm^4$$

$$I_{bt} = 29566666666.667\ mm^4$$

Modulus of Elasticity of Beam:

$$E_{cb} := 4700 \cdot \sqrt[2]{f'_{gc} \cdot MPa}$$

$$E_{cb} = \left(2.487 \cdot 10^4\right)\ MPa$$

Modulus of Elasticity of Beam:

$$E_{cs} := 4700 \cdot \sqrt[2]{f'_{gc} \cdot MPa}$$

$$E_{cs} = \left(2.487 \cdot 10^4\right)\ MPa$$

$$\alpha_f = \frac{E_{cb} I_b}{E_{cs} I_s}$$

Slab Adjacent to Short Beam:

$$I_{as} := \frac{l_b \cdot {h_f}^2}{12} = 3195833.333\ mm^3$$

$$\alpha_{f1} := \frac{E_{cb} \cdot I_{bt}}{E_{cs} \cdot I_{as}} = 9.252\ m$$

Slab Adjacent to Long Beam:

$$I_{bs} := \frac{l_a \cdot {h_f}^2}{12} = 2500000\ mm^3$$

$$\alpha_{f2} := \frac{E_{cb} \cdot I_{bt}}{E_{cs} \cdot I_{bs}} = 11.827\ m$$

$$0.2 \le \frac{\alpha_{f1} \ell_2^2}{\alpha_{f2} \ell_1^2} \le 5.0$$

$$\frac{\alpha_{f1} \cdot {l_b}^2}{\alpha_{f2} \cdot {l_a}^2} = 1.278$$ (Okay)

$$\frac{\alpha_{f2} \cdot {l_a}^2}{\alpha_{f1} \cdot {l_b}^2} = 0.782$$ (Okay)

Table 408.3.1.2 Minimum Thickness of Non-Prestressed Two-Way Slabs with Beams Spanning between Supports on All Sides

α_{fm} [1]	Minimum h, mm		
$\alpha_{fm} \le 0.2$	Section 408.3.1.1 applies		(a)
$0.22 < \alpha_{fm} \le 2.0$	Greater of:	$\dfrac{\ell_n \left(0.8 \frac{f_y}{1,400}\right)}{36 + 5\beta(\alpha_{fm} - 0.2)}$	(b)[2][3]
		125	(c)
$\alpha_{fm} > 2.0$	Greater of:	$\dfrac{\ell_n \left(0.8 \frac{f_y}{1,400}\right)}{36 + 9\beta}$	(d)[2][3]
		90	(e)

[1] $\boldsymbol{\alpha_{fm}}$ is the average value of $\boldsymbol{\alpha_f}$ for all beams on edges of a panel and $\boldsymbol{\alpha_f}$ shall be calculated in accordance with Section 408.10.2.7.

[2] $\boldsymbol{\ell_n}$ is the clear span in the long direction, measured face-to-face of beams (mm.).

[3] $\boldsymbol{\beta}$ is the ratio of clear spans in long to short directions of slab.

$\alpha_{fm} := \dfrac{2 \cdot \alpha_{f1} + 2 \cdot \alpha_{f2}}{4} = 10.539\ m$

$l_n := l_b - 2 \cdot \left(\dfrac{b_w}{2}\right) = 3335\ mm$

$\beta := \dfrac{l_b - b_w}{l_a - b_w} = 1.334$

$h_{min} := \dfrac{l_n \cdot \left(0.8 + \dfrac{f_y}{1400\ MPa}\right)}{36 + 9 \cdot \beta} = 76.418\ mm$

Since $\alpha_{fm} > 2.0$, We Select whichever is greater between:

$h_{min} = \dfrac{l_n \cdot \left(0.8 + \dfrac{f_y}{1400\ MPa}\right)}{36 + 9 \cdot \beta}$ and

$h_{min} = 90\ mm$

Therefore, Use $h_{min} := 90\ mm$

Selected Depth of the Two Way Slab: $h := 150\ mm$

APPENDIX O
DETERMINATION OF ALLOWABLE SOIL BEARING CAPACITY

Geotechnical Investigation; Determination of Allowable Soil Bearing Capacity

Step 1: Determine Soil Classification

A. Grain Size Analysis

SIEVE ANALYSIS					
Sieve Size	Diameter (mm)	Weight Retained (grams)	Weight Passing (grams)	%Passing / %Finer by Weight	
No.4	4.75	157.59	841.4	84.23%	
No.10	2	115.14	726.26	72.70%	
No.20	0.85	93.18	633.08	63.37%	
No.50	3	53.57	579.51	58.01%	
No.100	0.15	37.27	542.24	54.28%	
No.200	0.075	31.05	511.19	51.17%	>50%
Pan		511.19	0	0.00%	
		998.99			

Moisture Content | Bulk Unit Weight | Dry Unit Weight | Specific Gravity | Plasticity Index | Sieve Analysis

Table 4.2 Unified Soil Classification System

Major division			Group symbol	Typical name	Classification criteria	
Coarse-grained soils (More than 50% retained on No. 200 ASTM sieve)	Gravels 50% or more of coarse fraction retained on No. 4 ASTM sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines.		$U = D_{60}/D_{10}$ greater than 4; $C_c = D^2_{30}/(D_{60} \times D_{20})$ between 1 and 3.
			GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines.	Classification on the basis of percentage of fines. Less than 5% passing No. 200 ASTM sieve—GW, GP, SW, SP. More than 12% passing No. 200 ASTM sieve— GM, GC, SM, SC. 5% to 12% passing No. 200 ASTM sieve—Border-line classification requiring use of dual symbols.	Not meeting both criteria for GW.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures.		Atterberg limits plot below A-line or plasticity index less than 4.
			GC	Clayey gravels, gravel-sand-clay mixtures.		Atterberg limits plot above A-line or plasticity index less than 4.
	Sands More than 50% of coarse fraction passes No. 4 ASTM sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines.		U greater than 6; C_c between 1 and 3.
			SP	Poorly-graded sands and gravelly sands, little or no fines.		Not meeting both criteria for SW.
		Sands with fines	SM	Silty sands, and-silt mixtures.		Atterberg limits plot below A-line or plasticity index less than 4.
			SC	Clayey sands, sand-clay mixtures.		Atterberg limits plot above A-line or plasticity index greater than 7.
Fine-grained soils (50% or more passes No. 200 ASTM Sieve)	Silts and Clays (Liquid limit 50% or less)		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	Check Plasticity Chart	
			CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.		
			OL	Organic silts and organic silty clays of low plasticity.		
	Silts and clays (Liquid limit greater than 50%)		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.		
			CH	Inorganic clays of high plasticity, fat clays.		
			OH	Organic clays of medium to high plasticity.		
Highly organic clays			P_t	Peat, muck and other highly organic soils.	Fibrous organic matter, will char, burn, or glow. Readily identified by colour, odour, spongy feel, and fibrous texture.	

Note: Boundary classification: Soils possessing characteristics of two groups are designated by combinations of group symbols — for example, GW-GC, well-graded, gravel-sand mixture with clay binder

B. Plastic Limit Test

F21 =IF(C15<0,0,I7-B13)

	Plastic Limit Test			
	Borehole 1		Borehole 2	
Determination Number	1	2	1	2
Number of Blows	21	12	17	17
Container Number	S3D1	S1R2	S2R2	S1L1
Weight of Container, Wo (grams)	10.8	9.3	9.8	11.1
Weight of Container with Wet Soil, W1 (grams)	91.1	95.4	96	94.3
Weight of Container wth Oven-dry Soil, W2 (grams)	60.3	61.6	62.4	61.5
Weight of Water, W1-W2 (grams)	30.8	33.8	33.6	32.8
Weight of Oven-dry Soil, W2-Wo (grams)	49.5	52.3	52.6	50.4
Water Content w=((W1-W2)/((W2-Wo))*100	62.22%	64.63%	63.88%	65.08%
Average of Two Trials	63.42%		64.48%	
Plastic Limit (Total Average)	63.95%			

Test	No of blows/drops	Water Content %
Test 1	21	62.22
Test 2	12	64.63
Test 3	17	63.88
Test 4	17	65.08

C. Liquid Limit Test:

Determine Liquid Limit of Soil

	Test1	Test2	Test3	Test4
N (No of blows/drops)	21 No	12 No	17 No	17 No
W1	10.8 g	9.3 g	9.8 g	11.1 g
W2	91.1 g	95.4 g	96 g	94.3 g
W3	60.3 g	61.6 g	62.4 g	61.5 g
Water Content%	62.22	64.63	63.88	65.08

Liquid Limit of given Soil is

Liquid Limit

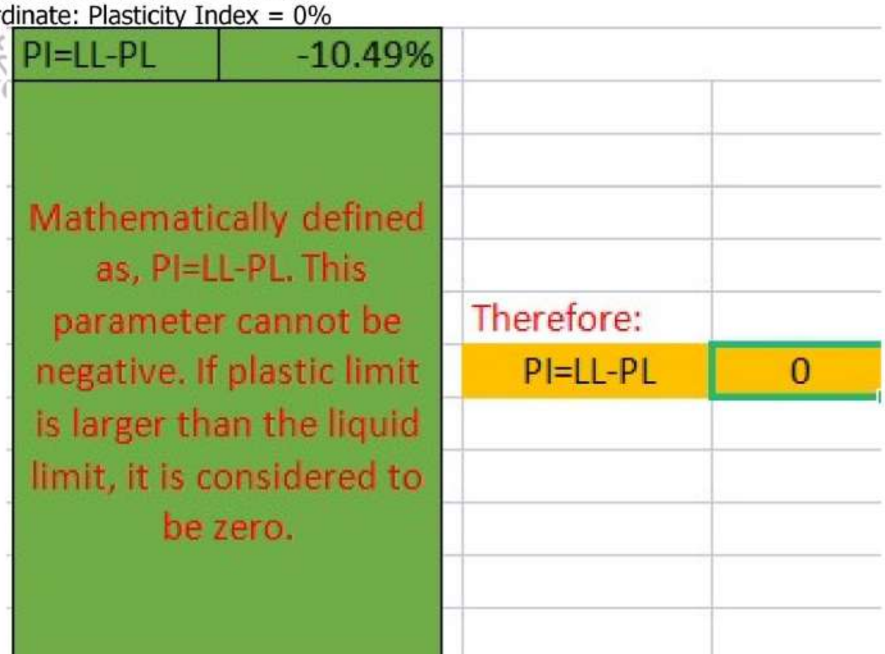
53 %

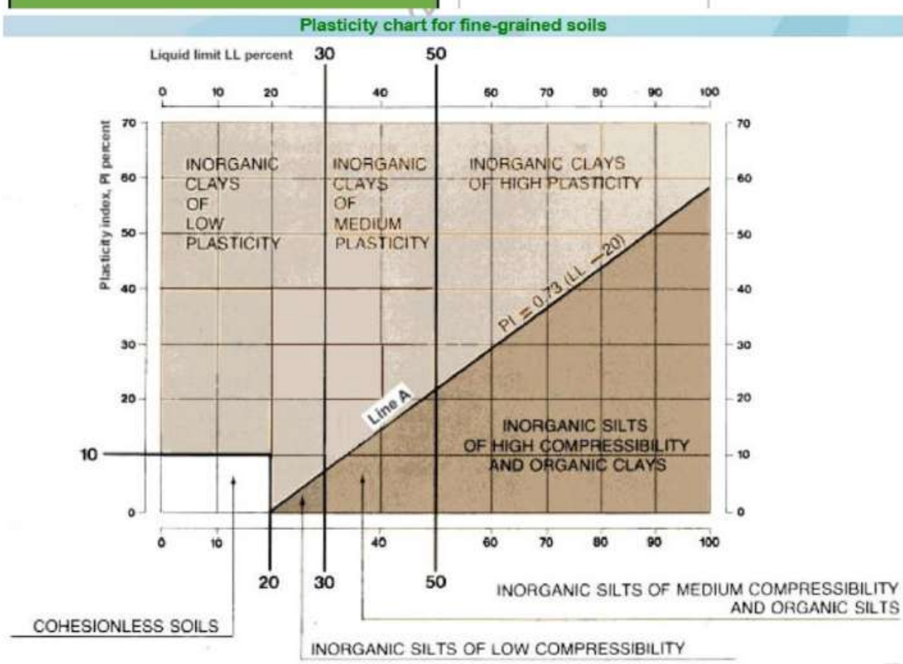
Liquid Limit %

From the reading,
corresponding to 25 blows/drops
water content is 53.46 %

H	I
Liquid LimitTest	
21	62.22%
12	64.63%
17	63.88%
17	65.08%
Liquid Limit	**53.46%**
Using Scatter Plot and Line Graph Correlation	

D. Plasticity Index
Abscissa: Liquid Limit= 53.46%
Coordinate: Plasticity Index = 0%





Based from the Plasticity Chart:
Soil Classification: OH - Inorganic Silts of High Compressibility and Organic Clays

Step 2: Determine Soil Friction Angle (ϕ), and Cohesion (c):

Description	USCS	Soil friction angle [°]			Reference
		min	max	Specific value	
Inorganic silts of high plasticity	MH	23	33		[1].
Clayey silts - compacted	MH			25	[3 cited in 6]
Silts and clayey silts - compacted	ML			32	[3 cited in 6]
Inorganic clays of high plasticity	CH	17	31		[1].
Clays of high plasticity - compacted	CH			19	[3 cited in 6]
Organic clays of high plasticity	OH	17	35		[1].
Loam	ML, OL, MH, OH	28	32		[7].
Silt Loam	ML, OL, MH, OH	25	32		[7].

Description	USCS	Cohesion [kPa]			Reference
		min	max	Specific value	
Inorganic clays of high plasticity - compacted	CH	-	-	103	[3].
Inorganic clays of high plasticity - satrated compacted	CH	-	-	11	[3].
Organic clays of high plasticity	OH	-	-	10	[1].
Loam - Compacted	ML, OL, MH, OH	60	90		[2].
Loam - Saturated	ML, OL, MH, OH	10	20		[2].

Step 3: Determine the N_q, N_c, and N_γ factors (Meyerhof's Coefficient).

Given :

Internal Friction Angle: $\phi := 17\ °$

Soil Cohesion: $c := 10\ kPa$

Depth of Footing's Base Measured from Ground Line: $D_f := 1.5\ m$

Initial Square-Footing Width: $B := 1000\ mm$ $L := 1000\ mm$

Orientation of Force relative to the vertical axis: $\theta := 0\ °$

Factor of Safety: $FS := 3.0$

Soil Unit Weight at a Given Depth: $\gamma_d := 15.61\ \dfrac{kN}{m^3}$ Thus, $\gamma_s = \gamma_d = \gamma_{UL}$

Soil Unit Weight at the Upper Layer: $\gamma_{UL} := 15.61\ \dfrac{kN}{m^3}$ $\gamma_s := 15.61\ \dfrac{kN}{m^3}$

Bearing Capacity Factor for Surcharge: $N_q := e^{\pi \cdot \tan(\phi)} \cdot \tan\left(45\ ° + \dfrac{\phi}{2}\right)^2 = 4.772$

Bearing Capacity Factor for Cohesion: $N_c := (N_q - 1) \cdot \cot(\phi) = 12.338$

Bearing Capacity Factor for Unit Weight: $N_\gamma := (N_q - 1) \cdot \tan(1.4 \cdot \phi) = 1.664$

Step 4: Determine the corresponding shape, depth, and inclination factors for the Surcharge, Cohesion, and Unit Weight.

Passive Pressure Coefficient: $K_p := \tan\left(45\ ° + \dfrac{\phi}{2}\right)^2$

$F_{cs} := 1 + 0.2 \cdot \dfrac{B}{L} \cdot K_p = 1.365$ $F_{qs} := 1 + 0.1 \cdot \dfrac{B}{L} \cdot K_p = 1.183$

$F_{cd} := 1 + 0.2 \cdot \dfrac{D_f}{B} \cdot \sqrt[2]{K_p} = 1.405$ $F_{qd} := 1 + 0.1 \cdot \dfrac{D_f}{B} \cdot \sqrt[2]{K_p} = 1.203$

$F_{ci} := \left(1 - \dfrac{\theta}{90\ °}\right)^2 = 1$ $F_{qi} := \left(1 - \dfrac{\theta}{90\ °}\right) = 1$

$F_{\gamma s} := 1 + 0.1 \cdot \dfrac{B}{L} \cdot K_p = 1.183$

$F_{\gamma d} := 1 + 0.1 \cdot \dfrac{D_f}{B} \cdot \sqrt[2]{K_p} = 1.203$

$F_{\gamma i} := \left(1 - \dfrac{\theta}{\phi}\right)^2 = 1$

Step 5: Determine Overburden Pressure or Surcharge:

$q := \gamma_s \cdot D_f = 23.415\ kPa$

Step 6: Determine Ultimate and Allowable Soil Bearing Capacity:

$$q_u := c \cdot N_c \cdot F_{cs} \cdot F_{cd} \cdot F_{ci} + q \cdot N_q \cdot F_{qs} \cdot F_{qd} \cdot F_{qi} + \frac{1}{2} \cdot \gamma_d \cdot B \cdot N_\gamma \cdot F_{\gamma s} \cdot F_{\gamma d} \cdot F_{\gamma i}$$

$q_u = 414.148\ kPa$ **(Ultimate Soil Bearing Capacity)**

$$q_a := \frac{q_u}{FS}$$

$q_a = 138.049\ kPa$ **(Allowable Soil Bearing Capacity)**

APPENDIX P
DESIGNER'S VITAE

Avance, Doreen Rose B.

Doreen Rose Bensurto Avance, 23 was born on October 26, 1999. She is a resident of Brgy. Coto Lambunao, Iloilo. She is the middle child of Jonathan P. Avance and Enriquita B. Avance.

She has 3 sisters and one brother. She loves her two younger sisters more than her life. She adores the calmness of the sea and beauty of mountains. She is adventurous and fond of exploring things. She loves driving and cooking. She wants to travel around the world with her family.

She graduated elementary at Coto Elementary School. She completed her Junior and Senior High School at Lambunao National High School.

She is currently enrolled at Central Philippine University, taking up Bachelor of Science in Civil Engineering.

Bascoguin, Frederick Anton B.

Frederick Anton Bernaldez Bascoguin, 23, was born on April 23, 2000. He is the youngest son of Jeremias F. Bascoguin and Regevie B. Bascoguin. He is currently residing at Brgy. Devera, Sara, Iloilo.

He has three siblings, all girls. He loves playing mobile games. Reading books such as manga and novels is one of his favorite things to do during his free time. Instead of going out to party, he prefers to stay at home and sleep.

He finished his elementary education at Hugo T. Apelo Memorial Elementary School. He completed his Junior High School education at San Juan Academy Inc. and graduated from Senior High School at Central Philippine University.

At present, he is taking up Bachelor of Science in Civil Engineering at Central Philippine University.

Daquil, Karl Cristian P.

Karl Cristian Pedrigosa Daquil, 23, was born on April 3, 2000. He is a resident of Brgy. Buenavista Passi City, Iloilo. He is the son of Cristino T. Daquil and Carla P. Daquil.

He has one younger sister and he is the eldest. He loves playing mobile games. He is fond of watching documentaries in his leisure time. His daily routine is to eat, read, and sleep.

He graduated elementary at Passi I Central School in Passi City. He attended his Junior High School at Passi National High School and Senior High School at West Visayas State University-Main Campus.

He is currently enrolled at Central Philippine University, taking up Bachelor of Science in Civil Engineering.

Marcos, Von Mauric R.

Von Mauric Rogan Marcos or “Vic,” a native of San Jose St. Poblacion Malinao Aklan was born on December 17, 2000. He is the youngest son of Vicente Luis D. Marcos and Ma. Melanie R. Marcos. He graduated elementary at Malinao Elementary School. He finished his Junior High School as First Honors at Infant Jesus Academy and Senior High School with High Honors at Central Philippine University. He enrolled in Civil Engineering since he loves Mathematics and Science.

His hobbies include swimming, biking, reading books, playing guitar, and he is a Mathematics and Science enthusiast. He was a Division Qualifier of Philippine Mathematical and Chemistry Olympiad, a 4th Placer in PRISAA Math Quiz Bee, and regarded as the First Kumon graduate in Aklan. He was the top examiner in the Engineering Entrance Exam held at Central Philippine University.

He is taking up a Bachelor of Science in Civil Engineering at Central Philippine University.

Tan, Louise Elaine V.

Born on May 14, 2001 in Laguinbanua East, Numancia, Aklan and the youngest daughter of Mr. Eric S. Tan and Hon. Lalaine V. Tan, but was raised by Mr. Victor Igtanloc and Laigel V. Igtanloc. She finished her Elementary in Kalibo Pilot Elementary School, her Junior high school in Regional Science High School for Region VI and pursued her senior high school in Central Philippine University.

She is a consistent student leader, a dancer, and a lawn tennis player. During her college years, she consistently served her department and the university. She was once a Secretary for Freshmen Council, Secretary for Engineering Student Council, Vice-President for fourth year in PICE-CPUSC, Engineering Representative for Engineering Student Council and Deputy Minister for Sports, Culture and Arts in CPU Republic.

Louise aims to continue her leadership up to the Engineering field. Despite her insecurities and imperfection, she promises to strive hard and become an engineer someday.