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Proposed Multi-purpose Hall in De La Paz Elementary School, Lubao, Pampanga

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Abstract:

Multipurpose halls adopted by foreign schools for more than 150 years to provide the needs of their students with their facilities. The Philippines was still lagging in the infrastructure of their schools. The De La Paz Elementary School in Lubao, Pampanga, is one of the schools in the Philippines experiencing a lack of facilities. This study measured the demands of the facilities of De La Paz Elementary School and Brgy. De La Paz. The researchers found out that the De La Paz Elementary Schools experienced a lack of facilities since 2012, a stage, court, clinic, and storage room, and the barangay has issues with their existing covered court. A multipurpose hall was proposed that can cater to the needs of the school and the barangay with facilities. The structural frame of the proposed multipurpose hall was performed using STAAD Pro. The structural member analysis was created by manual computation to determine the capacity of each structural member and compared it to the generated design forces from STAAD.Pro V8i.

Keywords **—Multipurpose halls, schools, facilities, needs**

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I. INTRODUCTION

A multipurpose hall is known to accommodate different events or activities that give learning and enjoyment. This structure also serves a large number of functions.

Multi-purpose halls can be transformed into the exact facility that is needed at a given time. It is a cost-effective and flexible space created to hold different uses. Lawinsider (2013) states that a multi-purpose hall is a space including the storage of materials, and a place for indoor and outdoor gatherings, meetings, and events. Multipurpose can be designed including school canteens and entertainment events which turn them into gathering places.

Since over 150 years ago, multi-purpose halls in schools have existed specifically as part of U.S. schools. The multi-purpose hall can is also known as an assembly hall. This hall can be used for recreational activities and celebrations, theatre, debates, public lectures, or as a gymnasium. It is also used by community members for various educational, cultural, or social purposes [20]. New York City elementary schools include building assembly rooms that could be subdivided with track-mounted wood partitions for their various activities for students and teachers [8].

Background of the Study

School Facilities

The school is the second home of the students, and almost 12 years of their lives are spent here which has a vital influence on a child's overall development health, behaviour, engagement, learning, and growth. And, it is not a new concept that school facilities can affect students' academic performance. The state of school facilities was examined by Doctor of Philosophy Mark Schneider, who found that it had a significant impact on student achievement and teachers' effectiveness [20]. This study found that students in newer or recently renovated buildings do better than older ones.

According to a Penn State University report, school facilities have an impact on hiring and retaining teachers [11]. Therefore, having adequate facilities helps the institution provide better instruction. Facilities at schools enhance the quality of the learning environment, which raises the standard of instruction. A student's capacity to participate in extracurricular activities and other types of learning is restricted by a lack of facilities.

The Philippine Institute for Development Studies (PIDS) states that the Philippines is still lagging compared to other countries, and the widening gap in facilities is affecting pupils' academic performance. The PIDS highlighted the current issues in the basic education sector which is the need for increased investments in school infrastructure [18].

In Valenzuela City, on November 7 at Lawang Bato Elementary School a multi-purpose building was inaugurated and built. The facility would serve and cater different events for the people and students of Barangay Lawang Bato. The structure consists of facilities like a basketball court, a stage, and bleachers. Mayor Wes Gatchalian came up with this project when he was invited to a graduation at this school. He witnessed the facilities in the school are already dilapidated and realized the sufferings of parents, students, and school personnel experience under the sunlight or rainfall [23].

Figure 1.1.1. De La Paz Elementary School Court and Stage
Reference: De La Paz Elementary School

The De La Paz Elementary School in Lubao, Pampanga lacks many facilities which affect the overall aspect of the student's health, behaviour, engagement, learning, and growth. The lack of facilities that the school is facing is the following: 1.) The stage and court of the school have been dilapidated for almost 10 years and the constituent has to do their activities in their hallway, 2.) The school doesn't have a canteen inside which makes their students buy outside the school or to be specific in front of their gate that recorded some incidents of one student getting hung on the gate of the school, and two students falling in the canals while climbing the fence of the school to buy food, and 3.) The school does not have a storage room, the principal's office and other rooms were used to stock materials. Figure 1.1.2 shows the number of students affected since 2012. The proposed multi-purpose hall will be designed to provide the lack of facilities at the De La Paz Elementary School.

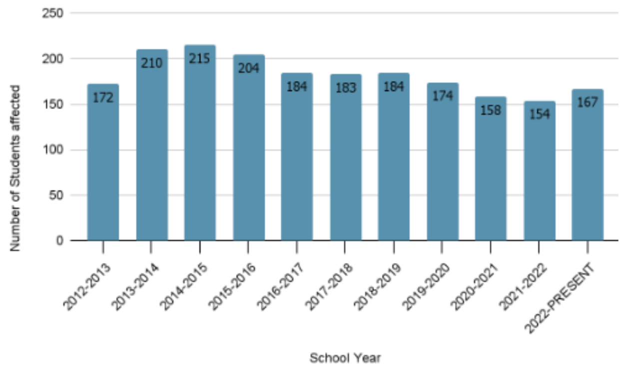


Figure 1.1.2. The number of students affected by lack of facilities
Reference: De La Paz Elementary School

Covering the court and stage

According to the World Health Organization (2021), climate change is the single yet biggest health threat worldwide and no one is safe from risks given by climate change. The people in low-income and disadvantaged countries and communities are not able to least minimize or prevent its effect. The United States Environmental Protection Agency also states that climate change threatens health and well-being in numerous ways.

Sun is the main source of heat and light. Due to climate change, the frequency, duration, and magnitude of heat causing heat-related deaths and illnesses are increasing. The World Health Organization recorded that in 2010, a 44-day heat wave in the Russian Federation resulted in 56,000 extra deaths and 70,000 deaths in Europe in 2003 due to the June-August catastrophe. WHO (2021) said that global temperatures and the frequency and intensity of heat waves will rise in the 21st century [25]. And even the small differences from seasonal average temperatures are associated with increased illness and death. All human beings are affected and some are vulnerable and more exposed, these include the elderly, infants and children, pregnant women, outdoor and manual workers, athletes, and the poor.

Although humans need sunlight to produce Vitamin D, too much exposure to sunlight also causes sunburn and tanning. And, sunlight is the main source of ultraviolet radiation, and long-term and repetitive exposure to UV radiation results in skin cancers either melanoma or non-melanoma, cataracts, and other eye diseases.

Dehydration and heat stroke are other more common effects of overexposure to the sun. When exposed to the sun, the skin will expel perspiration to cool the body down to prevent overheating. However, if the body does not restore the right amount of fluid waste due to perspiration, it will result in a high risk of dehydration. Late medication and preventive measures may be fatal. Dehydration in children is a very common occurrence, especially in hotter climates like the Philippines. According to a study by the Department of Science and Technology-Food and Nutrition Research Institute (DOST-FNRI), eight of every 10 Filipino children are suffering from dehydration.

Piedmont Healthcare (2022) links that sudden weather changes also may cause harm to human health. A sunny day and sudden rain might impair the immune system and cause upper respiratory infections. The quickly switching heating and cooling systems can dry up the air, which can help with severe and persistent nose and throat problems. Injuries to the muscles, joints, and lungs are also common after sudden rain. [1]

For almost 10 years, the De La Paz Elementary students' and teachers' recreational activities and celebrations, assemblies, and ceremonies are held in their hallway depicted in Figure 1.1.3. The population affected since 2012 is shown in Figure 1.1.2. Elementary Students' ages range from 5 to 7 and end at about age 11 to 13, and children are the most vulnerable sector. Although there is a stage at the school, as seen in Figure 1.1.1, it is not well-maintained, and students, teachers, and parents must also deal with the weather. Students and teachers alike do not want to stay under the heat or get wet and some programs or events may be hard to hold due to unsuspected weather changes. The use of the hallway is also not enough to protect the constituents of the school from the heat, sunlight, and weather.

Figure 1.1.3. Mass and De La Paz Elementary Graduation Rites 2022
Reference: De La Paz Elementary School

The proposed multi-purpose hall will also provide a much wider and safer space for students to gather and perform various school and extra-curricular activities protected from the heat of the sun or sudden or heavy rains.

Basketball and other barangay-related activities

Sport has existed since the dawn of time. It keeps societies active and healthy while also boosting morale and supporting local communities. Sports are more important than ever in the present era of cell phones, laptops, and other electronic devices. So, while installing crucial ideals, competitive sports encourage people of all ages to go outside and be active.

Basketball is the most popular youth sport around the world. According to the Sports & Fitness Industry Association in the US, 9.8 million boys and girls ages 6-17 played basketball in 2015. In the Philippines, it's been part of the culture. In the street, in both provinces and cities, you may see basketball courts.

Pampanga is known as one of the PBA basketball players' hometowns; some are Jayson Castro, Calvin Abueva, Armin Santos, and Japeth Aguilar. Local government units, specifically, Sangguniang Kabataan, launched basketball leagues to advocate sports among the youth.

Figure 1.1.4. Existing Court in Brgy. De La Paz Lubao, Pampanga
Reference: Researchers' actual visit

The residence of Brgy. De La Paz, especially the youth, are very active in sports like basketball. These youths were facing problems with their existing court. The Barangay De La Paz covered court in Figure 1.1.4 is not standard in dimension for the basketball court and is always used as parking for vehicles for the barangay officials.

The proposed multi-purpose hall would also be designed with a basketball court. This court would be of standard quality and dimension which will be useful to students and youth of the barangay. It may create opportunities for the youth of De La Paz to hone their skills in Basketball. This facility will also be helpful to other barangay-related activities when the existing covered court would not be applicable and available to use.

Evacuation Centre

Global warming, climate change, and changes in the environment become common news globally but shouldn't be considered normal. These continuous changes contribute to the increasing frequency, intensity, and unpredictability of severe weather and environmental events globally. Yearly, many humans are affected by disasters, both human-caused and natural disasters. These disasters have a big impact on the economy, business, or livelihood, and especially on the lives of mankind.

The Philippines is beside the largest ocean, the Pacific Ocean which is the birthing hurricane, and the country is considered to be part of the area of the Pacific Ring of Fire that has become more prone to earthquakes, and volcanic activities. Figure 1.1.5 shows the number of families affected due to different natural disasters from 2012 to 2021, it is proof of the unpredictability of a natural disaster.

A group of researchers at Lyceum of the Philippines 2019 pointed out that the Philippines is a particular country that is vulnerable to disasters due to its location in the Pacific Ring of Fire, and proposing a multi-purpose hall will also serve as an evacuation centre during typhoons and other calamities [6].

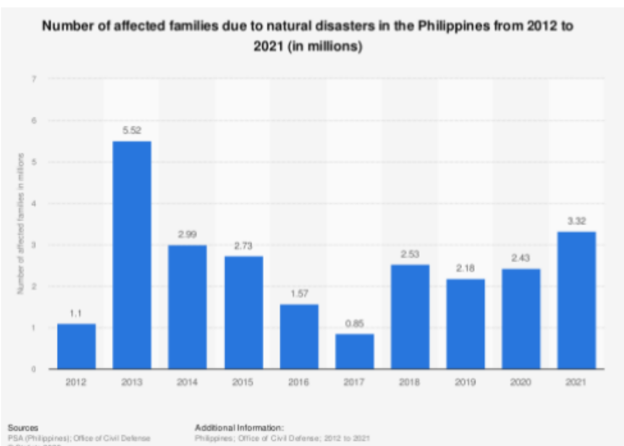


Figure 1.1.5. Number of affected families due to natural disasters in the Philippines from 2012 to 2021

Reference: https://www.statista.com

The Habagat 2013 was enhanced by Typhoon Maring, according to *Rappler (2013)*, it was a continuous 5-day rain that flooded several regions in Luzon, which affected 3,096,392 people, took 27 casualties, and 5,192 families were outside of evacuations due to full capacity [14]. Even in those elevated municipalities of Pampanga, the Lube also got submerged.

The Brgy. De La Paz has the highest elevation in the west district with 18.3m above sea level as shown in Figure 1.1.6, but the flood broke through in some portions.

The three assigned evacuation centres of Brgy. De La Paz wasn't capable of serving and giving proper shelter during calamities. The three assigned evacuation centres in the barangay are the covered court in front of the barangay hall, the church, and the school.

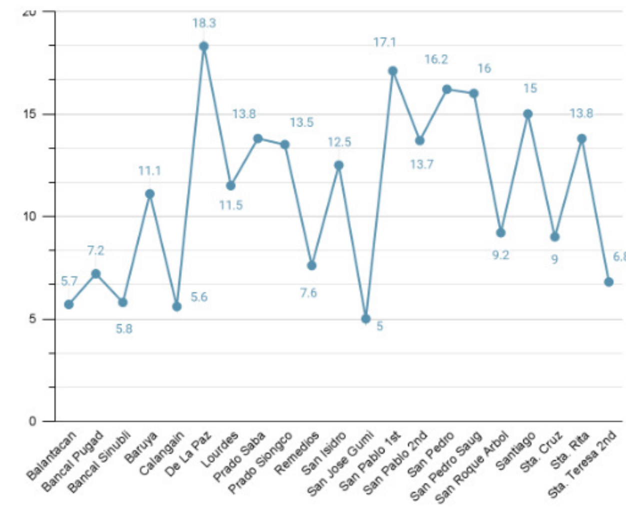


Figure 1.1.6. Lubao West District Barangay Elevations

Reference: Lubao, Pampanga Profile – PhilAtlas, 2022 [2]

According to the Barangay Disaster Risk Reduction Management Plan, the covered court could cater to 50 families, but the elevation of the court is the same as the elevation of the road and the roof is just the only cover that makes the court still affected by the rain. The church which can cater to 15 families also is easily flooded because it is not also elevated. The last evacuation would be the school, which is also the location of the proposed multi-purpose hall, the proposed multi-purpose hall would refrain the residents from using the classrooms (less damage to school materials).

Also, Pampanga is near the Iba Fault which is the epicentre of the Magnitude 6.1 earthquake last April 22, 2019, in which Pampanga felt Intensity VI and recorded 10 fatalities according to the Philippine News Agency (2019). PHIVOLCS explained why Pampanga got the most brutal hit of the earthquake not only because the epicentre is in Zambales, but also because the province sits on soft sediment and alluvial soil. These types of soils are both prone to strong shaking during an earthquake. Most of the houses in the provinces are not designed by structural engineers, and some of the residents were forced to stay and sleep outside of their houses.

Lastly, with the recent COVID pandemic that hits the whole world, the Brgy. De La Paz also recorded high cases when the surge was on. While the residents were being infected, the elementary school of the barangay was used as an isolation facility, and due to the lack of facilities in the barangay, some residents that are sick chose to stay in their houses with their family who was not infected by the coronavirus, which makes their family member got positive also. The barangay doesn't have a facility for evacuation centres that can be used as quarantine or isolation facilities.

An evacuation centre is a specified building specifically chosen as a site not expected to be negatively impacted by a certain hazard. The proposed multi-purpose hall would be designed as elevated and with partition walls inside which can serve as temporary shelters for the residents of De La Paz People during floods and other disasters like earthquakes and volcanic eruptions as well as an isolation facility.

The Barangay and its Population Growth

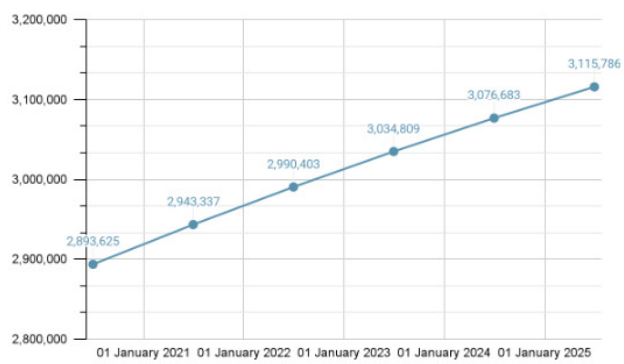


Figure 1.1.7 Updated Projected Mid-Year Population for the Philippines Based on the 2015 POPCEN Results: 2020-2025 (PAMPANGA PROVINCE)

Reference: Philippine Statistics Authority. (2021)

The Philippines is a Southeast Asian nation that is divided into 17 regions, each of which has 82 provinces. Pampanga has a land size of 2,002.20 square kilometres and is located in Central Luzon (Region III). The Philippine Statistics Authority (PSA) projects that Pampanga's population will increase by 44,406 by July 2023, when it would total 3,034,809 as shown in Figure 1.1.7 [22]. The yearly population growth rate in Pampanga is 2.20 percent, which translates to an increase of 220 people for every 10,000 people between 2015 and 2020.

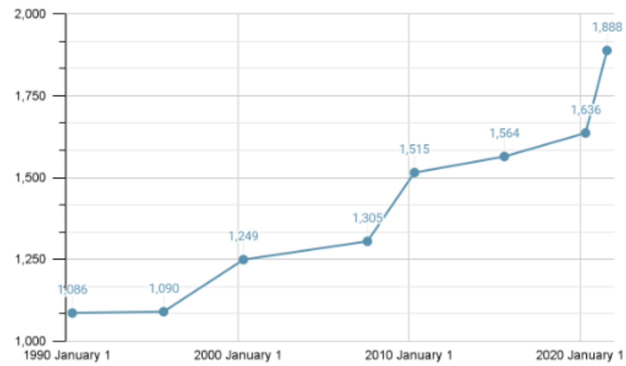


Figure 1.1.8 Brgy De La Paz, Lubao, Pampanga Population from 1990 - 2020

Reference: De La Paz, Lubao, Pampanga Profile – PhilAtlas [2]

The Brgy. De La Paz is one of the barangays in the Municipality of Lubao in Pampanga. It is located 10.7 km from Lubao Municipal Hall The barangay has a total land area of 446 hectares, a population of 1,888, 448 households, and 591 families in the 2021 census. Figure 1.1.8 signifies the positive growth rate of the population of Barangay De La Paz in Lubao, Pampanga from 1990 to 2021.

The proposed multi-purpose hall will not only be beneficial to the present residents of Brgy De La Paz but also would be a long-term and holistic approach for the growing population of Brgy De La Paz.

1.1 Study Area

The proposed multi-purpose hall will be located at De La Paz Elementary School, Barangay De La Paz, Lubao, Pampanga, which will solve the lack of facilities in the school, will protect the students and teachers from the effect of weather, will be used for barangay events and recreational programs, as well as serve as a proper and good quality evacuation centre.

Figure 1.1.1.a. Map of Barangay De La Paz, Lubao, Pampanga

The Brgy. De La Paz is located 10.7 km from Lubao Municipal Hall, with the highest topographic elevation of 18.3m in Lubao West suitable for a multi-purpose hall that can be used for evacuation. The Brgy. De La Paz is surrounded by Brgy. Sta. Rita in the East, Brgy. San Pedro, Floridablanca in the North, Brgy. San Pablo 1st in the West and San Pablo 2nd in the South.

The Brgy. De La Paz Records, the barangays total land area is 446 hectares, has a population of 1,888, 448 households, and 591 families in the 2021 census.

1.2 Objectives of the Study

1.2.1 General Objectives

The study aims to propose a Multi-purpose Hall to the. De La Paz Elementary School in Lubao, Pampanga.

1.2.2 Specific Objectives

The study specifically aims to:

- To assess or evaluate the demand of facilities of the constituents of De La Paz Elementary School in Lubao, Pampanga as well as the Brgy. De La Paz.
- To design a multi-purpose hall that can be transformed into the exact facility that the people need at a given time.
- To provide a rough cost estimate of the proposed Multi-purpose Hall.

1.3 Significance of the Study

The result of the study will have great benefits in the following:

- Student and Teachers: This study will help the students and teachers to solve their problems with the lack of facilities and provide a much wider and safer space for students to gather and perform various school and extra-curricular activities protected from the heat of the sun or sudden or heavy rains.
- Youth: This study will help the youth of Barangay De La Paz to have standard quality and dimension Basketball courts which will create opportunities for the youth of De La Paz to hone their skills in Basketball.
- Community: This study will help the community to have a multi-purpose hall that can be transformed into the exact facility that the needs of people at a given time.
- Local Government: This study will help the barangay in meeting the needs of their people by giving temporary shelters for the residents of De La Paz People during floods and other disasters like earthquakes and volcanic eruptions as well as an isolation facility.
- Future Researchers: This study will serve as a guide for future researchers to make other credible and reliable data-based decisions about whether they wish to conduct studies or obtain any related information about the proposed multi-purpose hall that they will surely need in their future studies.

1.4 Scope and Limitations of the Study

The goal of the study is to propose a multipurpose hall in Brgy. De La Paz Elementary School is in De La Paz Lubao, Pampanga. The design complies with the 2015 National Structural Code of the Philippines and makes use of Ultimate Stress Design (USD in concrete design), and Load and Resistance Factor Design (LRFD) in steel design. The dead load, live load, roof load, wind load, and seismic load would be the applied loads for the structure. STAAD Pro will be used by the researchers to assess the proposed multipurpose hall's structural framework. However, a manual calculation would be used to assess the structural parts.

This study would only be a one-story multi-purpose hall and follow Section 303.33.1 of the NSCP 2015, which states that a geotechnical consultation would only require buildings higher than two stories.

The study would only provide a probable cost estimate on structural frames, roofing, masonry, and excavation works.

1.5 Conceptual Framework of the Study

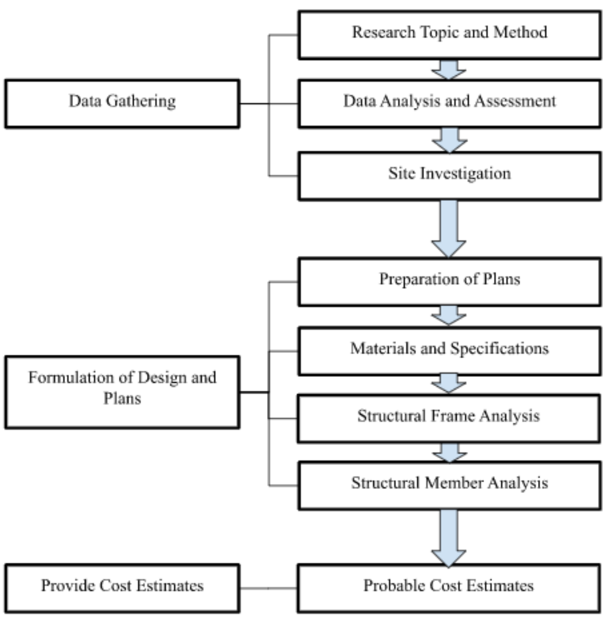


Figure 1.1.5.a Research Paradigm

The methods for the study will be divided into three phases, and each phase has steps to follow before proceeding to the next phase. Phase one will be data gathering, followed by the formulation of design and plans, and providing cost estimates. These phases will be elaborated on and explained in chapter two of the study.

1.6 Definition of Terms

- **Accommodate** - to hold or make a room without the inconvenience
- **Constituents** - members or part of an organization or group
- **Cost-effective** - good outcome or result without too much cost
- **Dilapidated** - ruin due to misuse
- **Facilities -** a place that can give service
- **Heatwave** - a period of unusually hot weather
- **Impact** - direct or major effect
- **Inaugurated** - a ceremony to formally announce or initiate the beginning of
- **Intensity** - the magnitude or level of
- **Lagging** - falling behind
- **Melanoma** - tumor
- **Proposed -** to give consideration or offer
- **Section -** a distinct part, specifically NSCP 2015

II. METHODOLOGY

This chapter provides an overview of the research methods used to help the hypotheses that had been developed, as well as the application of procedural analysis and decision-making concerning the information gathered regarding the proposed multi-purpose hall in Barangay De La Paz Lubao, Pampanga, which is situated at De La Paz Elementary School.

2.1 Data Gathering

The researcher gathered the data and understood the background of the study. The collected data came from different contributors, especially the Brgy's community, the De La Paz barangay captain, and the school head for the improvement of the barangay and the school. The evaluation of the current issues of the school and barangay lack of facilities will be used to screen potential solutions. Included here are the published studies relative to the topic, from the Barangay Disaster Risk Reduction Management Committee (BDRRMC), ICT of De La Paz Elementary School, and professionals relative to the study, such as registered architects and civil engineers practicing in the industry and academe.

The De La Paz Elementary School provided a list of students per year who experienced a lack of facilities, a copy of the history of the school, and a tax declaration to validate the school's ownership of the school land area. It was once donated by Mr. Pablo Dabu and later bought by Vice Governor Lilia G. Pineda. Tax Declaration is a preliminary site assessment or requirement for the site development plan and structural assessment comparison. And, at the Barangay Disaster Risk Reduction Management Office, researchers gained information about the assigned temporary three evacuation centres and their capacities.

For consultation on the design of the proposed multi-purpose hall, researchers surveyed their two Thesis Adviser Engr. Christian P. Dizon and Architect John Cyrus M. Ilao to know what to consider in building a multi-purpose hall and obtain tips and specifications.

2.1.1 Research Topic and Method

Quantitative data collection is done through interviews, specific observations, and document or archival reviews, and these were analysed using descriptive and inferred statistical techniques [4]. Quantitative research is a very effective way of obtaining the "structural" characteristics of social life and their ideas about this study.

Research about Research Methods for the Social Sciences was conducted in 2020 by Valerie Sheppard who defined an interview as a face-to-face or in-person meeting between the researcher and the respondents [16]. The researcher will make a list containing the inquiries that the interviewee will hear from the researcher.

The researchers prepared letters about the agenda of consent to conduct interviews in the Barangay and School, these were signed by the research coordinator Engr. Renzo L. Tala. The School Head of De La Paz Elementary School named Mrs. Yvette Galvez give access to researchers to observe the location. School staff provide some photos and the number of students affected by the lack of facilities per year from 2012 up to the present.The researchers together with Hon. Rolando M. Reyes Barangay Captain of Barangay De La Paz Lubao Pampanga conducted a question and answer about the history, land area, population, situation, and facilities of the Barangay De La Paz Lubao Pampanga. Also, the Barangay Captain lent their book about Barangay Disaster Risk Reduction Plans and a list of facilities in their barangay.

2.1.2 Data Analysis and Assessment

A set of checklists were developed based on observations made and the interviews performed. The researchers assess the feasibility of the proposed multi-purpose hall in Barangay De La Paz Lubao, Pampanga.

2.1.3 Site Investigation

Site investigation is also known as soil exploration. Soil is where the structure is constructed, which becomes one of the most important preliminary requirements in building or choosing a location for the structure.

This study would only be a one-story multi-purpose hall with a land area of 800 square meters, and under Section 303.33.1 of the NSCP 2015, which states that a geotechnical consultation would only require buildings higher than two stories.

2.2 Formulation of Design and Plans

There are relevant documents needed when starting a project, including the site development plan, architectural and structural drawings, the soil profile, loadings, applicable codes, the structural members, and the material specification. The footing, columns, beams, floor slabs, walls, and roofs are all structural members.

The Researchers will propose a multi-purpose hall, which is made of a steel frame (gable and portal frame), and reinforced masonry walls will enclose it on its four sides. Portal frames are braced frame systems that are usually used for a structure that needs to have large space without the need for interior columns. This frame can be fixed on a concrete slab or footing (such as a reinforced concrete pedestal). It also provides rigidity due to the use of high-strength material, steel The Compressive strength of reinforced concrete is 4000 psi while structural Steel is 25000 psi. Also, steel structural elements have high tensile strength compared to reinforced concrete structures thus increasing their resistance to dynamic loads.

2.2.1 Preparation of Plans

The researchers will utilize AutoCAD as a tool to prepare building plans, elevations, and detailed design layouts of the proposed multi-purpose hall, and it can also identify the type of materials that would be used.

2.2.2 Codes and Specifications

The proposed multi-purpose hall will be established with the following codes and specifications:

- Presidential Decree 1096 or National Building Code of the Philippines 2005
- ASEP Steel Handbook
- The National Structural Code of the Philippines 2015

2.2.3 Structural Frame Analysis

Structural plans provide details regarding the construction, installation, or reconstruction of any structure that serves reference needs to follow during site construction. The details of plans should be met, especially the load-carrying member of a structure. The proposed multi-purpose hall will be analysed sequentially by structural frame analysis and structural member analysis.

STAAD Pro is software that is widely used by architects and engineers. It is advanced for it gives faster and more precise analysis. This software is suitable for materials such as steel, RCC, aluminium, etc. [15]. Also, this software allows the users to perform analysis with a wide range of loads such as static, dynamic, wind, earthquake, thermal, and moving loads [19]. With that, the researcher used the STAAD Pro to design and analyse the structural frame of the proposed multi-purpose hall. STAAD Pro is used by almost 95% of design firms [5].

2.2.4 Structural Member Analysis

The capacity of each structural member concerning the generated design forces in structural frame analysis will be calculated by the researchers manually. Included are the following manual computation and design of:

- Purlins
- Rafter
- Steel Beam
- Steel Column
- Welds
- Anchor Bolts
- Base Plate
- Reinforced Concrete Column / Pedestal
- Reinforced Concrete Column
- Reinforced Concrete Beam
- Reinforced Concrete Beams
- Slab on Grade
- Isolated Footing

2.3 Provide Cost Estimate

Cost Estimation gives information on the number of materials, labour costs, and construction costs which makes it essential in the construction industry [24].

The materials to be used in the structural frame will be selected to achieve the lowest cost while maintaining the quality and stability of the structure.

III. RESULTS

This chapter reveals all of the information and findings from the calculations. The following significant finding was made after careful observation and evaluation of the study and application.

3.1 Data Gathered

The following tables are the data gathered which might affect and serve as a basis for the formulated plans.

Table 3.1.1 Demographic Profile of Barangay De La Paz

	MALE	FEMALE	TOTAL
Population	924	964	1,888
Senior Citizen	59	88	147
Children 0-17 yrs.	226	277	503

The records of population and vulnerable sectors of Barangay De La Paz in Lubao, Pampanga are in Table 3.1.1.

Table 3.1.2 Number of enrolees in De La Paz Elementary School in Lubao Pampanga S.Y. 2022-2023

Kinder	25
Grade 1	29
Grade 2	20
Grade 3	12
Grade 4	35
Grade 5	20
Grade 6	26
TOTAL	**167**

Here are the affected students with the lack of the facilities for the school year 2022-2023.

Table 3.1.3 List of Facilities in Barangay De La Paz in Lubao, Pampanga

Facilities	Available
Barangay Hall	o
Barangay Health Centre	o
Hospital	x
Day Care Centre	o
Multi-purpose Hall	x
Barangay Reading Centre	x
Market	x
Play Ground	**x**
Park / Plaza	x
Covered Court	o
Botika sa Barangay	**x**
Sportscenter / Gymnasium	**x**

Gathered from the records of the Brgy. De La Paz are the facilities in Table 3.1.3.

Table 3.1.4 List of Facilities of De La Paz Elementary School in Lubao, Pampanga

Facilities	Available	Remarks
Rooms	o	1:1
Comfort Rooms	o	1:1
Principal's Office	o	use as storage, clinic, office
Clinic	x	
Stage	o	dilapidated
Storage Room	x	
Library / Reading Room	**x**	
Computer Lab	**x**	
Canteen	x	
Covered Court	x	
Multi-purpose Room	x	

With the priority to provide the needs of the school and as well as the barangay. The proposed multipurpose hall will be designed with a canteen, storage room, stage, and court.

3.2 Implementation of Design Criteria

The researcher considered the strength and suitability of the structure to withstand the applied loads when designing it. In structural design, the geometry of the members is verified, assured, and approved for the specified load combinations based on the NSCP 2015. The chosen design must withstand the imposed live load without failure, such as collapse, damage, deflection, or vibration.

3.2.1 Design Principle

This study shall serve as the design basis for the civil/structural engineering works of the proposed multi-purpose hall in De La Paz Elementary School in Lubao, Pampanga.

3.2.2 Applied Codes, Standards, and References

Engineering design work for the proposed multi-purpose hall was performed using the latest editions of the following codes and standards.

3.3 Structural Design based on the NATIONAL STRUCTURAL CODE OF THE PHILIPPINES 2015 (NSCP 2015)

The design of the structures shall be governed by the NSCP 2015.

3.3.1 Dead Loads

The calculation of the dead load material for the wall, ceiling, and floor was determined in accordance with Section 204.2 of the NSCP 2015, and the floor loads were calculated based on Section 204.3.

- CHB 5'', Full Grout, Plastered on both sides -2.63 + 0.24 + 0.24 = 3.11 kPa
- Ceiling = 0.10kPa
- Mechanical, Electrical, Plumbing, and Fire Protection (MEPFS) = 0.10 kPa
- Roof (Purlins, Rafters & Roofing Sheets) = 1 kPa
- Allowance Roof Dead Load = 0.5 kPa

Materials:

- Concrete = 23.5 $kN/m3$
- Steel = 77 $kN/m3$
- Soil = 18 $kN/m3$

3.3.2 Live Loads

Since the structure is classified as a school building, assembly space and stage with moveable chairs, the live load was based on Table 205-1 of the NSCP 2015. The overall live load imposed is 7.2 kPa and 1.0kPa roof live loads.

All moving loads, such as people, tools, and other various equipment, are considered live loads.

Use floor load to govern:

- Assembly area with movable seats = 4.8 kPa
- Assembly area with stage areas = 7.2 kPa (GOVERN)
- Assembly area for emergency and evacuation = 2.9kPa
- Storage (Light) = 6.0 kPa
- Stores (Retail) = 4.8Kpa
- Allowance Roof Live load = 1.0 kPa

3.3.3 Seismic Loads

The term "seismic load" refers to the horizontal and vertical forces that, in terms of their design effect, are equal to the loads brought about by earthquake-related ground motion. Building-related and non-building constructions must be seismically designed in compliance with NSCP 2015 Section 208.

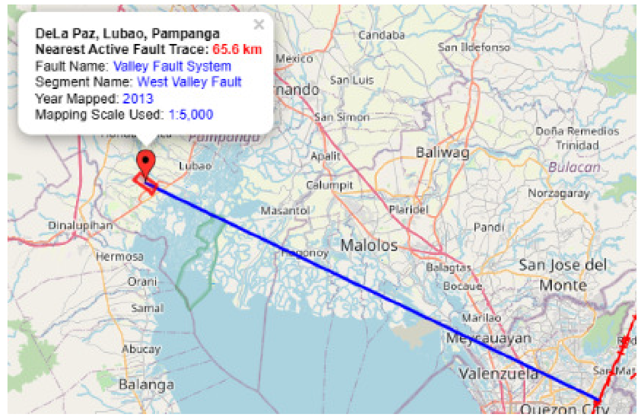


Figure 3.3.3.a Location of De La Paz, Lubao, Pampanga from West Valley Fault

According to NSCP 2015 Table 208-1, "Seismic Zone Map of the Philippines," Barangay De La Paz Lubao, Pampanga is located +65.6km from the West Valley Fault Line and is classified as being in Zone 4 with a maximum ground acceleration of 0.4g.Every school building must be constructed to resist earthquakes for Seismic Zone 4 with a matching Seismic Zone Factor of 0.4 unless a specific criterion is specified in the NSCP. The base shear coefficient must be determined using the following formula provided in the NSCP Earthquake Load Provisions for Building Structures. The total seismic dead load is W. (Soil Parameters not provided).

For its use as a public school building and emergency shelter, a Seismic Importance Factor (SIF) of 1.5 is advised.

Table 3.3.3.a Design parameters in solving earthquake base shear

Occupancy Category	I
Importance Factor (Table 208-1)	1.5

Soil Profile Type (Table 208-2)	SD - Stiff Soil Profile (Assumed)
Seismic Zone Factor, *Z* (Table 208-3)	0.4
Seismic Source Type (Table 208-4)	A
Near-Source Factor, *Na* (Table 208-5)	1.0
Near-Source Factor, *Nv* (Table 208-6)	1.0
Seismic Coefficient,*Ca* (Table 208-7)	0.44Na
Seismic Coefficient, *Cv* (Table 208-8)	0.64Nv
R (Table 208-11B)	8.0 (Steel SMRF) or 8.5 (Reinforced Concrete SMRF)
Ct	0.0853 (Steel Structure) or 0.0731 (Reinforced Concrete Structure)

Since the proposed structure is made of steel and reinforced concrete members. The researchers check the seismic analysis as steel and reinforced concrete.

3.3.4 Wind Load

Every school building must have walls and roofs that can resist winds of at least 250 kph (as determined in Section 207 of the NSCP). Given the severe damage that the southwest monsoon ("habagat"), the northeast monsoon ("amihan"), as well as the easterly winds, may do to roofing, walls, and fenestrations, these impacts must be taken into account. The table below shows the factors used in applying wind loads in the software STAAD V8i.

Table 3.3.4.a Design parameters in Wind Load

Occupancy Category (Table 103-1)	I
Basic Wind Speed,***V*** (Figure 207A.5-IA)	250kph
Wind Directionality Factor ***Kd*** (Section 7A.6-1)	0.85 (Buildings – Main Wind Force Resisting Frames)
Exposure Category (Section 207A.7)	B
Surface Roughness	B (urban and suburban)
Topographic Factor,***Kzt***	1.0 (not on a hill, ridge or elevated)
Gust Effect Factor, ***G*** (Section 207.5.8)	0.85 (rigid structure/low rise building)
Enclosure Classification	Enclosed
Internal Pressure Coefficient, ***GCpi*** (Fig 207-5)	+0.18, -0.18
H	9.2 (NGL to Apex)
Z	6.9 (NGL to Roof beam)
Terrain Exposure Constants	a (alpha) – 7.0 zg -365.76
Velocity Pressure Exposure Coefficient **kz =** 2.01(Z/Zg)^(2/alpha)	0.6464
Velocity Pressure **qz = 0.613KzKztKdV^2**	2.866 kPa
External Pressure Coefficient ***Cp*** (Fig 207-6 or Fig 207-8)	74

3.3.5 Soil properties

The Proponent must carry out the preceding relevant research and investigations that will serve as the foundation and structural design for each project. DepEd School buildings' foundation must be built to withstand 96 kPa of net permissible soil-bearing pressure (2,000 pounds per square foot or psf).

3.3.6 Material Strength/ Properties

- Concrete:

f'c = 21 MPa or 3000 psi

E = 4700f'c = 470021 = 21538.1 Pa

Density = 23.5 *KN/*m3

- Structural Steel (A36):

E = 200,000 Pa

Unit Weight = 77 kN/m

fy = 248 MPa

fu = 414 MPa

- Reinforcing Steel:

For 16mm Φ & smaller, fy = 276 MPa or GRADE 40

For 16mm Φ & larger, fy = 414 MPa or GRADE 60

3.4 Load Computations

3.4.1 Uniform Load

The CHBs dead loads are applied on structural members of the proposed structure, specifically to beams.

Table 3.4.1.a Dead Load (Uniform Force) acting on Beams

Converted Uniform weight of CHB wall (tributary height x CHB wall weight)		
Firewalls on both sides	(5.9/2)(3.11) + (2.4/3/)(3.11)	**11.6625 kN/m**
LOWER BEAM – Rear wall and front wall	(4.2/2)(3.11) + (1.7/2)(3.11)	**9.1745 kN/m**
UPPER BEAM – Rear wall and front wall	(1.7/2)(3.11)	**2.6435kN/m**
Canteen	(4/2)(3.11)	**6.22 kN/m**

3.4.2 Floor Load

Table 3.4.2.a Total Dead Load acting as Floor Load (Applied on Roof of the Structure and Canteen)

Converted Uniform weight of CHB wall	
Ceiling	**0.10 kPa**
Mechanical, Electrical, Plumbing, and Fire Protection (MEPFS)	**0.10 kPa**
Roof (Purlins, Rafters & Roofing Sheets)	**1 kPa**
Allowance Roof Dead Load	**0.5 kPa**
TOTAL	**1.7 kPa**

3.5 Load Combinations

The following provisions from NSCP 2015 Chapter 2 Page 11 were used for the structural analysis of the proposed multi-purpose hall.

Table 3.5.1 Basic load combinations for USD and LRFD

a. 1.2 DL + 1.6 LL + 0.5 RL (Section 203-2)
b. 1.2 DL + 1.6 RL + f1 LL (Section 203-3)
c. 1.2 DL + 1.6 RL + f1 WLX (Section 203-3)
d. 1.2 DL + 1.6 RL + f1 (-WLX) (Section 203-3)
e. 1.2 DL + 1.6 RL + f1 WLZ (Section 203-3)
f. 1.2 DL + 1.6 RL + f1 (-WLZ) (Section 203-3)
i. 1.2D+1.0WLX+f1L+0.5LR (Section 203-4)
j. 1.2D+1.0(-WLX)+f1L+0.5LR (Section 203-4)
k. 1.2D+1.0WLZ+f1L+0.5LR (Section 203-4)
l. 1.2D+1.0(-WLZ)+f1L+0.5LR (Section 203-4)
g. 1.2 DL + 1.0 EX + fi LL (Section 203-5)
h. 1.2 DL + 1.0 EZ + f1 LL (Section 203-5)

Note: f1 = 1.0 for places of public assembly live loads in excess of 4.79 kPa, and parking garages; and 0.5 for other live loads

The load combinations above would be utilized to estimate the worst-case loading for members.

3.6 Structural Report

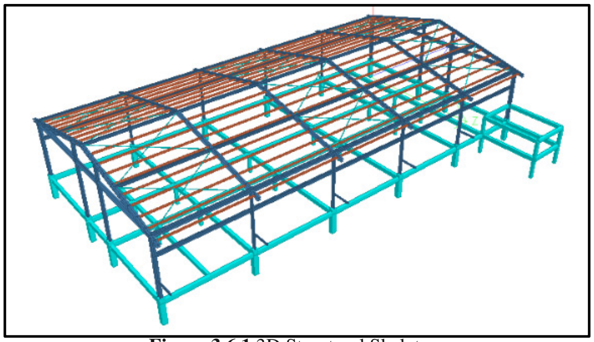


Figure 3.6.1 3D Structural Skeleton

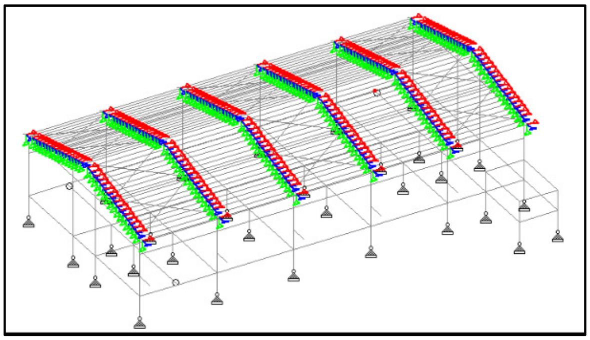


Figure 3.6.2 3D Structural Skeleton

3.7 Earthquake Base Shear Result

3.7.1 As Reinforce Concrete Structure

```
**********************************************************
*                                                        *
*  X  DIRECTION : Ta =  0.417 Tb =  0.279 Tuser =  0.000 *
*  T =  0.279, LOAD FACTOR =  1.000                      *
* UBC TYPE = 97                                          *
* UBC FACTOR V = 0.1941 x      5122.01 =     994.27 KN   *
*                                                        *
**********************************************************
```

Figure 3.7.1.a Base Shear Result along X Direction

```
**********************************************************
*                                                        *
*  Z  DIRECTION : Ta =  0.417 Tb =  0.210 Tuser =  0.000 *
*  T =  0.210, LOAD FACTOR =  1.000                      *
* UBC TYPE = 97                                          *
* UBC FACTOR V = 0.1941 x      5122.01 =     994.27 KN   *
*                                                        *
**********************************************************
```

Figure 3.7.2.a Base Shear Result along Z Direction

3.7.2 As Steel Structure

```
**********************************************************
*                                                        *
*  X  DIRECTION : Ta =  0.487 Tb =  0.279 Tuser =  0.000 *
*  T =  0.279, LOAD FACTOR =  1.000                      *
* UBC TYPE = 97                                          *
* UBC FACTOR V = 0.2063 x      5122.01 =    1056.42 KN   *
*                                                        *
**********************************************************
```

Figure 3.7.2.a Base Shear Result along X Direction

```
**********************************************************
*                                                        *
*  Z  DIRECTION : Ta =  0.487 Tb =  0.210 Tuser =  0.000 *
*  T =  0.210, LOAD FACTOR =  1.000                      *
* UBC TYPE = 97                                          *
* UBC FACTOR V = 0.2063 x      5122.01 =    1056.42 KN   *
*                                                        *
**********************************************************
```

Figure 3.7.2.b Base Shear Result along Z Direction

The base shear is the calculation of the maximum lateral force that is anticipated to be applied to a structure's base due to ground motion during an earthquake. The base shear will be distributed per floor level of the structure. It is determined using the lateral force formulae for the seismic zone, soil type, and building code. As shown in the analysis of the proposed structure, in comparison to steel or concrete structure. The proposed structure must be assumed as a steel structure for it must carry an earthquake base shear of 1056.42 kN compared to a reinforced concrete structure with 994.27 kN in both x and z directions.

3.8 Beam Displacement Summary

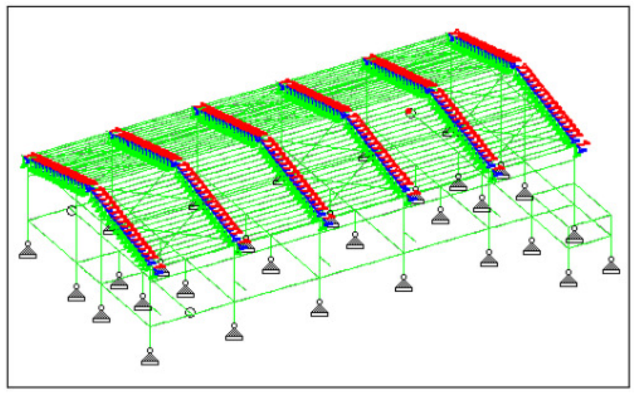


Figure 3.8.1 Critical Nodal Displacement Location

All Summary

			Horizontal	Vertical	Horizontal	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	144	6 WL X	**7.850**	0.015	-0.300	7.856	-0.000	0.000	-0.000
Min X	19	19 J. 1.2 DL	**-6.659**	-0.138	0.112	6.662	0.000	0.000	0.000
Max Y	20	8 WL +Z	0.085	**0.739**	5.937	5.984	-0.000	0.000	0.000
Min Y	198	21 L. 1.2 DL	-0.631	**-7.711**	-5.131	9.283	0.001	-0.000	-0.000
Max Z	19	20 K. 1.2 DL	-1.134	-0.142	**6.311**	6.413	-0.000	0.000	0.001
Min Z	19	9 WL -Z	-0.088	0.003	**-7.390**	7.391	0.000	-0.000	-0.000
Max rX	564	9 WL -Z	0.038	-0.007	-4.706	4.706	**0.003**	0.000	-0.000
Min rX	260	21 L. 1.2 DL	0.000	0.000	0.000	0.000	**-0.003**	-0.000	0.000
Max rY	687	22 G.1.2 DL	0.000	0.000	-0.000	0.000	0.001	**0.002**	0.000
Min rY	682	22 G.1.2 DL	0.000	0.000	0.000	0.000	-0.001	**-0.001**	0.000
Max rZ	570	19 J. 1.2 DL	-2.531	-0.393	-0.070	2.562	-0.000	0.000	**0.005**
Min rZ	28	19 J. 1.2 DL	-0.068	-0.250	0.000	0.259	-0.001	0.000	**-0.004**
Max Rs	198	21 L. 1.2 DL	-0.631	-7.711	-5.131	**9.283**	0.001	-0.000	-0.000

Figure 3.8.2 Nodal Displacement Summary

Figure 3.8.1 and Figure 3.8.2 describe the maximum possible nodal displacement under different loading conditions. The results show that the maximum nodal displacement happened due to a load combination 1.2DL+1.0(-WLZ)+0.5LL+0.5RL and it is located at node number 198 with a computed resultant of 7.711 millimetres.

3.9 Support Reactions Summary

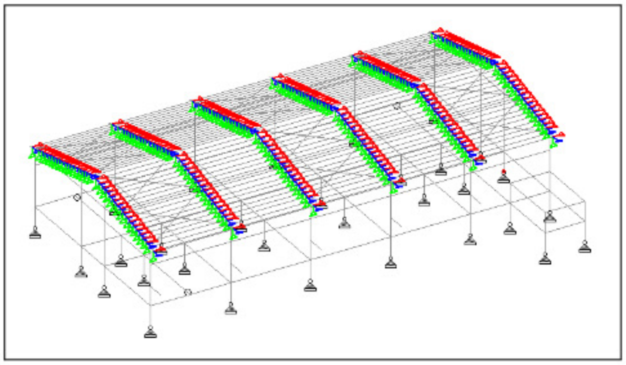


Figure 3.9.1 Maximum Support Reaction Location

			Horizontal	Vertical	Horizontal	Moment		
	Node	L/C	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	155	19 J. 1.2 DL	18.757	140.329	-4.818	0.000	0.000	0.000
Min Fx	150	18 I.1.2 DL	-27.857	94.592	1.117	0.000	0.000	0.000
Max Fy	153	18 I.1.2 DL	-12.225	198.546	-0.962	0.000	0.000	0.000
Min Fy	6	2 EZ	0.239	-8.476	-0.779	0.000	0.000	0.000
Max Fz	1	9 WL -Z	-0.082	3.652	38.085	0.000	0.000	0.000
Min Fz	1	20 K. 1.2 DL	0.546	117.625	-33.407	0.000	0.000	0.000
Max Mx	1	1 EX	-0.611	2.742	-1.350	0.000	0.000	0.000
Min Mx	1	1 EX	-0.611	2.742	-1.350	0.000	0.000	0.000
Max My	1	1 EX	-0.611	2.742	-1.350	0.000	0.000	0.000
Min My	1	1 EX	-0.611	2.742	-1.350	0.000	0.000	0.000
Max Mz	1	1 EX	-0.611	2.742	-1.350	0.000	0.000	0.000
Min Mz	1	1 EX	-0.611	2.742	-1.350	0.000	0.000	0.000

Figure 3.9.2 Summary Support Reactions

This figure shows that the maximum vertical force (Max Fy) is located at node 153 happened due to a load combination of 1.2DL +1.0WLZ + 0.5 LL + 0.5RL, the result indicates that the value for Max Fy is equal to 198.546 kN.

3.10Beam Stresses Summary

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	244	21 L. 1.2 DL	651	414.102	-52.696	-1.279	0.018	0.009	0.097
Min Fx	1053	23 H. 1.2 D	645	-318.073	92.842	2.289	0.013	-0.382	15.279
Max Fy	72	22 G.1.2 DL	79	0.000	157.338	0.000	-0.000	-0.000	210.743
Min Fy	141	19 J. 1.2 DL	106	-0.000	-156.882	-0.000	-0.000	-0.000	209.303
Max Fz	246	22 G.1.2 DL	173	168.809	68.361	85.577	-0.238	-39.107	32.085
Min Fz	240	22 G.1.2 DL	178	145.673	51.757	-64.527	0.208	33.912	27.820
Max Mx	254	20 K. 1.2 DL	142	0.000	22.499	-0.000	3.751	-0.000	11.790
Min Mx	171	21 L. 1.2 DL	123	0.000	7.160	0.000	-2.010	-0.000	11.476
Max My	222	19 J. 1.2 DL	178	53.205	3.577	-55.451	-0.008	82.174	22.497
Min My	25	22 G.1.2 DL	28	46.044	6.284	80.667	0.006	-84.177	23.491
Max Mz	72	22 G.1.2 DL	79	0.000	157.338	0.000	-0.000	-0.000	210.743
Min Mz	215	21 L. 1.2 DL	169	117.268	-37.440	-3.231	-0.001	3.942	-93.452

Figure 3.10.1 Summary Beam Stresses

The Figure 3.10.1 Summary Support Stresses is a table generated using STAAD software, the data shown in the table are a summary of different maximum and minimum values of stresses and their node location under various types of load combinations.

3.11Stress Diagrams (Combined Shear and Moment Diagram)

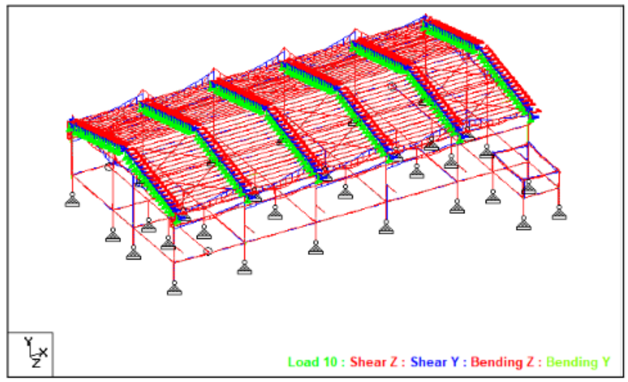


Figure 3.11.1 STRESS DIAGRAM DL + LL

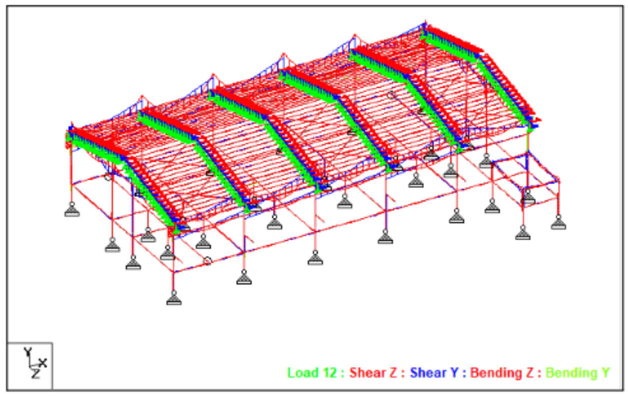


Figure 3.11.2 STRESS DIAGRAM 1.2 DL + 1.6 LL +0.5RL (Section 203-2)

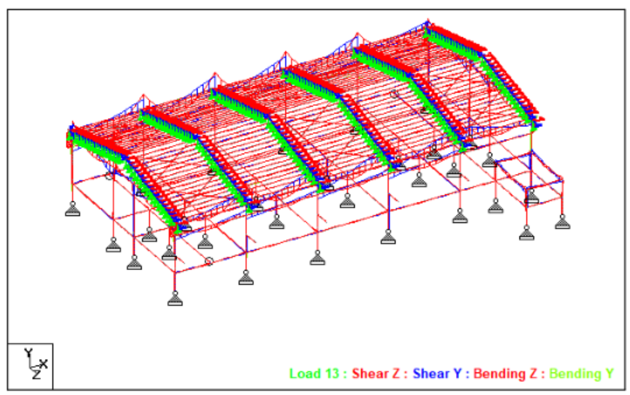


Figure 3.11.3 STRESS DIAGRAM 1.2 DL + 1.6 RL + f1 LL (Section 203-3)

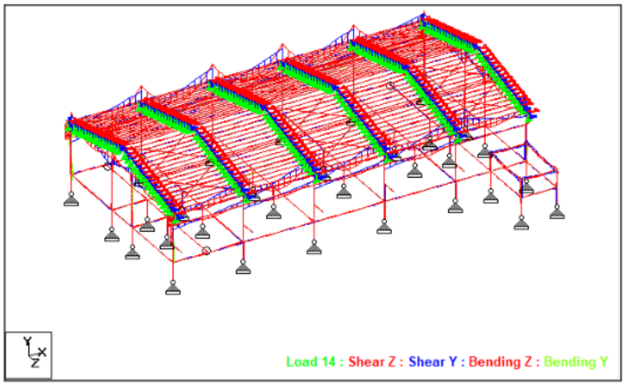


Figure 3.11.4 STRESS DIAGRAM 1.2 DL + 1.6 RL + f1 WLX (Section 203-3)

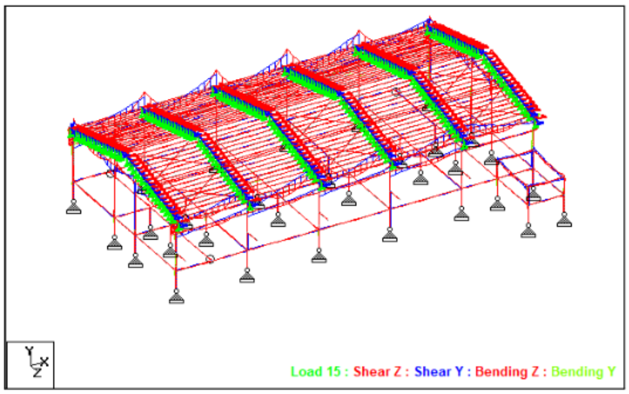


Figure 3.11.5 STRESS DIAGRAM 1.2 DL + 1.6 RL + f1 –WLX (Section 203-3)

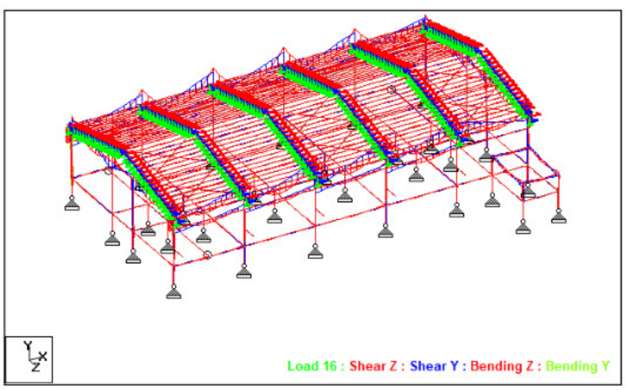


Figure 3.11.6 STRESS DIAGRAM 1.2 DL + 1.6 RL + f1 WLZ (Section 203-3)

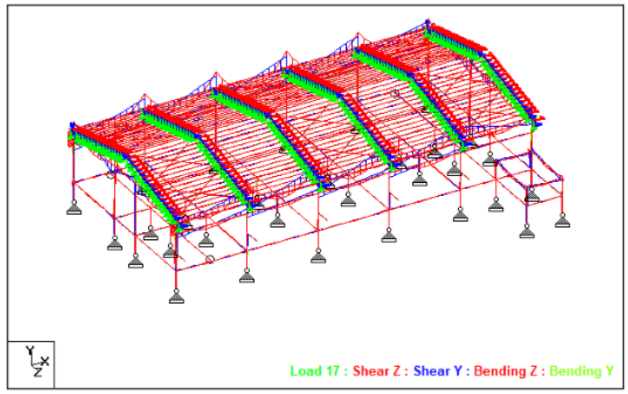


Figure 3.11.7 STRESS DIAGRAM 1.2 DL + 1.6 RL + f1 -WLZ (Section 203-3)

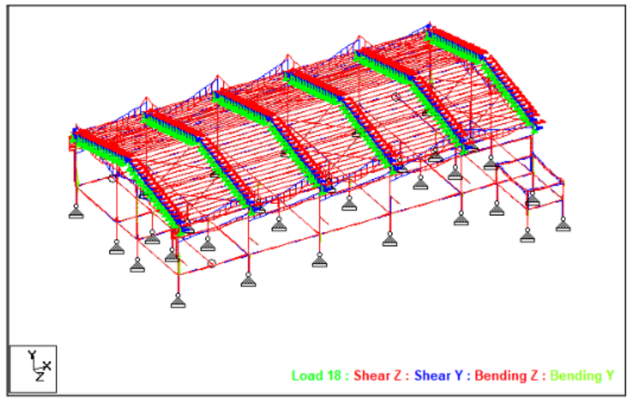


Figure 3.11.8 STRESS DIAGRAM 1.2D+1.0WLX+ 0.5LL+0.5LR (Section 203-4)

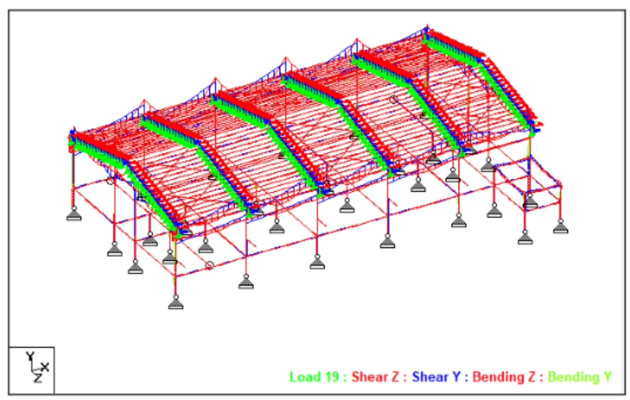


Figure 3.11.9 STRESS DIAGRAM 1.2D+1.0-WLX+ 0.5LL+0.5LR (Section 203-4)

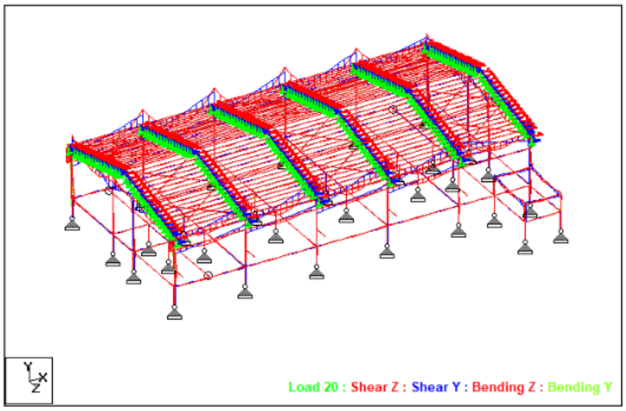


Figure 3.11.10 STRESS DIAGRAM 1.2D+1.0WLZ+ 0.5LL+0.5LR (Section 203-4)

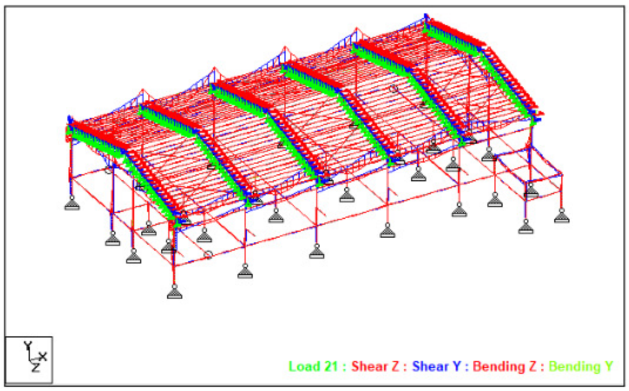


Figure 3.11.11 STRESS DIAGRAM 1.2D+1.0-WLZ+ 0.5LL+0.5LR (Section 203-4)

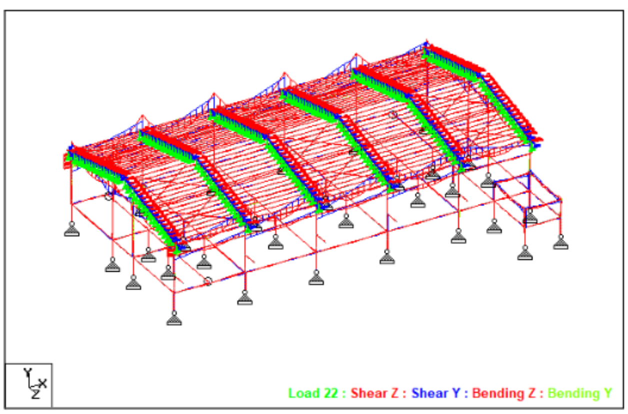


Figure 3.11.12 STRESS DIAGRAM 1.2 DL + 1.0 EX + 0.5 LL (Section 203-5)

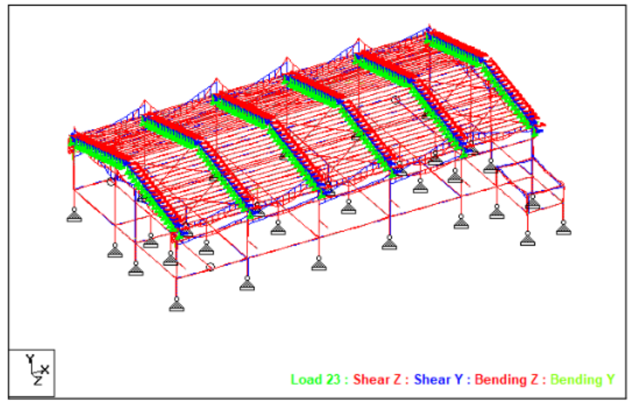


Figure 3.11.13 STRESS DIAGRAM 1.2 DL + 1.0 EZ + 0.5 LL (Section 203-5)

3.12 Load Application

For a building to serve its purpose effectively (i.e., to be safe and serviceable throughout its use), it must withstand several external risks and forces. These risks and forces are defined by the loads that a building must be able to withstand. The National Structural Code of the Philippines 2015 (NSCP2015) gives all the provisions that must be taken into account while developing the proposed multi-purpose hall.

3.12.1 Dead Load, Live Load, and Roof Load

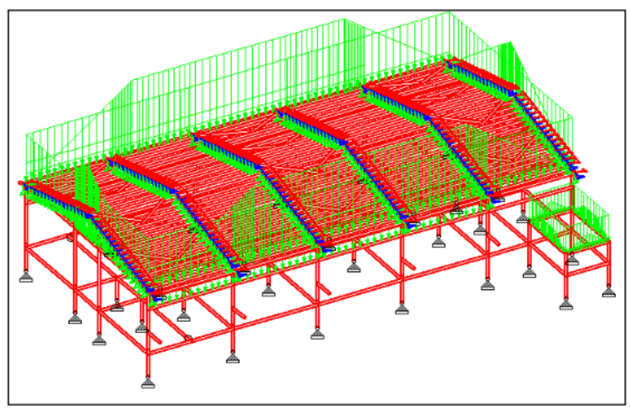


Figure 3.12.1.a 1.2 DL + 1.6 LL + 0.5 RL (Section 203-2) as Load Combination

3.12.2 Wind Load at Positive X-Direction

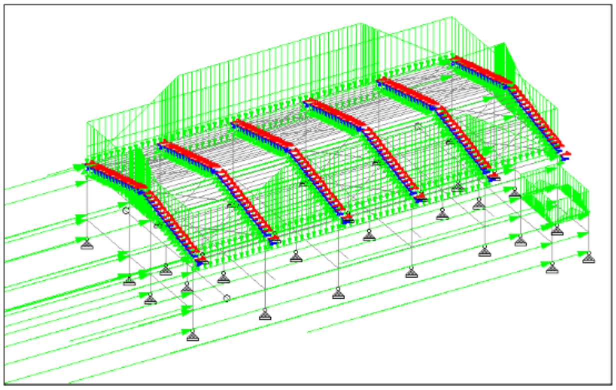


Figure 3.12.2.a 1.2 DL + 1.6 RL + f1 WLX (Section 203-3) as Load Combination

3.12.3 Wind Load at Negative X-Direction

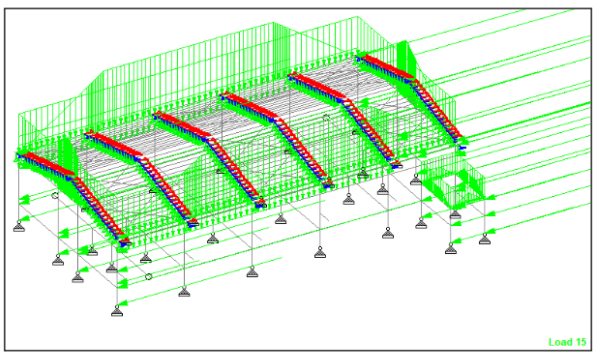


Figure 3.12.3.a 1.2 DL + 1.6 RL + f1 -WLX (Section 203-3) as Load Combination

3.12.4 Wind Load at Positive Z-Direction

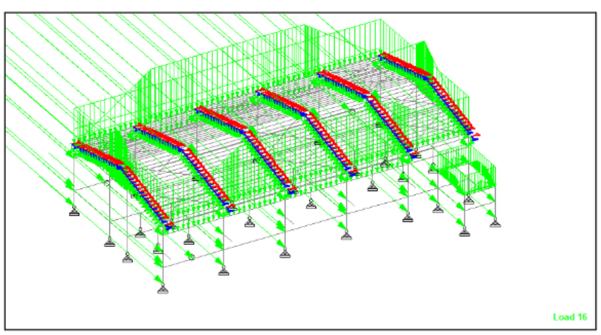


***Figure 3.12.4.a** 1.2 DL + 1.6 RL + f1 WLZ (Section 203-3) as Load Combination*

3.12.5 Wind Load at Negative Z-Direction

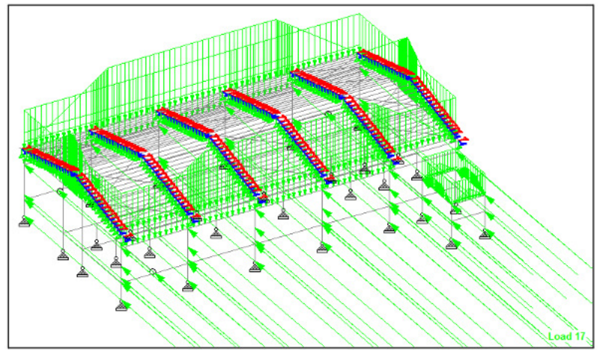


Figure 3.12.5.a 1.2 DL + 1.6 RL + f1 -WLZ (Section 203-3) as Load Combination

3.12.6 Seismic Load at X-Direction

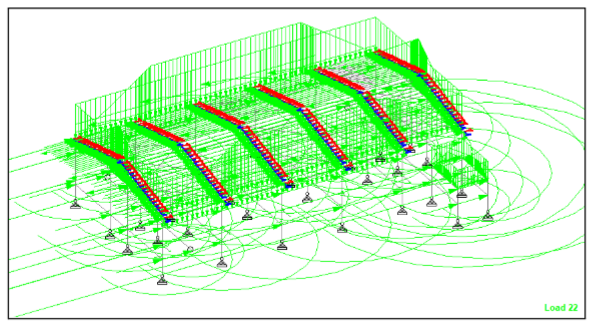


Figure 3.12.6 .a 1.2DL + 1.0 EX + fi LL (Section 203-5) as Load Combination

3.12.7 Seismic Load at Z-Direction

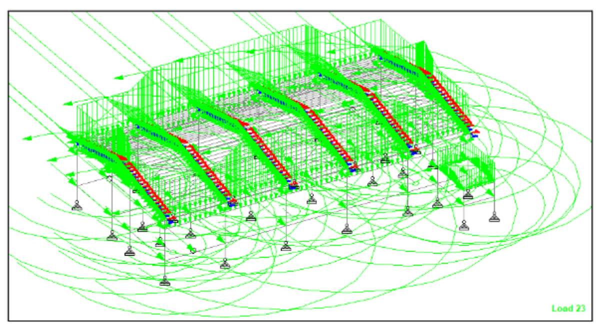


Figure 3.12.7.a 1.2 DL + 1.0 EZ + fi LL (Section 203-5) as Load Combination

3.13Results and Design of Structural Members

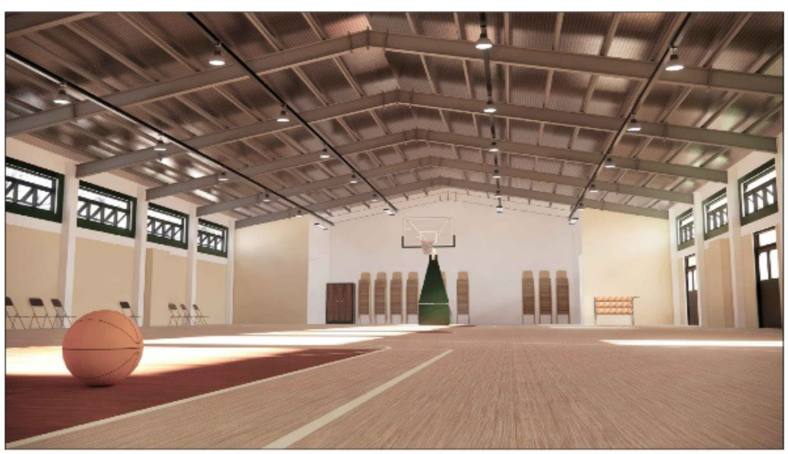
Results from STAAD are used in Designing structural members and schedules. These Schedules will be used in the structural plan of the proposed multi-purpose hall.

The Steel utilization ratio is calculated by the software by the actual member performance by internal pressures over allowable member capacity. Utilization ratios greater than 1 indicate that a member does not meet the criteria of the steel code, and these member sections should be adjusted.

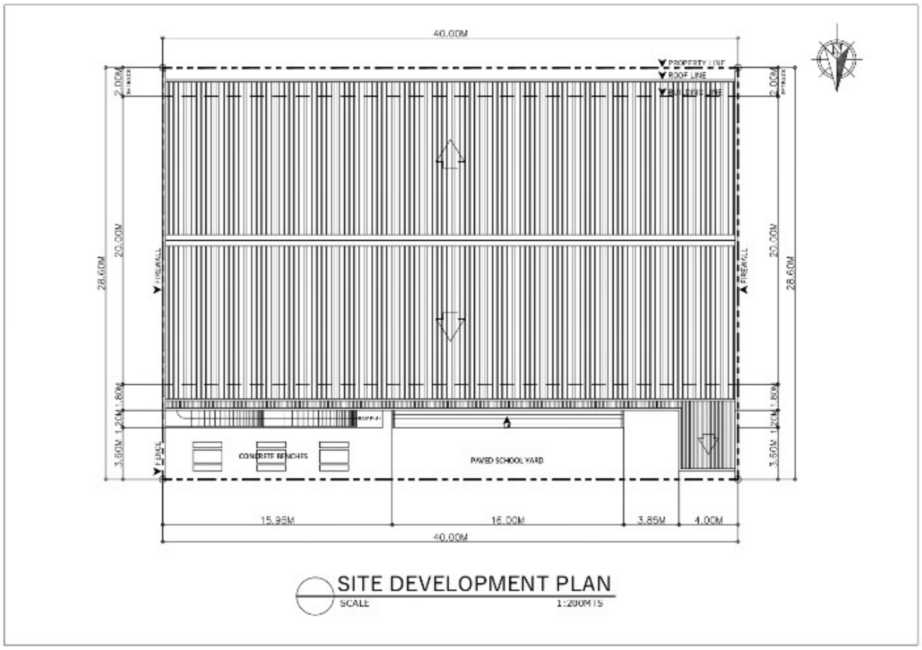
VICINITY MAP
NOT TO SCALE

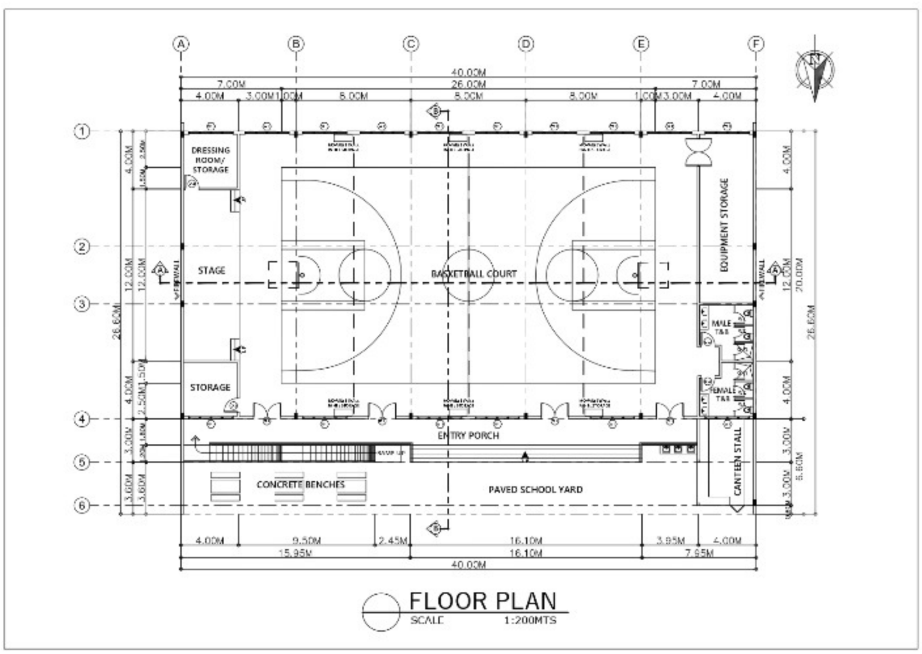

EXTERIOR PERSPECTIVE
NOT TO SCALE

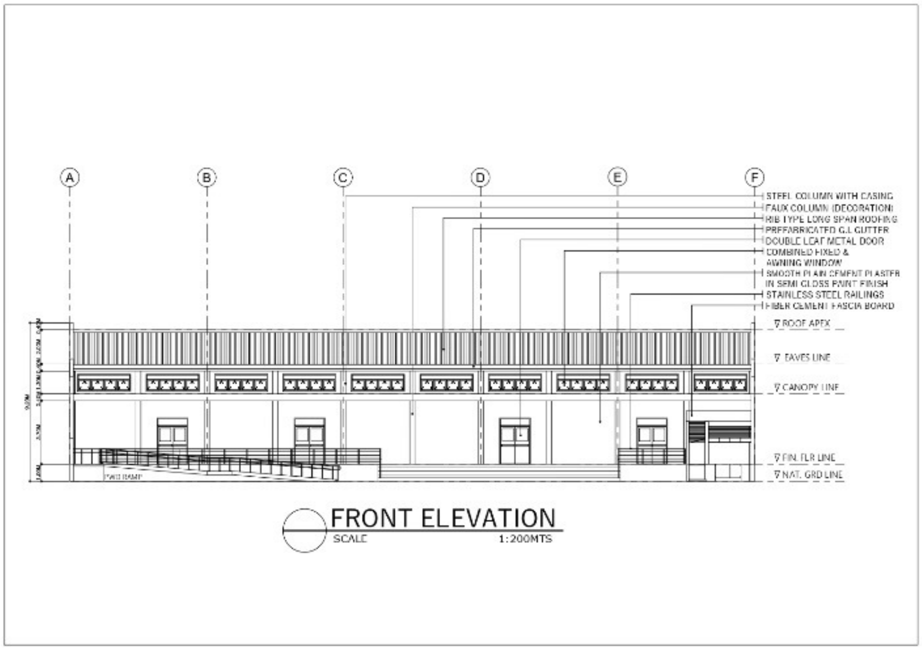
EXTERIOR PERSPECTIVE

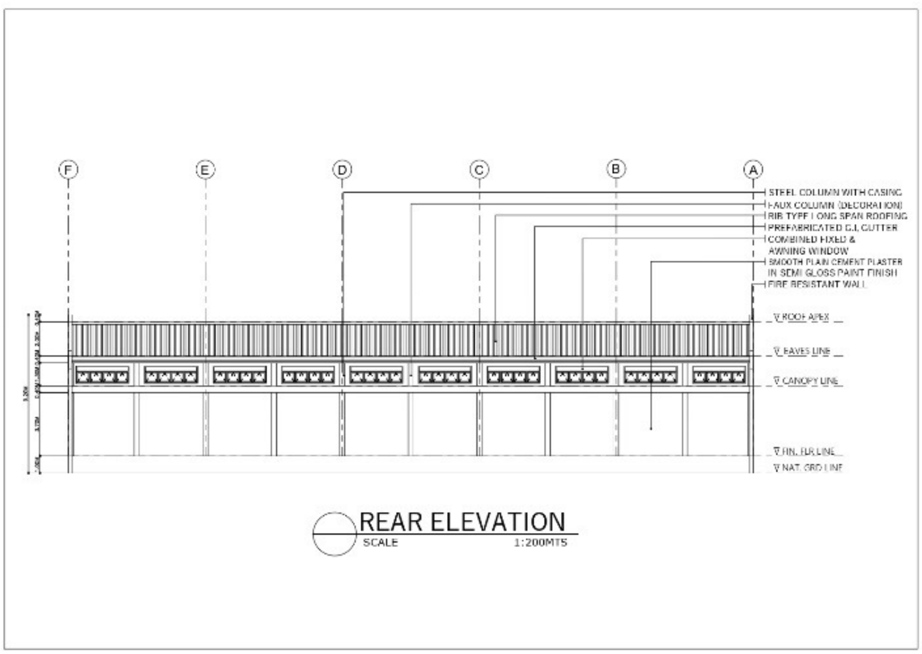


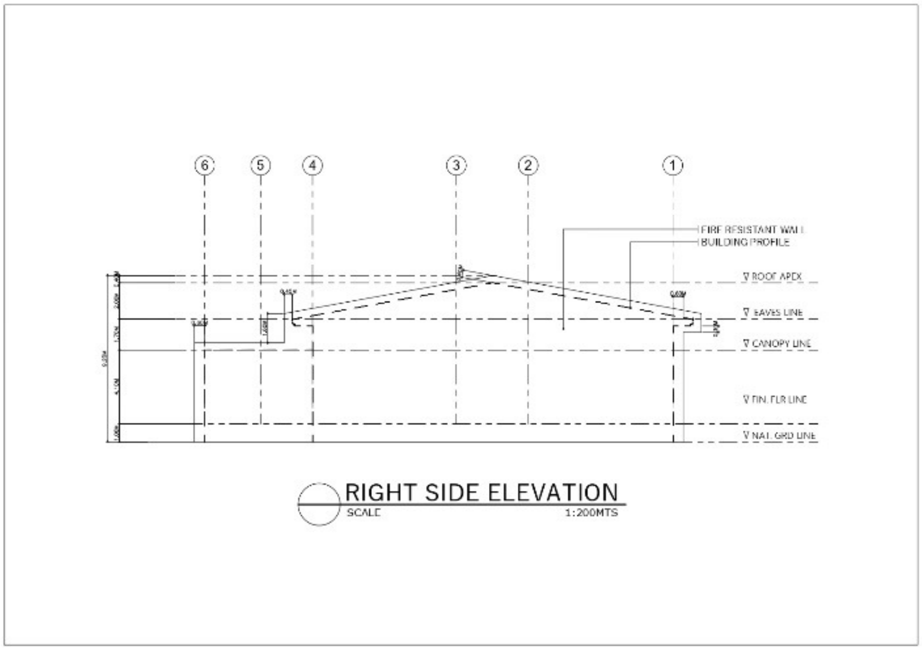
INTERIOR PERSPECTIVE

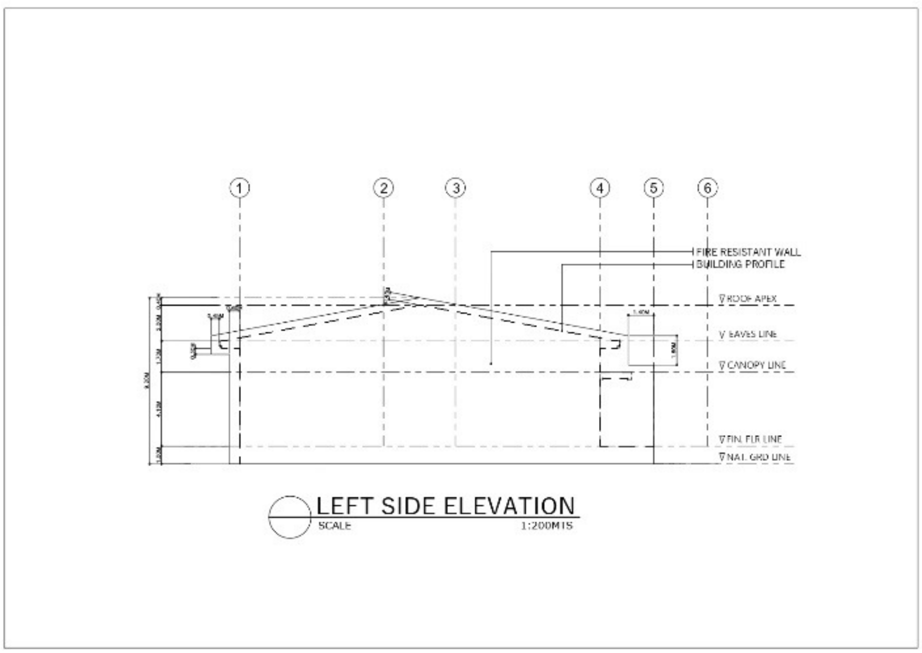

40.00M
PROPERTY LINE
ROOF LINE
2.00M
20.00M
28.60M
FIREWALL
3.50M
CONCRETE BENCHES
PAVED SCHOOL YARD
15.95M
16.00M
3.85M
4.00M
SITE DEVELOPMENT PLAN
SCALE
1:200MTS

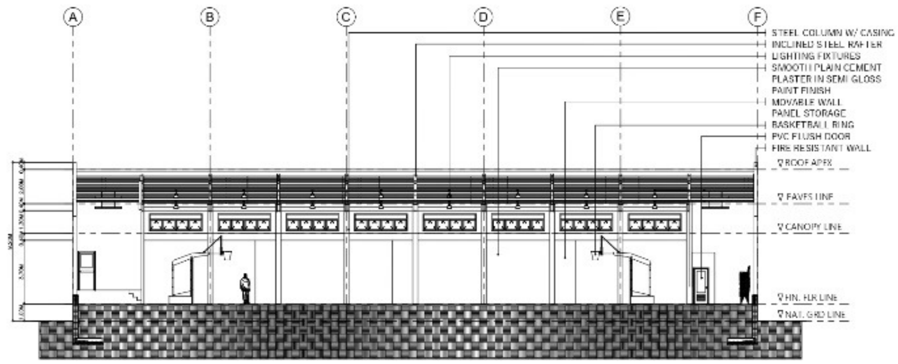

40.00M
26.00M
7.00M
4.00M
3.00M
1.00M
8.00M
DRESSING ROOM/ STORAGE
STAGE
BASKETBALL COURT
EQUIPMENT STORAGE
MALE T&B
FEMALE T&B
STORAGE
ENTRY PORCH
CONCRETE BENCHES
PAVED SCHOOL YARD
CANTEEN STALL
12.00M
20.00M
28.60M
9.50M
2.45M
16.10M
3.85M
15.95M
7.95M
FLOOR PLAN
SCALE
1:200MTS


A
B
C
D
E
F
STEEL COLUMN WITH CASING
FAUX COLUMN (DECORATION)
RIB TYPE LONG SPAN ROOFING
PREFABRICATED G.I. GUTTER
DOUBLE LEAF METAL DOOR
COMBINED FIXED & AWNING WINDOW
SMOOTH PLAIN CEMENT PLASTER IN SEMI GLOSS PAINT FINISH
STAINLESS STEEL RAILINGS
FIBER CEMENT FASCIA BOARD
ROOF APEX
EAVES LINE
CANOPY LINE
FIN. FLR LINE
NAT. GRD LINE
FRONT ELEVATION
SCALE 1:200MTS

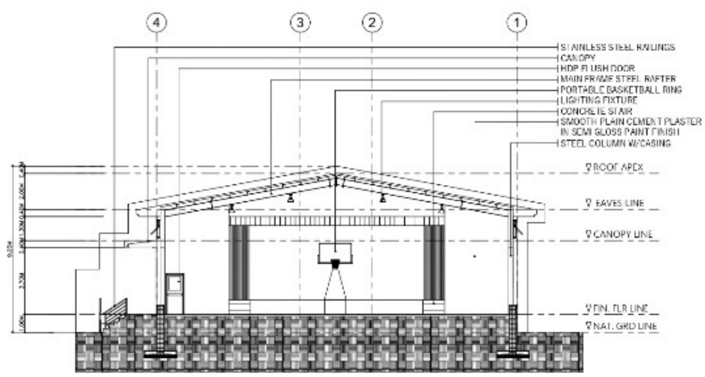

F
E
D
C
B
A
STEEL COLUMN WITH CASING
FAUX COLUMN (DECORATION)
RIB TYPE LONG SPAN ROOFING
PREFABRICATED G.I. GUTTER
COMBINED FIXED & AWNING WINDOW
SMOOTH PLAIN CEMENT PLASTER IN SEMI GLOSS PAINT FINISH
FIRE RESISTANT WALL
ROOF APEX
EAVES LINE
CANOPY LINE
FIN. FLR LINE
NAT. GRD LINE
REAR ELEVATION
SCALE 1:200MTS


FIRE RESISTANT WALL
BUILDING PROFILE
ROOF APEX
EAVES LINE
CANOPY LINE
FIN. FLR LINE
NAT. GRD LINE
RIGHT SIDE ELEVATION
SCALE
1:200MTS

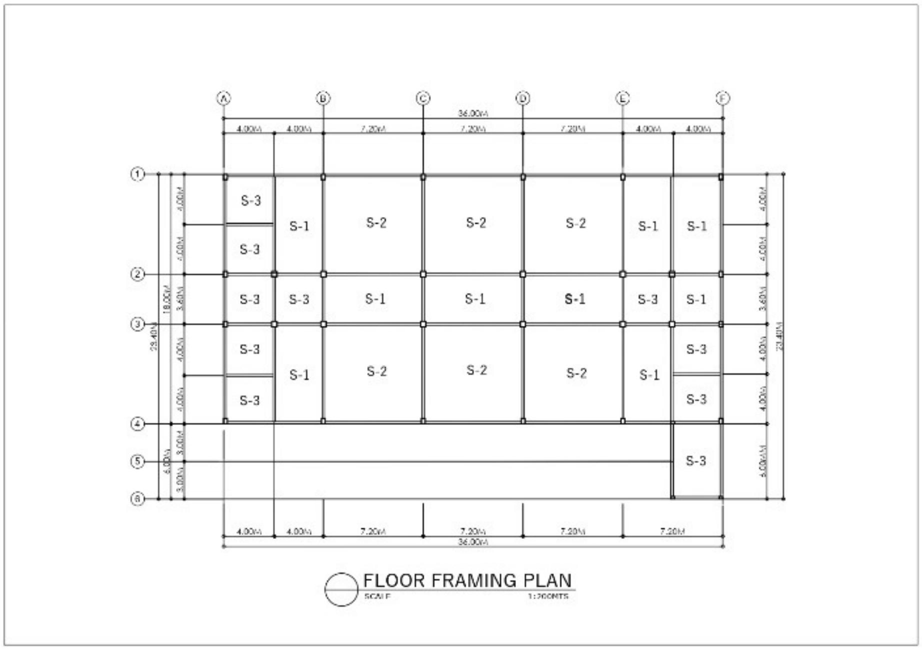

FIRE RESISTANT WALL
BUILDING PROFILE
ROOF APEX
EAVES LINE
CANOPY LINE
FIN. FLR LINE
NAT. GRD LINE
LEFT SIDE ELEVATION
SCALE
1:200MTS

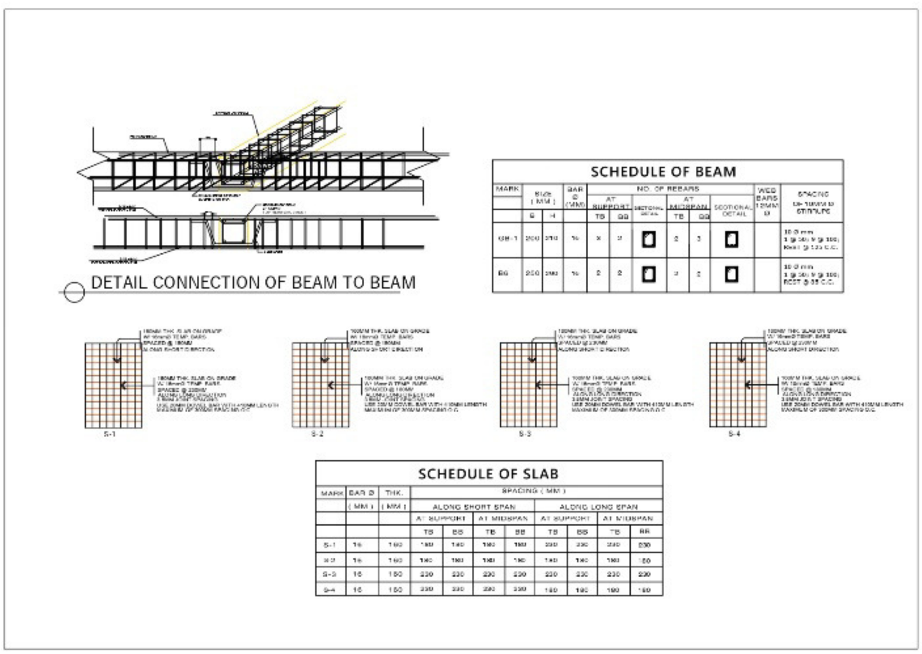


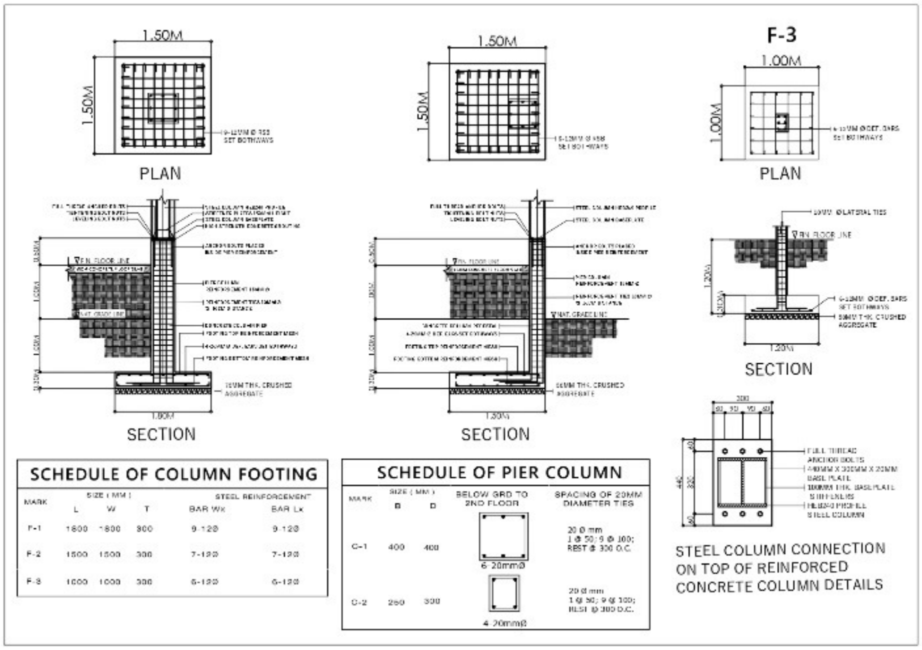
LONGITUDINAL SECTION THRU A
SCALE 1:200MTS

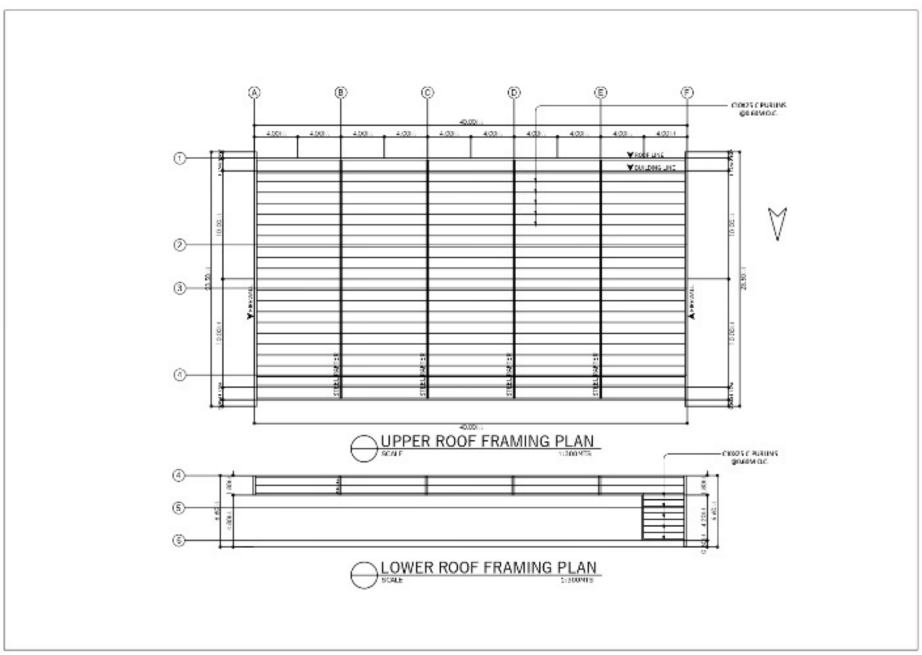


CROSS SECTION THRU B
SCALE 1:200MTS


FLOOR FRAMING PLAN
SCALE 1:200NTS
36.00M
4.00M
7.20M
S-1
S-2
S-3
23.40M


DETAIL CONNECTION OF BEAM TO BEAM
SCHEDULE OF BEAM
MARK
SIZE (MM)
NO. OF REBARS
AT SUPPORT
AT MIDSPAN
SECTIONAL DETAIL
WEB BARS
SPACING
S-1
S-2
S-3
S-4
SCHEDULE OF SLAB
MARK
BAR Ø (MM)
THK. (MM)
SPACING (MM)
ALONG SHORT SPAN
ALONG LONG SPAN
AT SUPPORT
AT MIDSPAN
TB
BB


F-3
1.50M
1.50M
1.00M
1.00M
PLAN
PLAN
PLAN
SECTION
SECTION
SECTION
SCHEDULE OF COLUMN FOOTING
MARK
SIZE (MM)
L W T
STEEL REINFORCEMENT
BAR Wx
BAR Lx
F-1 1800 1800 300 9-12Ø 9-12Ø
F-2 1500 1500 300 7-12Ø 7-12Ø
F-3 1000 1000 300 6-12Ø 6-12Ø
SCHEDULE OF PIER COLUMN
MARK
SIZE (MM)
B D
BELOW GRD TO 2ND FLOOR
SPACING OF 20MM DIAMETER TIES
C-1 400 400
6-20mmØ
20 Ø mm
1 @ 50; 9 @ 100;
REST @ 300 O.C.
C-2 250 300
4-20mmØ
20 Ø mm
1 @ 50; 9 @ 100;
REST @ 300 O.C.
STEEL COLUMN CONNECTION
ON TOP OF REINFORCED
CONCRETE COLUMN DETAILS


UPPER ROOF FRAMING PLAN
LOWER ROOF FRAMING PLAN

3.13.1 Purlins

Table 3.13.1.a Results and Design of Purlins

DESIGNATION	Spacing	Deflection	
		allowable	actual
C10x25	600mm	33.33mm	2.206mm

3.13.2 Rafter

Table 3.13.2.a Results and Design of Rafter

DESIGNATION		UTIL. RATIO	AXIAL FORCE (kN)	
			ACTUAL	CAPACITY
B1 - RAFTER	W10X45	0.798	420.531KN	1,795.60 KN

3.13.3 Steel Structural Beams

Table 3.13.3.a Results and Design of Structural Steel Beam

DESIGNATION		UTILI. RATIO	MOMENT (kN-m)		SHEAR (kN)		DEFLECTION ALONG Y (mm)	
			ACT	CAP	ACT	CAP	ACT	ALLOW (L/360)
B2 - ROOF BEAM	W8X24	0.064	3.17	84.59	2.08	167.15	0.189	22.22
B3 - ROOF BEAM	W10X68	0.774	210.65	312.48	157.26	398.06	14.352	22.22
B4 - WALL BEAM	W10X33	0.748	70.51	141.96	50.89	246.75	8.073	22.22
B5 - CANTILEVER	W4X13	0.017	0.379	22.99	0.411	93.60	1.758	5

3.13.4 Steel Structural Columns

Table 3.13.4.a Results and Design of Structural Steel Column

DESIGNATION		UTIL. RATIO	AXIAL FORCE (kN)	
			ACTUAL	CAPACITY
C1 - CORNER COLUMN	W10X68	0.781	123.260	539.17
C2 - FRONT AND REAR COLUMN	W10X19	0.731	99.07	990.74
C3 - SIDES COLUMN	W10X33	0.747	177.103	622.84

3.13.5 Welds

Use 148.61mm length welds or perimeter weld, 10mm thick.

3.13.6 Design of Base Plate

Use 350mm x 350mm x 15mm thick base plate.

3.13.7 Design of Anchor Bolts

Use 6-20 mm Anchor Bolts with 150mm hook length and total length of 250mm.

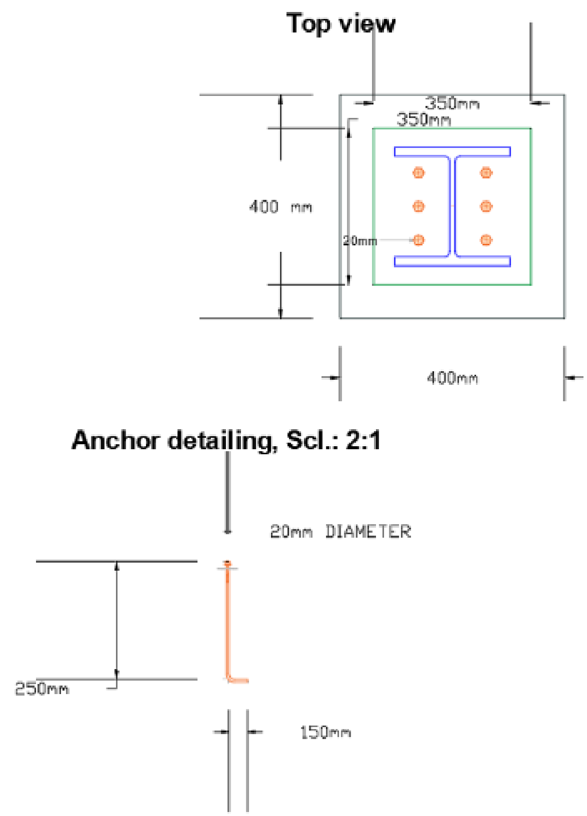


Figure 3.13.7.a Structural Drawing of Anchor Bolts

3.13.8 Schedule of RCC Columns

When developing the reinforced concrete column, axial loads are taken into account.

For columns, a minimum reinforcement ratio is needed to prevent bending, which could happen regardless of the conclusions drawn from the analysis. Additionally, it is necessary to lessen the impact of the concrete's creep and shrinkage under prolonged compressive stresses.

Steel bars resist failing under a sustained service load by the minimum reinforcement ratio in the column. According to ACI 318-19, the minimum longitudinal reinforcement ratio for a column is 0.01 times the column's gross area.

Table 3.13.8.a Schedule of Reinforced Concrete Columns

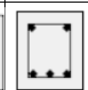
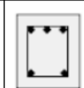
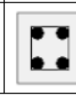
DESIGNATION	AXIAL LOAD (kN)		SIZES	HEIGHT	RSB	SPACING OF LATERAL TIES
	ACT.	CAP.				
C4 - PEDESTAL COLUMN	198.30	1816.47	400mm x 400mm	2.5m	8-16mm	250 mm
C5 - CANTEEN COLUMN	22.56	968.42	250mm x 250mm	4m	4-20mm	300 mm
C6 - FOOTING COLUMN	81.59	745.80	250mm x 250mm	2m	4-16mm	250 mm

3.13.9 Schedule of RCC Beams (see APPENDIX S for Manual Computations)

The beam must be able to withstand tension and compressive loads. The allowable moments that would be used to solve this design are the maximum moments in the structural analysis.

Table 3.13.9.a Schedule of Reinforced Concrete Beams

MARK	ACT. MAX. MOMENT (kN-m)	SIZE (mm)		REINFORCEMENT BARS (16mm diameter bar)				SPACING OF STIRRUPS
		(b)	(D)	SUPPORT		MIDSPAN		
				TOP	BOT	TOP	BOT	
B6 - CANTEEN ROOF	41.730	250	290	3	2	2	3	125 mm c/c
GB1 - GRADE BEAM	15.633	200	210	2	2	2	2	85 mm c/c

MARK	BAR ARRANGEMENT		
	LEFT SUPP.	MIDSPAN	RIGHT SUPP.
B6 - CANTEEN ROOF			
GB1 - GRADE BEAM			

3.13.10 Schedule of Slab

Table 3.13.10.a Schedule of Slab

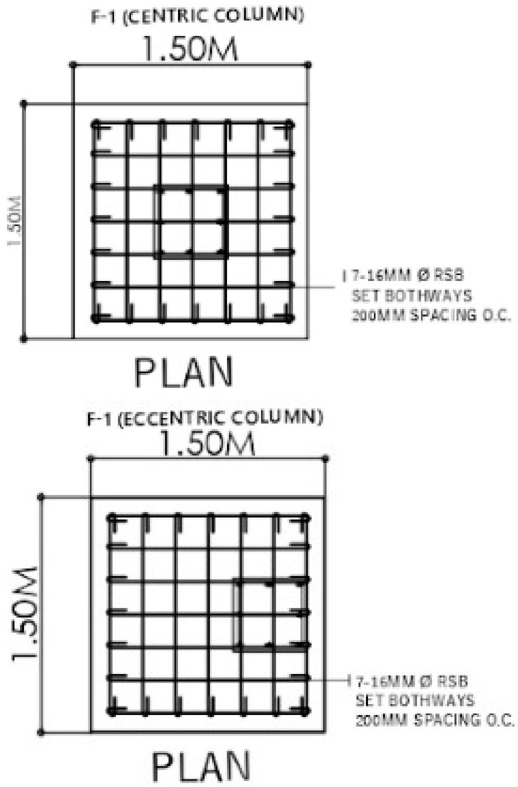
MARK	BAR DIA. (mm)	THK. (mm)	SPACING							
			ALONG SHORT SPAN				ALONG LONG SPAN			
			TB	BB	TB	BB	TB	BB	TB	BB
S-1	16	160	180	180	180	180	230	230	230	230
S-2	16	160	180	180	180	180	180	180	180	180
S-3	16	160	230	230	230	230	230	230	230	230
S-4	16	160	230	230	230	230	180	180	180	180

3.13.11 Schedule of Footing

When designing the column footings, live loads and dead loads are used.

Table 3.13.11.a Schedule of Footing

DESIGNATION	LENGTH	WIDTH	HEIGHT	Bar X	Bar Y	REMARKS
F1 - FOOTING 1	1.5m	1.5m	300mm	7-16mm RSB 200mm spacing	7-16mm RSB 200mm spacing	Square Footing
F2 - FOOTING 2	1m	1m	300mm	4-16mm RSB 300mm spacing	4-16mm RSB 300mm spacing	Square Footing



F-2

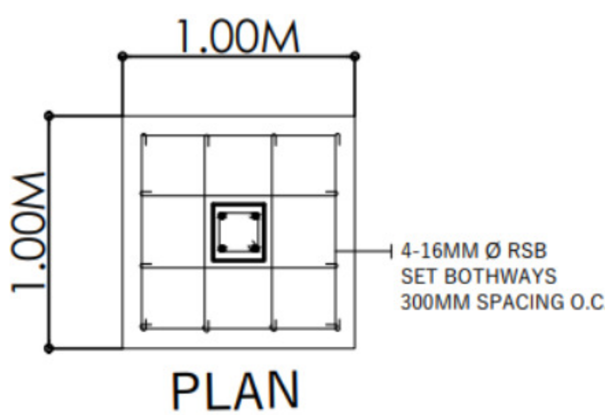


Figure 3.13.11.a Structural Drawing of Footings

3.14 Cost Estimate

PROJECT:	PROPOSED MULTI-PURPOSE HALL IN DELA PAZ ELEMENTARY SCHOOL, LUBAO, PAMPANGA	
CREATED BY:	GROUP 3 - BSCE 4M	
LOCATION:	LUBAO, PAMPANGA	
C O S T E S T I M A T E S U M M A R Y		
1.0	EXCAVATION WORKS/ BACKFILLING	
	1.1 EXCAVATION	846,650.00
	1.2 BACKFILLING	280,000.00
2.0	CONCRETE WORKS & REINFORCEMENT WORKS	
	2.1 BEAMS, COLUMNS & FOOTING	474,346.17
	2.2 SLAB	629,385.41
3.0	MASONRY WORKS AND PLASTERING WORKS	
	EXTERIOR AND INTERIOR WALLS	403,429.05
4.0	STRUCTURAL STEEL WORKS	
	3.1 BEAMS AND COLUMNS	1,676,612.33
	3.2 ROOF	1,156,667.48
	~~Php~~	5,467,090.44

The cost of the construction of the proposed multi-purpose hall is 5,467,090.44. It much cheaper by 78.1802% or 7,017,223php difference than a reinforced concrete construction

IV. DISCUSSION

4.1 Conclusion

Due to the lack of facilities in the De La Paz Elementary School and the inadequate design of the basketball court in barangay De La Paz, the proposed multi-purpose hall is a great solution to cater to these facilities. It will give a much wider and safer space for students to gather and perform various school and extra-curricular activities protected from the heat of the sun or sudden or heavy rains. It will create opportunities for the youth of De La Paz to hone their skills in Basketball. This facility will also be helpful to other barangay-related activities when the existing covered court would not be applicable

Since this proposed multi-purpose was designed as elevated and with partition walls inside, it can serve as a temporary shelter during calamity and disasters.

The goal of the researcher is to create a structure that will benefit not just the school but also the whole barangay. With the continuously growing population of Brgy De La Paz. It will be beneficial in a long-term and holistic approach.

Also, this proposed multi-purpose hall can be adopted by other barangays or schools with the problem of lack of facilities. And for the reason that it follows the guidelines and colours of DepEd, this proposed multi-purpose hall can be picked out by the said department.

The cost estimate of the proposed multi-purpose hall gives us knowledge of the big difference and advantages of using a steel frame structure.

The researchers applied all their knowledge and skill in their field, with the guidance of instructors of DHVSU and other persons related to the field.

The researchers carried out the structural analysis, site inspection, cost estimations, and technical specification preparation in ways that will help future researchers.

4.2 Recommendations

The following recommendations are made by the researchers for potential future researchers and study participants:

1. Steel utilization ratio can be adjusted up to the allowable by the NSCP which is 1.0. The Researcher utilized a steel ratio ranging from 0.6 to 0.8 for a factor of safety, but the allowable is up to 1.0.
2. Future researchers may visit DepEd Office to inquire about the specific facilities to be adopted, for example, the storage rooms of the proposed facilities can be changed based on the recommendation of DepEd.
3. Future researchers may use solar panels to make the structure more emergency-prepared and environment-friendly.
4. Future researchers may design benches with roofs to have protection from the weather.

ACKNOWLEGMENT

First and foremost, the researchers express gratitude to Almighty God for allowing them to complete this thesis study and for providing knowledge and wisdom.

The researchers would like to extend their heartfelt thanks to their two thesis advisers. First, to Engr. Christian P Dizon, for his guidance during the writing of this paper, specifically with the analysis and design of structural members of the proposed structure, and to Ar. John Cyrus M. Ilao has been an excellent consultant in providing advice and encouragement. We are pleased and grateful for the opportunity to work with them.

Immeasurable gratitude also extended to the following individuals for their assistance and support in making the thesis study possible: First, Engr. John Robert D. Gabriel taught the researchers how to use and analyse data on STAAD.Pro V8i and some provisions when using structural steel members which were a big help in this study; Engr. Ma. Luz Q. Manuntag and Engr. Gilmark P. Repulda instructs the data needed to collect to make the study more feasible, and for guiding with the computation of footings; and Engr. Francis Cayanan, and Engr. Ralph Nicole Yalung for serving as our panellists and sharing their knowledge and vital feedback for the improvement of this study. This thesis builds on work done following their recommendations.

We would also like to thank the Dean of the College of Engineering and Architecture, Engr. Jun P. Flores, and Chairperson of Department of Civil

Engineering, Engr. Irene R. Roque for their continuous support.

To the constituents of De La Paz Elementary School and Brgy. De La Paz, thank you for welcoming the researchers and giving the data needed for this study.

And lastly, many thanks to our dear parents for their unconditional, unequivocal, and loving support.

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