

Architectural Plan for A Bi-Level Annex Structure at Kasili Lakeside Resort and Hotel

Solloso, Marlon C.

College of Engineering & Information Technology
Surigao del Norte State University, Surigao City, Philippines
marlonsolloso@yahoo.com

Abstract: *The core focus of civil engineering lies in structural design, with the foundational principle in structural engineering being the creation of elemental components and sections for buildings. An annex building serves as an extension to the main edifice, fulfilling diverse user needs. This study's primary objectives encompass crafting an annex structure capable of rivalling the aesthetic appeal of prominent hotels, engineering resilience against climatic phenomena, addressing lakeside challenges, and assessing compliance with the National Building Code and National Structural Code of the Philippines. The study diligently fulfilled the aesthetic prerequisites set forth by the LGU of Mainit. Accounting for wind, earthquake, dead, and live loads directly impacting the structure, the researcher conducted a comprehensive analysis, leveraging resultant moments to design each structural element. Given the project's location atop an embankment, the researchers conservatively employed the weakest soil pressure to underpin footing design. Rigorous evaluation by industry professionals, aligned with the stipulations of the National Building Code of the Philippines, substantiated the structure's integrity, resulting in official approval.*

Keywords: bi-level, resort, hotel, disaster resistant.

I. INTRODUCTION

Hotels play a pivotal role within the hospitality industry, serving as prominent establishments. The Philippines currently boasts an extensive array of hotels, numbering in the thousands. These hotels not only boast captivating aesthetics but also demonstrate structural stability. To remain competitive amidst the diversity of hotels, the notion of incorporating extensions or constructing annex buildings has gained traction. An annex building serves as a supplementary component to the primary structure, adeptly addressing the diverse requirements of its occupants. Such an annex can either mirror the scale of the primary building or assume a more compact form. It typically encompasses additional rooms, strategically accommodating heightened demand for accommodations. This trend aligns with the evolving landscape of the hospitality sector [1].

Kasili Lakeside Hotel and Resort is strategically positioned along Rizal St., Barangay Quezon, Mainit, Surigao del Norte (Reference 1). Remarkably, it stands as the solitary hotel within this locale, affording it a distinctive advantage of overseeing the tranquil lake. The resort presents itself as an exceptional choice for hosting gatherings, offering a capacious convention hall alongside meticulously designed swimming pools. These pools cater to both adults and children, showcasing enhanced amenities aimed at captivating tourists' attention [2].

In the contemporary construction landscape, an array of construction systems has emerged, presenting the challenge of selecting innovative approaches [3]. Among these methods, concrete framing stands out as a construction system capable of delivering exceptional compressive strength in comparison to alternative building materials [4]. Through the incorporation of reinforcement, concrete framing gains the ability to effectively counteract substantial tensile stress, thereby bolstering its structural integrity [5]. The task of designing and analyzing a structure resilient enough to navigate environmental challenges is a formidable one [6]. In the current era, innovative construction systems have gained prominence, particularly for socialized housing projects or to compete with other emerging structures while maintaining unwavering stability. For instance, the utilization of concrete framing not only streamlines construction processes but also contributes to the reduction of embodied carbon emissions, aligning with sustainable construction practices [7].

In every forthcoming project, a pivotal determinant that could wield considerable influence is the geological context. This encompasses multiple facets, including the foundational soil's stability to ensure the structure's steadfastness and resilience, as well as the precise positioning of the site itself, nestled beside the serene lake. Addressing these variables becomes paramount in conceiving effective strategies, vital to the project's longevity in the face of various environmental occurrences [8, 9].

Furthermore, the aspirations of the entity commissioning the project emerge as an additional critical factor. The complexity is heightened when erecting a structure proximate to a lake, necessitating meticulous consideration due to the inherent challenges posed by the site's weak soil composition and susceptibility to substantial winds. To navigate these intricate dynamics successfully, comprehensive and strategic planning is indispensable [10, 11, 12].

The incorporation of technology as a solution holds promise for enhancing structural analysis, particularly through the utilization of civil engineering software tools [13]. These software applications not only contribute to heightened accuracy in calculations but also streamline the analysis process, thus affording more time and focus on other crucial construction activities. This optimized approach aids in ensuring timely project completion while maintaining elevated standards of stability and quality [14].

In the contemporary era, marked by a technology-driven ethos, engineering software occupies a central role in expediting the analytical phase [15]. A gamut of software options caters to diverse engineering needs – from design software like AutoCAD, facilitating intricate drawings, to project management software such as Primavera, enabling estimation and predictive planning [16]. While the integration of these software solutions is increasingly anticipated among students and practitioners alike, it's noteworthy that traditional methodologies retain their value in tandem with technological innovations.

The LGU-Mainit is actively engaged in a multitude of contemporary projects, among which the Kasili Lakeside Resort and Hotel stands as a prominent economic venture [17]. As part of their comprehensive planning, the LGU-Mainit is meticulously evaluating projects spanning 2019 and 2020, with a pronounced focus on bolstering the resort and hotel's offerings. This strategic endeavor holds the foremost priority, driven by the intent to elevate the establishment's stature in competition with other lodging and leisure establishments across the province [18].

The overarching objective encompasses not only internal enhancement but also the larger aspiration of drawing increased tourist footfall. This concerted effort aims to catalyze economic growth within the municipality, contributing to a heightened economic standing. Through such deliberate initiatives, the LGU-Mainit exemplifies their commitment to holistic progress and sustainable development [19, 20].

II. METHODS

Reinforced Concrete Design involves the incorporation of steel reinforcement into concrete, constituting a vital approach for structurally designing buildings. This method is of paramount significance in formulating the architectural framework of the research study, encompassing facets ranging from slab design to column arrangement, along with the meticulous delineation of dimensions and bar spacing.

Structural Analysis pertains to the assessment of the effects of external loads on physical structures and their constituents. This scrutiny extends to all structures necessitating the endurance of such loads. Its relevance to the study is underscored by its capacity to ascertain potential structural vulnerabilities, facilitating an evaluation of the research study's resilience against both external and internal stresses.

Construction Scheduling is a meticulously recorded procedure that catalogues activities, resource allocation encompassing equipment, materials, and labor, while estimating their completion timelines within the construction process. Its utility to the researcher lies in the adept management and projection of work performance should the project be realized for construction.

Construction Estimate denotes the prognostication of the structure's cost, guiding the determination of expenses, quantities, and requisite labor within the stipulated timeframe. This practice empowers the study's researcher in gauging the project's scope and feasibility, budget allocation, and prediction of the impending structural expenses.

Value Engineering operates as a systematic methodology to augment the worth of products, equipment, and services via a comprehensive examination of their functional attributes and a ratio-based assessment of their costs. This concept

serves as a potent tool for the researcher, facilitating the refinement of project design and enhancing the utility of the product through judicious economic means.

Shown in the Figure 1 below is the flow chart of the study. Guidance in generating the design holds pivotal significance as it forms the bedrock for the structure's behavior. A crucial facet within this endeavor is comprehending the soil profile, particularly its behavior within the lakeside context. Ascertaining this information is vital to grasp the intricacies of lakeside soil dynamics. Augmenting this knowledge, engineering personnel integrate data gleaned from the main building's construction history, shedding light on past challenges and lessons garnered over the years.

Subsequently, preliminary designs come to fruition, meticulously tailored to align with the LGU's prerequisites, intricately catering to the guests' needs. These requisites undergo scrutiny against the National Building Code and National Structural Code of the Philippines. This dual-pronged evaluation ensures adherence to these regulations, concurrently assessing if the preliminary designs are judicious, secure, and economical. Such scrutiny seamlessly dovetails into the overarching objectives of civil engineering, ensuring safety and efficiency in design.

The ultimate product of this comprehensive process is an annex building design, meticulously structured and analytically sound. This robust outcome is a direct result of the integration of insights from governing construction codes, signifying a harmonious marriage between theoretical precision and practical applicability.

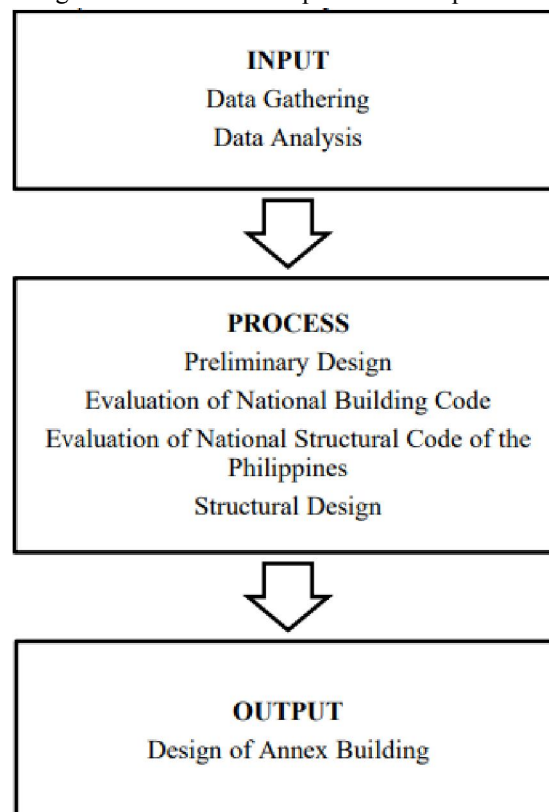


Figure 1.Flowchart of the Study

2.1 Project Setting

The project is situated at Rizal St., Barangay Quezon, Mainit, Surigao del Norte as shown in Figure 2. The existing lawn tennis court of the said hotel will be demolished and be extended and that will serve as a lot having an area of 1104 sq. m. The soon-to-rise structure is surrounded with various existing projects and is really located at the side of the 4th largest lake of the Philippines, which is the Lake Mainit.

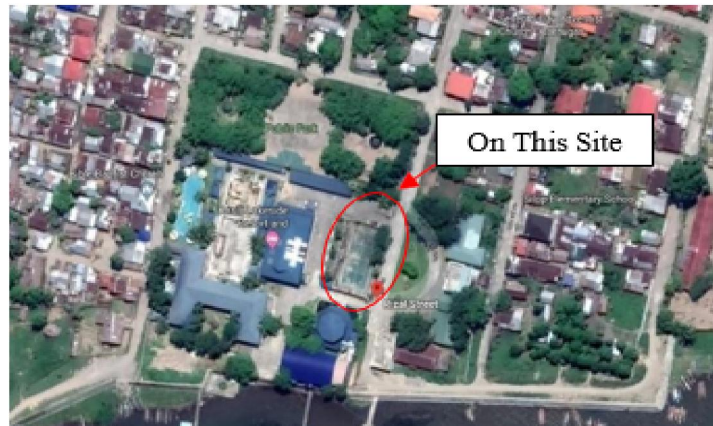


Figure 2.Location of the Project

2.2 Instruments

This study employs a selection of computer software applications as tools for conducting the research.

- *Drafting Software* is a computer-aided program used for creating blueprints encompassing various domains such as architecture, bridges, and computer chips, among others.
- *Graphic Software*, provided by Google, facilitates both 3D and 2D modeling with a reputation for user-friendly functionality. This software finds utility in architectural, film, and game design, transitioning designs from two dimensions to three through a patented method of pushing and pulling.
- *Structural Design Software* stands as one of the globally prevalent structural analysis and design software solutions. It offers a spectrum of analysis methods ranging from traditional static analysis to contemporary techniques such as p-delta analysis, geometric non-linear analysis, Pushover analysis (Static-Non Linear Analysis), and buckling analysis. Additionally, it encompasses diverse dynamic analysis approaches spanning time history analysis to response spectrum analysis.
- *Microsoft Office*, encompassing Microsoft Excel, Microsoft Word, and Microsoft Project, serves as a pivotal tool in facilitating this research. These applications expedite the generation of reports, construction estimates, PERT-CPM analyses, and related tasks, resulting in efficient documentation and data input. Particularly noteworthy, Microsoft Project aids researchers in estimating costs and establishing a comprehensive work breakdown structure. It additionally offers scheduling capabilities, serving as a foundation for tracking construction progress in terms of adherence to schedule timelines.

Illustrated in Figure 3 is the sequential implementation process of the study, meticulously aligned with established engineering protocols. A Notice to Proceed, officially released by the Local Government Unit (LGU) of Mainit, signifies the green light for researchers to advance to the subsequent phase. To delineate the study's scope and execution, the research team, in conjunction with a co-author, engages in comprehensive discussions with the municipal mayor, a crucial precursor before proceeding. This notice assumes pivotal significance as an official documentation, facilitating accurate data acquisition.

The subsequent step involves on-site investigations and meticulous data accumulation. Armed with the Notice to Proceed, the researchers interface with hotel personnel, substantiating the study's formal authorization. The existing main building, erected over a decade ago, undergoes thorough scrutiny, offering insights into the anticipated behavior of the lakeside-located annex building. This phase extends to an inquisitive exploration of the lakeside soil's response to substantial loads, supplemented by the collaboration of the municipal engineer and architect. These professionals furnish technical insights integral to the annex building's design and analysis.

Sequentially, the compilation of local construction requisites ensues, a critical reference for project execution. Collaborating with municipal engineering personnel, researchers acquaint themselves with the mayor's stipulated mandates, as the project area spans a 1104 sq m section within the Kasili Lakeside Resort and Hotel. This space, currently

a tennis court, is earmarked for the envisioned annex building. The structure is envisioned to encompass a convention hall almost akin to the existing one, 24 guest rooms of varying amenities, a rooftop tennis court, and an elevated pool. The design and analysis phase then takes center stage, with plans and specifications necessitating expeditious generation. Leveraging software expedites this process, ensuring adherence to the stipulated study timeline. To enhance precision, civil engineering software supplements the analysis, supported by manual calculations when deemed necessary. Alignment with the National Building Code and National Structural Code of the Philippines safeguards adherence to regulatory requisites.

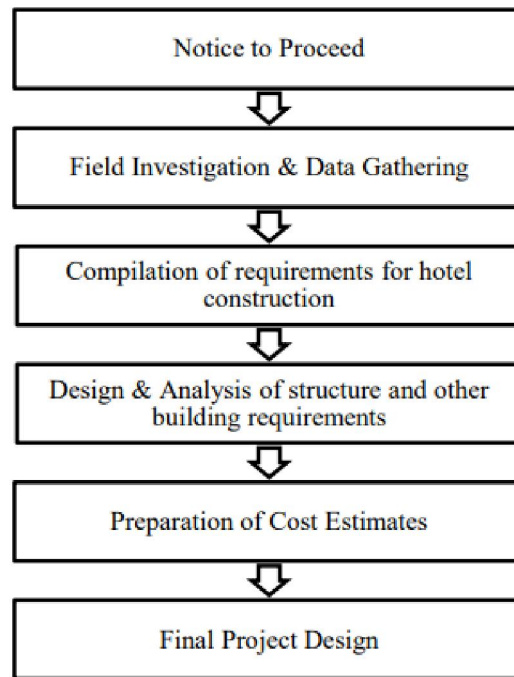


Figure 3. Project Implementation Flow

Critical to project viability, the preparation of cost estimates follows. The LGU-Mainit earmarks 50 million for the annex building's construction, slated for the later part of 2019 or the initial quarter of 2020. This financial forecast is pivotal in evaluating budget adequacy, encompassing all financial aspects while furnishing transparency regarding budget allocation. The ultimate culmination arrives with the final project design. This phase solidifies the study, culminating in comprehensive plans, specifications, structural profiles, cost estimates, and all prerequisites essential for the construction phase, subject to LGU-Mainit's approval.

III. RESULTS AND DISCUSSION

The researcher engage in a comprehensive analysis of a structure, aligning with both the aesthetic and structural stipulations outlined by the LGU. The Local Government Unit of Mainit has articulated a desire for a contemporary design that resonates with current trends, enabling the establishment to vie with upscale hotels, even as its main building retains a more natural and conventional design aesthetic. The researcher adeptly fulfill the LGU's vision, incorporating distinctive features such as a rooftop tennis court and verandas accompanying each room. These verandas provide panoramic vistas, overlooking the expansive locale and adjacent to one of the Philippines' renowned lakes. Within a lot area spanning 1104 sq. m, the researcher effectively meet the LGU's spatial requisites, meticulously accounting for occupancy considerations. The design encompasses a conference hall, strategically positioned adjacent to a café and kitchen. The LGU's foresight in locating the kitchen proximate to the conference hall ensures seamless catering during events. A meticulous approach also factors in the sunset's impact on the aesthetic dimension. Given that the proposed structure's facade is oriented toward the setting sun, considerations encompass the integration of barriers or blinds for room windows, safeguarding visitor comfort.

Delving beyond exterior aesthetics, the researcher extends their focus to room designs, underpinned by thoughtful deliberations. Graphic software facilitates this envisioning process, yielding the perspective view depicted above. This rendition, meticulously crafted in alignment with the LGU's mandates, portrays a structure characterized by modern aesthetics. Evident in this depiction is the building's contemporary allure, poised to stand its ground among other competitive hotels as shown in Figure 4.



Figure 4. Perspective of the Project

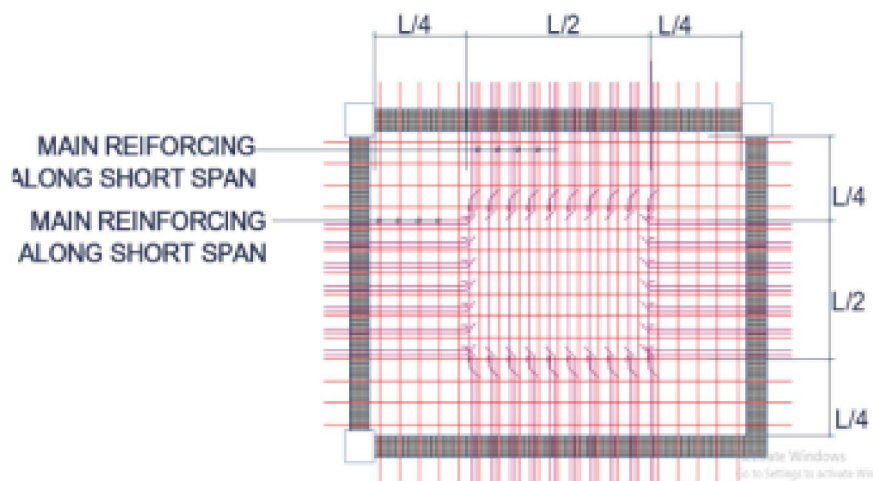


Figure 5. Structural Slab Design of the Project

Figure 5 illustrates the fundamental design data that underpins the creation of the slab design. The visual depiction in the Figure encapsulates the plans and sections delineating the intricacies of the slab's composition. This slab boasts a thickness of 200 mm and is fortified through the integration of 12 mm diameter straight bars, complemented by bend

bars strategically positioned at 180 mm intervals along the central axis. It's noteworthy that the reinforcement configuration for both one-way and two-way slabs maintains uniformity in terms of steel bar diameter and spacing. Scrupulously abiding by the stipulated steel requisites applicable to both longer and shorter spans of the slab, the ensuing outcomes were rigorously validated.

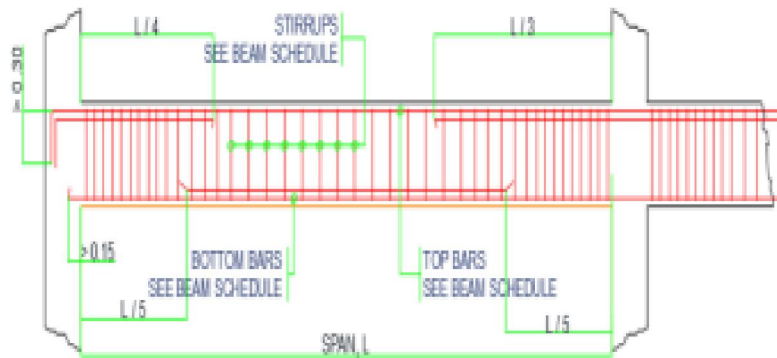


Figure 6. Structural Beam Design of the Project

Figure 6 illustrates the intricate section particulars governing the beams within the structure. In this visual representation, the higher bars correspond to tension bars, while the lower ones signify compression bars. The design rigorously adheres to consistent dimensions, encompassing a width of 300 mm coupled with a depth of 450 mm. Within the reinforcement schema, the incorporation of a 25 mm diameter bar is pivotal for both the topmost primary straight bars and the accompanying bend bars. Within the context of the two-storey configuration, distinctive dimensions govern each beam category. The girder beam assumes proportions of 300 mm by 450 mm, while the roof beam exhibits dimensions of 250 mm by 350 mm. Concurrently, the floor beam sustains the dimensions of 300 mm by 450 mm, contributing to a harmonious and structurally resilient framework.

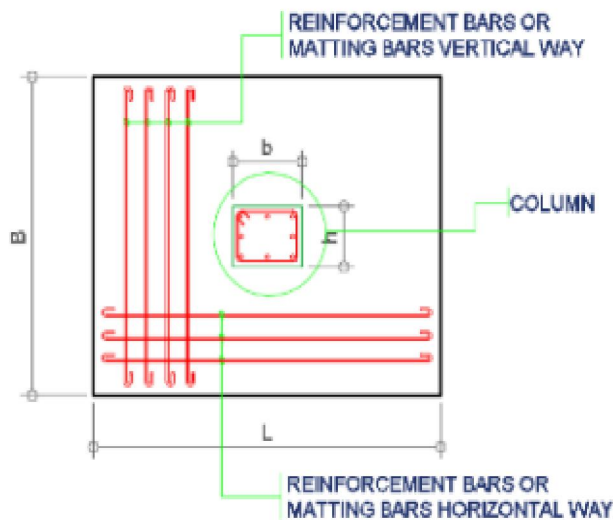


Figure 7. Columns and Footings Design of the Project

The configuration of columns and their placement is visually depicted in Figure 7. Computed structurally, the dimensions of the columns amount to 350 mm by 350 mm. Similarly, the structural computations dictate the dimensions of the footing to be 2.0 m by 2.0 m, with a footing depth of 2.5 m.

IV. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

- Through the utilization of graphic software, the researchers successfully realized the aesthetic prerequisites, resulting in a contemporary design poised to rival other hotels in terms of visual appeal. This software facilitated the creation of a detailed, animated depiction of the proposed structure, meticulously aligned with the outlined plans and specifications.
- Navigating the intricate interplay of design criteria influenced by the specific location and contextual circumstances, the researcher adeptly formulated all essential structural elements. Mindful of the unique demands inherent to the area, each design decision was made while meticulously adhering to requisite criteria.
- Attaining compliance with the stipulated criteria, the researcher effectively fulfilled all requisite mandates. The scrutiny and evaluation of the professionals ensured alignment with the NBC and NSCP, validating the structural integrity of each facet of the project.

4.2 Recommendations

- Explore cost-effective yet durable building materials accessible in Sison to reduce housing expenses.
- Given the site's topography, thorough site inspections were essential.
- Incorporate innovative construction techniques, such as precast, to enhance project construction efficiency.

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