Sheet Pile Estimating and Proposal Development for Deep Foundation Construction: From case study to framework

Sandra Khaled Alshalabieh
Advisor: Hector J. Cruzado, PhD
Graduate School

Abstract

The preparation of cost proposals for deep foundation projects often lacked standardization and technical consistency, resulting in delays and inaccurate estimates. This project addressed that problem by developing a structured framework for preparing sheet pile proposals, using the Lilly del Caribe flood-mitigation project in Carolina, Puerto Rico, as a case study. The methodology combined geotechnical analysis, design review, vendor coordination, and cost modeling to ensure accuracy and efficiency. The framework integrated the use of Bluebeam Revu for drawing markups, Microsoft Excel for structured cost estimating, and standardized Request for Quotation (RFQ) procedures for supplier evaluation. The total estimated budget, including mobilization, was $4.39 million, with an expected completion time of eighty working days. Implementation of the framework improved coordination, reduced inconsistencies, and produced technically sound, economically feasible, and competitive proposals for deep foundation construction projects.

Introduction

A geotechnical construction firm based in San Juan, Puerto Rico, routinely prepares bids for deep foundation projects, particularly those using sheet pile wall systems for excavation support, waterfront stabilization, and flood mitigation. These projects demand precise interpretation of technical data and careful alignment of cost estimates with engineering requirements to ensure accuracy and competitiveness. The project identified the absence of a standardized and efficient process for preparing cost proposals, often resulting in inconsistencies, delays, and reduced proposal quality. To address this issue, a structured framework was developed using the Lilly del Caribe flood-mitigation project as a case study. The framework integrates technical review, geotechnical analysis, vendor coordination, and cost modeling to improve proposal accuracy, consistency, and efficiency, enhancing both operational performance and bidding competitiveness.

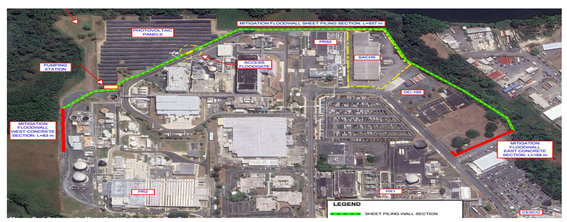

Figure 1.
Aerial view of the Lilly del Caribe flood-mitigation

Problem

- ⚙️ Lack of standardized procedures → Develop a structured framework that ensures accuracy, efficiency, and consistency in sheet-pile proposal preparation.
- 🔗 Limited coordination between engineering, estimating, and procurement teams → Integrate technical review, cost estimating, and procurement workflows into one unified process.
- 📄 Incomplete or inconsistent documentation during bid preparation → Ensure clear scope definition, technical compliance, and timely delivery of complete proposal packages.
- 📑 Absence of a formal review stage before submission → Establish an internal coordination review with the project manager before final submission.

CASE STUDY: PROPOSAL PREPARATION FOR THE LILLY DEL CARIBE PROJECT

The chart below illustrates the standardized workflow followed in preparing the sheet-pile proposal for the Lilly del Caribe project .

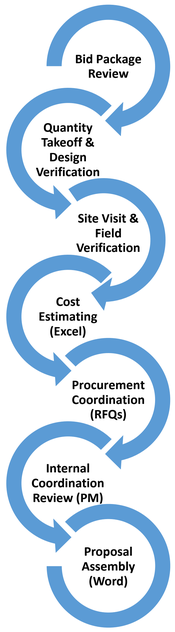

Figure 2. Standardized process for sheet-pile proposal preparation applied to the Lilly del Caribe project.

Methodology

The methodology focused on developing a standardized framework for preparing sheet-pile proposals, using the Lilly del Caribe project as a model for validation. The process began by defining the framework's purpose to establish a repeatable and efficient method that ensures technical accuracy and consistency in proposal preparation. The overall sequence of activities and framework development is illustrated in Figure 4, which maps the major stages from document review to framework validation. Each stage was formalized and assigned to specific roles. The geotechnical engineer reviewed boring logs and groundwater data to verify embedment and drivability requirements, while the project engineer extracted design data, calculated quantities, and verified section properties. The selected sheet pile section, an AZ 24-700 epoxy-coated steel profile, is shown in Figure 3.

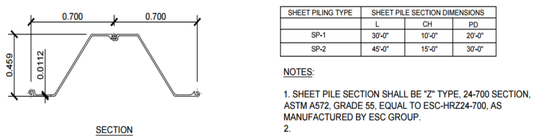

Figure 3.
AZ 24-700 epoxy-coated sheet-pile section

Historical company records past estimates, proposal templates, RFQ logs, and vendor correspondence were analyzed together with recognized industry best practices. Standard digital tools were integrated into the workflow: Bluebeam Revu and Adobe Acrobat for markups and takeoffs, Microsoft Excel for structured cost estimating, and Microsoft Word for proposal documentation. The framework also formalized procurement and review procedures, defining how RFQs are issued, quotations evaluated, and coordination meetings conducted prior to final submission. It was then validated retrospectively by applying it to the Lilly del Caribe case, comparing each framework step to actual project activities, and refining it based on feedback from estimators and project managers.

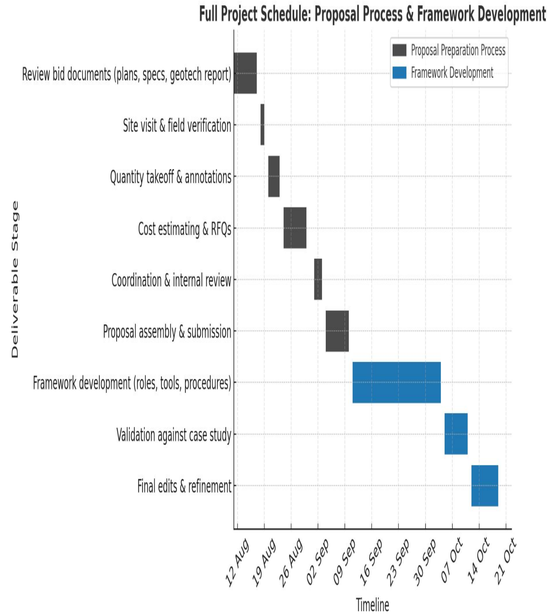

Figure 4
Flowchart of the Sheet Pile Proposal Preparation Process

Results

The proposed framework was implemented in the Lilly del Caribe flood mitigation project to validate its practicality, efficiency, and accuracy. A comprehensive cost estimate was developed in Microsoft Excel, integrating data from the geotechnical report, structural drawings, vendor quotations, and production planning sheets. The summarized outcomes are presented in Table 1, which highlights the total sheet-pile wall area, estimated cost, and proposed duration. The project's estimated cost was $4.39 million, including mobilization and setup, for the installation of AZ 24-700 epoxy-coated sheet piles covering 61,150.5 square feet, with a planned construction duration of eighty working days. Implementation of the framework improved accuracy, coordination, and documentation quality, reducing estimation errors and enhancing communication between technical and procurement teams. It also established standardized templates for future proposals. These results confirm the framework's potential as a practical, transparent, and technically sound model for consistent and competitive deep-foundation proposal preparation.

Table 1.
Summary of Framework Application Results

Parameter	Value / Outcome
Total Estimated Budget	$4.39 million
Sheet-Pile Type	AZ 24-700 (Epoxy Coated)
Total Area Installed	61,150.5 sq ft
Duration	80 working days
Improvements	Efficiency, accuracy, and consistency in proposal preparation

Conclusions

The implementation of the standardized framework in the Lilly del Caribe case study demonstrated its effectiveness in producing accurate, consistent, and technically compliant sheet-pile proposals. The framework successfully integrated design verification, cost estimating, procurement, and risk analysis into a single coordinated process. Defining clear roles, using standardized digital tools, and incorporating structured reviews strengthened collaboration between engineering, estimating, and procurement teams. The resulting process improved decision-making, reduced uncertainty, and increased proposal efficiency and reliability. Overall, this project achieved its main objective by developing a repeatable and practical model that enhances accuracy, consistency, and competitiveness in deep foundation proposal preparation.

Acknowledgements

Gratitude is extended to Dr. Héctor J. Cruzado Vélez, advisor and professor at the Polytechnic University of Puerto Rico, for his guidance and continued support throughout this project. Appreciation is also given to the faculty of the Graduate School of Engineering Management for their valuable instruction and mentorship. Special thanks are offered to the engineering firm that provided project data and professional insight, which contributed to the practical development of this research.

References

[1] Pile Buck International, Inc., Design and Construction of Sheet Pile Walls. Pile Buck International, 2016.
[2] U.S. Army Corps of Engineers, Design of Sheet Pile Walls (EM 1110 2 2504). Washington, DC: Department of the Army, 1994.
[3] D. L. Lindstrom, Procurement Project Management Success: Achieving a Higher Level of Effectiveness. Plantation, FL: J. Ross Publishing, 2014.
[4] D. Hillson and P. Simon, Practical Project Risk Management: The ATOM Methodology, 3rd ed. Oakland, CA: Berrett Koehler, 2020.
[5] L. Blank and A. Tarquin, Engineering Economy, 7th ed. New York, NY: McGraw Hill, 2012.