



Capstone Design Project Abstract

Project Title: Rainwater Harvesting System Sizing

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The rainwater collection industry is critical for addressing water scarcity and aging infrastructure, yet many systems are currently plagued by incorrect sizing. Designers frequently rely on worst-case assumptions or incomplete data, leading to oversized tanks that are unnecessarily expensive to install and maintain. These high costs often result in systems being deactivated, wasting investment and discouraging the adoption of sustainable water solutions.

The objective of this project is to develop a reliable, user friendly tool that uses 30 years of weather data to assist engineers in sizing rainwater harvesting systems with greater precision. The scope includes identifying key variables such as specific daily water usage to produce consistent results across various building types. A significant challenge involves handling missing or erroneous rainfall data, which can introduce compounding errors into system reliability calculations. Additionally, the team had to pivot from an initial requirement for installable software to Microsoft Excel which is more user friendly and accessible for our client.

The selected solution is a Mass Balance Daily Simulation tool developed in Microsoft Excel. This model simulates daily tank storage over decades using a water balance equation that accounts for previous day's storage, rainfall, and daily water demand. The tool has the ability to size for direct systems which have a singular water collection tank as well as an indirect system which requires both storage and buffer tanks. Our tool also allows users to input specific size constraints, such as available area for a secondary buffer tank and required filtration system to ensure the design is feasible for the building's footprint while still meeting the daily water demand requirements. Furthermore, the program calculates the Return on Investment that considers initial costs, maintenance costs and inflation on city water costs to provide a payback period analysis to help clients visualize the long-term financial benefits. The final deliverables include a comprehensive Excel calculator featuring a user-friendly interface with automated calculations and visual outputs that compare cost and efficiency of various systems to determine the ideal filtration and tank(s) sizes.