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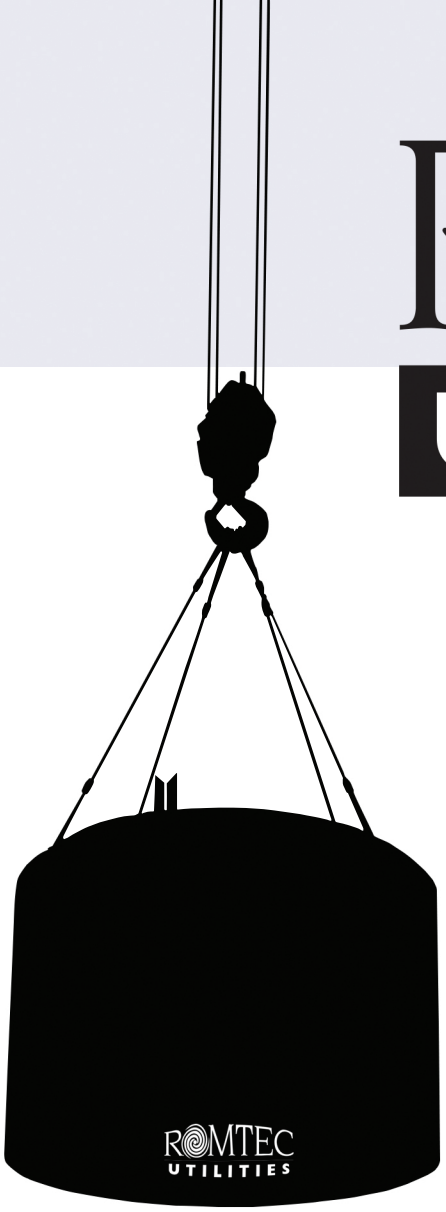

The Importance of Successful Basin Design

with Precast Concrete and Fiberglass Pump Stations

Romtec Utilities
Technical White Paper

www.RomtecUtilities.com

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Figure 1: Good Basin Design

Introduction

Designing precast concrete and fiberglass wet wells must address a number of potential issues. These issues can stem from unique site requirements, dated design standards, fluid viscosity, or a number of additional concerns. Romtec Utilities advocates using appropriate design procedures for all wet wells, sumps, or catch basins. To illustrate the importance of effective basin design, here are examples of how the design of a basin can influence the function of the pumps, the pump station construction/installation, and the size and dimensions of the total system.

Pumps

The foremost concern of pump station owners and operators is almost always the pumps. In many instances, customers and engineers will only specify a preferred pump with little interest in the rest of the system. In regards to the pumps, effective basin design is a priority for ensuring the long-term functionality and condition of the pump station. A poor basin design can increase the presence of detrimental pump conditions such as turbulence, turbidity, aeration bubbles, and solids buildup.

Turbulence can cause problems for pumps by shifting mount components, guiderails, electrical conduit, mechanical seals, and the discharge piping. The repetition of unmitigated hydraulic force can increase the maintenance needs and shorten the life-cycle of a pump station. Sizing the wet well appropriately can drastically reduce the concerns that turbulence presents for the pumps and associate components.

Turbidity is another pump killer. If water is suspected or known to contain suspended particles, the wet well should be sized in such a way as to not concentrate the turbid fluid. By preventing the concentration of suspended particles, the pump impeller, volute, and discharge piping will experience less wear and require less maintenance.

Aeration bubbles occur when fluids move in a manner that creates a whirlpool or vortex. The formation of these bubbles is called cavitation, and they are very harmful to pumps and piping if they get pumped. Typically, vortices and the corresponding cavitation are found in wet wells that are too cramped. This effect can be related to in-well turbulence, but cavitation does not always require strong forces to be created and cause problems.

Solids buildup is exactly how it sounds. Suspended solids progressively cling to the structural elements of the basin until the fluid is restricted from reaching the pump at an adequate rate. This buildup effectively chokes the pump from taking in enough water, causing cavitation or air-binding. Designing the basin correctly will ensure that suspended solids are pumped at a rate that will slow the progress of buildup to a manageable interval.

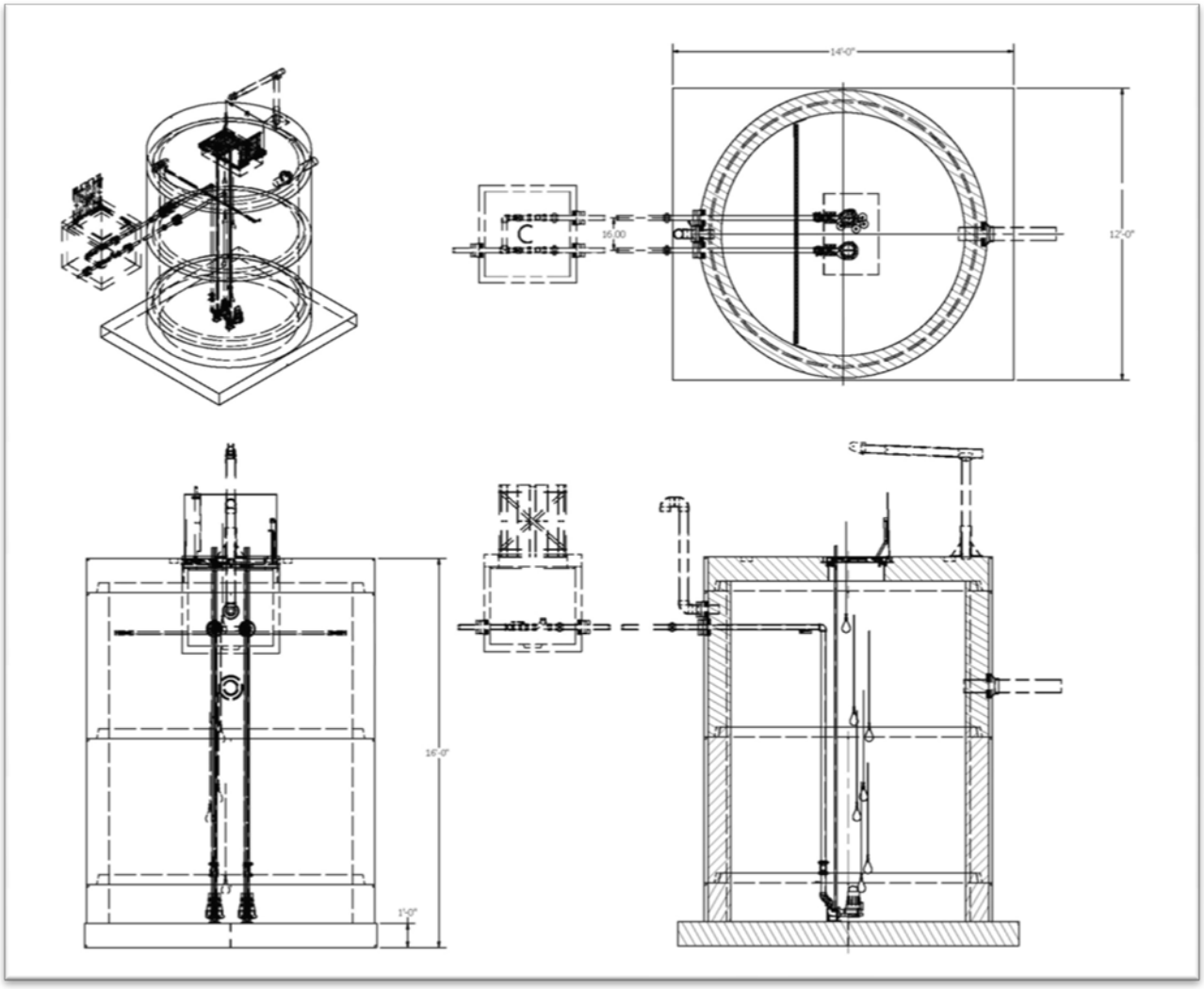


Figure 2: Bad Basin Design

Figure 2 shows an example of a bad basin design. In this example, the pumps are too small for the size of the wet well. There is no bevel in the bottom of the well. Without a bevel, solids will not be direct to the pumps and the inflows will cascade, increasing turbidity and turbulence. This design would produce a very harsh environment for the pumps. Figure 1 would likely experience all of the problems discussed above during its life-cycle.

Construction and Installation

The advantages of choosing precast concrete or fiberglass over poured in-place basins are the savings in cost and time and the consistency of the manufacturing quality. Whereas these benefits are real, they are only maximized when the total basin components are designed effectively. This includes prefabricating and pre-installing necessary components, managing penetrations and joints, providing adequate lifting hardware, calculating uplift, and testing the components for maximum stress.

In precast concrete, it is advantageous to precast some elements directly into the concrete. Not only does this reduce the time for on-site installation, but it also increases the strength of the installed components. With fiberglass basins, it is possible to pre-install most of the in-well components and the access hatches. This alleviates the responsibility if the contractor to work on the fiberglass basin and preserves the integrity of the manufacturing process.

Penetrations and joints need to be handled appropriately during both design and installation. Penetrations are typically cored before delivery to guarantee they meet the design specifications. In some rare cases, penetrations are cored onsite when the exact elevations of invert piping are not known, but this is not typical. Romtec Utilities provides the gaskets, seals, and coatings to construct impervious penetrations and joints quickly and effectively. An onsite Romtec Utilities installation advisor will also provide support in joining the concrete components correctly.

Figure 3: Using Romtec Utilities Uplift Brackets

Not all precast concrete is produced the same way, and lifting hardware is an oversight by many manufacturers. Without designing and communicating the provided lifting hardware, precast concrete components can arrive at a jobsite without a way to offload them. Often times, this situation will lead to jury rigged lifting methods that can damage concrete components and setback construction schedules. Romtec Utilities has several lifting methods –for different equipment– that can be prefabricated into the concrete for reliable lifting anchors.

When concrete or fiberglass basins are installed in the ground, they generate buoyancy from water levels in the ground. Romtec Utilities prefabricates monolithic concrete bases with reinforced collars engineered to negate the forces of buoyancy. Fiberglass wells also use uplift collars to counter act buoyancy. If the uplift calculations are not properly configured in the basin design, the basin can literally pop out of the ground.

Testing the precast concrete and fiberglass components before delivery is another important aspect of basin design. Using vacuum and leak testing demonstrates that a basin will be sufficient from a structural point of view to handle the psi and hydraulic forces that are present in a given pump station. Romtec Utilities predefines the necessary strength of the total basin to allow accurate testing of the sump components.

Size, Shape, & Depth

There are numerous contributing factors that implicate the designing of wet wells in terms of size, shape, and depth. These factors can include local design standards, local/regional codes, geological circumstances, owner/operator preferences, water chemistry, calculated rates, existing infrastructure, and more. This document does not attempt to address the sum total of minutia for this aspect of basin design considerations, but it is helpful to communicate that Romtec Utilities has supplied many pump stations with unique basin designs in terms of size, shape, and depth.

Typically, Romtec Utilities supplies round concrete basins ranging from 4’ to 12’ in diameter up to 40’ deep. A substantial percentage of the pump stations in the United States will fall into this range of basin sizes. The biggest advantages to designing basins within this window are that they are fairly standard configurations and the basin components are cheaper to manufacture. These benefits spread from the designers to the manufacturers to the contractors and to the owners/operators.

Rectangular sumps are being required from Romtec Utilities at an increasing frequency. Several design factors can result in choosing a rectangular sump. A prominent factor is the need for adequate pump spacing when multiple pumps are required. In a 12’ diameter wet well, no more than four pumps could be reliably specified. In a circumstance where more than four pumps are required, using a rectangular sump is typically the most cost-beneficial solution. This ensures that the pumps do not “compete” to intake water.

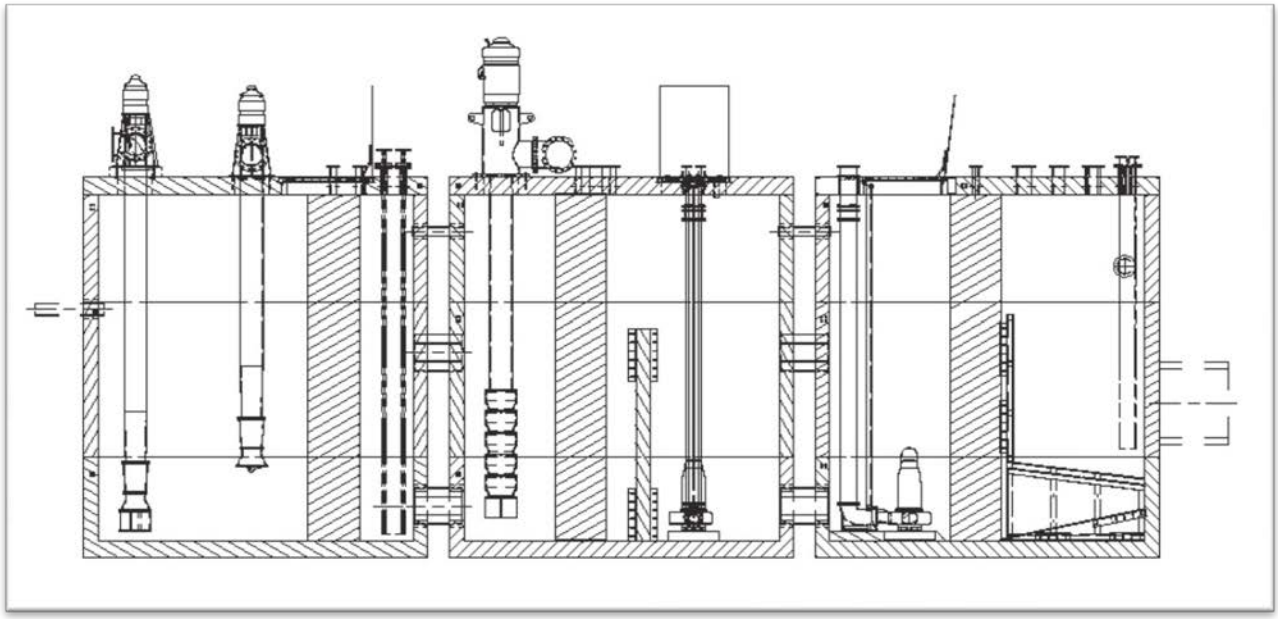


Figure 4: Eight Large Pumps in Three Rectangular Basins

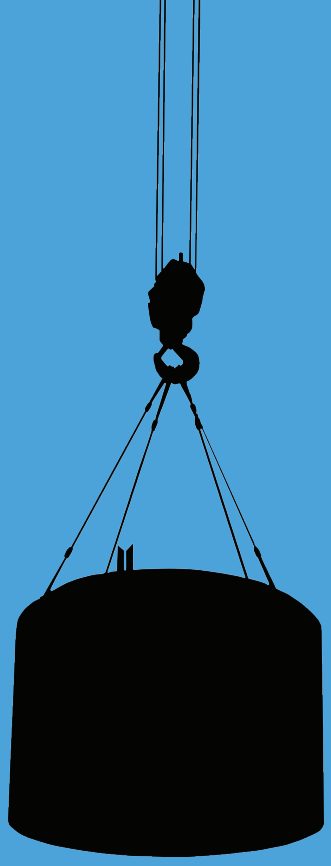
Another factor for choosing a rectangular well is high inflow rates. This issue is also a matter of the amount of space in the basin. High to extreme inflow rates will typically need baffling structures or weir walls to contain the turbulence. As the flow increase, the demands on the baffle are also increased, requiring more and more robust structures. This is simply to say they require more space. Just as before, the rectangular shaped well is a more cost-beneficial solution than increasing the basin diameter.

Deep wells are typically only used at great need because of the severe design requirements involved. When precast concrete is used for deep wells, the sheer weight of the well requires the base and bottom barrels to be very thick. If the basin is not designed effectively to compensate for the added weight, the well could fail. Thicker precast components can be expensive because of the added materials, nonstandard forms, and more segregation concerns.

Dewatering is another consideration for deep wells that should be planned for in the pump station design specifications. In all but the driest climates, groundwater is typically present at 10-20 feet below the surface. Plans for adequate dewatering are necessary anytime excavation goes below the groundwater level, but with deep wells, the amount of water needing pumped out is more significant. An effective basin design should first try to avoid a deep well, but if one is needed, proper planning is a necessity.

Conclusion

Using basins, wet wells, or sumps made of precast concrete or fiberglass will provide the most cost beneficial components that will outperform and outlast poured-in-place components for pump stations. This is only true when the best practices are employed during the design of the pump station. The basin is a part of a complete system and as such needs to be successfully integrated into the pumping requirements, the site requirements, and the customer requirements. Romtec Utilities takes the necessary step to make sure that the complete basin design is documented and approved to satisfy all these criteria for a successful pump station project.



About Romtec Utilities

Romtec Utilities, Inc. designs, manufactures, supplies, and installs site specific packaged pump stations. Our pump stations include detailed drawings and specifications in the CSI format with all structural, mechanical, communication, and electrical plans. Our documentation also includes a complete bill of materials, a well-defined scope of work and services, and a complete system warranty. Our complete packaged systems serve commercial, municipal, state, federal, agricultural, and industrial applications for virtually any type of water-pumping system.

Romtec Utilities, Inc. began operation in 2000 in Roseburg, Oregon. The US economic conditions at that time fostered the growth of a booming housing market, and Romtec Utilities did a lot of business working with developers and public agencies who needed packaged lift stations. Romtec Utilities distinguished itself by offering quality designs, fast lead times, and an ability to get projects approved and installed quickly.

In the wake of the 2008 Financial Crisis, the market changed and so did Romtec Utilities. Romtec Utilities made a rigorous evaluation of its product offering to become more cost competitive. We also placed more emphasis on working with industrial clients with a broad range of applications.

In the following years, Romtec Utilities underwent dramatic changes that have ultimately made us a better company. We expanded our interests to include more stormwater, more wastewater, and more industrial water applications. We improved our vendor relationships to provide our customers with more products and capabilities at lower prices. We developed an efficient and precise documentation process to foster fast and clear communications, and we strengthened our field services and repair capabilities.

We have completed hundreds of projects across the United States and have supplied packages for international installations. Contact us for assistance. We love to talk about pumping systems of every type, shape, and size!

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