Introduction

Genesis 3, Inc. provides an international forum for continuing education and the establishment of higher standards in watershape design, engineering, and construction. In pursuit of this goal, Genesis hereby publishes this Position Statement regarding hydraulic safety.

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Format

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Position Statement

1.1 Flow Rate Reference

1.1.1 The flow rate that should be referenced for the configuration, line size determination, and cover/grate selection of the suction outlets shall be the maximum flow rate of the pump at its maximum RPM (3,450 for variable frequency drive systems); or,

1.1.2 For retrofits only, if the pump has variable frequency drive technology, the speed shall be locked so that the flow rate cannot exceed the existing configuration, line sizes, or cover/grate selection.

1.2 Suction Outlet Configuration

1.2.1 Suction outlets shall be configured in split pairs or more.

1.2.2 When isolation valves are located between a suction outlet and pump, any isolatable suction line shall be sized for 100% of the system's reference flow rate per section 1.3 below.

1.3 Suction Outlet Plumbing Velocities

1.3.1 The velocity limit in the plumbing at the outlets is 6 feet-per-second by code (ANSI/APSP-7). We recommend that the maximum *design* velocity on the suction side of the pump be limited to 4.5 feet-per-second.

Commentary

Even if a pump is set to a lower flow rate, or if a valve is throttled to reduce the flow rate, it is possible that the system could be changed to a higher flow rate that exceeds the design of the suction outlet system. Designing for the worst-case scenario ensures that safety will be maintained at all times.

It is possible that even if a variable speed pump can operate at 3,450 RPM, a locking system may limit that to some lower RPM in a way that prevents the accidental operation at a higher RPM. This is acceptable for retrofits but new construction should be configured and sized to handle the flow rate at maximum RPM even if the speed-locking feature is available.

Where suction outlets are unavoidable, nothing has proven safer than outlets configured in split pairs with properly sized covers/grates and properly sized plumbing to handle the flow rate. The split outlets shall be configured so that when one is blocked the remaining outlet(s) will handle 100% of the flow rate without exceeding 6 feet-per-second *in the plumbing*.

Valves are easily adjusted or closed and if certain valves cause an undersized line to be isolated as the sole suction point, the velocity could be dangerously high.

Several things can increase the velocity in a line between the time that the design is established and when the system is actually built and operated. For example, the design flow rate might only be 50 gallons per minute, but when the pump is selected it may be necessary to choose a fixed-speed pump that is slightly larger than needed and this will result in higher flow rates than desired. If 50 gallons per minute results in a velocity of 6 feet-per-second in the plumbing, the pump selection alone might result in a velocity that exceeds the 6 feet-per-second code limit.

Energy efficiency is greatly enhanced by lowering the line velocity. Cavitation, operating noise, and suction entrapment hazards are also reduced by lowering the line velocity. Equipment life is extended.

Slower velocities do allow for proper pipe scour.

1.4 Suction Outlet Covers

1.4.1 The recommended maximum water velocity through any suction outlet cover/grate shall not exceed 1.5 feet-per-second or the safe operating limit determined by independent testing, whichever is lower.

Some jurisdictions already use a 1.5 feet-per-second maximum velocity.

The ANSI/APSP-16 American National Standard for Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, and Hot Tubs provides a somewhat complicated method for manufacturers to test and list much higher velocities. Our position is that this process promotes differing interpretations and test results at the expense of safety. Some suction outlet covers/grates are actually listed for velocities that exceed our recommended suction velocities in the plumbing.

There is at least one suction outlet cover on the market that is listed for over 6 feet-per-second which actually exceeds the velocity limit of the associated plumbing. Velocity limits are sometimes established by hair entrapment testing and even if a cover passes a test at over 6 feet-per-second we do not agree that it should be used at a velocity that exceeds the plumbing.

Energy loss through hydraulic fittings and orifices is directly proportional to the square of the water velocity. In other words, if the velocity doubles the energy loss (head loss) quadruples. Covers listed for 4.5 feet-per-second will result in about 89% energy savings when the velocity is limited to 1.5 feet-per-second.

1.4.2 Low-profile anti-vortex suction outlet cover/grates shall not be used.

At this time, the term "low profile" is undefined. However, most anti-vortex covers are designed with a raised upper surface and the openings located at least partly on the sidewall of the perimeter. This configuration is more difficult to block than the low profile versions where the upper surface is not raised much and the perimeter openings are essentially flush with the floor and upper surface of the cover.

1.4.3 The recommended flow rate for an unblockable cover/grate used in a single configuration should be calculated by applying the maximum 1.5 feet-per-second velocity across the remaining open area of the cover/grate after the representative torso has blocked as much of the cover as possible.

This criteria will result in two flow rates for all unblockable covers. The first flow rate will represent the maximum flow that the cover/grate can pass at 1.5 feet-per-second after the representative torso has blocked as much of the cover as possible. The second flow rate will represent the maximum flow that the cover can pass at 1.5 feet-per-second when it is used in split pairs or more. The second flow rate is not reduced by the blockage of the representative torso.

Currently, certain "unblockable" suction outlet cover/grates are listed with high flow rates but the representative torso can easily block over 80% of the drain, which results in potentially dangerous hair entrapment velocities through the remaining area.

1.4.4 Skimmer equalizers shall not be required unless the skimmer is the sole source of suction for a pump. When installed, they shall be installed in split pairs separated by 3-feet clear in accordance with sections 1.1 through 1.4 above.

Skimmer equalizers are used to prevent pump damage when the skimmer runs dry due to low water level or blockage by debris. The low water level issue is easily solved with automatic fill devices that are standard on all new pools.

Skimmer blockage by leaves or other debris is a valid concern in some environments but not all. Many pools (e.g., indoor or those without problematic vegetation) may never have blocked skimmers so there is no justification for the equalizers.

When equalizers are installed they need to be installed in split pairs separated by 3-feet clear or on different planes in conformance with all the standards pertaining to regular split suction outlet pairs. This is because a float valve or equalizer valve (e.g., Hayward SP1078) in the skimmer will effectively turn the equalizer into a suction outlet.

Some states are requiring them to be plugged in commercial applications.

1.5 Dedicated Vacuum Ports

1.5.1 Dedicated vacuum ports shall have approved positive-sealing covers *and* isolation valves.

1.6 Engineered Vent Stacks

1.6.1 Engineered vent stacks shall not be used.

When a suction outlet system is operating properly, the engineered vent stack will be partially full of water that is never circulated, filtered, or sanitized. The engineered vent stack provides a location for pathogens and algae to reproduce.

Introduction

Genesis 3, Inc. provides an international forum for continuing education and the establishment of higher standards in watershape design, engineering, and construction. In pursuit of this goal, Genesis hereby publishes this Position Statement regarding energy and resource efficiency.

This Position Statement was assembled with input from leading professionals in the pool and spa industry including individuals that are not members of Genesis. The contributors share a common goal of improving safety, reducing energy consumption, raising the current standards, and building better quality projects. The positions are not biased toward specific manufacturers or products.

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Position Statement

2.1 Line Velocities

2.1.1 The velocity limit in the plumbing at the outlets is 6 feet-per-second by code (ANSI/APSP-7). We recommend that the maximum *design* velocity on the suction side of the pump be limited to 4.5 feet-per-second.

2.1.2 The maximum velocity on the discharge side of any pump shall be 8 feet-per-second maximum. We recommend that the maximum *design* velocity on the discharge side of any pump be limited to 6.5 feet-per-second.

2.2 Spa Jet Systems

2.2.1 We recommend that spa jet systems are configured with dedicated jet pumps.

2.3 Energy Star

2.3.1 Energy Star listed equipment is preferred over non-Energy Star listed equipment.

2.4 Control System

2.4.1 All pumps and lighting equipment shall be connected to timeclocks or controllers that enable scheduling of the equipment and adjustment of variable

Commentary

See Position Statement #1 for additional commentary regarding velocity limits and configuration at suction outlets.

Energy efficiency is greatly enhanced by limiting the velocity.

Energy efficiency is greatly enhanced by limiting the velocity.

Furthermore, noise is reduced and plumbing systems last longer when they are not stressed by high pressures and high headloss. This results in extended equipment life which conserves resources.

A filtration system that includes venturi jets is wasteful when the jets are not utilized. Also, typically, jet systems do not require filtration. Since filtration and jets are usually two separate functions, they should each have their own dedicated pumps.

Filtration pumps are often much lower horsepower than those required to operate jets. Therefore, a filtration pump must be oversized if also used as a jet pump. Using a combined system results in wasted energy by operating a pump that is larger than required for filtration since the jet function is only utilized a minimal amount of time.

frequency drives for pumps if used.

2.5 Alternative Heat Sources

2.5.1 All pool or spa filtration systems shall include provisions for the connection of alternative heat sources. This shall include 3 feet of pipe before any heater or the rough-in of supply and return lines for the future connection of solar, radiant, or geothermal heating.

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Position Statement

3.1 Automatic Fill Device

3.1.1 An automatic fill device shall be installed.

Commentary

Low water conditions may create safety hazards including increased risk of suction entrapment on skimmer equalizers, shallow diving envelopes, and potential damage to equipment.

IAPMO/ANSI USPSHTC 1 – 2009 section 306.2 states that the connection to the fill device "shall be protected by an air gap or a reduced pressure principle backflow preventer" (RPBP).

3.2 Overflow Line

3.2.1 An overflow line should be installed.

Without an overflow line, if the water level reaches the rim of the pool or surge basin the water may flood decks, damage landscaping, damage nearby structures, etc. It is preferred that the overflow be controlled.

3.2.2 Overflow lines should discharge to the storm drain for outdoor pools and the sanitary sewer via an air gap for indoor pools; however, local codes may have specific requirements and the authorities having jurisdiction shall be consulted.

The preference is that chlorinated water is not discharged to the storm drain but it is generally acceptable to discharge to the sanitary sewer. However, if a pool receives precipitation, the resulting consolidated flow rate (rain across the entire pool surface area and decks that slope to it) could easily peak at rates that exceed a sanitary sewer's capacity – resulting in a sanitary sewer overflow (SSO) where untreated sewage is discharged into the environment. This is not expected for indoor pools where an overflow connection to the sanitary sewer via an air gap is appropriate in most situations.

IAPMO/ANSI USPSHTC 1 – 2009 section 313 states that when wastewater is discharged to the sanitary sewer, there shall be an air gap connection to a minimum 3" sewer line. This applies to equipment maintenance drains, filter backwash lines, etc. It is up to the local authorities having jurisdiction as to whether precipitation overflowing a pool is considered wastewater.

3.3 Flexible PVC Hose/Tubing

3.3.1 Flexible PVC hose or tubing shall not be used.

IAPMO/ANSI USPSHTC 1 – 2009 section 311.1 states: "Listed plastic circulating piping and fittings for non-threaded applications between all mechanical equipment and pools, spas, or hot tubs shall not be less than Schedule 40." Hose and tubing are not included in this requirement.

IAPMO/ANSI USPSHTC 1 – 2009 section 311.2 states: "Listed plastic threaded circulating pipe between all mechanical equipment and pools, spas, and hot tubs shall not be less than Schedule 80. Threading of plastic pipe in the field is prohibited. Threads shall be molded." Hose and tubing are not included in this requirement.

IAPMO/ANSI USPSHTC 1 – 2009 section 311.3 states: "Plastic piping shall be permitted to be cold bent for sizes two (2) inches (50 mm) or less with a radius of not less than five (5) feet (1524 mm) without the application of heat. Bends of small radii and exceeding two (2) inches (51 mm) shall be manufactured with the use of thermostatically controlled equipment and shall be listed." Hose and tubing are not included in this requirement and we believe that the heat bending requirement reinforces the fact that rigid PVC pipe should be used since hose and tubing does not require special practices to bend it.

Flexible PVC hose is easily kinked if the minimum bend radius is exceeded. Even if not kinked, any deflection of the circular cross section decreases the area and increases the velocity in that section – excessive velocities increase headloss and wear the pipe prematurely.

Although most flexible PVC hose has a somewhat smooth interior surface, they typically have bumps from the corrugated structure and this increases headloss.

The wall thickness is typically more than

	equivalent rigid PVC pipe so headloss is also increased over comparable pipe sizes. Vacuum pressures have collapsed flexible PVC hose and it is also easily crushed by tree roots. Water-hammer has been demonstrated to cause flexible PVC failures at solvent-welded joints. Termites have damaged flexible PVC hose.
3.4 Surge Basins	
3.4.1 Surge Basins for vanishing edge and slot-edge systems shall be filtered.	Water-in-transit systems serve as skimming systems even when dedicated skimmers are included on a separate filtration system. Without a filter on the surge basin, collected debris is returned to the main vessel, creating unsanitary and cloudy water conditions, and maintenance problems.
3.5 Filters	
3.5.1 Cartridge filters shall be limited to 0.375 gpm per square foot of filter surface area.	This has been a commercial limit for many jurisdictions. Anything higher risks damage to the cartridges and results in excessive headloss.
3.5.2 Sand filters shall be limited to 15 gpm per square foot of horizontal surface area. We recommend that sand filters be limited to 12 gpm per square foot of horizontal surface area. Sand filters should be backwashed at 15 to 18 gpm per square foot of horizontal surface area in order to suspend the media and release trapped debris.	It is common to see sand filters in the pool industry rated for 20 gpm per square foot. This unit flow rate will result in channeling of the media – especially with the typical short-profile filters common in the industry.
3.6 Skimmers	
3.6.1 Skimmers shall not be operated above the manufacturer's recommended flow rate. For common 8" wide floating weir skimmers, this is usually about 75 gpm.	High flow rates in the skimmer can result in vortexing and air entrainment that is problematic for the pump.
3.6.2 Skimmer equalizers shall not be required. When installed, they shall be installed in split pairs separated by 3-feet clear.	Skimmer equalizers are used to prevent pump damage when the skimmer runs dry due to low water level or blockage by debris. The low water level issue is easily solved with automatic fill devices that are standard on all

new pools.

Skimmer blockage by leaves or other debris is a valid concern in some environments but not all. Many pools (e.g., indoor or those without problematic vegetation) may never have blocked skimmers so there is no justification for the equalizers.

Even if a pump ran dry, the resulting damage and expense would be insignificant compared to the risk of suction entrapment on the equalizers.

When equalizers are installed they should be installed in split pairs separated by 3-feet clear or on different planes in conformance with all the standards pertaining to regular split suction outlet pairs. This is because a float valve in the skimmer will effectively turn the equalizer into a suction outlet.

Introduction

Genesis 3, Inc. provides an international forum for continuing education and the establishment of higher standards in watershape design, engineering, and construction. In pursuit of this goal, Genesis hereby publishes this Position Statement regarding structural requirements.

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4.1 Structural Loads

4.1.1 Structural analysis shall include, but not be limited to the following: soils, surcharge loads, slope stability, seismic forces, hydrostatic, hydrodynamic, wind, and storm surge when necessary.

4.1.2 A soils investigation shall be done per the requirements of International Building Code (IBC) sections 1705.6 and 1803 or the International Residential Code (IRC) section R401.4.

4.2 Reinforcing Steel

4.2.1 Reinforcing steel shall have a minimum of 3" clearance to soil and water.

4.2.2 Reinforcing steel in shotcrete shall have non-contact lap splices and spacing per International Building Code (IBC) sections 1910.4.2 and 1910.4.3, or

4.2.3 Reinforcing steel in shotcrete may have contact lap splices only if the laps are stacked parallel to the direction of the shotcrete (e.g., one bar is behind the other and not stacked side by side).

4.3 Concrete

4.3.1 The minimum compressive strength of the concrete is fc'=4,000 psi with a maximum water-cementitious material ratio (w/cm) of 0.50.

Commentary

It seems obvious but a surprising number of construction defect cases involve structural failures due to inadequate analysis of the underlying soils.

ACI 318 requires 3" clearance when the concrete is cast against and permanently exposed to soil. We recommend the same even if the concrete is formed and then backfilled with soil. We also recommend a 3" clearance against the water since typical cementitious finishes are not waterproof. Additionally, well-built structures may be remodeled which often results in losing up to ½" of the shell when the original plaster is removed.

Non-contact lap splices prevent shadowing of the shotcrete behind the steel.

Shadowing of the shotcrete can be prevented because the cross-sectional width of the bars is no greater than a single bar.

The American Concrete Institute's ACI 318-08 Building Code Requirements for Structural Concrete includes Chapter 4 Durability Requirements. Table 4.3.1 Requirements for Concrete by Exposure Class defines a Category P1 exposure as concrete "in contact

	with water where low permeability is required." Table 4.2.2 specifies the Requirements for Special Exposure Conditions. The 4,000 psi minimum compressive strength has also been affirmed by the American Shotcrete Association in their Position Statement #1.
4.3.2 Where concrete is exposed to freezing and thawing in a moist condition, the minimum is fc'=4,500 psi with a maximum water-cementitious material ratio (w/cm) of 0.45.	ACI 318-08 Table 4.2.2.
4.3.3 For corrosion protection of reinforcement in concrete exposed to chlorides from deicing chemicals, salt, saltwater, brackish water, seawater, or spray from these sources, the minimum is fc'=5,000 psi with a maximum water-cementitious material ratio (w/cm) of 0.40.	ACI 318-08 Table 4.2.2.

4.4 Shotcrete

4.4.1 Shotcrete includes both wet-mix and dry-mix (gunite).	Defined by International Building Code (IBC) section 1910.1 General: Shotcrete is mortar or concrete that is pneumatically projected at high velocity onto a surface.
4.4.2 Shotcrete shall be done at a high velocity of 350 to 400 feet-per-second.	See the American Shotcrete Association's Position Statement #1 (www.shotcrete.org)
4.4.3 Shotcrete compressive strength shall follow the American Shotcrete Association's Pool and Recreational Shotcrete Committee Position Statement #1.	See the American Shotcrete Association's Pool and Recreational Shotcrete Committee Position Statement #1.
4.4.4 Shotcrete terminology shall follow the American Shotcrete Association's Pool and Recreational Shotcrete Committee Position Statement #2.	See the American Shotcrete Association's Pool and Recreational Shotcrete Committee Position Statement #2.
4.4.5 Shotcrete sustainability benefits shall	See the American Shotcrete Association's

follow the American Shotcrete Association's Pool and Recreational Shotcrete Committee Position Statement #3 and include the following: 4.4.5.1 Formwork savings of 50 to 100% over conventional cast-in-place construction. 4.4.5.2 Formwork does not have to be designed for internal pressures. 4.4.5.3 Complex shapes require very little – if any – formwork. 4.4.5.4 Labor savings of at least 50% in repair applications. 4.4.5.5 New construction speed savings of 33 to 50%. 4.4.5.6 Better bonding to the substrate enhances durability. 4.4.5.7 Adaptability to repair surfaces that are not cost-effective with other processes. 4.4.5.8 Ability to access restricted space and difficult-to-reach areas, including overhead and underground.	Pool and Recreational Shotcrete Committee Position Statement #3.
4.4.6 Shotcrete watertightness shall follow the American Shotcrete Association's Pool and Recreational Shotcrete Committee Position Statement #4.	See the American Shotcrete Association's Pool and Recreational Shotcrete Committee Position Statement #4.
4.4.7 Shotcrete contractor and crew qualifications shall follow the American Shotcrete Association's Board of Direction Position Statement #1.	See the American Shotcrete Association's Board of Direction Position Statement #1.
4.4.8 Rebound, trimmings, and loose debris shall be removed from the structure and shall not be used in any manner within the structure or vessel.	Required by International Building Code (IBC) section 1910.6.
4.5 Special Inspections	
4.5.1 Special Inspection is inspection of construction requiring the expertise of an *approved special inspector* in order to ensure compliance with the code and the *approved construction documents*. Special Inspections are in addition to the inspections performed by the building official.	IBC 2012 chapter 2 defines special inspection, continuous special inspection, and periodic special inspection. IBC 2012 section 1704 details the qualifications, report requirements, statement of special inspections, contractor responsibilities, and other requirements.
4.5.2 Continuous Special Inspection is	IBC Section 1705 lists several requirements

performed by the *special inspector* who is continuously present when and where the work to be inspected is being performed and includes but is not limited to the following requirements:

for special inspection. We have listed key elements that are important for the pool, spa, and water feature industry but this list is not inclusive of all requirements.

ACI 318-11 requires Special Inspection and records per section 1.3.

4.5.2.1 At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.

IBC 2012 Table 1705.3.7 which also references ASTM C 172, ASTM C 31, ACI 318 sections 5.6 and 5.8, and IBC 2012 section 1910.10.

4.5.2.2 During concrete and shotcrete placement for proper application techniques.

IBC 2012 Table 1705.3.7 which also references ACI 318 sections 5.9 and 5.10, and IBC 2012 sections 1910.6, 1910.7, and 1910.8.

4.5.3 Periodic Special Inspection is performed by the *special inspector* who is intermittently present where the work to be inspected has been or is being performed and includes but is not limited to the following requirements:

4.5.3.1 For reinforcing steel, including prestressing tendons, and placement.

IBC 2012 Table 1705.3.7 which also references ACI 318 sections 3.5 and 7.1-7.7, and IBC 2012 section 1910.4.

4.5.3.2 To verify the use of the required design mix.

IBC 2012 Table 1705.3.7 which also references ACI 318 chapter 4 and section 5.2-5.4, and IBC 2012 sections 1904.2, 1910.2, and 1910.3.

4.5.3.3 For maintenance of specified curing temperature and techniques.

IBC 2012 Table 1705.3.7 which also references ACI 318 sections 5.11-5.13, and IBC 2012 section 1910.9.

4.5.3.4 To inspect formwork for shape, location and dimensions of the concrete member being formed.

IBC 2012 Table 1705.3.7 which also references ACI 318 section 6.1.1.

Introduction

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Position Statement

5.1 Compliance

5.1.1 Designers, engineers, builders, service professionals, and retail professionals shall comply with all applicable laws and codes and should comply with all guidelines and Genesis 3, Inc. and American Shotcrete Association's Position Statements.

Commentary: Conformance to laws and codes is required. Following guidelines and our other Position Statements is strongly recommended but not necessarily required.

5.2 Competency

5.2.1 Designers, engineers, builders, service professionals, and retail professionals should maintain a pattern of reasonable care and competency in all professional endeavors.

5.3 Responsible Control

5.3.1 Designers, engineers, builders, service professionals, and retail professionals shall maintain responsible control over their work and shall not sign, seal, or formally authenticate drawings, specifications, or contract documents which he/she has no responsible control.

Commentary: Professional engineers and licensed architects call this "plan stamping" and it is illegal.

5.4 Fraud

5.4.1 Designers, engineers, builders, service professionals, and retail professionals shall avoid fraudulent activities such as plagiarism, bribery, kickbacks, etc.

5.5 Misrepresentation

5.5.1 Designers, engineers, builders, service professionals, and retail professionals shall avoid false statements or claims, especially misrepresentation regarding professional qualifications and experience.

5.6 Professional Recognition

5.6.1 Designers, engineers, builders, service professionals, and retail professionals should recognize the professional contributions of colleagues and business associates and avoid claiming work as their own when it was developed with a team.

5.7 Violations

5.7.1 It is the duty of every Member to immediately report to the Advisory Board regarding conduct in violation of the Code of Conduct. The Advisory Board may act on the reported conduct in accordance with the Genesis 3, Inc. Membership Cancellation Policy.

By policing and maintaining the integrity of our membership we help ensure the value of our system to our members and their clients.