MIL – HDBK – 1037.1

TRAINING AND RECREATIONAL POOLS

DRAFT

FORWARD

This design manual is one of a series developed from an evaluation of facilities in the shore establishment, from surveys of the availability of new materials and construction methods, and from selection of the best design practices of the Naval Facilities Engineering Command (NAVFAC), other governmental agencies, and the private sector. This manual uses to the maximum extent feasible, national professional society, association, and institute standards in accordance with NAVFAC policy. Deviations from these criteria should not be made without prior approval of NAVFAC Headquarters (Code 04).

Design cannot remain static any more than can the naval functions it serves or the technologies it uses. Accordingly, recommendations for improvement from within the Navy, other governmental agencies, and from the private sector are encouraged and should be furnished to NAVFACENGCOM Headquarters Code 04. As the design manuals are revised, they are being restructured.

This publication is certified as an official publication of the Naval Facilities Engineering Command and has been reviewed and approved in accordance with SECNAVINST 5600.16.

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MIL – HDBK – 1037.1

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TABLE OF CONTENTS

Section 1.INTRODUCTION

1. SCOPE. Design Manual for Swimming Pools, MIL-HDBK-1037.1, presents observations and criteria pertinent to the design of swimming pools, bathhouses and natatoria for the Navy and Marine Corps. Pools for which the single purpose is training are not included. The facilities discussed include both training and recreation programs for military personnel, dependents and guests.

a. Application of the Design Manual. MIL-HDBK-1037.1 shall apply to all NAVFAC facilities.

b. Publication Format. This design manual is basically divided into eleven sections, with applicable Tables and Drawings located after the main body of text.

c. Emphasis of the Design Manual. Emphasis of MIL-HDBK-1037.1 is on guidelines which can be utilized by experienced, competent engineers, architects, designers and command representatives associated with aquatic facilities in the design and planning of swimming pools, bathhouses and natatoria.

2. CANCELLATION. MIL-HDBK-1037.1 Swimming Pools, of 1998, cancels and supercedes the design and planning criteria on swimming pools, bathhouses and pool enclosures located in NAVFAC DM-37.1 Swimming Pools., 1985.

3. RELATED CRITERIA. Certain criteria related to swimming pools, but not covered in this manual are covered in the following MIL-HDBK-1000/1A:

NAVFACENGCOM DESIGN MANUALS AND MILITARY HANDBOOKS FOR ENGINEERING AND DESIGN

	Source	Subject
a.	DM-01.03	MAY 1985 Architectural Acoustics
b.	DM-02.04	SEP.1986 Structural Engineering-Concrete Structures
c.	DM-03.01	MAY 1986 Plumbing Systems
d.	DM-03.03	JAN. 1987 Heating, Ventilating, Air Conditioning & Dehumidifying Systems
e.	DM-07.03	APR. 1983 Soil Dynamics, Deep Stabilization and Special Geotechnical Construction
f.	MIL-HDBK-1001/2	JUL. 1987 Materials and Building Components
g.	MIL-HDBK-1001/5	FEB. 1990 Roofing and Waterproofing
h.	MIL-HDBK-1002/1	NOV. 1987 Structural Engineering- General Requirements
i.	MIL-HDBK-1002/2A	AUG. 1996 Structural Engineering Loads (Basic Sept. 1988)
j.	MIL-HDBK-1002//3	SEP. 1987 Structural Engineering – Steel Structures
k.	MIL-HDBK-1003/19	May 1987 Design Procedures for Passive

		Solar Buildings
l.	MIL-HDBK-1004/10	JAN. 1990 Cathodic Protection
m.	MIL-HDBK-1004/6	MAY. 1998 Lightning Protection
n.	MIL-HDBK-1006/1	JUL. 1987 Policy and Procedures for Construction Drawings and Specifications Preparation
o.	MIL-HDBK-1006/3B	OCT. 1990 Policy and Procedures for Engineering and Design Criteria Manual Preparation Superceded MH 1006/3A 3/31/89
p.	MIL-HDBK-1006/4	JUL. 1987 Policy and Procedures for Definitive and Standard Drawing and Standard Specification Preparation
q.	MIL-HDBK-1011/2	JAN. 1990 Cooling Buildings by Natural Ventilation

NAVFAC Guide Specifications (NFGS) and Regional Guide Specifications are also a part of MIL-HDBK-1000/1A and are available for reference.

4. OBJECTIVES OF AQUATIC POOL FACILITY

a. Quality in Aquatic Pool Facility. Appropriate quality comparable to similar buildings at the military installation shall be the emphasis of all planning and design programs. Such facilities shall feature exceptional construction techniques and materials necessary for aquatic structures and support spaces.

b. Minimum Staffing Levels. The number of staff members will be dictated by management based upon the size and type of facility.

c. Administrative Efficiency. Administrative efficiency includes the supervisory/ management functions, patron services, staffing levels and economic requirements associated with the aquatic facility. The facility design shall seek the most economical solution regarding the above operational factors.

d. Minimum Life-Cycle Costs. The costs for material, finishes, equipment, HVAC, structure etc. are essential considerations, which impact long-term capital and maintenance costs. Planning must recognize the products and materials necessary for technical applications to aquatic environments.

e. Energy Conservation. Pools, natatoria, bathhouses and supporting mechanical equipment should be designed to take advantage of natural energy sources, where possible, for heating, lighting and ventilation. Energy conservation shall be addressed in all areas of pool and facility design.

f. Automation. Automation of mechanical systems, such as water treatment equipment, pool filtration systems, and HVAC systems shall be provided to conserve labor and energy.

g. Maintenance All planning and design considerations should minimize maintenance costs.

h. Access by the Physically Disabled. Navy aquatic facilities are intended to provide opportunities for aquatic activities for all eligible patrons, visitors, or employees including those who are physically disabled. Such facilities shall be constructed, operated and maintained to provide accessibility for disabled people to all areas. Some climbable apparatus, i.e., waterslides, and diving boards will not be accessible or usable for many non-ambulatory persons. To make such apparatus accessible and usable would require modifications to the equipment and the pool envelope that could be hazardous to segments of the able-bodied population.

The facilities described herein are usable by all authorized personnel and should be made available to everyone on an equal basis. The elements or spaces described herein shall be labeled with signs and/or symbols for use by the physically disabled where specifically required in accordance with Chapter 18, Department of Defense Construction Criteria Manual, DOD 4270.1-M.

5. PARTICIPANTS

a. General Eligibility The primary purpose of a recreation program is to meet the needs of active duty military personnel, dependents and other authorized patrons. Other authorized participants are outlined in the Special Services Manual, Navy Military Personnel Command (NMPC).

b. Fees and Charges. When established, fees should be lower than the fees for comparable commercial activities in the local community. As a general policy, when fees and charges are employed, they should be used to enrich the program and provide service which could not otherwise be offered.

c. Identification. All persons who desire to utilize a recreation swimming facility must produce identification upon entering the control point. Identification may be in the form of an Armed Forces Identification Card, Uniformed Services Identification and any Privileged Cards, or other identification authorized by the Commanding Officer.

6. ADMINISTRATION

a. Procurement. Design and construction of aquatic facilities are the responsibility of the Commander, Naval Facilities Engineering Command.

b. Operational.

(1) Commander, Naval Military Personnel Command is the designated agent of the Chief of Naval Operations for the policy formulation, administration, supervision and execution of Navy-wide, recreational, aquatic program and facilities. As the Navy program manager, overall program responsibilities are delegated to the Director, Recreational Services Department (N-11).

(2) The Commander or Commanding Officer of the installation is responsible for the overall operation and maintenance of aquatic facilities at the local command.

(3) Recreational Services Director is responsible for program administration at the local command.

(4) Aquatic Supervisor/Pool Manager is responsible to the Recreational Services Director at each command for the safe and efficient operation of all recreational aquatic facilities.

c. Pool Staff

(1) Each bathhouse facility is managed by a team of managers, depending upon facility size, configuration, program and hours of operation.

(2) Aquatic staff personnel shall be utilized for the collection of fees, instruction, facility operation, patron safety, supervision and custodial maintenance.

(3) Aquatic facilities shall be supervised by trained and certified lifeguards.

7. NAVY AQUATICS PROGRAMS

The design program shall be based upon management's plans for the patrons' activities. This activity scope may encompass leisure swimming, competitive activities, special events, therapeutic functions, when applicable, and a high level of instruction and training.

a. Recreational Programs. The primary function of the Navy's recreational aquatic program is to provide a safe and healthful environment for the aquatic activity of Navy personnel and their dependents.

b. Aquatic Training. The aquatic facility shall be utilized to support all water based, recreational skill and safety instruction.

c. Fitness Training. The aquatic facility shall be designed and utilized to attain and sustain a high level of wholesome, constructive fitness through both guided and self-guided exercise programs.

d. Therapeutic Use. Recreation pools may be utilized to support therapeutic functions. However, general facility planning and design shall be based on recreational use as supplemented with requirements for the temporary and permanent physically disabled.

e. Competitive Activities. Special requirements for application of competitive programs to the recreational swimming facility shall be incorporated to the greatest degree possible without detriment to the other basic programs.

Section 2. PLANNING FACTORS

1. DESIGN CONSIDERATIONS The design considerations presented herein shall be observed in all planning and design including the number and size of swimming pools authorized and the allowable areas for swimming pools, natatoria and bathhouses,

2. DESIGN THEORY There is evidence that prehistoric people were fascinated with aquatic recreation, both in natural bodies of water and man made pools. Today aquatic recreation occurs in structured and unstructured water activities. In most facilities these two activities are combined in one pool or a group of pools, i.e., the competition length pool, with most, if not all deep water, and the recreation pool, which is mostly shallow water with exotic and dynamic water features which include waterslides, fountains, waterfalls, vortexes and rivers.

a. Design Regulations

The construction documents for any pool requires the approval of a local or higher jurisdictional public health agency. The regulations of one agency are usually similar in standards with other public health organizations.

Even though there may be isolated situations where the project is exempt from military or local regulations, a nationally recognized standard should be used in the design and engineering phases. Such a standard is the NSPI-ANSI Standard for Public Swimming Pools. (See Appendix)

Training/competition pools and recreation/leisure pools should meet the jurisdictional regulations and/or NSPI-ANSI standards to maintain a safe and sanitary environment for swimmers plus complying with the rules and regulations of the appropriate national or international governing body for competitive aquatic sports.

b. The rule making bodies that affect competition/training pools in the U.S., its territories and its commonwealth are the following:

FINA	Federation Internationale De Natation Amateur
USS	United States Swimming, Inc.
USWP	United States Water Polo, Inc.
USSS	United States Synchronized Swimming, Inc.
USD	United States Diving, Inc.
NCAA	National Collegiate Athletic Association
NFSHSA	National Federation of State High School Association

The FINA rules which regulate all international competition in swimming, diving, water polo and synchronized swimming, including the Olympics, is the recognized standard. National rules may modify the FINA rules to apply to competition characteristics and traditions more suited to a country's sports history, i.e., NCAA measures short course events in English standard rather than metric.

Unless there is a justified exception, all military pool dimensions and features should comply with FINA rules. (See Appendix for comparison chart from official Design Compendium published by the National Swimming Pool Foundation.

3. SITE DEVELOPMENT

a. Planning/Designing the Site

The site planners' role is to understand the preliminary design program of the project and to then analyze the site and its physical characteristics with that program in mind. The following is an outline of key site issues that must be recognized and interpreted as to how they can best be matched with the design program:

b. Location/Orientation

The location of the facility is often limited to only one choice; however, sometimes there are several options. These options are either on the same site or separate sites. If the possible locations are on the same property, many site characteristics will be the same but some may be different. Things to consider are the following:

1. Orientation of the future outdoor facility:

- Relationship to existing recreation buildings and site.
- Sun orientation
- Prevailing winds
- Surface and subsurface drainage
- Existing utility location
- Vehicular access to the facility and circulation issues including drop off areas, service/supplies, parking and emergency vehicle access.
- Contiguous or nearby land uses that may impact site, i.e., visual, smell, noise

2. Orientation of future indoor facility

- Relationship to existing recreation buildings and site.
- Sun orientation for fenestration of natatorium
- Sun orientation for outdoor sun deck
- Sun orientation and its influence on heat relief and heat gain issues at building entrance and fenestration.
- Prevailing winds that may influence roof design
- Surface and sub-surface drainage
- Existing utility locations
- Vehicular access to the facility and circulation issues including drop off areas, service/supplies, parking and emergency vehicle access.
- Contiguous or nearby land uses that may impact site, i.e., visual, smell, and noise.

c. Soil and Water Table Conditions The condition of the sub-surface material is a fundamental factor in the design, construction and life experience of the facility whether it be an outdoor center with support enclosures such as a bathhouse or an

indoor year 'round complex with one or more pools. The soils report prepared by a licensed geotechnical engineer is the key information in deciding the types of foundations and footings for conventional soils as well as unconventional alternatives in the presence of abnormal water table, aquifers, subsidence, expansive soil, rock formations and lava tubes.

The geotechnical condition that exists below surface and the resulting cost to stabilize a structure can significantly impact the project cost. For that reason, the designer must understand the conditions and the various ways to solve the problem because one option may be better for the life of the project than another. Also, the design engineers must understand the possible ramifications of the various design solutions. For example, expansive soils are common in parts of the United States and several design solutions have been used to support structures such as pools.

1. Over excavate and replace with engineered fill to an appropriate compaction per cent as specified by the geotechnical engineer.
2. Over excavate and structurally support the pool tank(s) over a void with piers to refusal or with friction piles. The height of the void is calculated to exceed the rise of the expansive soil when hydrated.

Another common design problem that often confronts a structural engineer is a high or fluctuating water table. If the water table often rises to near the ground surface, the pool has a constant potential of "floating" a meter or more out of the ground whenever it is emptied, which is annually for most outdoor pools in regions with summer only use. An indoor pool may be emptied every one to five years, depending upon the maintenance policy of management. The frequency doesn't matter. Every time the weight of the water is removed from the pool tank, the potential exists for the pool to be buoyed up by the hydrostatic pressure created by a high water table.

This potential for costly damage to the pool, deck, piping and building enclosure is avoided by several different design strategies. The first is to install a sufficient number of hydrostatic check valves in the bottom of the pool shell to neutralize the hydrostatic pressure by releasing ground water into the pool tank as the pool is drained. Another option is to combine a limited number of hydrostatic valves with an automatic dehydration system of the water table that is activated when the pool begins to empty. The third alternative is to prevent the pool from ever floating by increasing the thickness of the concrete floor thus creating ballast to overcome the upward pressure of the high water table.

All three, and these are only three, have advantages, however, the ballast option has a benefit the others don't because it is fail-safe (if properly engineered) because it is completely static. There are no moving parts to fail, no collector tubes below ground to clog over time and no motors and switches to malfunction.

(The protocol for geotechnical soil analysis is described in Section 4, subsection 5.)

d. Landscaping. Landscaping must be incorporated in all pool facility designs. The site shall be landscaped to provide privacy and screening. from adjacent activities. The ground area within the perimeter fence shall be planted with grass, and preferably sodded if the budget permits. Landscaping shall enhance appearance while requiring only minimal maintenance.

The landscaping of a poolscape is done for several reasons. The most important is to create a fabric of plant material to surround and compliment the aquatic center. How this is done will be influenced by climate, the choice of local plants/ground cover and the landscape designer's theme.

Perhaps equally important is the use of large landscape elements to screen wind, provide shade, shield visual and sound sources that are considered undesirable. Some people consider trees near a pool to be an unacceptable arrangement because they presume the trees will shed leaves and create a housekeeping problem. There are situations where this can occur but often the beauty and softness that is achieved with appropriate species is worth the limited sweeping and vacuuming of the pool. Likewise, the choice of plant material can deter birds and insects. The seasonality of the location and prevailing winds are all factors in developing a successful landscape design solution.

e. Climatic Considerations. Outdoor and indoor/outdoor pool facilities shall be sited to take advantage of available winter sun and summer breezes while providing shelter from harsh climatic conditions. Plantings, windbreaks, and relationship to adjacent buildings shall be selected with energy conservation in mind. In indoor and indoor/outdoor pools, the long axis of pool enclosures should be in an east—west orientation to allow for a larger southern exposure when beneficial.

If there is support for the use of a swimming pool in an unlikely location, the pool can be built. Construction techniques can create a pool **on mountain sides, cantilevered over cliffs, three stories below the street level, in a sandy beach, on top of lava tubes, in the Arctic, any place on earth that someone wants to swim in a pool.** It's a matter of budget. Budget to overcome the design and construction challenges and budget to operate the complex.

Outdoor facilities are influenced by weather while indoor facilities must be designed and engineered so that the building can operate efficiently during the twelve-month cycle. The designer must understand the program requirements and how to integrate the poolscape with the climate. See Sections 4 and 5.

f. Topographical Considerations Choosing a site solely for topographic characteristics is a luxury. Most potential recreation sites are available because they are part of an overall master plan where competing priorities influence which land use goes where. Therefore, planners most often apply their skills to adapting a less than perfect site to the requirements of a specialized development.

Excluding views and panoramas, which cannot be evaluated in this document, more fundamental issues such as space available, surface drainage and distance from access roads and/or utilities are major considerations. Conventional wisdom states that

an outdoor pool or natatorium should be built on high ground and not in a surface water runoff or a low point on the property. The reason is not only to minimize surface water ponding and flooding during heavy downpours but also the potential for a rising water table creating destructive hydrostatic pressure under the pool. Rainy seasons sometimes correspond with emptying outdoor pools for pre-season cleaning which can result in a worst case scenario for floating a pool.

Other site factors to consider are existing topographical features such as contours, large stands of trees, natural existing bodies of water and logical approaches for both pedestrian and vehicular traffic to the complex. In some cases, contiguous land uses are driving issues that emphasize related topographical features.

g. Circulation Traffic circulation for an aquatic center is similar to most public recreation facilities. Entry to the site must take into account the major access roadway; the desired visual approach to the complex, the drop off zone, if children will be a major portion of the user population, plus a parking area, a pedestrian walkway system, and possibly a separate bike path network and a service road access for delivery of chemicals and supplies for food services.

There is one unique characteristic of an outdoor swimming pool complex. There is really no back door. No "back of house" area for snack bar and chemical deliveries, refuse collection, storage, service access and pick up,. Therefore, these needs must be planned for in a non-conventional way, with screening walls or berms, road turnaround, trash container pad and delivery off loading areas.

An indoor aquatic center can function more like a conventional building with an entrance and an out of site delivery area with refuse storage and pick up.

h. Indoor/Outdoor Relationships. Recreational pool planning shall emphasize the development of indoor/outdoor aquatic facilities. indoor/outdoor pools may be sited with other recreation service elements in development of the recreation or aquatic complex. In larger, populated areas, the indoor/outdoor swimming relationship may be supplemented during the summer season by beaches, lakes, and other available outdoor pools.

A natatorium can be created with a contiguous outdoor feature that requires user access back and forth. These features can include a sun deck, a secondary outdoor pool of varying size or even one large pool, a part of which is enclosed and the other part outdoors year 'round. In all of these cases, the outdoor facilities face a south and west exposure (in the Northern Hemisphere). Such an orientation bathes the outdoor amenities in afternoon sun and is therefore inviting to users. There are some sites in the warmer to hot climates where unacceptable temperature and sun exposure may dictate eastern orientation if the natatorium enclosure is tall enough to create a functional sun shade during the late afternoon hours.

4. POOL TYPES: TRAINING/COMPETITION AND RECREATON/LEISURE

a. Training/Competition Pools:

A competition sized pool is designed in accordance with rules stipulated by one or more governing bodies, i.e., FINA or a national confederation or association. Such a pool can then be used for training athletes of all age groups, fitness lap swimming, aquatic aerobic exercise and swimming lessons for all skill levels including parent and infant. The course lengths can be 22.9 meters (25 yards), 25 meters, 50 meters. The pool widths will vary but are sometimes wide enough to accommodate a short course (22.9 meter [25 yard], 25 meters) cross pool lanes, 50 M pools usually feature eight to ten long course lanes.

If the pool is to be used for invitational competition events, a number of support features and spaces will be required including spectator seating (deck seating, mezzanine seating and gallery seating), timing station, meet management room and athlete waiting area.

b. Recreation/leisure pool. The contemporary recreation/leisure pool is considered a freeform body of water, consisting mostly of shallow water and featuring participatory water recreation elements such as waterslide(s), a river, fountains that can be partially controlled by users and tethered floatables for riding or as water walks with ropes and cargo nets overhead for balance. Leisure pools also feature zero beach areas for walk-in access, which are popular with all ages. Larger leisure pool complexes occasionally include wave pools, which can be of various sizes. There are even projects with small wave systems in wading pools.

c. Special Use Pools, The name "special use" is listed by some health departments to recognize pools that are used by a population that is unique compared to those who use the pools described above. Such pools are designed for the physically disabled or impaired, ambulatory and non-ambulatory, continent and incontinent. These pools can be in hospitals, rehabilitation centers, aquatic therapy centers and health clubs. The users range from quadriplegic patients to people temporarily disabled with sport or workplace injury.

A special use pool can also be an athletic training facility for race swimming, diving, water polo and synchronized swimming, especially if a high level of technology will be used to analyze the performance and development of the athletes. Such technical features usually include underwater cameras, overhead cameras, pressure plates, monitors for pulse rate, blood pressure and even blood analysis. Other special use pools may be used for non-conventional aquatic uses, i.e., equipment and systems testing for NASA, industry, university laboratories, military and governmental agencies.

d. Outdoor Pools As a general rule, outdoor swimming pools are primarily utilized to support recreational aquatic program and generally support a 90-day aquatics program.

Outdoor pools can be classified as seasonal and year 'round which is determined by climate and/or the user market. For example, an outdoor pool, which is used 12 months a year in a tropical locale is common place but there are also usable outdoor pools in the winter when the sun is hot and the wind is screened. The outdoor pool has an advantage over the indoor pool because the pool and poolscape can be much larger and flexible in shape arrangement since it is not limited by the building footprint nor impacted by the enclosure's construction cost. The flexibility and size of the outdoor pool can result in larger attendance than the indoor pool for the same number of days of operation. If an indoor aquatic center is constructed for the same dollar amount as an outdoor complex, the indoor facility will be much smaller with fewer users during the outdoor season but possibly the same over 12 months as the outdoor pool during the three summer months.

e. Indoor Pools Indoor swimming pools are appropriate at commands where mission or training requirements demand year-round aquatic capabilities, and/or extreme weather conditions necessitate the use of an enclosure.

Activities for an indoor facility suggests that the first priority is a lap pool where attendees can learn to swim, learn to swim better, faster, farther, different strokes and different applications, i.e., scuba, swim team, synchronized. Indoor aquatic centers are usually associated with an institution that provides organized programs and a conventional lap pool tends to provide greater flexibility for all ages and skill levels than a leisure pool shape.

If capital funds are available for both a lap pool and a leisure pool, the latter adds a recreation and entertainment dimension to the indoor aquatic center that creates a more dynamic natatorium than one with only a lap pool. The organized activities attract a small number of attendees but they attend frequently, i.e., lap swimming, swim team, swim lessons, aqua aerobic exercises, etc. In contrast, those who use the leisure pool, other than users who participate in organized activities and then extend their stay to use the leisure facilities, tend to visit less frequently but they will travel a greater distance and stay longer, therefore, their total numbers are significant.

The combination provides a well-balanced aquatic attraction for a population that will respond to such a variety of activities and amenities.

Indoor pools should be designed only where appropriate and when an indoor/outdoor swimming pool proposal has been evaluated as not being required or feasible.

f. Indoor/Outdoor Pools Indoor/outdoor swimming pools permit continuous utilization while reducing requirements for unnecessary facility and staff duplication. In general, this type of pool is preferred if an indoor pool is appropriate, in accordance with the criteria above. The indoor/outdoor pool will conform to the requirements of indoor pools applicable to use in other than the summer season and will conform to the requirements of an outdoor pool's summer use.

This unique pool design is seen more often in Europe than in the rest of the world. The appeal of the indoor pool with a swim channel through the natatorium wall to an outdoor body of water may have its genesis in the popular use of hot mineral springs (spas) during cold weather, especially in Scandinavian and mountain regions of European countries further south. Whatever the reason, both resort spas and public aquatic centers in Europe frequently have an outdoor pool connected with a channel to the indoor pool so users can swim back and forth year 'round.

Other versions include a convertible enclosure where the roof is partially removed by motors. This feature converts a natatorium into an open air area with outdoor weather. Some European natatoria are able to remove all or a major part of their building enclosure, which converts the indoor pool into a truly outdoor facility with a minority percent of walls and roof complete with unlimited sun, wind and rain exposure. Regardless of the percent the roof opens, there is an immediate change in the relative humidity level when the outside humidity is lower than that in the natatorium, which is most often the case.

g. Above-Ground Pools. Most public pools, regardless of type, are built in the ground because that protocol is more economical and efficient than a pool and its systems supported above grade. There are occasions, however, when site conditions or overall economics will dictate that the pool(s) be built out of the ground. A roof top pool on a high rise building is an obvious example. Poor soil, an underground rock formation or a cliff can force the pool to be structurally supported. When these situations occur, design and material options present themselves. Roof top pools are often made of stainless steel and occasionally aluminum because the weight of the vessel is much less. The side walls of heated, above-ground pools should be insulated or, as a minimum, protected from exposure to winds.

h. In-Ground Pools The cost benefit of in-ground pools exist when stable/soil provides support for the pool shell, the piping systems, and electrical conduits. Another advantage the in-ground pool has over the above ground structure is the lower cost of the installation of the pool deck. A reinforced deck poured on grade is much more economical than a structural deck spanning a void and cast on top of beams and piers.

As a general rule, in-ground pools shall be constructed of one of the following:

(1) Cast-in-place concrete
(2) Pneumatically applied concrete
(3) Poured-in-place concrete floor with pneumatically applied concrete walls
(4) Stainless steel walls and floor
(5) Stainless steel walls and poured in place concrete floor.

5. POOL CONFIGURATIONS. Swimming pools shall be designed to encourage patron's safety, minimize staffing, simplify management, resist vandalism and enhance services.

Swimming pools have been part of the human experience since Roman times. During those centuries the "bathing" experience was really a social event where people met and

conversed about current events, politics and business. While the common perception based upon period films is a setting populated by powerful leaders, historical research indicates most "baths" were for the hygienic benefit of the masses. Similar public bathhouses appeared during recent European history for the working class and the poor, again for hygiene purposes since urban living quarters had no such facilities.

During the late 19th Century, man-made swimming pools began to appear, attracting people away from the more dangerous rivers, lakes and ocean beaches. Because of conventional construction methods and techniques, rectangular tanks were constructed. Then with the popularization of competitive swimming and the accompanying standardization of dimensions, public pools began appearing in several uniform lengths and widths. This led to more training and competitive swimming, which drove the creation of many more pools of competitive length. As a result, the great majority of public pools built for all types of owners including the military have been designed to competitive swimming and diving standards even though few hours, if any, of the pool time is used for these activities. Most of the pool time consists of recreation and instruction.

a. Freeform Rectilinear

It was not until the evolution of the leisure pool concept did pool shapes begin to reflect the areas associated with density of use or water feature location, i.e. waterslide, participatory play equipment, river, etc. The planning and design discipline applied to the new freeform leisure pools occurred after ratios were developed in the industry that identify capacities for different features and activities for frozen capacity at peak hours as well as daily capacities which can in turn be interpolated into seasonal attendance projections. As a result, outdoor leisure pools can emphasize the zero entry area because small children are a large part of the market. Waterslides of all sizes are popular with the various age groups. These features require a large area ratio per use but the stair to the slide can accommodate a large number of attendees out of the water. Other activity areas have their own unique capacity requirements.

b. Rectangular, "L", "Z" and "U"

The length of a rectangular pool is usually a competitive length with deep water at one end with diving boards and shallow water (.9M – 1.2M) at the opposite end.

A modification of this shape is an "L" configuration. The "L"area can be for a diving board zone outside of the race course in the rectangle. The size of the "L" is usually a function of the number of diving boards and platforms, their lateral clearances and forward distance requirements. The "L" can also be a shallow water alcove with water depths varying between zero and 1.M – 1.2M whichever is required to match the contour of the rectangle pool at the point of connection.

When two alcoves are attached to the rectangular pool, the pool is called a "U" shape or a "Z" shape.

c. Multiple Pools. Multiple pools are common in both outdoor poolscapes and in natatoria. Whether the facility has two or more than two bodies of water, the commonality of such complexes is a large and diversified demand. Specific activity

requirements can sometimes justify or even demand separate pools, i.e., a 2 meter deep competition racing pool with a separate and warmer diving pool that has a required minimum depth of 5 meters for a 10 meter tower. A third body of water could be a warm water, shallow teaching/warm-up pool and a fourth could be a whirlpool spa.

A leisure pool complex might feature a wave pool, a shallow water 0 M to 1.2M deep activity pool with participatory play features, a separate plunge pool for waterslides and an endless river. In both of the examples, the separate pools can be combined into one large tank encompassing all of the features. This can be beneficial from the point of construction cost, labor costs, operation and maintenance cost. The reason for the cost savings is the smaller project footprint for only one pool both indoor and outdoor.

The users may object to some of the restrictions the large single pool creates. In the competitive tank the temperature required by the swimmers is 3 to 5 degrees (C) below that of divers. The diving pool and the teaching pool is a similar temperature, but the required water depths vary from 5M to 1M. Most regulations require a maximum 1:12 ratio of slope when changing depth from zero to 1.5 meters and a 1:3 ratio of slope when changing from 1.5 meters to a greater depth. These slope requirements require significant horizontal dimension and resulting areas.

The leisure pool complex offers a similar challenge although water temperature is not an important factor. What drives the separation of tanks is demand. Bather load during peak times is a management issue. Typical users move from feature to feature. Foot traffic, swimmers in the pool and queuing either in the water or on the deck sometimes indicates the advantage of separate pools. Likewise, cost savings can be experienced without compromising management and entertainment value with one large pool, which includes all features.

Other factors that can influence the decision between multiple pools and one pool (outdoor and indoor) is area available, topographical contours, geotechanical profile of the site and available budget.

6. ACTIVITY ZONES

The design solution can be a simple one with a reasonable construction cost. The bathhouse shall reflect the architectural characteristic of buildings on the base unless there is a decision to create an aquatic or recreation statement. (See 1037.1-A3, A4, A5)

a. Bathhouse The bathhouse functions as a service facility for the activities related to the aquatic program. Its purpose is to accommodate the requirements of the patrons through the provision of dressing areas, lockers or baskets, toilet/shower facilities, first aid/guard room, and pool administration. For the management of the pool, it provides the control center, offices, staff facilities, and storage rooms for equipment and supplies. Through proper orientation the structure may also provide protection against prevailing winds.

The entrance should be emphasized with a sun relief overhang if the local climate experiences near 35 degrees during the season and to identify the access to the control

point. A control station must be provided at or near the entrance. A public or semi-public outdoor swimming facility is unique. Although cash payments are made for admissions, i.e., guests, most attendees use some form of pass. It may be most effective for control to collect the passes at the bathhouse entrance and then return the pass when the passholder leaves at the end of the visit. If large numbers of patrons enter and exit the facility throughout the day, a control kiosk or desk is efficient. Those entering present their pass at the front of the kiosk counter and then pass to the right into the bathhouse common space with entry to the dressing rooms or to the pool deck. Those leaving pick up their pass at the pool side of the kiosk and again pass the kiosk to their left. This conventional pattern avoids conflict in the circulation during times of heavy traffic.

The bathhouse dressing rooms must include the following: benches, lockers, some dressing booths, and with at least one for the physically disabled. Toilet plumbing fixtures are determined by the applicable building/plumbing code and/or health department regulations. Lockers can be located in the dressing rooms or in a common area outside the dressing rooms. The latter arrangement is efficient for outdoor facilities where most attendees arrive in swim apparel and desire only a security lock for valuables. These small lockers can be located in the common area of the bathhouse or on the deck near the bathhouse. The latter location usually requires a rain and sun shelter for the lockers.

The use of clothes baskets, a basket room with an attendant, has almost disappeared due to the high labor cost and the popularity of beach and swim wear that dries quickly allowing swimmers to wear their swim suits to and from their quarters. The emphasis of management has shifted to securing valuables.

Many current facilities, both outdoor and indoor provide family dressing rooms where a parent can change one or more children of the opposite gender and then by-pass the respective men's or women's dressing room. This family dressing room, which can also be used by the physically disabled, is usually 5 to 10 M^2 with a padded bench 1.5M x 1M, without a H/C shower, lavatory and toilet. Multiple units are common.

The bathhouse also contains one or more management offices, a snack bar, storage, filtration and chemical rooms. For many decades the custom has been to build a dedicated filter building behind the deep end of the pool. This was rationalized as a way to minimize the piping run from the main outlets to the surge tank and the filter. Experience has shown that the savings in pool piping is exceeded by savings in utility runs for electric, sanitary, potable water, gas (if required) and in a service driveway for deliveries as well as a necessary filter building construction cost. When the filters are located in the bathhouse, at or below grade, all utilities go to one location and deliveries can be scheduled for off hours allowing vehicles to use the main circulation pavements.

b. Pools The destination point for attendees is the pool(s), with the various water activities taking place in one or more bodies of water. These pools must have structural systems, filtration, chemical treatment, recirculation via a perimeter overflow system, a heating system, and materials for interior finishes.

c. Swim Pool Deck The fundamental purpose of the concrete deck around a pool is to avoid a muddy, slippery, unsanitary morass. Since concrete or stone walkways have been constructed around pools for centuries, it is easy to understand the primary function of this apron pavement. The design has been enhanced with drainage networks and extensions have become sidewalks and pathways connecting related activity zones, such as outdoor court games like volleyball, basketball, shuffle board and even tennis. Decks also provide space for furniture and sun relief structures as well as landscape treatments.

An indoor poolscape will usually follow the same principles of design as the outdoor, but there are modifications. The foot traffic, i.e., approach, control, access to dressing rooms are the same. However, if the aquatic center is part of a larger recreation complex, there is likely to be variations in control, locker room size and layout, adjacencies, physical design of building systems, additional mechanical systems and the interface or isolation of utilities and systems.

d. Hydrotherapy Pools. Hydrotherapy pools or whirlpool baths, at the option of the command, shall be installed either as a contiguous feature of the pool or as a separate entity in the deck or even in the dressing rooms of an indoor or indoor/outdoor pool.

7. PUBLIC AND SUPPORT SPACES (See 1037.1 – A15, A16)

a. Lobby Area and Control Point This space, in either an indoor or outdoor aquatic center, serves as a conduit between the control point and the pool(s). It can also be a congregation area before the control point. In an outdoor facility this pre-control point assembly area is often called a "plaza" which accommodates queuing for the control point(s). At either location the space is part of the transition, from outside of the aquatic center, through a control system to support spaces such as the dressing rooms and showers and then to the pools.

b. Dressing Rooms The dressing rooms for men and women are usually laid out in a conventional floor plan with each having two portals. The first is from the dry area, i.e., lobby and is for shoe traffic. The opposite portal is for wet barefoot traffic. The traffic flow in the dressing room is customarily dry side portal to the dressing and locker area. Once the user has changed to swim wear, traffic passes to the toilet area and then the showers which is the last specific area before exiting the dressing rooms to the pool deck and ultimately the pool. Most health department regulations require that the showers be between the pool exit portal and the toilet facilities. This appears to be based upon the assumption that the shower location will remind patrons to shower after using the toilet facilities. How effective this arrangement is as an auto-suggestion is unknown but it does appear to be a better location than any other. Several decades ago many health departments required the traffic pattern to pass through the showers and then through a foot bath before exiting onto the pool deck. In the 1990's circulation is permitted to pass-by the shower area and not to walk through the showers. Footbaths have disappeared from most regulations based upon their ineffectiveness.

c. Public and Spectator Toilets. In earlier decades, many bathhouses for public pools featured restrooms located on the outside walls of the structure thus creating public toilet facilities for non-users of the pool. In the 1990's the value of these small restrooms has waned because of the limited use, the vulnerability to vandalism due to lack of supervision and the use of these spaces for unintended purposes.

d. Pool Control Office. The number of offices at a pool will vary depending upon the activities and management policy at the facility. An outdoor seasonal facility will have an admission control point that is either a stand-alone structure near the pool manager's office and/or the **pool control office**. The latter is an office where staff works, does paper work and brief meetings occur. Records are kept in this office and it is generally the nerve center for managing the aquatic center and support spaces.

In larger aquatic centers with larger programs, more offices may be required, i.e., the lifeguard/first aid office, instructor's office, coaches' office(s).

e. Pool Manager's Office. Year 'round facilities with pool hours ranging from early in the morning to late evening, 7 days per week and with a large staff can generate additional administrative time. Therefore, a separate office for the pool manager and the assistant manager can increase the efficiency of the operation by providing a private work space that can be secured when no occupants are in the room. Most facilities that do not have this dedicated office space for the manager and his or her immediate staff require the key management team to carry out their work in a common room that can become a cluttered and confusing congregating area over the period of several shifts.

f. Lifeguard Room. With the exception of small pool complexes, lifeguard rooms are being provided for these staff members. This space is used for break time, changing clothes and posting of job assignments and schedules. This room can also serve as the first aid center with medical supplies, a sink and toilet. 9 to 12 M^2.

g. Storage Area. There are usually three storage zones at an aquatic center. A dry storage area for office supplies, food supplies and housekeeping supplies. These items are not homogeneous and the dissimilar materials must be stored at different locations in the building. The second zone is for pool chemicals. Depending upon the chemical system, there may be one or possibly two locations. The third zone is custodial and loose pool equipment, which is homogeneous in most respects and can be a single location, although convenience may dictate several small locations. The commonality of this latter equipment is that it frequently is wet when it is stored. It consists of pool cleaning equipment, competition equipment such as racing lanes, reels, water polo goals, kickboards, rescue tubes, etc. Such equipment storage space should feature waterproof surfaces and a floor drain.

There are two ways to plan storage space. One is to ask the pool manager what will be adequate. The other is to identify all of the equipment that will be used at the pool and layout a floor plan, wall plan (mount) and ceiling plan (hang). Consideration should also be given to shelves, lockers and wall storage bins.

h. Filter and Pump Room. Understandably, this is space that is as important as the pool itself. The recirculation system is made up of key process and delivery equipment necessary to maintain a sanitary body of water for human immersion. The filter room must have certain features. Obviously, all of the equipment must be inside the room for security reasons and life cycle experience. If the filter room it is at deck level, an access to the pool deck is recommended for the benefit of operations staff so they can check the pool after adjusting or cleaning the systems. If the filter room is below grade, deck access should be as convenient as possible. (See 1037.1 A43)

If the filter room is at deck level, a depressed pump pit (1.2M) shall be created so all pumps have a flooded suction. A pump pit is an ideal location for the probe sensors and a static line from the pool for the water level controller. The pit must have a floor drain to carry off spillage when the hair and lint strainer is cleaned and other minor releases of water.

Contiguous spaces to the filter room include the chemical room with a separate space or even rooms for the primary sanitizer and for the chemical buffer. If an ozone generator is used, it also will have a separate room. Likewise if a boiler room is near, it should be separated atmospherically from the chemical and buffer rooms. An off-loading area with delivery access for chemicals, supplies and maintenance services must be planned.

An indoor year 'round aquatic center in a seasonal climate will require some form of conventional heating, ventilation and air conditioning. In some projects dehumidification is an isolated recirculation system in which the captured heat is used to warm the pool water, potable water or the natatorium air. Regardless of the mechanical system, it should be in a separate space from the filter and chemical rooms. The area required for the mechanical equipment can be as great as 20% of the natatorium surface area. If the local climate and the owner will permit roof top units, the indoor space can be reduced.

i. Electric Panel Station. The switch gear (electrical) room is usually at or near the filter and mechanical rooms although other locations are sometimes dictated. If the natatorium will be used as a televised venue, then the switchgear room should be easily accessible to the TV vans for required power. Sometimes this requirement is met with outdoor tombstones with power, phone and even water hook ups at the parking area for vans.

j. Food Service. Food Service is a common design program requirement. It is a desired feature in many types of aquatic centers especially outdoor poolscapes where attendees spend longer time and in a more leisure mode than at indoor facilities. Food service operations greatly depend upon the setting, the climate, the use of the pool(s) and most importantly, the size of the attendance. Small facilities frequently have a vending machine enclosure off the pool deck. A large leisure pool complex will predictably develop a large menu with counter service and in some cases a cafeteria line and/or buffet. The food service protocol must respond to the demand of the attendees but not more so. Frequently food service facilities are criticized as being too small. Other

projects find that the food service system was over built and therefore inefficient. In today's world of fast food service, there is no justification to prepare meals on site, rather food processed off site and then served at the concession stand is most common at existing facilities. The basic menu mix consists of something hot, something cold, something dry and something wet served with the aid of ovens, warmers, soft drink dispensers, ice machines, refrigerators and popcorn machines.

j. Spectator Seating. Spectator Seating is more often associated with natatoria than with outdoor pools that are used primarily for recreation. Spectator seating is universally associated with competition in any sport. For swimming, the seating shall be located with viewing from the side of the course so the spectator can follow the race, water polo matches and synchronized swimming from end to end. Likewise the viewing of springboard and platform diving is preferred from the side, not head on.

Seating locations vary. Deck seating is usually found in small natatoria with short course pools, i.e., 25M. Larger natatoria with diving platforms and long spans develop overhead clearances that will easily accommodate second floor gallery seating. Sometimes budget or other influencing factors leads the designer to create mezzanine seating where the first row is 1 to 1.5 meters above the pool deck which improves the line of sight over deck seating but is not quite as desirable as gallery seating. Like those sitting in deck seating, spectators in mezzanine seats can still have their view blocked by athletes and officials walking on the deck. End seats are sometimes provided when building configuration dictates and the primary racecourse is short course across the long course pool. It's likely that everyone prefers side seating. It is only when extraordinary circumstances exist that alternative orientations occur.

Seating construction can vary. Permanent seats are often considered the first choice due to easier housekeeping tasks and lower annual costs. However, when other issues are considered such as first costs, convertible space, frequency of competition events, emergency exit requirements, density of spectators and parking requirement ratios, a mixture of seat construction types are considered, i.e., retractable, temporary and portable.

Other factors that must be considered with spectator seating is approach, controlled access, traffic patterns that do not cross wet decks, ADA design issues, emergency exits and custodial implications and parking requirements.

A typical seat count for a short course (25M x 18.2M) natatorium is 100-250 seats.

A long course pool (50M x 22.9M) that will host major competition can require 1000 permanent seats plus 500 temporary seats. A frame of reference follows: U.S. Division I universities with highly developed swimming and diving programs that wish to attract the National NCAA Championship meets frequently provide 1000 to 2000 seats made up of both permanent and temporary seats. The U.S. Olympic Festival requirements were 2500 to 3000 seats prior to that events demise. At the top of the scale is the Olympic Venue for aquatic sports with a requirement of 15,000 to 20,000 seats which includes up to 1/3 reserved for VIP's, the Olympic family and the media.

Military facilities, which will host multi base teams, will require 250 to 500 seats. Since these events are infrequent, a combination of permanent and temporary seats are the most cost effective.

8. POOL ENCLOSURES

Training/Competition Pool(s)

An indoor aquatic center is a building consisting of two or more rooms. One room is the natatorium, which contains one or more pools.

a. Indoor Short Span Indoor short span natatoria house pools in the $280M^2$ to $930M^{2.}$ and have a narrow width, i.e., 28-30M. Such a space can accommodate all types of pools as long as their widths are in the range listed above. A short span across the building offers greater variety of materials in the relative cost range. Concrete is considered a first choice for life cycle costs due to its total resistance to corrosion and its lifetime durability if properly coated. A concrete roof system can be cast-in-place with beams and deck, it can be built up with precast T's and precast planks or it can be a combination depending on the structural type of the building.

b. Indoor Long Span. When the natatorium width exceeds 35 meters, the depth of the beam and its length begins to add significant costs for both fabrication and for delivery. At these costs alternative roof structural systems become attractive. The most economical systems are steel trusses, which must be covered with a high build epoxy coating to protect against corrosion. Glulam beams with wood decking has been successful when the wood is properly processed and humidity in the natatorium is controlled. Tensile roofs are successful in some building types if budget is available for first cost and environment control. If a steel system is chosen, the trusses should be tube or box type. Bar and angle joists are difficult to coat and recoat due to recesses and the high number of welds, bolts and webs. Corrosion quickly occurs in these poorly or non coated points.

c. Typical Natatorium Program Spaces, and Systems. The program of spaces for a natatorium is a list with dimensions and area of each respective room and passageway. This document is developed as a predesign tool to assist the designer in identifying the spaces, which comprise the total aggregate building. Construction cost values are given to the spaces, which result in a planning estimate. Should the budget be exceeded by these calculations, the size of the program spaces should be revisited before valuable time is consumed in design.

Example of a Design Program of Spaces:

TYPICAL AQUATIC CENTER

The following area requirements are recommended for a typical Aquatic Center with a 50M pool and a leisure pool:

1.	Natatorium with 50M x 22.9M Pool plus a 975 M^2 /Leisure Pool	2783 sq. meters
2.	Spectator Seating	269 sq. meters
3.	Lobby Entrance	81 sq. meters
4.	Stairway	89 sq. meters
5.	Trainer's Room (19 sq. meters each x 2)	38 sq. meters
6.	Locker Rooms	
	- male	75 sq. meters
	- female	129 sq. meters
	- male adult	39 sq. meters
	- female adult	52 sq. meters
	- male ADA	6 sq. meters
	- female ADA	5 sq. meters
7.	Unisex Dressing Room	12 sq. meters
8.	Offices	
	- administrator	17 sq. meters
	- coach, instructor	7 sq. meters
	- lifeguard, first aid	14 sq. meters
	- computer	9 sq. meters
9.	Classroom	56 sq. meters
10.	Storage	54 sq. meters
11.	Filter Room	200 sq. meters
12.	Pump Room	21 sq. meters
13.	Weight Room	136 sq. meters
14.	Nursery	25 sq. meters
15.	Control Point	10 sq. meters
16.	Administrative/Bookkeeping	29 sq. meters
17.	Dry Toilets for Spectators	37 sq. meters
18.	Snack Bar/Vending Area	14 sq. meters
19.	Physical Therapy Rooms	33 sq. meters
	SUBTOTAL	4240 sq. meters
	Walls and Circulation @ 10%	424 sq. meters
	TOTAL	**4664 sq. meters**

SECTION 3. GENERAL DESIGN FACTORS

1. DESIGN CRITERIA MOST OFTEN USED IN THE INDUSTRY:

Source: National Spa and Pool Institute – American National Standards Institute, ANSI-NSPI – Public Pool Standards
State Health Department Regulations
FINA
NSPF - CPO
Counsilman/Hunsaker & Associates

a.	Chlorine Level	=	1.5 PPM 700 MV Oxidation Reduction Potential
b.	pH Level	=	7.2 to 7.4
c.	Bromine Level	=	3.0 ppm 700 MV Oxidation Reduction Potential (confirm)
d.	pH Level	=	7.2 to 7.4
e.	Total Alkalinity	=	100-120 ideal 80 – 140 acceptable (confirm)
f.	Calcium Hardness	=	200-400 ppm (confirm)
g.	Total Dissolved Solids (TDS)	=	200 – 600 ppm ± (confirm) Replace water when TDS reaches 1200 ppm
h.	Water Temperatures:		
	Competition Pool	=	26º - 28º
	Recreation Pool	=	30º - 31º
	Spa	=	39.5º
	Therapy Pool	=	31º - 35º
	Unheated pool temperature determined by ambient temperature over 24 hour period.		
i.	Indoor Air Changes	=	6-8 changes of natatorium air volume/hour with 25% outside air minimum
j.	Indoor air temperatures	=	1 deg. above water temperature of competition or recreation pool. Temperatures of spas and therapy pools are excepted.
k.	Indoor Relative Humidity	=	50% R.H. during normal operation
l.	Dewpoint	=	17 deg. (approximately) with air temperature of 29.5 deg.
m.	Air Velocity	=	less than 7.6 m/min. up to 2.5M above pool deck
n.	Overhead Illumination	=	Competition 100 lux Recreation 30 lux (confirm) Instruction 50 lux Indoor Deck 20 lux (confirm)

Outdoor Deck
Illumination 1 watt/s.f.

n. Overhead lamp of choice = Metal Halide
o. Underwater lamp of choice = Quartz
p. Slope of pool deck = 1:48
q. Slope of pool floor = Deeper than 1.5M = 1:3
Shallow than 1.5M = 1:12

r. Pool Perimeter Overflow System
- gutters sized to accommodate 100% of pool total flow rate
- modulating main outlet valve in surge tank to always pass at least 20% for pool total flow rate
- main outlet piping sized to pass 100% of total pool flow rate.

s. Surface skimmers to accommodate 80% of total pool flow rate.
t. Piping Material of Choice:
PVC Schedule 40 or 80 depending upon application
u. Pipe Velocities: (confirm)
Suction = 6 f/s
Pressure = 10 f/s
Gravity (gutter) = 3 f/s
v. Filter System of choice:
Sand High Rate 36.7m^3/H/M^2/filter area
Manual of semi automatic
w. Ceiling clearance above a diving board or platform = 5M
x . Bather Load
Water Depth
<40 mm = 1 person/M^2 of water surface
<1500 mm = 1 person/2.13M^2 of water surface
<1500 mm = 1 person/7.6 M^2 of water surface
Each diving board deduct 10M^2 of water surface

y.

TABLE 404.1
MINIMUM NUMBER OF PLUMBING FACILITIES [a]
(See Sections 404.2 and 404.3)

OCCUPANCY	WATER CLOSETS (Urinals see Section 420.2)*		LAVATORIES	BATHTUBS/ SHOWERS	DRINKING FOUNTAINS(see Section 411.1)	OTHERS
	Male	Female				
Swimming pools	1 per 100	1 per 50	1 per 150	-	1 per 1,000	1 service sink

*Urinal substitute for up to 50%of water closets

2. ACCESS BY THE PHYSICALLY HANDICAPPED. Swimming facilities shall meet the minimum requirements of the Architectural and Transportation Barriers Compliance Board Minimum Guidelines and Requirements for Accessible Design as incorporated in Chapter 18, DOD 4270.1—N, except that the following additions and modifications to those provisions for specific NAVFAC swimming facilities shall take precedence. The following criteria are additions and modifications to DOD 4270.1—N Chapter 18, and all other requirements of Chapter 18 must also be met in all NAVFAC

facilities.

a. Bathhouse.

(1) Toilet Stalls. At least one standard, 5—foot (1500 mm) wide toilet stall complying with DOD 4270.1—N, Chapter 18, Figure 12/7, shall be provided in each toilet room where toilet stalls are provided. For space and economy, in group toilet rooms where multiple lavatories are to be provided, the stall may be made 5.5 feet (1700 mm) wide and have one lavatory, complying with DOD 4270.1—N, Chapter 18, Section 5.12 B (4) (a) (b) (c) (d) (e), placed within the stall in lieu of one lavatory in the group lavatory area. See Facility Plate 7, Toilet Stall with Lavatory.

(2) Dressing Area. Where dressing areas are provided, either separately or in conjunction with toilet stalls or shower stalls, the area shall meet the following requirements:

(a) The dressing area shall contain a bench, sized, mounted, and with clear space in front of it as indicated. The bench shall be open underneath for its full width and shall be 1.5 feet (450 mm) above the floor. It may be slatted or solid material, but it is preferred that the bench surface be padded and upholstered. Materials shall be capable of withstanding repeated wetting and rough treatment.

(b) The dressing area shall be in a separate cubicle, sized as indicated, or shall have privacy curtains or partitions enclosing it and its clear floor space.

(3) Access to Pool

(a) Ramps. Where a ramp is used for access to a pool, the ramp shall be oriented parallel to the swimming lanes and shall be separated from the pool by a wall which forms the poolside.

(b) Stairs. If stairs are provided, it is recommended that the risers on the steps be 180 mm, if possible.

(4) Pool Lifts.

(a) Some lifts are manually—operated and can only be operated by an attendant. Other lifts are hydraulically powered by water pressure and can be controlled by the user. See Appendix.

(b) The lift equipment must be selected early in the planning process, so that required features may be incorporated. The lift should be treated as a built—in item, procured as a part of the construction contract. Some lifts require installation of sockets, anchors, and water service built into the deck. A lift shall not have any permanently mounted component, which remains, in the pool at all times.

3. FIRE PROTECTION. See NAVFAC DM—8.

Fire protection issues in a natatorium usually apply in the requirement for sprinkling the non-water surface area of the natatorium, the support spaces and the spectator area. The other issues are usually chemical storage/control, emergency exits and emergency vehicle access.

Section 4. POOL DECK AND POOL DESIGN

1. POOLSCAPE

a. Frozen Capacity

The term "Frozen Capacity" refers to the maximum capacity in a facility at one time, which is, understandably, the peak period for the day, whether it is an indoor facility or an outdoor facility. There does not exist a comprehensive formula but a combination of ratios currently used in the industry and is used to determine bather load and frozen capacity.

The majority of health departments in the U.S. use the following formula for bather load sizing; shallow water = <1500 x water depth: = 1 person/3M², (includes wading pool)

Deep Water = <1500 water depth = 1 person/7.6M²; (each diving board deduct 10M² of water surface of pool area)

EXAMPLE	PERCENTAGE	
Total surface area zones	2286M²	
Wading area 40 mm or less	229M² 10%	1 person /M²
Shallow area 1.5M or less	1372M² 70%	1 person/2.13M²
Deep area 1.5M or more In water surface	685M² 30%	1 person/7.6M² Deduct 28M² from water surface, diving board, drop slide or waterslide
Plus holding capacity at stair to slide		1 person/lineal 300mm of waterslide

b. Pools and Pool Areas for Swimming and Non-Swimming Activities

Certain swimming and non-swimming activities that occur in a pool, understandably, develop their own specialized areas over a period of time. The obvious being the deep water for the diving boards and the shallow water for the non-swimmers. Other activities that can generate and influence swimming pool design are special water play areas in a leisure pool, a deep-water field of play for water polo, a deep-water competition pool for national caliber training and competition and specialized teaching areas.

c. Materials and Finishes

Choices of materials are rather limited for the inside of a pool, all of which must be resistant to water immersion. Likewise, materials and finishes for a natatorium must have certain qualities as does exterior materials used with an outdoor pool.

Competitive Swimming Pool Design Standards

Item		Pool Type	FINA International	USS Long Course		USS Short Course		NCAA Long Course		NCAA SHORT COURSE		NFSHSA	
		Pool		Preferred	Acceptable	Preferred	Acceptable	Preferred	Acceptable	Preferred	Acceptable	Preferred	Acceptable
Pool	Length & Construction Tolerance		50.03 M (164' 1 11/16")	50.03 M (164' 1 11/16")	50.03 M (164' 1 11/16")	75' 1 3/16"	25.03 M	50.0254 M (164' 1 1/2")	50.0254 M (164' 1 1/2")	75' 1" (22.89 M)	25.0254M(82' 1 1/4")	75' 1" (22.89 M)	25.0254M(82' 1 1/4")
	Width		21 M (68' 10 3/4")	75' (22.86M)	60' (18.29M)	Same as USS Long Course		75' 1" (22.89 M)	60' (18.29 M)	60' (18.29 M)	45' (13.72 M)	60' (18.29 M)	45' (13.72 M)
	Min. Depth		1.8 M (5')	6' 7" (2M)	4' (1.22M)	Same as USS Long Course		4' (1.22 M)		Same as NCAA Long Course		3' 6" (1.0668 M)	
Actual Course Length		Bounded Water Volume	50 M (164' 1/2")	Same as FINA		25 Yards 75' (22.86 M)		50 M (164' 1/2")	50 M (164' 1/2")	25 Y 75' (22.86 M)	25 M (82' 1/4")	75' (22.86 M)	25 M (82.021')
End Wall Depth			0.8 M (2' 7 1/2")	Same as FINA		Same as FINA		3' 6" (1.07 M)		Same as NCAA Long Course		3' 6" (1.0668 M)	
End Wall Tolerance			No Provision in Rule Book	No Provisions in Rule Book		No Provisions in Rule Book		1/4" (0.64 cm)		Same as NCAA Long Course		No Provisions in Rule Book	
Lane Width			2.5 M (8' 2 3/8")	9' (2.75M)	7' (2.13M)	Same as USS Long Course		9'(2.74M) 8'(2.44M) 7'(2.13M)	7'(2.13M)	7' (2.13 M)		7' (2.13 M)	
Number of Lanes			800%	800%	*	Same as USS Long Course		8 9 10	800%	800%	600%	No Provisions in Rule Book	
Side Lane			.5 M (1' 7 3/4")	1.6" (0.43M)	1.6" (0.43M)	Same as USS Long Course		Required		Same as NCAA Long Course		May be Provided	
Lane Line Anchors			Recessed	Same as FINA		Same as FINA		Permanent - Recessed		Same as NCAA Long Course		Same as NCAA Long Course	
Lane Line Floats			Continuous 5-11 cm. Min. Diameter (2" - 4 1/4")	Continuous 2" - 4 1/4" (5-11 cm.) Min. Diameter		Same as USS Long Course		Contiuous		Same as NCAA Long Course		Same as NCAA Long Course	
Backstroke Indicator			5 M (16' 5") from each end 1.8 M (5' 11" above water level)	16' 5" (5 M) From Each End 5' 11" (1.8 M) Above Water Level		15' (4.572 M) from Each End 7' (2.13 M) Above Water Level		5 M from Each End 7' (2.13 M) Above Water Level		15' (4.572 M) from Each End 7' (2.13 M) Above Water Level		15' (4.572 M) from Each End 7' (2.13 M) Above Water Level	
False Start Indicator			15 M (49' 2 3/4") from starting end	49' (15 M) From Starting End		36' (11M) from Starting End		20 M From Starting End		60' From Starting End		42' (12.80M) From Starting End	
Pool Bottom Markings	Bottom Lane Line Width		Min. 0.2 M (8" Max. 0.3M (11' 3/4")	Minimum 10" (25 cm.)		Same as USS Long Course		Minimum 12" (30.48 cm)		Same as NCAA Long Course		Minimum 12" (30.48 cm)	
	Cross Line Length at End of Lane Lines		1.0 M (3' 4")	3' 4" (1.0 M)		Same as USS Long Course		36" (.91 M)		Same as NCAA Long Course		36" (.91 M)	
	Cross Line Width		Same as Lane Line Width	Same as Lane Line Width		Same as USS Long Course		Same as Lane Line Width		Same as NCAA Long Course		Same as Lane Line Width	
	Distance From Cross Line to Wall		2.0 M (6' 7")	6' 7" (2.0 M)		Same as USS Long Course		5' (1.52 M)		Same as NCAA Long Course		Same as NCAA Long Course	
End Wall Targets	Shape		Cross	Tee or Cross		Same as USS Long Course		Same as FINA		Same as FINA		Verticle Bar	
	Width		Same as Lane Line Width	Same as Lane Line Width		Same as USS Long Course		Same as Lane Line Width		Same as NCAA Long Course		Same as Lane Line Width	
	Length Below Water Level		1.8 M (5' 11")	3' 4" (1.0 M)		Same as USS Long Course		3' 6" (1.07 M)		Same as NCAA Long Course		3' 6" (1.07 M)	
	Length of Cross		.5 M (1' 7 3/4")	*		*		36" (.91 M)		Same as NCAA Long Course		N/A	
Deck Reqd	Minimum Width		No Provision in Rule Book	No Provisions in Rule Book		No Provisions in Rule Book		15' (4.572 M) Starting & Turning Ends 10' (3.05M) at Sides Minimum		Same as NCAA Long Course		No Provisions in Rule Book	
	Distance From Water Level							6" (15.24 cm) - 12" (30.48 cm)		Same as NCAA Long Course		2" (5.08cm) Minimum	
Starting Platform	Dimension		0.5 M x 0.5 M Min. (1' 7 3/4" x 1' 7 3/4")	1' 8" x 1' 8" Minimum (0.5 M x 0.5M)		Same as USS Long Course		20"x20" (50.80cm x 50.80cm) Min.		Same as NCAA Long Course		Same as NCAA Long Course	
	Height Above Water		0.5 M to 0.75 M (1' 8" to 2' 5 1/2")	1' 8" (.50 M) Minimum 2' 5" 1/2" (.75 M) Maximum		2' 6" (0.762 M) Maximum		Same as USS Short Course		Same as USS Short Course		Same as USS Short Course	
	Slope Angle		10 deg. Maximum	Same as FINA		Same as FINA		Same as FINA		Same as FINA		Same as FINA	
	Backstroke Grips		0.3 M to 0.6 M Above Water (12" to 24")	12" (0.3 M) to 24" (0.6M) Above Water		Same as USS Long Course		Within 30" (0.762M) of water Surface		Same as NCAA Long Course		Same as NCAA Long Course	
Timing Required	Electronic Touchpad Dimension		240cm.x 90cm. x 1cm. (7' 6"x2' 9 3/4" x 3/8") 30cm. (111/4") above 60cm. (22 1/2") below water	6'6" (2M)Min. Width 2' (0.6M) Min. Depth 3/7" (1cm.) Max. Thick	5' (1.52M) Min. Width 2' (0.6M) Min. Depth 3/8" (1cm.) Max. Thick	Same as USS Long Course		6'6" (2M)Min. Width 2' (0.6M) Min. Depth 1/2" (1cm.) Max. Thick	No more than 6" narrower than lane - 2" (.061M) min. - depth 1/2" (1.27cm) min. thick	Same as NCAA Long Course		No More Than 6" (15.24cm) From Lane Markers	
	Resolution		1/100th second	Same as FINA		Same as FINA		Same as FINA		Same as FINA		1/100th sec.	1/10th sec.
	Scoreboard		No Provision in Rule Book	Required		Same as USS Long Course		Same as USS Long Course		Same as USS Long Course		Same as USS Long Course	
	Lap Counter		No Provision in Rule Book	No Provisions in Rule Book		No Provisions in Rule Book		Required - each digit must be 12"(30.48cm) high		Same as NCAA Long Course		Same as NCAA Long Course	
Lightin g Reqd	Deck Level Lighting		100 Footcandles Min. at starting & turning ends	100 Footcandles over entire course		Same as USS Long Course		Same as FINA		Same as FINA		No Provisions in Rule Book	
	Underwater Lighting		No Provision in Rule Book	No Provisions in Rule Book		No Provisions in Rule Book		May be Installed		Same as NCAA Long Course		Same as NCAA Long Course	
Ladders			No Provision in Rule Book	Recessed or Removable		Same as USS Long Course		Same as USS Long Course		Same as USS Long Course		Same as USS Long Course	
Overflow Systems			Required - Must Maintain Constant Water Level With no Appreciable Water Movement	Same as FINA		Same as FINA		Same as FINA		Same as FINA		Same as FINA	
Water Temperature			24 deg.C (75 deg.F Min.)	78 - 80 deg. F. Min.		Same as USS Long Course		79 - 81 deg. F. Min.		Same as NCAA Long Course		78 - 82 deg. F. Min.	
Air Temperature			No Provision in Rule Book	76 deg. F. Maximum		Same as USS Long Course		Not more than 4 deg. below water Temp		Same as NCAA Long Course		No Provisions in Rule Book	
Chemical Treatment System			Required	No Provisions in Rule Book		No Provisions in Rule Book		No Provisions in Rule Book		No Provisions in Rule Book		No Provisions in Rule Book	
Distance From Swim Pool to Diving Pool			5 M (16' 5") Minimum	No Provisions in Rule Book		No Provisions in Rule Book		No Provisions in Rule Book		No Provisions in Rule Book		No Provisions in Rule Book	

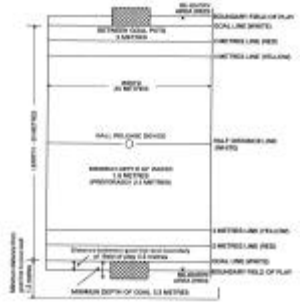
Compiled From: FEDERATION DE NATATION AMATEUR HANDBOOK 1994 - 1996
UNITED STATES SWIMMING 1996
NATIONAL COLLEGIATE ATHLETIC ASSOCIATION 1996 OFFICIAL SWIMMING GUIDE
NATIONAL FEDERATION OF STATE HIGH SCHOOL ASSOCIATIONS - 1995 - 1996 SWIMMING & DIVING RULES

The above chart has been developed by the NSPF to provide a comparison of factors.
Confirm dimensions and interpretations with current rule books of respective organizations.

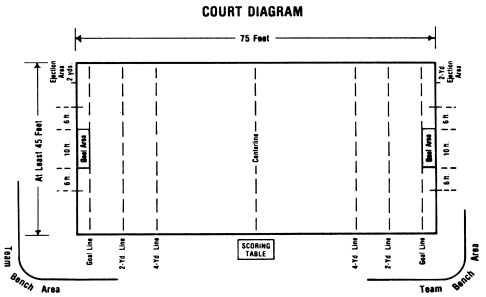
STANDARDS SUBJECT TO CHANGE, CONFIRM DATA WITH CURRENT RULE BOOK.

Aug-97

FINA & USA Water Polo



NFSHSA Water Polo



NCAA Water Polo

COURTESY OF NATIONAL SWIMMING POOL FOUNDATION

CORRECTED 6/98

Competitive Diving Board Design Standards

Minimum Standard Diving Facility Dimensions For Springboard Diving	NFSHSA 1995-1996			FINA USA Diving NCAA	1994-1996 1995-1996 1996	
	Board	**English**	**Metric**	**Board**	**English**	**Metric**
Length of Board	1M	16'	4.877M	1M	16'	4.80M
				3M	16'	4.80M
Width of Board	1M	20"	0.508M	1M	20'	.50M
				3M	20'	.50M
A) Springboard Back to Pool Wall	1M	6'	1.829M	1M	6'	1.80M
				3M	6'	1.80M
B) Springboard to Pool Wall at Side	1M *	10'	3.048M	1M **	8' 3"	2.50M
				3M **	11' 6"	3.50M
C) Springboard to Adjacent Plummet	1M *	8'	2.438M	1M **	7' 11"	2.40M
				3M **	8' 7"	2.60M
D) Springboard to Pool Wall Ahead	1M	29'	8.839M	1M	29' 7"	9.00M
				3M	33' 8"	10.25M
E) Springboard to Ceiling Overhead	1M	16'	4.877M	1M	16' 5"	5.00M
				3M	16' 5"	5.00M
F) Clear Overhead, Behind and Each Side of Springboard (^{F} Distance Listed Above) (^{E} Depth Listed Below)	None Listed			1M F	8' 3"	2.50M
				E	16' 5"	5.00M
				3M F	8' 3"	2.50M
				E	16' 5"	5.00M
G) Depth of Water at Springboard (^{G} Distance Listed Above) (^{E} Depth Listed Below)	None Listed			1M G	16' 5"	5.00M
				E	16' 5"	5.00M
				3M G	16' 5"	5.00M
				E	16' 5"	5.00M
H) Depth of Water at Springboard	1M	12'	3.658M	1M	11' 6"	3.50M
				3M	12' 6"	3.80M
J) & K) Distance and Depth Ahead of Springboard (^{J} Distance Listed Above) (^{K} Depth Listed Below)	1M J	20'	6.096M	1M J	16' 5"	5.00M
	K	11' 3"	3.430M	K	11' 2"	3.40M
				3M J	19' 9"	6.00M
				K	12' 2"	3.70M
L) & M) Distance and Depth Each Side of Springboard (^{L} Distance Listed Above) (^{M} Depth Listed Below)				1M L	4' 10"	1.50M
				M	11' 2"	3.40M
				3M L	6' 7"	2.00M
				M	12' 2"	3.70M
N) Maximum Slope to Reduce Dimensions Beyond Full Requirements	None Listed			Depth 30° Height 30°		

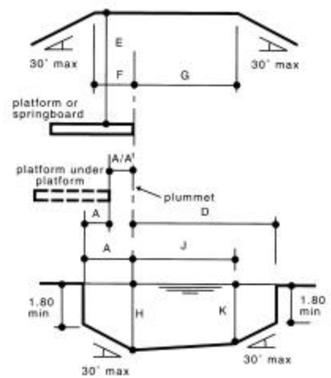
NFSHSA - National Federation of State High School
NCAA - National Collegiate Athletic Association 1996
FINA - Federation Internationale Denatation Amateur 1994-1996
USA Diving United States Diving, Inc. 1995-1996

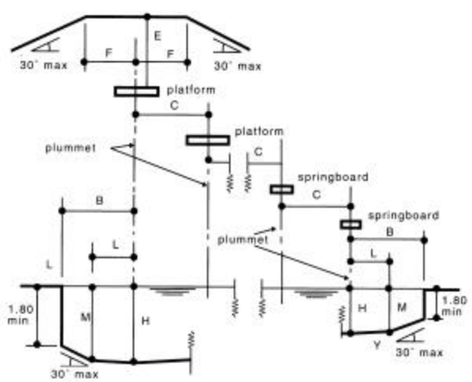
NFS
* Side of Board to Wall
Side of Board to Side of Board

NCAA, FINA
** Plummet to Wall
Plummet to Plummet

The above chart has been developed by the nspf to provide a comparison of factors.
Confirm dimensions and interpretations with current rule book of respective organizations.

STANDARDS SUBJECT TO CHANGE. CONFIRM DATA WITH CURRENT RULE BOOK.





NOTES:

Correction

Items J and L are reversed to correct original matrix.

June 1998

Competitive Diving Platform Design Standards

Minimum Platform Diving Facility

Dimensions For Diving Platforms	FINA 1994-1996 / USA 1995-1996 / NCAA 1996 / 14'10"		
	Platform	**English**	**Metric**
Length of Platform	1M	14' 10"	4.50M
	3M	16' 5"	5M
	5, 7.5 & 10M	19' 9"	6M
Width of Platform	1M	24"	.6M
	3, 5 & 7.5M	5'	1.5M
	10M	6' 7"	2M
Height Above Water	1M	1.969' - 3.281'	.60 - 1.00M
	3M	8.530' - 9.843'	2.60 - 3.00M
	5M	16.405'	5M
	7.5M	24.607'	7.5M
	10M	32.81'	10M
A) From Plummet Back to Pool Wall	1M	2' 6"	.75M
	3 & 5M	4' 2"	1.25M
	7.5 & 10M	5'	1.5M
AA) Platform Back to Plat. Directly Below	5, 7.5 & 10M	5'	1.5M
B) From Plummet to Pool Wall at Side	1M	7' 7"	2.3M
	3M	9' 7"	2.9M
	5M	14'	4.25M
	7.5M	14' 10"	4.5M
	10M	17' 3"	5.25M
C) From Plummet to Adjacent Plummet	1 Plat. To 1 Spring	5' 5"	1.65M
	1/3 & 3/3 Plat.	6' 11"	2.1M
	5/3, 5/1, 7.5/5/3/1	8' 3"	2.5M
	10/7.5/5/3/1	9' 1"	2.75M
D) From Plummet to Pool Wall Ahead	1M	26' 3"	8M
	3M	31' 2"	9.5M
	5M	33' 8"	10.25M
	7.5M	36' 1"	11M
	10M	44' 4"	13.5M

Dimensions For Diving Platforms	NCAA FINA US Diving						
	Platform	**English**			**Metric**		
E) Platform to Ceiling Overhead From Plummet	1 & 3M	11' 6"			3.5M		
	5M	11' 6"			3.5M		
	7.5M	11' 6"			3.5M		
	10M	16' 5"			5M		
F) Clear Overhead Behind & Each Side of Platform	1, 3, 5, & 7.5M	F/9' 1"	E/11' 6"		F/2.75M	E/3.5M	
	10M	F/9' 1"		E/16' 5"	F/2.75M	E/5M	
(F Distance Listed First)							
(E Depth Listed Second)							
G) Clear Overhead, Ahead of Platform	1, 3, 5, & 7.5M	G/16' 5"	E/11' 6"		G/5M	E/3.5M	
	10M	G/19' 9"		E/16' 5"	G/6M	E/5M	
(E Distance Listed First)							
(G Depth Listed Second)							
H) Depth of Water at Platform	1M	11' 2"			3.3M		
	3M	11' 10"			3.6M		
	5M			13' 2"			4M
	7.5M			14' 10"			4.5M
	10M			16' 5"			5M
J) Distance and Depth Ahead of Plummet	1M	J/16' 5"	K/10' 6"		J/5M	K/3.2M	
	3M	J/19' 9"	K/11' 6"		J/6M	K/3.5M	
K) (J Distance Listed First)	5M	J/19' 9"		K/12' 10"	J/6M		K/3.9M
(K Depth Listed Second)	7.5M	J/26' 4"		K/14' 6"	J/8M		K/4.4M
	10M	J/36' 1"		K/15' 7"	J/11M		K/4.75M
L) Distance and Depth Each Side of Plummet	1M Platform	L/4' 8"	M/10' 6"		L/1.4M	M/3.2M	
	3M Platform	L/5' 11"	M/11' 6"			M/3.5M	
M) (L Distance, Listed First)	5M Platform	L/14'		M/12' 10"	L/4.25M		M/3.9M
(M Depth Listed Second)	7.5M Platform	L/14' 10"		M/14' 6"	L/4.5M		M/4.4M
	10M Platform	L/17' 3"		M/15' 7"	L/5.25M		M/4.75M
N) Maximum Slope to Reduce Dimensions Beyond Full Requirements	Depth°30 Height°30						

Aug. 97

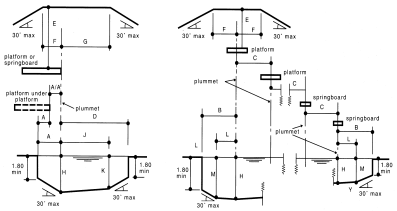
NCAA - National Collegiate Athletic Association 1996
FINA - Federation Internationale de Natation Amateur 1994-1996
USA Diving - United States Diving, Inc. 1995-1996

NOTE: Min. USA diving & FINA dimensions "C" (plummet to adjacent Plummet) applys for platforms of min. widths. For wider platforms increase "C" by half the additional width(s).

The above chart has been developed by the NSPF to provide a comparison of factors. Confirm dimensions and interpretations with current rule book of respective organizations.

STANDARDS SUBJECT TO CHANGE. CONFIRM DATA WITH CURRENT RULE BOOK.

FINA, USD, NCAA



Longitudinal Section
Diagrammatic Only

Cross Section
Diagrammatic Only

COURTESY OF NATIONAL SWIMMING POOL FOUNDATION

ITEM	MATERIALS	
Pool Shell	Reinforced Concrete	-cast-in-place pneumatically applied concrete
	- Stainless steel (304 or 315 low carbon)	
Pool Interior Finish	- Tile, ceramic frostproof - Marble plaster for white field - Swimming pool paint	
Inserts and Anchors	- Stainless Steel - Chrome plated brass	
Fittings	- PVC Inlets – - PVC Outlets	
Piping	- PVC Schedule 40, 80 (All PVC Piping to conform to ASTMD-1785)	
Gutter Grating	- PVC - High Impact Plastic - Fiberglass reinforced acrylic	

d. Markings and Lane Designation

Markings are key to the utilization of the swimming tank for practice, training, and competition, as well as warning signs and depth markings to inform the user of the respective depth of the pool at various points on its perimeter. (See Appendix for National Swimming Pool Foundation, Design Compendium charts and diagrams.)

e. Diving Board and Platform Criteria

The diving area, whether it be included in the overall pool volume or be a stand alone diving pool, has certain features, the most obvious is surface dimensions which are driven by rules from authorities whether they be the respective health department or a national competitive diving organization. Such rules dictate the lateral and overhead clearances, the distance forward of the diving board or platform, as well as the depth under the diving plummets and to each side. (See Appendix for NSPF fold out charts and diagrams)

f. Waterplay Areas, Wading Pools and Splash Pools

These facilities are the most popular in an aquatic center complex and the more intricate and complex are the water features, such as sprays, fountains, slides, etc., the more challenging is the engineering. Some health department regulations, as well as

manufacturers' recommendations, dictate lateral dimensions between features, both one to the other and to the pool perimeter plus water depth and safety features.

g. Construction

The construction of the pool tank is usually influenced by the regulations or standards that was used as the guide for the design. This describes such things as the slope of the pool floor, the wall-to-floor joint of the pool, the interior colors and perimeter overflow design and construction. The location of inlets, underwater lights, ladders and lifeguard stands.

h. Zero Entry and Slopes

With the development of the leisure pool, the public has been re-introduced to the zero-entry or "beach" profile. The walk-in access was typical in the 1920s, 30s and 40s. As pools began to take on the shape of competitive tanks, these features disappeared. Now they have returned with the stand-alone leisure pools and are especially popular for outdoor facilities. The slope is 1:12 with a non-slip texture from the edge of the pool (not the edge of water) to a water depth of (1.4 M). Handrails are often required in indoor facilities where semi-ambulatory users attend.

2. POOL DECKS.

The deck area around a swimming pool can be much the same as the specialized and differentiated areas in the pool itself. This is especially true in outdoor pools where orientation to the sun or away from the sun is frequently emphasized as well as traffic patterns out of dressing rooms to the shallow water of the pool with the deep water being farthest away. The latter also applies to conventional indoor pools.

Custom and Practice

Indoor Rectangular Pool: Side of pool from vertical interior pool wall to building wall – 10 ft. minimum.

If balcony seating, line of sight will increase deck width to 18 ft. 20 ft. Edge of pool water surface must be observable by all spectators.

End of pool: 12 ft. minimum deep end of pool if no diving boards.

1M diving board requires 15 ft. min 4600 mm.

3 M diving board requires 18 ft. min. 5500 mm.

(Note: Dive stand models vary in footprint dimensions.)

End wall: 12 ft. minimum shallow end of pool to building wall.

Outdoor Rectangular Pool: Same as indoor rectangular pools plus deck width for lounges, sunbathing area, queuing area for water features, i.e., diving boards, waterslides, food service, eating table area, approach to bathhouse. (See 1037.1-A12)

Outdoor Freeform Pools Circulation around perimeter of pool requires deck widths similar to outdoor rectangular pool. (See 1037.1-A12)

These minimum widths must not be compromised due to the requirement of a handicapped ramp, which shall be located exterior to the pool proper with entry into the

shallow end or due to the provision for movable or telescopic bleachers in indoor pools can occupy a posting at the deck with minimum 1800 mm walkway. Additionally, the configuration and projecting elements of the bathhouse design may permit minimum deck widths to be increased to also respond to program variations.

a. Circulation. Entrances and exits to all pool areas from the bathhouse shall be planned to guide patrons and spectators along prescribed routes. Patrons shall be introduced only at the shallow end. Circulation shall also provide convenient access to the handicap ramp or lift.

b. Construction. Decks exterior and interior shall be carefully engineered and controlled. Backfill, structural reinforcement, and environmental factors at the time of the pour shall be checked.

Allowance shall be made in the construction schedule to allow maximum self consolidation of the compacted backfill of pipe trenches and excavation nearest the pool. Pool decks shall be supported on the pool structure.

Where possible in outdoor facilities, the top of deck edge must be above surrounding grade 100 mm to allow positive drainage away from the pool and deck.

Additionally, in freezing climates, the deck shall have a drainable, pervious base course. The use of water stops, caulking of the deck joints, and frost walls should be considered.

c. Finish Materials. All decks shall be relatively smooth, of slip-resistant construction, and easy to clean by hosing.

In outdoor facilities, the use of concrete with and slight broom finish is generally acceptable. A rough or coarse broom finish produces a hazard.

d. Slope. Deck drains are required in most deck areas. The drains shall be located between 1500mm and 2400mm from the pool edge and serve a maximum of 23.2 M^2. Drains selected shall not have sharp or angular lines: In high density areas, such as bathhouse entry/exit, diving board stands, and the starting end for competitive swimming events, drains shall serve a maximum of 13.9 M^2. The entire deck shall slope to the nearest drain. The deck itself shall slope away from the pool a minimum of 2 mm per 100 mm in wet climates and high density areas.

3. POOL

a. Pools and Pool Areas for Swimming and Nonswimming Zones (Exterior and Interior). The length of the main pool shall be 25 meters or 50 meters long by the width, which is determined by the number of lanes desired.

Mosaic or ceramic tile are excellent pool wall finishes. Marbleized plaster and epoxy coatings are also satisfactory. Tile may be utilized for the pool markings, lane designations, edge of deck (curb) treatment, and water line. Epoxy finishes can be used for the remainder of the pool interior, if budget or cost problems evolve. The advantage of tile is durability and lower maintenance expenditures. Pool plaster or coating finishes are generally medium cost and have a service life of 4 to 10 years depending whether pool is indoor or outdoor.

A zero entry ramp shall be equipped with a skid-resistant surface, (coefficient of friction 7.5%).

All variations in pool depth of 500 mm shall be marked on the pool deck. In the case of indoor pools, markings may also be located on the adjacent walls. For outdoor pools, depth marking may also be mounted on the perimeter fence at the edge of the deck.

b. Diving Area.

Dimensions and Areas. The dimensions are shown on FINA Chart for diving boards and platforms. (See Appendix for NSPF diving board and platform Charts.)

4. EQUIPMENT AND FURNISHINGS.

a. The development of leisure pools in the 1990's has occurred because of the manufacture of participatory water play equipment. This synergism between these two phenomenon has made each happen. Water play systems, both static and interactive attractions, have been key. The latter is more popular because of the opportunity for young children and their parents to personally activate the different modes of sprays, showers, jets, etc.

b. Movable Bulkhead. The bulkhead shall be a monolithic fiberglass boxed girder structure with horizontal translation only. Common dimensions are 1,200 mm wide x 1,400mm deep x width of pool. The bulkhead will move the length of the pool above the gutter lip after the buoyancy chambers are activated and it will be capable of being moved by four people (two at each end). The bulkhead will feature air chambers that can be pressurized as a means of floating the bulkhead off the gutter lip for ease of horizontal movement.

The bulkhead will feature a handhold at water level on each turning surface face (racing lane). In this way, the bulkhead will present a configuration at the water surface similar to the pool gutter at the opposite end of the race lane. Wall targets, recessed rope anchors, starting block anchors and water polo goal anchors shall be provided on the bulkhead.

The use of a movable bulkhead will provide greater program flexibility with a variety of teaching stations.

c. Movable Floor(s). Modern natatoria are frequently built to accommodate a high demand of various aquatic activities, which require various water depths. In some pools this situation is solved with a movable floor that tracks from 2 M to '0' M with desired depths in between. There are different designs with most manufacturers in Europe, Australia/New Zealand and Japan.

The floor is a solid plane 25 M x 12 M, or less, that moves up and down in the water either by a stainless steel scissors jack mechanism driven by a motor in a dry space behind the pool wall, or by cables that pull the floating floor under the water or released tension allowing the floor to rise through the water.

d. Water slides are available in many sizes and lengths. They include an open body slide, a closed tunnel slide, an open tube slide (using an inflated rubber tube) for an individual and a slide wide enough for a rubber tube with two or more people. The height of slides can vary from a few inches for a children's pool to 20 to 30 ft. for a leisure pool. Commercial waterparks feature much taller slides for enhanced thrill value, which attracts the teen and young adult market.

e. Diving boards are manufactured according to specific dimensions dictated by FINA and U.S. Diving. Different grades of quality and performance are produced within those dimensions. High performance boards used in sanctioned competition have various enhancements to provide greater lift, faster action and the temporary storage of energy, which benefits experienced competitive divers.

Note: While the FINA width for the 10 meter platform is two meters, the expected adoption of simultaneous, synchronized diving by two people off the same platform as an official event is expected before the 2,000 Olympics. Therefore, designs should create 10 meter platforms with a minimum of 3 meter width.

f. Diving stand and platform access: Diving stands shall be factory fabricated. The structure shall be a single sloping pedestal of stainless steel tubing. Anchorage shall be in accordance with the manufacturer's recommendations. Only sloped steps with handrails shall be permitted to the diving boards. Steps may be located either at the back or side of the tower depending on deck space available. Handrails at board level shall extend to the pool wall. The top of the guardrail shall be minimum of 750 mm above the diving board. Access to these diving levels shall be by stair and not a ship's ladder. Due to wet treads and handholds, people (mostly children) have fallen from the ship's ladders resulting in permanent injury or death. These accidents have decreased to almost none where 3 meter stands with stairs have been installed and used (see Appendix).

g. Lifeguard stands or platforms can be fixed in the deck or be portable, but shall be standard manufactured stands with a design that harmonizes with the diving stands. Sloped steps may be at the rear or side, depending on deck space available. The range in seat height varies from approximately one meter to 2.4 meters. The diving zone requires an individual lifeguard stand. The movable stands are more popular among pool managers, because of the flexibility in positioning depending upon bather load and the ability to move them for routine deck and pool perimeter cleaning. (Movable stands may be stored in the pool equipment and storage room when not in use. The doors leading to this room must be large enough to accommodate this equipment.) Note: Field of vision of any lifeguard shall not exceed 180 degree and shall overlap a minimum of 15 degrees.

h. Starting blocks or starting platforms are factory fabricated with over a dozen types or models available for specifications, all meeting FINA and/or U.S. Swimming requirements for dimensions and texture. Custom starting blocks can be

fabricated, but the cost compared to mass-produced units has reduced that option to a very small percent of the market. Portable equipment shall be stored in the pool equipment and storage room, when not in use, to eliminate casual usage. Inserts and anchors shall be installed in the deck in accordance with manufacturer's recommendations.

i. Deck equipment includes; ladders, grab rails, stanchions for backstroke and recall lines.

j. Loose equipment includes lane lines, lane line reels, lifesaving equipment, floatables, i.e., kickboards, pull buoys, etc.

k. Pool Accessories. Pools are to be designed with unobstructed racing lanes. Consequently, no obstructions shall project from the pool wall. Steps shall be built or cast into the pool wall. Stainless steel above deck—mounted grab rails shall be installed to provide for safe entry and exit at recessed steps. Pool accessories are outlined below in a comprehensive list of accessory equipment required for the operation of the pool both for safety equipment and for custodial purposes. Quantities will vary depending upon the size of the pool (s).

1. Safety Equipment. Provide the following:
   - U.S. Coast Guard approved life rings with throw ropes 1-1/2 times the width of pool (at each guard stand)
   - shepherds hook minimum 12 ft. in length (four wall-mounted)
   - safety ropes complete with anchors at proper locations (transition depth points)
   - first aid kit as per health department regulations
   - eye wash station at or near chemical treatment systems (wall hung package unit)
   - fire extinguisher as per local code
   - spineboard (3)
   - stretcher
   - rescue tube(s)
2. Pool Cleaning Equipment.
   - A portable vacuum cleaning system with an electric 1-1/2 HP pump/motor mounted on a hand cart with pneumatic tires, vacuum head, telescopic pole and a fifty foot two inch vacuum hose.
   - Sets of telescopic pole and wall brushes (determined by size of pools).
   - A built-in vacuum system with discharge pump in filter room or a robot pool cleaner.
   - 1-1/2 inch and ¾ inch hose bibbs should be provided on each wall of the natatorium for maintenance purposes (maximum of 15 M apart)
   - Commercial swimming pool test kits.
3. Stanchions and stanchion sockets. Stanchions for supporting backstroke lines, recall lines, and splash curtains shall be stainless steel tubing with a top

closure plug fitted with both an eyebolt and a sliding collar side eyebolt.

4. Antiturbulent racing lines. Continuous 100-127 mm diameter discs of alternating colors strung on a vinyl covered stainless steel cable, including end hooks and tension devices, shall be used between each lane. If storage reels are utilized, the door to the pool equipment and storage room and an exterior door must be large enough to accommodate this equipment and deck drains (slot) must withstand psi at wheel tangent point of loaded reels.

l. Built in Equipment. Such equipment for the bathhouse includes lockable bulletin boards; clothes hooks; towel hooks; hairdryers; fixed lockers or baskets with shelving firmly affixed; towel dispensers; soap dispensers; mirrors; fixed benches; telephones; lighted clocks; and public address system.

m. Consumable Equipment. Consumable equipment shall include first aid kits, water test kits, PC, cleaning supplies and office supplies.

5. COLOR: POOL, WALLS, DECK

Any factor which reduces the pool's effectiveness due to color alteration shall not be permitted. Chromatic finishing materials which do not alter the natural light blue color of a well maintained pool, and likewise create the clear, warm atmosphere of a natatorium shall be utilized. The designer shall select colors which comply with established principles concerning the reaction of colors to water.

a. Pool.

(1) Matte white has proven to create the best visibility and the strongest safety factor for lining a competitive pool. White ceramic mosaic tiles, marble plaster or a white coating should be provided for producing this recommended finish.

(2) Lane and target markers shall always be in a contrasting color, preferably a dark blue (cobalt) or black, thus providing a strong visual guide on the pool bottom and a visual reference target on the end walls.

(3) Decorative elements (symbols, insignias, or logos) are usually not recommended for use on the pool bottom in a competitive pool as they may be visually distracting to swimmers.

b. Walls. Ceramic tile, both glazed and mosaics tile, are the preferred materials for creating these effects.

c. Miscellaneous Data.

Should the selection of finishing materials for the pool, deck, and walls appear monochromatic or utilitarian, accent colors can be introduced in other applied forms. These could include banners, acoustical panels placed well above eye level, such as in portions of the ceiling, or structural elements, etc.

The colors used in a competitive swimming pool are standard for a race course. All jurisdictional regulations, both in the competitive governing bodies as well as health departments dictate that the interior be white and that markings be in a contrasting color or, in some cases, it is stipulated to be black. Custom and practice of the industry and the sport is black markings on the pool bottom, on the wall targets and on a line marking the above water race lane lines as per regulation. In the case of a pool with two perpendicular race courses, i.e. 25 M by 22.9M (25 yds.) or 50 M by 25 M or 22.9M (25 yds.), the cross-pool stripes and targets are often in a dark blue so as to have some differentiation between the primary race course, i.e. 50 M and the short course.

Leisure pools, both indoor and outdoor, customarily have white fields with the same markings in black or a dark blue. These special colors or patterns are designed for the bottom of the tank and can be chosen without limitation except that faint colors tend to loose the visual impact when underwater.

The walls of the natatorium can be chosen from many shades from the color pallet. The most common colors are soft colors with a tendency toward the warm in certain climates or in conjunction with the overall color scheme of a building. While blue is often used, bright colors with interesting patterns are effective in bringing life to what can be a rather static indoor space. One color that should be avoided on the natatorium walls and on the ceiling is green. The reason is that the reflection of the walls and the ceiling or any plane with a green color onto the pool water will create a green appearance suggesting algae. Understandably, this is not desirable.

The ceiling of a natatorium is usually a light color which reflects light from the ambient illumination in this space or direct up lighting depending upon the lighting design of the natatorium. A dark ceiling tends to make the room more demanding in its need for artificial light especially if there is limited or no fenestration. Deck colors are limited due to the function of the pool deck. Most decks have a color darker than white, which can be in color tile with earth tones, blues tones, or even off white. A border around the pool perimeter approximately 500 to 1,400 mm meters away from the water, (depending upon the size of the natatorium and deck widths) is very effective as a contrast with the pool deck and the blue water in the pool. The white border tends to accentuate the blue of the pool water for positive visual effect.

In cases where the budget will not permit tile, other options are a colored broom- finish concrete scored on 1 meter squares or plain broom-finish concrete with the same treatment, but, always with the tile border described above.

Section 5. NATATORIA

1. DESIGN CONSIDERATIONS. A swimming pool enclosed within a structure produces a number of design challenges that must be understood before they can be solved. Some are physical relative to dimensions, materials, finishes and others are systems for moving water, air and controlling humidity, which is influenced by the off-gassing of chloramines, bromomines, as well as moisture drive creates the necessity of vapor barriers to minimize or prevent vapor passing through a natatorium wall to adjacent spaces, indoor or outdoor. The light in a natatorium is, likewise, an element that has several sources, i.e. natural and artificial. The control of sound is equally important, depending upon how the natatorium will be used.

2. NATATORIUM WALLS. The walls and roof create most of the envelope of the natatorium and unlike the floor (deck) are the surface areas that must confine the relatively unstable atmosphere. The air is continually accommodating water vapor released from the pool surface plus off-gassing chemical compounds as well as carbon dioxide from the occupants, which mixes with the fresh air being drawn into the room. The performance standard for the natatorium is negative air pressure relative to the contiguous spaces, i.e., outdoors and other rooms and walls in the Aquatic Center. To achieve these objectives, the following factors must be considered:

The total pressure in a natatorium combines air pressure and vapor pressure (a function of humidity). When the total pressure is negative it prevents the movement of air pressure and humidity from migrating through the walls to the spaces beyond that are at a lower total pressure. This is often referred to as “moisture drive”. When natatorium atmosphere passes into adjacent building spaces it can raise the level of humidity, cause condensation and transfer chemical smells.

If moisture drive forces water vapor into an exterior wall, which is below dewpoint, condensation will occur in the wall which in turn can cause efflorescence on the surface of the wall and eventually the loss of mortar and grout.
Several wall systems are in commonly used for natatorium construction:

a) Masonry bearing walls
b) Structural steel columns with a masonry in-fill walls
c) Cast-in-place concrete walls
d) Precast concrete walls (tilt up)

Because of the need to provide a high quality air and vapor barrier to prevent moisture drive through the wall, double wythe masonry walls with insulation in the center are often selected by the Architect. If the inner wythe is structural, it is usually coated on the inside with a high build epoxy paint as a first line of defense to moisture migration. On its exterior side, architects frequently specify the masonry to be coated with a spray-applied synthetic rubber material (as an air-tight vapor barrier) which seals around penetrations such as conduit and horizontal wire type reinforcing. Insulation can be tightly fit (and observed) before an exterior veneer is installed. Many variations of this example exist and should be investigated by the Architect for local suitability and costs. Often an exterior wythe is masonry and the insulation can then be applied to the inside face before the air and vapor

barrier is installed on the inner surface of the insulation. Then the interior veneer block is installed to the inside of the natatorium.

In any wall system selected by the Architect, the following guidelines should be considered.

a) Moist air must be stopped from entering the wall cavity and reaching a surface below the dew point temperature; therefore, the vapor barrier must be continuous through the wall and its interface with the roof's vapor barrier.

b) While a high quality finish with the perm rating below 1.0 on the interior is a first line of defense. It alone cannot protect against moisture drive, because of fissures in the wall and the potential for bypassing the surface coating.

c) A satisfactory air and vapor barrier is needed to the warm side of insulation.

d) Weep holes are frequently provided into air spaces of wall cavities outside the vapor barrier and insulation so that any condensation will drain to the outdoors. A sloped galvanized sheet metal flashing between masonry wythes will prevent this moisture in the insulation cavity from going towards the interior.

e) The outer wythe must be protected from moisture drive from the interior which can result in efflorescence or spalling on the exterior.

3. CEILINGS AND ROOF

a. The overhead clearance above the diving boards must be as specified in the FINA and U.S. Diving regulations, i.e., 5 M, if diving boards are part of the program.

b. Structural (Natatorium)

There are many materials that have been used to cover an indoor pool:

- concrete
- steel truss with steel or wood decking
- wood beams and decking
- tensile membrane
- air supported membrane

Of the above, concrete is the best long term life cycle choice due to its durability. There are several designs, i.e., cast-in-place beams and decking, concrete T's or double T's with concrete planking plus variations

The most frequent solution is structural steel with metal decking due to lower first costs, especially with long span spaces, the vulnerability of mild steel to aggressive atmosphere requires special coating procedures. Pipe trusses shall be used and not bar or angle joists even though this type support is less costly because of the difficulty in painting and repainting during the life of the structure and the resulting susceptibility to corrosion.

Wood has several advantages if properly treated and correctly interfaced with building systems. Appearance is one, maintenance is another, air circulation and humidity control is critical for the physical condition of a wood roof system.

Tensile membranes that interface with concrete or steel super structures are effective and dramatic in appearance. They are also costly as a first cost and can experience a maintenance expense greater than the conventional systems. Added to this is the potential for discoloring and darkening if the membrane is translucent, which is one reason for selecting this system.

Another consideration in designing a natatorium roof and ceiling is the requirement to suspend light systems, speaker systems, conduit, ductwork, catwalks and acoustical treatment.

c. Roof Composition

The most common roof design for a natatorium is conventional with the exception of a continuous vapor barrier. The roof decking is carried by girts and purlins. Above the deck is a vapor barrier membrane on top of which is adequate insulation. Above the insulation is the exterior deck upon which is the waterproof strata in the form of conventional bitumastic, synthetic membrane, a variation of a standing seam metal deck securing the roof to the interior deck without compromising the vapor barrier requires attention in the over design. Another opportunity for compromise of the vapor barrier envelope around the natatorium is the roof to wall interface.

Note: The vapor barrier is primarily a protection against freeze-thaw damage and condensation control outside of the natatorium. Structures in year 'round warm climates can omit vapor barriers unless migration of humidity into adjacent indoor spaces is an issue.

d. An acoustical treatment should be used in the natatorium ceiling.

e. Ceiling and roof systems are frequently the site of problems created by thermal transfer. Since the ceiling is remote and over the swimming pool, maintenance is difficult and costly. A careful evaluation of the various options should be made. Materials and systems should be selected which will not trap moisture or result in below dew point temperatures on structural members.

f. Prolonged condensation can cause ceiling deterioration, corrosion of structural members and even leaks as a result of a rupture in the roofing membrane. The choice of roof and ceiling insulation plus finish materials can be critical as well as the selected comprehensive roof system. The moisture barrier between the natatorium and the roof system "sandwich" must not be compromised during design or construction. Cases have occurred in winter climates where warm, moist air invaded the "sandwich", condensed, froze, expanded and ruptured the exterior roof watertight membrane.

The HVAC system should be coordinated with the design of the roof and ceiling because the successful integration of these two features can make both elements more effective. Pockets of poor air circulation in the ceiling profile which can hold warm, moist and often aggressive air is one of the common causes of deterioration. The proper placement of the air distribution supply outlets and the exhaust discharge to outside air at strategic points can eliminate this hazard. Sometimes systems are designed properly only to have ineffective aiming of the supply outlets during construction. The proper design of an air-handling system can greatly assist in combating any negative effects on the roof structure by aggressive atmospheric conditions in the natatorium space. It is essential that the wall

and roof surfaces be treated by the heating system in such a way that a high dew point is maintained on interior surfaces in colder weather and that dead air spaces in the roof profile be avoided.

In the case of a suspended ceiling, the control of the dew point on structural roof members is critical because the attic space above the natatorium will frequently experience conditions not found in similar structures above a more conventional use area. For this reason, the attic space should be warmed and pressurized with air discharging to the natatorium below or to the outdoors.

4. NATATORIUM HEATING AND VENTILATION

The air heating system in an enclosed swimming pool space should be designed with primary consideration for temperature control and reducing humidity. Evaporation and water vapor created by the large mass of water surface affects both comfort and the physical experience of materials. Evaporation of the water surface is affected by water temperature, air temperature, air velocity and relative humidity.

The atmospheric environment of modern natatoria is controlled by computer controlled mechanical systems that conditions incoming air, distributes it and circulates it throughout the space and then exhausts the air with its pollutants and carbon dioxide outside of the building.

Through the utilization of modern micro process units, the temperature, relative humidity, heat loss, heat gain and equipment operation can be monitored. This data can be evaluated by a predetermined "program" and the most efficient mechanical system profile activated. The end result is economy and comfort.

The environmental control system for an enclosed swimming pool space must provide:

- dehumidification to eliminate the destructive effect of condensation on building materials
- ventilation during both occupied and unoccupied periods to satisfy jurisdictional health and code requirements and to avoid destructive accumulations of chlorides that will attack ferrous materials.
- air heating to offset building heat losses and maintain a space temperature of 1.0 degrees Celsius above the water temperature which minimizes evaporation and maximizes human comfort
- pool water heating to maintain a comfortable and appropriate temperature for users while minimizing evaporation
- prevent wall and roof condensation

Air movement should be kept within the following limits: air velocity at a point below 2.5M above the pool deck should not exceed 7.5 MPM in order to avoid creating a chill as a result of evaporation on the wet skin surface. Spectator areas should have higher air velocities of 12M to 15.25M. High velocity warm air in the face of spectators can be very uncomfortable, therefore, cool air should be introduced over any raised spectator gallery for a major venue facility. This is not practical in a natatorium with seating on deck.

5. CONDENSATION CONTROL and PROTECTION

Outlined below are key issues that must be considered in the design of a natatorium.

- A high quality and effective vapor barrier must be installed in roof and walls.
- Mechanical dehumidification which keeps relative humidity at 50%. The system is designed to provide a slightly negative pressure in the natatorium per ASHRAE recommendations to reduce moisture drive. The systems must be balanced and perform properly. (Note: A performance standard of 50% RH at water surface quiescence must also provide a RH of no higher than 55-60% during surface agitation and falling water during pool use. All of this turbulence increases water evaporation.
- The HVAC diffusers wash walls and skylights to prevent condensation.
- Supply is introduced high, return occurs low, with the majority of return air exhausted to the outdoors equal to 25% of air turnover rate.
- Walls and ceiling insulation levels are adequate to maintain interior surface temperatures above dew point.

OWNER EDUCATION

Condensation will occur in every natatorium! It is more likely to occur (and its damaging effects increased) in inverse proportion to the project budget. Architects and engineers could provide a building with the means of ridding itself completely of the humidity and condensation threat if the budget were unlimited. In the same way, near total protection from external sources of fire, or wind or seismic threats could be designed. However, because of limited budget it is necessary to design the building to a reasonable level of protection. By involving the Owner in the decisions, the risk of future complaints can be substantially reduced. There is a point of diminishing returns where it is not cost effective to provide a "perfect" building. Condensation must be minimized. The remaining condensation that occurs must be prevented from damaging the building. The factors that can be controlled by the architect's design team include humidity, air temperature, air pressure, insulation, vapor barriers, materials and finishes.

HUMIDITY

Evaporation from the pool surface can be minimized by keeping the natatorium air temperature no more than 2 degrees warmer than the water, but usually not over 30 (C). Pool temperatures vary from 25.5 to 26.6 (C) for competition, 26.6 to 29 (C) for recreation and instruction, 29 to 30 (C) for leisure, 31 to 33 (C) for certain therapy programs and 37.7 to 39.5 (C) for spas.

Evaporation of the water is affected by water temperature, air temperature, air velocity and relative humidity. The HVAC system should provide:

- mechanical dehumidification to maintain 50% relative humidity (RH)
- ventilation to ASHRAE standards to provide fresh air for occupants and dilute chemical compounds in the air which can lead to "sick building syndrome" complaints and attack ferrous metals
- heating of the inside air to offset building heat losses and maintain temperature 2 degrees above water temperature although not usually above 29° (some operators set temperatures at 26°'s.)

- warm air "washing" of walls, ceilings, and exterior openings (skylights, doors, windows) to reduce condensation.
- cooling natatorium air in summer months.

DEWPOINTS

If the inside air temperature is 29.5 degrees with 50% relative humidity, the dewpoint is approximately 17 degrees. At winter temperatures of -12 to 2 degrees, the dewpoint will be reached with resulting condensation on exterior double glazed windows, metal doors and frames. With the use of anodized aluminum opening casements and hardware, corrosion is minimized if not avoided. If condensation will still occur on glazing and casements, provide surface drains to carry off to waste so as not to damage area materials.

6. NATATORIUM LIGHTING

a. NATURAL LIGHT

Overhead natural lighting should be provided if consistent with the architect's design concept. This may take the form of sky lighting or top lighting, utilizing clerestory features over the center of the pool. It is sometimes desirable to utilize natural light through the use of wall windows. The problem of reflected glare on the water, however, is a major concern in natatorium design because it creates safety problems as well as a negative spectator situation. This problem can be solved by the use of movable window shutters, curtains and/or a saw tooth wall plan which features window openings directed away from the spectator area.

If both types of pools are included in a natatorium, different treatment of natural light is suggested. The competition lap pool should avoid windows opposite the spectator seats and at the ends of the pool because breaststroke and butterfly swimmers will be affected by the glare on the water as they approach the turning walls. Coaches will also be negatively affected if they have to look at swimming with a wall window beyond which creates glare silhouetting swimmers in the water.

The leisure pool has different requirements. Although the reflected glare still occurs, it is important to have a visual relationship with the outdoors. Skylights can counter the reflection on the water surface as well as create a light and airy ambiance.

b. ARTIFICIAL LIGHT

For competitive training and racing, lighting fixtures placed in the ceiling, directly overhead (i.e., the light fixture is perpendicular to the water surface) is preferred. Relamping has been accomplished through the use of perimeter ceiling lamps around the edge of the pool (the lamp must extend out over the water's edge at least 150 mm beyond end wall of the lane, so that a shadow is not cast across the turning walls.) These fixtures will cast an asymmetrical elliptical pattern so that the center of the pool is illuminated.

Metal Halide lamps are recommended for overhead fixtures. The different levels of intensity are achieved by increasing the number of fixtures in operation. Dimmers are usually not cost effective.

The overhead lighting in the leisure pool can be indirect, direct or a combination of the two.

7. POOL DECKING

a. Deck Surface

The swimming pool deck around the pools should be of a non-slip surface. While 25 MM x 25 MM or 50 MM x 50 MM ceramic tile set on a concrete slab is the traditional American solution, it is recommended that consideration also be given to other tile sizes.

b. Deck Drainage

Deck drainage can be accomplished in several different ways:

I. A system of area drains with the surrounding deck sloped to the respective drain.

II. A grid covered trench in a concentric rectangle outside of the pool approximately 750 MM to 1,000 MM.

III. An open tile joint approximately 15 MM wide with a PVC pipe buried 50 MM below the tile course. Periodic outfalls carry the trapped water away to a sanitary sewer.

The frequent disadvantage of trench or slot drains indoors is water will pond in a low area in the drain flume and stagnate. Sometimes the resulting septic odor is noticeable. Because of the abundant fresh air frequent breeze, this is not noticed outdoors.

The advantage of the concentric perimeter drains is that most splash out water is captured near the pool edge and the deck slopes two directions instead of sloped in four directions with an area drain..

The traditional deck drain network results in a sloped deck surface. A concentric slot or trench drain is recommended for rectangular pools and area drains are recommended for the leisure pool deck area. Area drains shall provide for all outdoor pools. Slot drains frequently pond water in the below dock flumes which can produce a septic smell from stagnant water and harbor pathogens and spores. Slot drains are susceptible to damage from lane reels.

c. Depth Markings

The respective depths of the pool should be marked for size, shape and interval space as set forth by the jurisdictional regulations or 300mm high letters and/or numerals set in non-slip tile in the pool deck. 100 MM inch high depth markings should be located in the vertical face above the pool perimeter. All depth markings should be in colors contrasting with their background.

The markings should be readable as the swimmer approaches the pool, and they should be located in the pool deck within 600 mm of the water's edge.

Warning signs stating - "Danger-Shallow Water - DO NOT DIVE" must be provided at the pool perimeter in the deck at pool depths 1.5M or less. These warning signs should appear approximately every 6M in the designated location.

d. Pool Deck Widths

The deck widths should be as follows:

1. Shallow end of a rectangular pool should be a minimum of 4.5M from water's edge to second pool.

2. Side of pool deck width should be a minimum of 3 M or more from water's edge to building wall on the side opposite the spectator area.

3. Deck width in front of spectator area should be 5.25 M minimum for balcony seating but adequate for proper sight lines to edge of water if deck seating.

The dimensions are to the natatorium wall and include wall mounted benches.

e. Drinking Fountains

One wall mounted drinking fountain should be provided for an indoor pool and possibly two for the outdoor pools. Hose bibbs should be featured on the four walls of the natatorium. Hose bib total for outdoor pool(s) depends on deck area of poolscape. A 40 mm hose bibb should also be provided to enable custodial staff to quickly flush down pool decks. (Indoors and outdoors)

f. Permanent Benches

Wall mounted benches for swimmers should be provided along the natatorium walls. These benches should be fiberglass or painted aluminum. A masonry block wall bench with hinged seats is an option which creates storage under the benches or a return air system may be a part of masonry seats.

8. SPECTATOR SEATING

Seats should be located with a side view of the race course. A design that combines permanent seats and a flat mezzanine either behind the permanent seats or to the side may "fit" with the natatorium space. Larger attendance will occur for a US age group invitational meet.

There are several configuration options and combinations among those the most advantageous view is from a balcony one story above the water. Lesser quality viewing is a mezzanine approximately 1.2 M above the pool deck. The least desirable but still acceptable is deck level. The varying factor is obstruction of view by people walking back and forth along the deck, i.e., officials, athletes and coaches.

9. POOL CLOCK

A time of day clock shall be installed on the natatorium wall in such a way that it can be easily seen for reference, and a second clock should be provided in the lobby which can be read from the pay phone location.

Pace clocks shall be provided in the natatorium. These clocks will require an electrical outlet and should be located on the long wall on each side of the race course used for training. Battery operated pace clocks are also used because they are portable and are self-standing.

Note: Depending on the spectator seating design, the pace clocks can be mounted on the wall either in front of, behind or opposite the spectator area.

10. ACOUSTICS

Consideration must be given to acoustical problems that develop in a natatorium. Structural features and finish materials should be selected that will reduce noise levels and absorb sound. In this regard, it is recommended that acoustical building materials be used on the walls and in the ceiling of the natatorium and that other noise dampening features be included.

Ceiling decks have been successful when a perforated epoxy coated galvanized structural steel panel is used. Further acoustical enhancement occurs if the panel is backed with polyethylene encapsulated fiberglass.

A different approach for solving the problem of acoustics for a concrete roof system is hanging acoustical baffles between the concrete beams or T's. Suspended acoustical panels made of fabric covered fiberglass, anodized aluminum or a combination of these are functional. Not only do these units serve a technical purpose but they can also add color to the space. All must be corrosion resistant.

As with other materials in a natatorium, acoustical wall and ceiling structures must be corrosion resistant and interface with a vapor barrier.

11. SOILS CONSIDERATION

a. Report Preparation. A soils report shall be prepared by a registered professional geotechnical engineer as a recommendation for the final design and writing of specifications. This report shall follow the guidelines established in DM—7.1 and DM—7.2 and the criteria below.

A plan shall be furnished, along with the written report showing the number and location of test borings. Diagrams of test boring records that show the description of soil at various levels and through the different soil types should also be included.

b. Soil Characteristics. The physical and chemical properties of the soil shall follow the guidelines established in DM—7.1 and DM—7.2 and the following criteria.

(1) Standard penetration tests shall be made continuously for the initial 3700 mm of the boring.

(2) The pH value of the soil and ground water shall be determined and recommendations made regarding corrosion protection.

c. Design.

(1) Bearing. Allowable bearing values of the soils shall be provided in the report, following DM—7.1 and DM—7.2 requirements.

(2) Lateral Pressure. Lateral pressure diagrams in the report shall be made for design of walls using an equivalent fluid pressure.

(3) Settlement. Recommendations for further soils testing and evaluation shall be made if it appears that total settlement or differential settlement will be more than nominal.

(4) Stability in Vertical Cut. The report shall describe the ability for soils to maintain a vertical bank when concrete walls are to be placed using the earth cut as one face of a form, or when pressure—applied concrete walls are used. When vertical earth banks cannot be maintained, recommendations shall be made in the report for the amount of slope that can be maintained.

d. Temporary and Permanent Dewatering. Recommendations shall be made regarding temporary and permanent dewatering, following DM-7.1 and DM-7.2 requirements.

12. STRUCTURAL CONSIDERATIONS

a. Selection of construction type for swimming pools

1. Cast-in-place (poured) concrete

CIP is the most conventional type of concrete construction for swimming pools when those pools are indoors and part of a large structure and/or multi-use building, which consists of a large amount of cast-in-place concrete. The economy of including the concrete pool shell by the general contractor, who is pouring the other formed work, usually creates a cost benefit.

2. Pneumatically applied concrete

Shotcrete or Gunite concrete application is used in most swimming pool construction in the United States because of advantages in flexibility of pool shape, less cost for forming since the earth embankment is used as the rear of the form and there is no front form and because the material is skreeded and shaped prior to hardening. It also has advantages in access to remote sites due to its pneumatic technique.

3. Stainless steel pools, whether with only a stainless steel side wall or, in some cases, an entire pool, is a type of construction that is used in a relatively small percentage of the swimming pool market, although there are special applications where this type of pool is a practical solution, i.e. roof-top, temporary competition pools or low-budget projects. Stainless steel gutters have captured a significant share of the commercial and public pool market in the United States during the past 30 years. The reason is based upon several features of the stainless steel perimeter overflow system:

a. The factory fabricated sections are welded together on the site while being leveled and attached to the reinforcing steel in the concrete walls.

b. The supply water is returned to the pool through a pressure tube in the base of the stainless steel gutter at the top of the pool wall. This avoids any underground piping for either wall inlets or floor inlets. The supply piping from the filter is only several feet below grade as it is the collector piping for gutters. While the piping from the main outlets to the surge tank and then filters is under the floor of the pool in the deep, this is a relatively short run and, should there be a problem can easily be located. The disadvantage of the stainless steel system is the potential for corrosion, either in a short period or likely over a long number of years. The corrosion occurs at welds, both in the gutter and in the converter boxes, which transfers the water to the filter system and back.

Section 6 BATHHOUSE

1. ENTRANCES AND CONTROL

a. The purpose of the entrance and control point for this activity building is the same as any secured space. The goal is to limit the access to those people who are authorized for admission either by showing a valid identification pass or paying the appropriate fee. The same control point is usually the avenue of departure from the facility.

b. Indoor pool facility. Following the entry at the control point the attendees enter a dressing room per gender and change to swim wear, shower, etc. and then enter the natatorium via a deck side or wet portal.

c. Outdoor pool facility. An outdoor facility dictates the same traffic pattern as the indoor with the exception that modern bathhouses frequently have a direct passageway from the control point onto the pool deck, thus, by-passing the dressing rooms. The reason is that most attendees at outdoor swim facilities arrive at the complex in their swimwear with some form of over garment such as beach robes, tee-shirts and pool jackets. Door ways to the dressing rooms, toilets and showers are located just inside the control point.

2. BATHHOUSE FUNCTIONS

a. The central function of the bathhouse is to provide a control point for guests, shelter a dressing room, provide toilet and shower facilities and a management office. The bath house also can contain a filter and chemical room for the pools, storage, and a food service snack bar.

b. Bathhouse relationship to other elements of the site include entry to the pool deck near the shallow water entry to the pool(s), access to the snack bar/eating area and visual access to the general poolscape for staff. Other adjacencies include service drives, parking and handicapped parking spaces.

c. Acoustics can be important in the dressing rooms because of the loud noise by users, especially during a crowded period, plus the sound of showers, toilets and lockers opening and closing. Treatment for this aspect of the environment can be solved in a conventional way, but materials shall be resistant to water vapor produced by the wet surface of the dressing room floor, lavatories and showers, which not only generate water vapor, but at a high temperature.

d. Overhead lighting in dressing rooms must be energy efficient, non-corrosive and achieve a light level of 20 Lux on a relatively uniform basis.

e. Heating, ventilation and air condition is rarely used in the bath house for an outdoor facility. On some occasions there may be a rationale for HVAC in the

dressing room spaces or if the dressing rooms are to be used for another purpose during the winter months i.e. dressing area for outdoor sports.

f. Maintenance requirements will include the following:

A janitor's closet, hose bibs strategically located for washing down floors, electrical receptacles for power equipment, floor drain systems that will minimize man hours for cleaning and scrubbing, storage for housekeeping supplies and equipment.

3. BATHHOUSE SPACES

The following spaces are described relative to what occurs in those areas:

a. General Operations reflect approximately a 60/40 ratio between men and women patrons. In remote and fleet centers, male use is greater. When spectator accommodations exist, a 50/50 ratio of men and women spectators shall be used.

b. The control area features a plaza or congregating area on the outside of the control point and or a lobby or large passageway from the control point to the dressing rooms and/or the pool deck. Approximate area 5% of pool capacity x 19 M^2. Include control desk, public phone, bulletin boards.

c. The dressing area should be divided into a dry area immediately inside the access portal, which will have the lockers, benches as well as a dry toilet and lavatory. The wet side of the dressing rooms include toilets, lavatories, urinals and showers beyond which is the exit portal to the outside pool deck. Area shall be 5-10% of pool capacity. Note: if facility use is casual off duty time occupancy demand will be much less than demand if a unit changes from uniforms all at the same time.

d. The shower area shall be sized in accordance with plumbing fixture requirements. See Table 1. The open shower bay with post or column shower outlets shall be utilized. Privacy shower/drying spaces, including those accessible to physically disabled patrons, will vary with Commands and geographic locations. These spaces shall be kept to a minimum, not exceeding 20 percent of the shower requirements for women, and 10 percent for men.

e. The drying area shall accommodate the same number of patrons as the showers and towel hooks, one per person shall be provided.

f. The toilet area shall be sized in accordance with plumbing fixture requirements. See Table.

g. The janitor's closet shall contain a service sink with hose bibb mixing faucet or a floor rinse basin with hose bibb mixing faucet. Galvanized steel shelving shall be installed to mete storage and utility or housecleaning requirements.

h. The pool manager's office is usually located off the lobby area or off the pool deck area and serves as a work station when he or she must fill out reports, meet with staff and/or patrons. Approximate 9-12 M^2

The telephone system; intercommunication system; public address system; bathhouse, swimming pool, pool deck and all exterior lighting systems shall all be controlled from this office. Observation windows if required shall be located at a height permitting pool observation from seated or standing positions.

i. Lifeguard's office is to be used as a break room and meeting area for lifeguards with information posted relative to schedules, safety instructions and general communication. Approximate 10-15 M^2. Lockers and privacy curtains shall be provided on window opening if changing clothes is designated.

j. First Aid Room: This room shall be large enough to contain a desk chair and training table with a rigid padded surface, a lavatory and even a toilet. The first aid support may also be provided in the form of a closet in the lifeguard room containing the necessary first aid supplies. The current practice in pool emergencies is to not move the injured until paramedics arrive by emergency vehicle and equipment.

k. Storage room shall be conveniently located for the proposed use of its storage contents, i.e. pool maintenance equipment, swim team equipment, custodial equipment for the bathhouse. The size of such storage rooms will be dictated by the size of the complex and the respective number items to be stored. Approximately 4-6% of total water surface area.

l. Filter room space requirements are dictated by the size of the filter system required for the pool(s), the number of recirculating pumps for water features in the pools, the chemical treatment system and the requirement for a pool heater(s) if programmed. Added to the filter room will be the chemical rooms containing the primary sanitizer and the reciprocal buffer.

4. EXTERIOR WALL SYSTEMS

a. The bathhouse wall systems are basically the same systems as that for the natatorium, i.e. load bearing masonry, structural framing with masonry infill, cast-in-place concrete and tilt-up precast concrete. The surface material shall be a suitable finish for epoxy paint with colors dictated by base protocol. Permanent color and finish shall be the prime considerations in the selection of a material. Additionally, the color and finish selected shall compliment and be coordinated with adjacent or surrounding facilities. Because of geographical location and budgetary constraints, painted CMU are a consideration for a swimming pool bathhouse. Metal bathhouses are not recommended due to corrosion.

b. Bathhouse windows shall be avoided with the possible exception of glass transparent walls enclosing the control and lobby area. Translucent skylights are recommended for natural daylight into the locker rooms, the lobby and possibly storage, if climate permits.

c. Bathhouses for outdoor pools rarely justify a vapor barrier or insulation for maintaining a warm interior temperature. In hot climates, insulation shall be provided in the roof system to prevent unacceptable heat gain.

5. CEILING AND ROOF SYSTEM

a. The structural framing and roof deck in a bathhouse can be conventional with wood being a recommendation along with concrete. The structural steel bar joist and metal decking must receive the same coating specifications as described for a natatorium. Bar joist and angle joist will satisfactorily support the roof system, but will be a greater maintenance challenge due to the difficulty of recoating the difficult access points, such as angles, welds, webs, bolts and flanges in this type of a structural unit. These points will eventually experience spreading corrosion.

b. Roofing for a bathhouse can be conventional for the size and scale of the structure with special attention to the detailing of skylights, if provided. A satisfactory structural deck material is cement fibre panels with acoustical and fire retardant qualities. Refer to Structural Cement Fibre Products Association.

c. Vapor retarders shall provide a continuous seal from water vapor and be installed in accordance with the roofing manufacturer's specifications.

d. Single sheet roofing; built-up, multiple-ply membrane; or sloped roofing systems shall be considered.

e. Finish Material: suspended or applied acoustical tile ceilings should not be installed. Additionally, the ceiling deck system shall provide maximum light reflection.

6. FLOORS

a. The material for a bathhouse floor is reinforced concrete. The surface of the concrete can be finished in tile. It can also be scored as broom-finished concrete or it can be scored as stained concrete. All tile applications must use non-slip tiles with a co-efficient of friction of 7.5%.

b. The slope of floor must be a minimum of 2% with a greater per cent recommended to drain off service water quickly. The floor drain system shall be area drains with the deck sloped to these respective floor outlets.

c. The wall to floor intersection in the dressing room areas and toilet areas shall be coved as per health department specifications to minimize dirt accumulation and for the ease of cleaning.

7. INTERIOR PARTITIONING SYSTEMS

a. The partitions in the dressing rooms occur at the showers, toilets, urinals and dressing stalls. These partitions shall be epoxy-coated masonry or high density plastic (phonelic) with stainless steel hardware.

b. All door casements shall be aluminum or painted galvanized steel with aluminum or galvanized hollow core doors with respective aluminum or galvanized steel hinges. All galvanized steel elements must be coated with a 12 mil high-build epoxy. All window openings shall have aluminum casements including openings at the snackbar.

(1) Wall Finish and Color. Walls throughout the bathhouse shall be of masonry construction. Plaster or gypsum wall board are not suitable in even "dry areas", including locker rooms, basket storage corridors, lobby, and offices.

Wall tile, including structural glazed CMU, ceramic tile, from floor to ceiling, should be considered in toilet, shower, and drying areas.

CMU with block filler and epoxy or urethane coatings withstand general abuse, enhance sanitation, and deter vandalism; their use is optimum throughout the bathhouse occupied spaces.

(2) Glazing. Interior glazing shall be kept to a minimum and, if required, shall be of clear, safety glass. Interior glazing should be applied to offices.

(3) Entrances, Doors, and Hardware. The front entrance shall be fitted with anodized aluminum doors and frames. Other doors and frames may be painted galvanized, hollow metal construction.

8. EQUIPMENT AND FIXTURES

Outlined below is a basic list of primary equipment and fixtures required at a bathhouse:

a. Tack board or bulletin board

b. Bill/coin change machine

c. Lockers or baskets for clothes storage

Lockers should be high impact plastic with stainless steel hardware. Stainless steel or galvanized can be used, if epoxy coated, throughout. Conventional baskets are acceptable if that checking plan for clothing is selected.

d. Vending machines

Conventional vending machines can be provided and located either inside the bathhouse or outside in a constructed alcove which is shielded from the weather with a roof.

e. Public telephones shall be provided either in the lobby or on the dry outside wall of the bathhouse.

f. Drinking fountains shall be provided on the wet side of the bathhouse on the pool deck. These can be tap water dispensers or refrigerated water coolers. The latter shall only be used in non-freezing climates due to their difficulty to winterize.

g. Spin dryers for swimsuits shall be provided in the locker rooms. Quantity shall be determined by size and occupancy load of the dressing rooms.

Section 7 – POOL WATER TREATMENT, RECIRCULATON AND FILTRATION

1. WATER TREATMENT.

a. Chemical Treatment. Automatic chemical treatment shall be provided to maintain the stated water standards and disinfection. Bromine or ozone disinfecting systems shall not be specified without Facility Command approval.

(1) Adjustable chlorinating equipment shall be provided with a capacity to maintain a minimum of 1.5 ppm of free residual chlorine in the pool. Chlorine may be applied as a 15 percent hypochlorite solution or as a chlorine solution from chlorine gas from cylinders containing liquid chlorine under pressure. Chlorination equipment shall have the capability of raising the residual chlorine level to 5 ppm. Storage and handling of chlorine shall conform to OSHA and fire code standards.

Calcium hypochlorite erosion feeders developed in the 1990s and operated with booster pumps with interface with analyzers has eliminated most of the inconveniences of earlier generations.

The point of chlorine and buffer application shall be downstream of the filter, pump, heater, and other accessories. A separate pump and/or pump loop should be provided for injecting chlorine.

(2) Ultraviolet radiation shall not be provided.

b. Evaluation of Chemical Types. Chemical systems shall be selected by availability, cost of treatment, ease of operation, hazards involved, and ease of operation. Filtration of swimming pool water is required for the removal of suspended particles, effecting a pool that is clear and inviting. Chemicals are also required for controlling bacteria, viruses, and algae and thus providing effective sanitizing. This process changes the pH balance of the pool water; secondary treatment is required to restore and maintain the proper pH level for comfort and to prevent deterioration of the pool surfaces and mechanical equipment by the pool water. Total alkalinity must be considered in the pool water chemistry.

(1) Chlorine Gas.

(a) Chlorine gas is an inexpensive disinfectant for pool use; however, the hazards of handling and the expense of chlorination equipment are deterrents to the use this disinfectant.

(b) The use of chlorine gas increases the acidity of the pool water by producing hypochlorous acid and hydrochloric acid. The hypochlorous acid is the disinfecting agent and the hydrochloric acid is the unwanted byproduct. The buildup of hydrochloric acid in the pool water can be neutralized by adding a solution of soda ash into the return line.

(2) Calcium Hypochlorite.

Calcium hypochlorite is a dry product which is water soluble. The

product is available in tablets or granular form. Calcium hypochlorite is fed through an automatic feed system with a booster pump. Due to residue build up, the feeder valves must be cleaned frequently.

(3) Sodium Hypochlorite.

Sodium hypochlorite is the same solution that is common in household bleaches, usually containing around 15 percent of available chlorine. Sodium hypochlorite is usually fed into the return water system through the hypochlorinator. The solution normally contains sodium hydroxide to prevent deterioration during storage. Sodium hydroxide is alkaline and reacts with common acids in the pool water, making the use of soda ash unnecessary. Should the pool become too alkaline, then muriatic acid or sodium bisulfate must be injected to restore the pH balance.

2. STORAGE OF CHEMICALS.

a. General Requirements. It is essential, whichever system is adopted, that during the early stages of the project, designers should obtain and follow the recommendations on the safe storage and use of the materials involved.

b. Storage of Chemicals. Chemicals for the treatment of the swimming pool water shall be stored in a cool dry location near the chemical feed system. Such storage, relative to quantity and location must meet jurisdictional regulations regarding such stored items propagated and enforced by applicable fire and life safety standards. This will affect the fire rating of the walls, doors and ventilation. It is desirable to have an access doorway between the chemical rooms and the filter room. This is prohibited in some jurisdictions and the operator must exit the building to enter the chemical rooms from outside. A delivery access for chemical truck usage must be provided.

Sodium hypochlorite, which is stored in a large polyethylene container shall sit in a retention shell. This shell can be concrete or can be polyethylene fabricated for the particular tank. The purpose of the retention tank is to capture any spillage of liquid chlorine or leakage should the tank fail. A hose bib should be located in the near vicinity of the chemical room for flushing down the area for housekeeping, which also requires an area drain in the chemical room.

c. Chlorination/Disinfection Room.

(1) Cylinders of liquid chlorine shall be stored with the chlorinators in a separate room.

(2) The room shall be-sited at ground floor level remote from building entrances and exits and from any other source of fire or explosion, but good access for the installation and removal of cylinders shall be provided.

(3) The room and the ventilation outlets from the room shall be remote from areas used by the public, from windows, and any inlets utilized for ventilation purposes. This is to prevent the possibility of chlorine gas, escaping from a leak, being distributed throughout the bathhouse and pool enclosure by the ventilation system.

The room shall be separated from the rest of the building by the following

fire ratings: 1 hour at the floor/ceiling and 1 hour at the walls,

(4) Any internal connections (particularly at low level) between the room and its surroundings such as piped services, drains, service ducts, etc. shall be sealed.

(5) The room should have escape doors which open outwards to the open air and the access door should have a suitable lock, preferably of the mortise type.

(6) The room shall be adequately ventilated by natural and/or mechanical systems. Chlorine gas is 2.5 times heavier than air so the system adopted should be such that the room is particularly well ventilated at low level. Natural systems may use louvered doors and/or wall louvers to provide a sweep—through of air. Mechanical systems should have ductwork taken to floor level.

(7) The room must not be damp.

(8) The room shall be maintained at a temperature of approximately 20-28 degrees C. and feature a continuously (SP) exhaust fan operated.

(9) The room must not be used for the storage of any other chemical or material.

(10) A suitable warning sign should be posted.

(11) As an additional precaution, a chlorine gas detector shall be provided. On sensing a gas leak in the bottle storage area, the detector will sound an alarm.

d. Sodium Hypochlorite. For sodium hypochlorite application, enclosed areas will be required around storage tanks to contain chemicals in the event of leakage.

e. Other Chemicals. It is necessary to provide proper storage space for solid disinfecting chemicals; space for chemicals for pH adjustment and flocculation shall be provided.

3. RECIRCULATION AND FILTRATION SYSTEMS

A pressure sand high rate filter system shall be specified unless there is extenuating circumstances whereby an alternative system will be more practical. Other types include vacuum sand system, either prefabricated or built on-site with a cast-in-place chamber, vacuum diatomaceous earth which can be factory fabricated or built on-site with a cast-in-place concrete tank and a filter element system assembled from factory components. The last is a factory fabricated pressure diatomaceous earth filter, which makes up less than 1% of the market and would only be used if a special condition proved that this particular type of equipment would be the most practical.

The pressure sand high rate filtration system is used in over 90% of the swimming pools built in the United States. The tanks for these systems shall be fiberglass because of its non-susceptibility to corrosion and aggressive swimming pool water. These tanks must be manufactured according to the National Sanitation Foundation Standard 50 and carry the approval label of that testing laboratory. Recirculation pumps shall be non-corrosive or be internally coated with a protective system to prevent corrosion.

a. Recirculation Systems. A recirculation system shall be provided complete with recirculation pumps, filters, and disinfectant equipment, with a capacity to produce a

complete pool water turnover in not more than 6 hours. The pool water turnover time for therapeutic pools shall be a maximum of 3 hours. The pool water turnover time for wading pools shall be thirty (30) minutes.

For outdoor pools in dusty regions or near large wooded areas with possible high pollen problems, a faster turnover rate shall be considered to maintain water clarity.

(1) A water level controller that monitors the pool surface level, releases water through an air gap and into a fill funnel which discharges into the surge tank or pool. Water Supply/ Distribution, and Disposal (Pool Fill and Water Makeup).

Direct connection between the water supply and the pool is prohibited. Automatic pool water makeup shall be provided by maintaining the water level in the tank at a set point. A 150mm air gap shall be provided between the potable water supply and the fill funnel in the supply line to the pool. A flow—controller valve which is pressure sustaining shall be provided in the pool makeup water line if water pressure is low or water main size is small.

(2) Outlets

Two or more outlet drains shall be provided at the deepest point of the pool, each large enough to empty the pool completely in a maximum of 6 hours. The free area of the outlet grating shall be a minimum of four times the area of the discharge pipe, with the maximum velocity of water passing through the grate not to exceed 450 mm per second. The openings in the grating shall be no larger than 12 mm.

(3) Pool Hydraulic Systems:

All equipment, piping, and valves shall be readily accessible for the proper control and operation of the swimming pool. For typical recirculation systems, see Appendix, Typical Piping Diagrams. Recirculating piping system shall be designed for a maximum velocity of 1830 mm per second in suction lines, and 3050 mm per second in pressure lines.

(a) Valves:

All valves shall be labeled for normal and backwash positions. Valves shall be butterfly or ball valves for two position operation. A balancing valve shall be installed in the pump discharge line.

(b) Pool Water Inlets:

Inlets shall be located to produce uniform circulation of water through the entire pool. Inlets shall be located around the walls of the pool tank, 600-1200 mm below the surface area or equidistant across the floor of the pool. Flows through each inlet shall be adjustable.

(c) Recirculation pumps: Pumps must be capable of producing the required volume under the maximum head and in a reciprocal manner have sufficient flow rate to backwash the pressure type filters.

A vacuum limit switch to stop the recirculation pump should be provided on each vacuum type filter. A harmful level of vacuum develop shall

be provided on each system.

4. PERIMETER OVERFLOW SYSTEMS

a. Gutters:

A flume shall extend around the entire perimeter of the pool. Its purpose is to capture the static and dynamic surge created by the users. The captured waves plus the water that flows across the gutter weir flow to filter pump via the surge tanks, the surge tank absorbs the displacement water that has risen in the pool and release air entrained in the gutter water before it is drawn into the filter pump.

The gutter profile cross sections have four basic forms:

I. Fully recessed because the pool deck cantilevers over the flume and the deck edge is aligned with the pool wall below.

II. Deck level gutters feature a grate across the flume and the rear of the gutter is the same elevation as the pool deck beyond.

III. Roll-out is the name given to a deck level gutter that has a curb where the gutter ends and the deck begins. The curb deters water from washing over the deck during periods of turbulence.

IV. Parapet gutter – a modified fully recessed gutter that is used as the end(s) of a competition/teaching pool when the side walls feature or deck level or roll-out gutter.

The use of surface skimmers is another type of perimeter overflow system which features a modulating weir which creates a constant flow from the pool surface into a basket housed in a suction chamber cast in the pool wall. Surface skimmers are mostly used on residential, apartment and club pools. In some states their use is approved regardless of pool size. Many states, however, limit their use to pools 280 M^2 or smaller.

b. Vacuum Systems

A vacuum cleaning system with separate piping and pump system for totally independent operation shall discharge waste water from the pump to the sewer or surge tank. The connections of the vacuum cleaning tools and hose shall be compatible. The vacuum ports shall be submerged and located so that all pool surfaces may be reached with the cleaning tools. An automatic pool cleaner should also be considered, due to operational ease and economy.

c. Filtration Systems.

(1) Filtration Purposes: The required high quality of pool water is achieved by interception of participants with strainers and then filtration.

(2) Schematics. See Appendix for recommended pool recirculation and chemical piping arrangements.

(3) Backwashing and Water Rate Turnover. Backwash water shall be discharged into a sanitary sewer, septic tank, or other disposal system approved by local authorities.

Section 8. HEATING, VENTILATING, AIR CONDITIONING AND PLUMBING

1. BATHHOUSE:

a. Ventilating: The ventilation of the bathhouse varies depending upon the designated spaces. Understandably, the humidity in the showers will create the greatest demand when the showers are fully occupied. 8–10 outside air changes per hour are recommended for the dressing rooms which include the showers, toilets and dressing area. Offices and food service areas will require less depending upon type of use or equipment used.

b. Heating: Most bathhouses that are part of outdoor facilities are not heated. When heating is provided, it is commonly delivered by forced air through ductwork with supply and return openings. Heat sources can be:

1. direct fired boiler
2. steam or hot water heat exchanger generated on site or from a central plant.

c. Air Conditioning: Bathhouses for outdoor swim facilities are rarely air conditioned except the food service work area is often treated using a window type unit. Likewise an office or meeting room may have a dedicated unit.

d. Mechanical System Materials: Ductwork, supply and return openings shall be epoxy coated galvanized steel. Hangers and fasteners will be the same.

e. Water supply system plumbing piping and fixtures as per jurisdictional standards.

f. Floor drains shall be area type drains outfalling to sanitary sewer. Strategic location of floor drains in dressing, toilet and shower areas can minimize custodial time in executing daily cleaning. Floor drains must be provided for snack bar including corner drain for soft drain and ice machines. Floor drains in the storeroom and filter room must provide a means of cleaning the respective area and capture spillage from hair and lint strainers.

2. NATATORIUM

a. Ventilation is required for health and safety of the occupants and for the durability of ferrous metals in the natatorium and its support spaces. Air turnover shall be 6 to 8 hours to accommodate wet surfaces, occupancy and chloramine accumulation which in excessive concentrations is corrosive and harmful to some forms of human tissue, i.e., lungs and eyes. ASHRAE requirement is 2.5 $L/s/-M^2$ minimum for occupancy and wet surfaces only. Outside air shall be introduced at no less than 25% of air turnover and with the capability to achieve 100% outside air introduction.

b. Air conditioning and Dehumidification should maintain an average air temperature in the natatorium of 29 deg. to 32 deg. depending upon type of pool, water

features and activity level. The design relative humidity shall be between 50% to 55%. The dressing rooms and natatorium support spaces shall be approximately the same.

c. Materials – provide aluminum ducts with isolation pad between duct and epoxy coated galvanized steel hangers and fasteners. A less costly option is epoxy coated galvanized steel duct, with hangers and fasteners.

d. Water supply shall be conventional as per jurisdictional code.

e. Deck drains – provide deck drains on the pool deck using stainless steel drain covers. (Coordinate with architect for deck slopes to drains.)

Section 9 - ENERGY CONSERVATION

1. UTILITY REQUIREMENTS Energy conservation shall be accomplished in all areas of an aquatic facility. See Table 2, Demand Loads for Swimming Pools, Northern and Southern Climate, for utility requirements common to typical pool facilities.

During programming phase, a site analysis must be made regarding utility requirements, i.e. electricity loads an phases, potable water, volume and pressure for filling pools (with pressure-control valve to prevent pressure drop in bathhouse or natatorium). Sanitary requirements for volume and capacity relative to backwash discharge of pressure sand filters and back flow preventers if necessary for deck drainage and other sanitary source water, energy source for pool heater and boiler for building (source and load requirements).

With regard to energy conservation, an indoor facility in cold climates shall be oriented to shield against prevailing wind and negative lift forces on roof profile. In hot weather climates, the building shall be oriented to protect entrance opening and food service counters from direct sunlight, as well as reflected sunlight and heat from pavement directly outside openings. This can be accomplished with overhangs at the entrance control point as well as the snack bar counter area. Sun relief is also becoming popular for waiting lines at the snack bar and deck table areas.

2. SITE/BUILDING ORIENTATION. The site shall be selected to provide shelter from harsh weather yet allow exposure to winter sun and cooling summer breezes. Windbreaks and landscaping can be used to aid in this. Whenever possible, energy shall be saved by aligning the longest side of the building to face south. During the winter, the low winter sun can be admitted through south glazing to provide heating and daylighting. In summer, the overheating caused by low morning and afternoon sunlight on the east and vest faces is reduced.

3. BUILDING/ENCLOSURE ENVELOPES The most important thing about the envelope of an indoor aquatic center as well as a bathhouse for an outdoor poolscape, is to shield the interior spaces from wind, heat, cold, precipitation, and any other exterior environmental conditions that can negatively affect the building. Energy conservation applies primarily to the indoor facility in which a relative static envelope will permit the proper functioning of the HVAC/dehumidification system. The seasonal bathhouse, likewise, can use passive ventilation designed in the walls and roof to minimize mechanical exhaust with its associated energy consumption.

4. SOLAR ENERGY USAGE. Solar energy should be considered for space, pool, and domestic hot water heating.

Since the 1970s when solar energy was being researched and developed as a means of overcoming increased costs of fossil fuel source energy field experience has shown solar energy is not a practical substitute. The conversion of solar energy to heating water is one of the simplest applications and, for that reason, solar energy was adopted in California and several other states as a preferred energy source for swimming

pools. Practicality proved that this was not a technology that would grow in the swimming pool industry. There are, however, certain applications for passive solar energy in natatorium. These facilities are primarily in the cold belt and the use of solar energy is supplemental to that of the mechanical fossil fuel primary system. When this application is made, strategic glazing is required with the understanding that heat gain can cause an imbalance in the indoor space if not properly accounted for in the design.

a. Passive. Passive solar heating systems where the building itself serves as a solar collector and heat—storage device should be considered. South—facing glazed areas, protected from the summer sun by overhangs, admit heat and light during the winter months.

The concrete pool deck, masonry walls of the bathhouse, and swimming pool itself may be designed to be the needed thermal mass for providing energy storage and to dampen temperature fluctuations.

b. Active. In general, active systems employ hardware and mechanical equipment to collect and transport heat and should be considered.

Because the pools are heated to temperatures only a few degrees warmer than daily ambient conditions, low cost collectors without glazed covers can be used efficiently and are permitted. Frequently, water circulation through solar collectors is accomplished by tying in to the pool circulation system. No additional pumps or storage tanks are required in this type system.

Domestic hot water can be supplied using solar energy by utilizing a system of solar collectors.

Solar energy can be harnessed for space heating using active systems. In many cases, however, this may be uneconomical. A solar heating system shall follow the guidelines in NAVFAC Technical Report No. 877.

5. POOL RECIRCULATON AND FILTRATION

The energy costs of operating a sand pressure system is higher that of operating a vacuum diatomaceous earth system due to the head requirements for the pressure sand. This economy is offset by the cost of the filter media of the diatomaceous earth system. Because filtration pumps must operate 24 hours a day producing a constant flow rate, cycling and reduced speed are not permitted. The selection of more energy efficient pumps and the sizing of impellers has reduced energy consumption as compared to older models. The automation of chemical controllers has reduced the running time of these fractional horsepower pumps. So while there is a savings as compared to older methods of dosage, the size of the pumps makes the economies relatively insignificant.

Pool recirculation and filtration equipment consumes a major portion of a pool facility's energy budget because of the required continuous operation. While little can be done in existing facilities to conserve energy, short of pump replacement, many opportunities exist during the design phase of a new pool.

a. Turnover Period. Careful consideration of the filtration load shall be made to select a turnover period as long as possible while meeting the filtration requirements. This is usually established and enforced by a jurisdictional health department/agency.

b. Pump and Motor Selection. Energy efficient pumps and motors shall be selected for use to the extent that their higher initial cost is generally offset by their operating economy, assuming continuous operation.

c. Automatic Controls. Automatic chemical controllers and filter backwash controls can save labor, provide closer control of the pool water quality, and conserve energy. A pump which automatically backwashes a filter because of pressure drop will perform frequently with a lower hydraulic head. Operating expenses and greater efficiency in staff management and pool safety may be realized.

Section 10 - LIGHTING AND ELECTRICAL REQUIREMENTS

1. POOL LIGHTING

Underwater Lighting; The interior of a swimming pool must be illuminated for safety reasons and for visibility needs of competitive swimmers. Because the interior surface is over 95% white, the reflection from light sources is relatively efficient considering the medium is water. Therefore, visibility can be achieved at a satisfactory level from overhead lighting 1000 Lux and above or through overhead lighting and underwater lighting. Underwater lighting is not always essential and many indoor facilities omit underwater lights. The answer to the question of underwater lights and relative overhead lights is influenced by the issue of relamping overhead lighting and fenestration over a large percentage of an exterior wall especially opposite a spectator seating area. Underwater lights will help illuminate the medium under the water surface, which reduces some of the reflective glare from the wall natatorium windows. Underwater lights also permit a more flexible fixture layout overhead, which can be more easily accessed for relamping.

Underwater lighting should be incandescent for 500 watt fixtures and below and quartz for 1,000 watt. The larger fixtures are used in wide pools such as 50M by 25M and 25M by (25 yd) 22.9M.

Outdoor pools, which will be used after dark, shall have underwater lighting and overhead lighting. Underwater lighting shall be 1 watt per 930 mm^2 of water surface area. The light level outdoors where overhead lights are located around the periphery of the pool deck shall provide of 200 Lux on the pool deck and approximately 300 Lux on the pool water surface.

Overhead light fixtures in the natatorium should have metal halide lamps with the fixtures being made of aluminum to avoid corrosion damage. Metal halide shall also be used for the overhead lighting at an outdoor pool.

The fixture type over an indoor competition pool shall provide down lighting. Indirect lighting is inappropriate because, a.) it takes approximately twice as many watts to create a 1000 Lux through indirect lighting as it does through down lighting, b.) a natatorium with indirect lighting gradually becomes darker each day after it is opened due to dust on the lens as well as dirt accumulating on the reflective ceiling, c.) A pool with indirect lighting overhead reflects the lighted ceiling, which, due to its

character, does not penetrate the water medium the same way the direct down lighting does.

Relamping overhead light fixtures can be done through catwalks if the fixtures are over the water or along the perimeter of the pool using man lift, but the fixtures must be out over the water surface approximately 100 millimeters so as to wash the vertical wall with light and prevent a shadow line being cast across that wall which can distort the vision of oncoming swimmers preparing to turn. A recent development by manufacturers of metal halide fixtures is a "light tunnel" which has a metal halide lamp at the end of a long plastic tube, which can extend 25 meters or more. This provides down lighting directly over the pool with the relamping function taking place over the pool deck. These lamps can also be located directly above the racing stripes at the bottom of the pool providing a reference for backstrokers.

	Preferred	Minimum
Deck Area	300 Lux	500 Lux
Water Surface	Minimum With Underwater Lights 300 Lux	Without Underwater Lights 1000 Lux

In addition, 1500 Lux, including supplemental lamp locations required if television coverage is authorized.

Recommended levels of illumination for:
Recreation Pools:

	Preferred	Minimum
Deck Area	500 Lux	200 Lux
Water Surface	With Underwater Lights 600 Lux	Without Underwater Lights 300 Lux

2. BATHHOUSE LIGHTING.

a. Natural. Lighting within a space with natural lighting shall be photocell controlled with on/off time switch. The photocell shall be adjusted to turn off fixtures when illumination inside the room exceeds 200 Lux. Photocells shall be recessed in the ceiling of the space and shall be calibrated to turn off electrical illumination at the prescribed level.

b. Illumination Level. The illumination level for the bathhouse shall be 20 footcandles.

Lighting poles shall be kept to the minimum height, so as to ensure easy access for maintenance. (9000 to 10600 mm) poles are suggested as an average height for most outdoor installations. Higher poles should not be used unless access to a bucket truck is assured for maintenance.

3. WIRING. See Swimming Pools, NEC Article 680.

a. Convenience Outlets. Waterproof, grounded, convenience outlets in

wet/damp areas shall be ground fault interrupted (GFI).

b. Electrical Equipment. Electrical equipment in wet and damp areas shall be switched by a GFI control circuit. Refer to NEC Article 680.

c. Grounding. See Methods of Grounding, NEC Article 680.

(1) Conductors. See NEC Article 680.

Bathhouse Lighting, Illumination in the bathhouse can be sourced by natural light through sky lights and window openings, white light fixtures as long as they are corrosion resistant and the level of illumination is standard for similar use spaces in conventional buildings.

All electrical insulation around and in a swimming pool as well as all metal inserts, embedments and fixtures must be grounded according to the National Electric Code Article 680, including reinforcing steel in the pool shell.

Section 11. - COMMUNICATION

1. SIGNALLING SYSTEMS. These systems shall be used for call out.

2. CLOCKS. Clocks shall be used for training use and general information.

3. PUBLIC ADDRESS. Public address is necessary for paging and public announcements. The central unit shall be in the pool manager's office and/or control point. Microphone points may be required near the pool itself. Points shall be provided at the pool manager's office and central control desk. Speakers are required in the pool enclosure or area and in the locker/dressing area. Lifeguard stands should include intercommunication with the pool manager' s office.

4. TELEPHONES. A phone for incoming calls shall be located at the control point and pool manager's office. Coin-operated phones for the staff and the public shall be located as required.

5. CLOSED CIRCUIT TELEVISION. This may be considered for supervising the changing rooms, corridors, pool enclosure, or other areas for additional security.

6. TELEVISION AND SOUND BROADCAST. These may be considered if the pool is planned for national or international events which may be televised or broadcast. The broadcasting companies should be consulted as to their requirements.

7. SCOREBOARDS, ELECTRONIC JUDGING MID TIMING EQUIPMENT. This equipment should be utilized if the pool is planned for national or international events.

APPENDIX OF REFERENCES

Publications containing information cited in this manual:

American National Standards Institute/National Spa & Pool Institute (ANSI/NSPI)
NSPI
2111 Eisenhower Avenue
Alexandria, VA 22314
Phone: (703) 838-0083

Publication: American National Standard for Public Swimming Pools (ANSI/NSPI 1991)

National Swimming Pool Foundation (NSPF)
10803 Gulfdale, Suite 300
San Antonio, TX 78216
Phone: (210) 525-1227

Publication: Official Swimming Pool Design Compendium (5th Edition)

American Concrete Institute (ACI)
P.O. Box 9094
Farmington Hills, MI 48333
Phone: (248) 848-3700

Publication: ACI318 – 95 Building Code Requirements for Structural Concrete and Commentary

Illuminating Engineering Society (IES) of America
120 Wall Street, 17th Floor
New York, NY 10008
Phone: (212) 248-5000

Publication: 1993 IES Lighting Handbook

National Fire Protection Association (NFPA)
11 Tracy Dr.
Avon, MA 02322
Phone: (617) 770-3000

Publication: Latest edition, NFPA 70 National Electrical Code, Article 680

NAVFACENGCOM Design Manuals and Military Handbooks for Engineering and Design. (See list on 1037.1-1)

For other manuals published for NAVFACENGCOM. contact:

Navy Publications and Printing Service Office
NPM DODSSP, BLDG 4D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Phone: (215) 697-2569

Current Rule Books for:

Federation Internationale de Natation Amateur (FINA)
Avenue de Beaumont 9
1012 Lausanne
Switzerland
Country & City Codes (41-21)
Phone: 312 6602

U.S. Swimming, Inc. (USS)
One Olympic Plaza
Colorado Springs, CO 80909
Phone: (719) 578-4578

U.S. Diving, Inc. (USD)
Pan American Plaza
201 S. Capitol Ave., Suite 430
Indianapolis, IN 46225
Phone: (317) 237-5252

U.S. Water Polo, Inc. (USWP)
1685 West Uintah
Colorado Springs, CO 80904-2921
Phone: (719) 634-0699

National Collegiate Athletic Association (NCAA)
6201 College Boulevard
Overland Park, Kansas 66211-2422
Phone: (913) 339-1906

National Federation State High School Association (NFHS)
11724 NW Plaza Circle, Box 20626
Kansas City, Missouri 64195-0626
Phone: (816) 464-5400

NOTE: The following details are typical for many designs in the United States and are thus shown in conventional English standard dimensions. If such details are considered beneficial to the Handbook by the review committee, all details will be converted to metric for the final document.

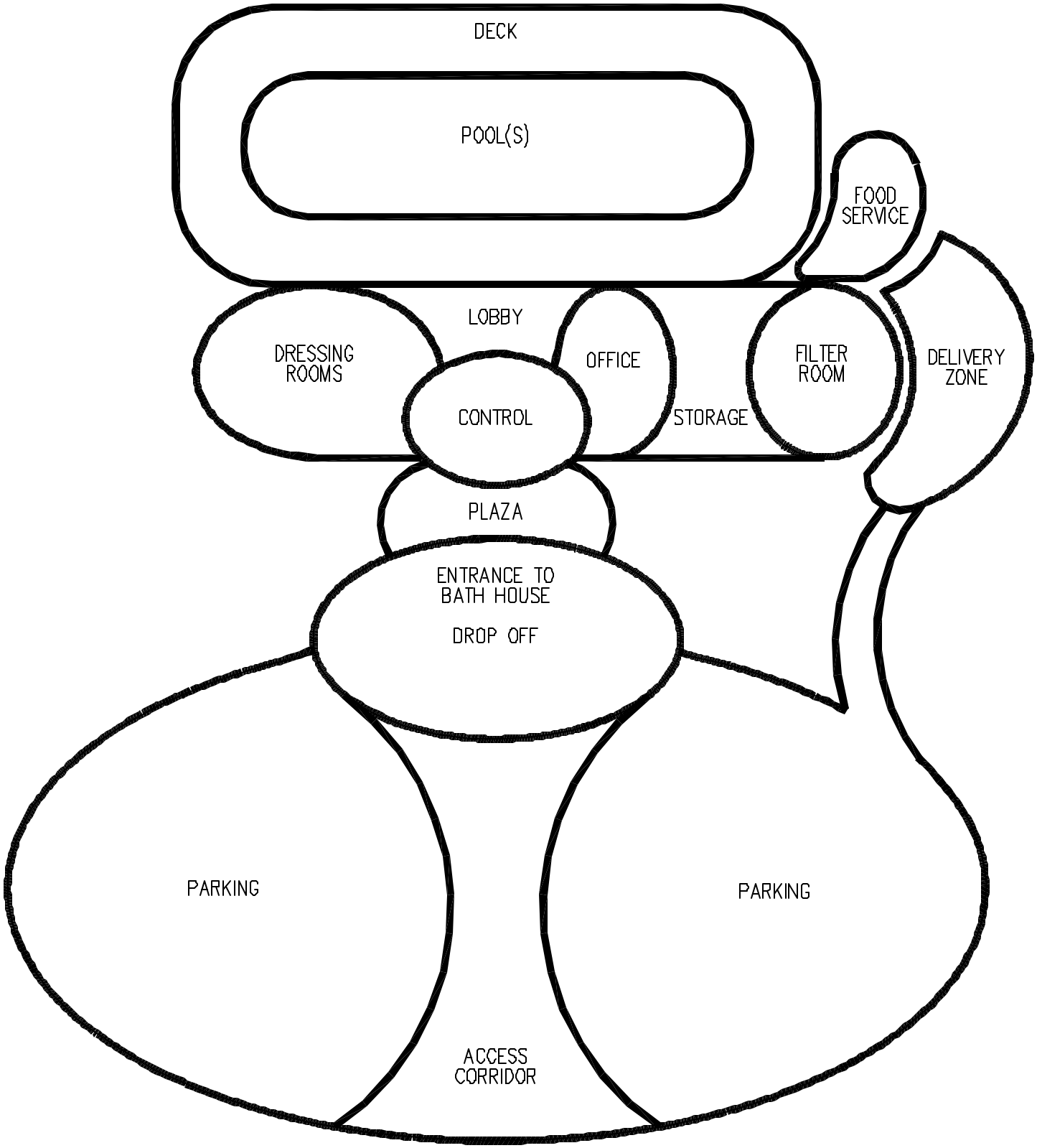


DIAGRAM OF OUTDOOR SWIM CENTER RELATIONSHIPS

DRAFT

1037.1-A3

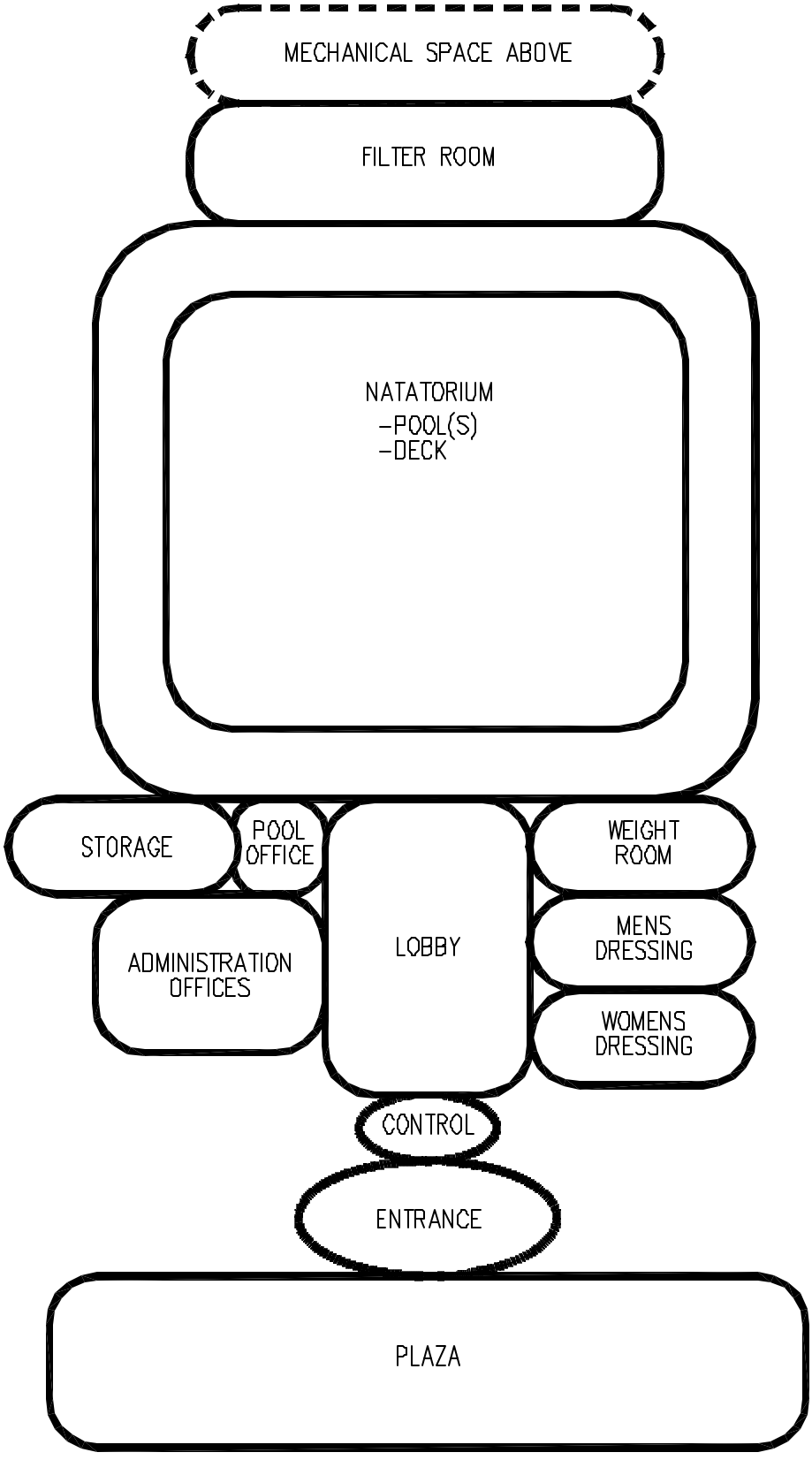
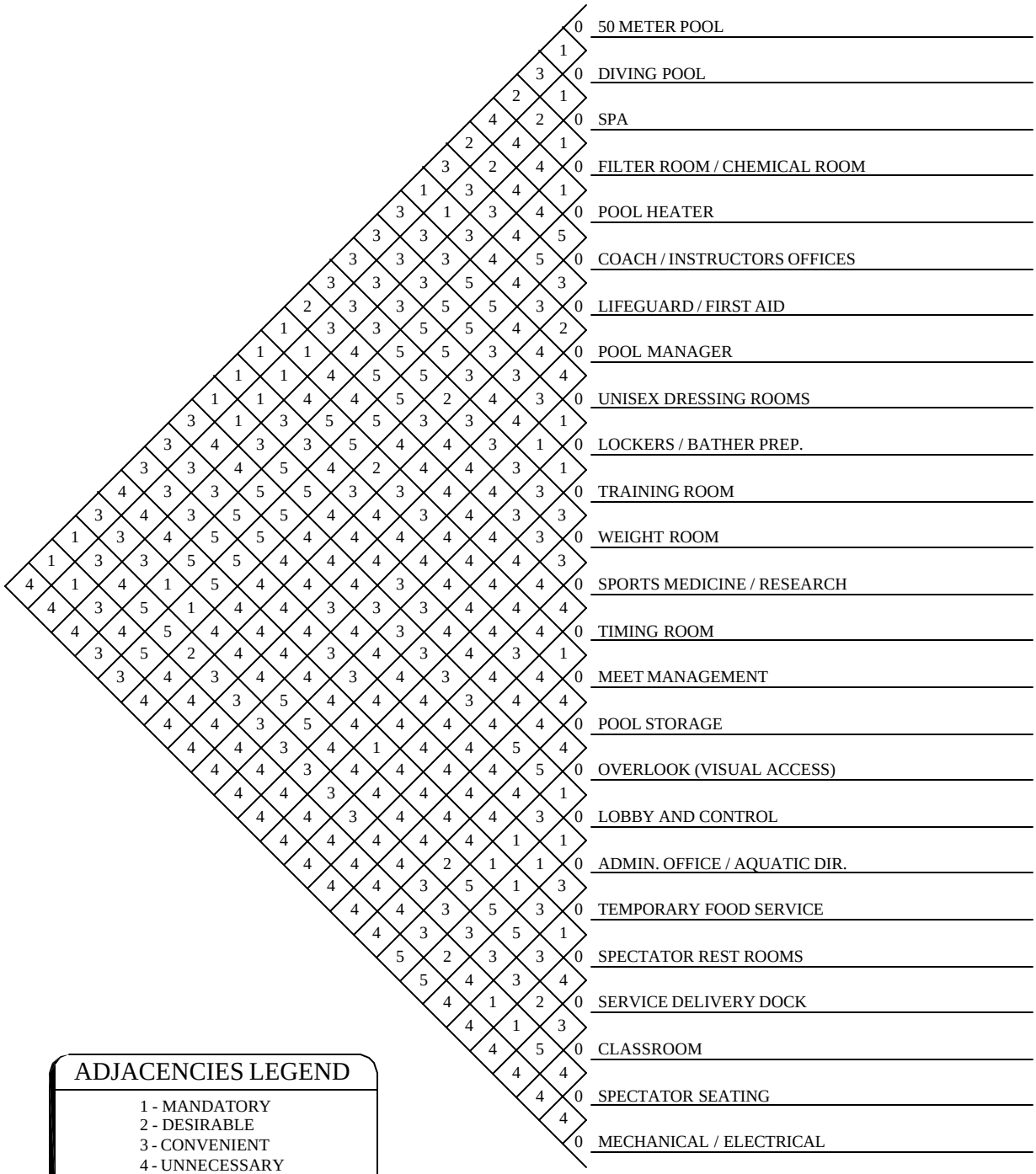


DIAGRAM OF INDOOR AQUATIC CENTER RELATIONSHIPS

DRAFT

1037.1-A4



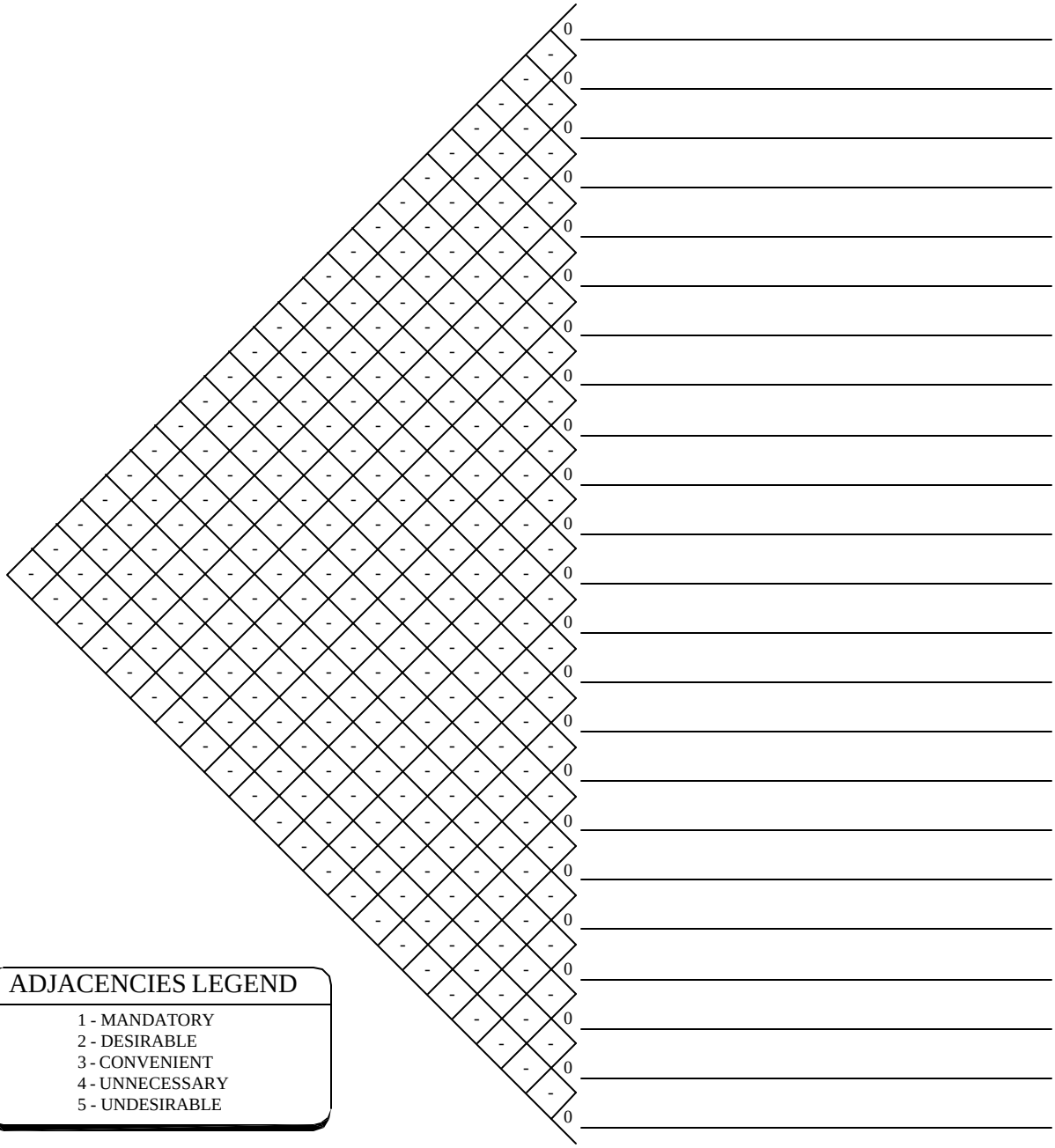
ADJACENCIES LEGEND

1 - MANDATORY
2 - DESIRABLE
3 - CONVENIENT
4 - UNNECESSARY
5 - UNDESIRABLE

AQUATIC CENTER
ADJACENCY DIAGRAM

DRAFT

1037.1-A5



ADJACENCIES LEGEND
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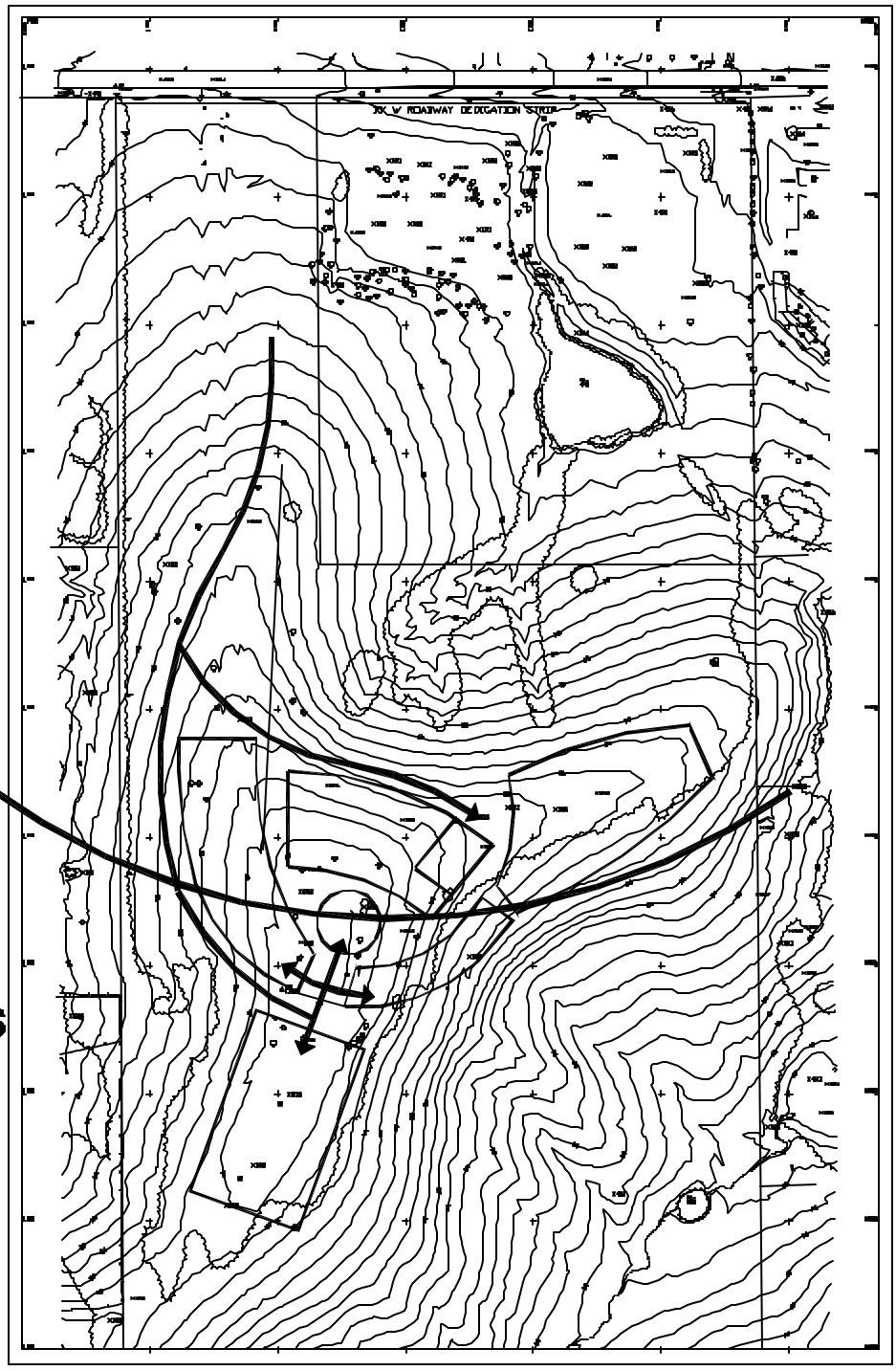
3 - CONVENIENT
4 - UNNECESSARY
5 - UNDESIRABLE

ADJACENCY DIAGRAM

DRAFT

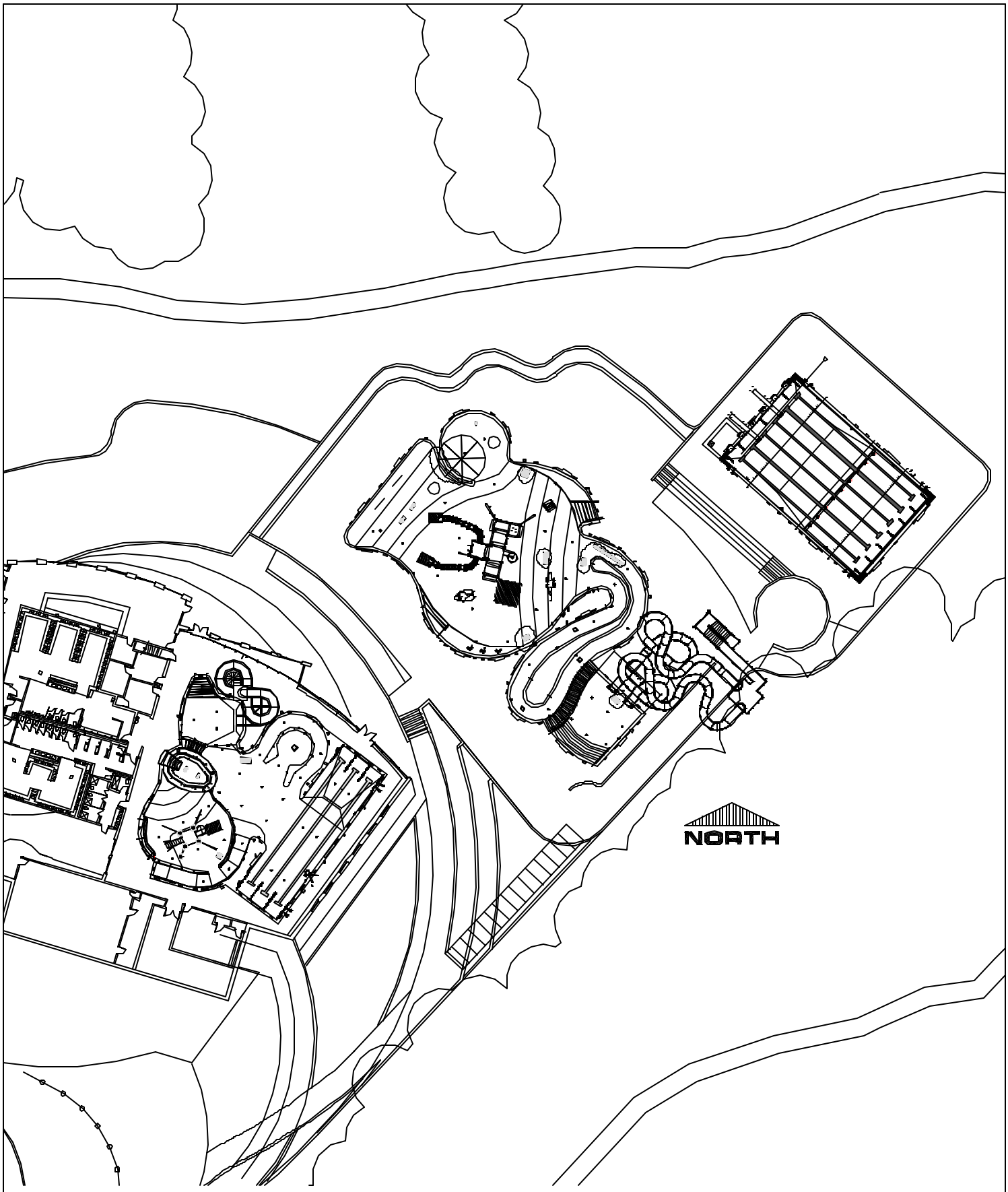
1037.1-A6



SITE PLAN WITH
TOPOGRAPHY

DRAFT

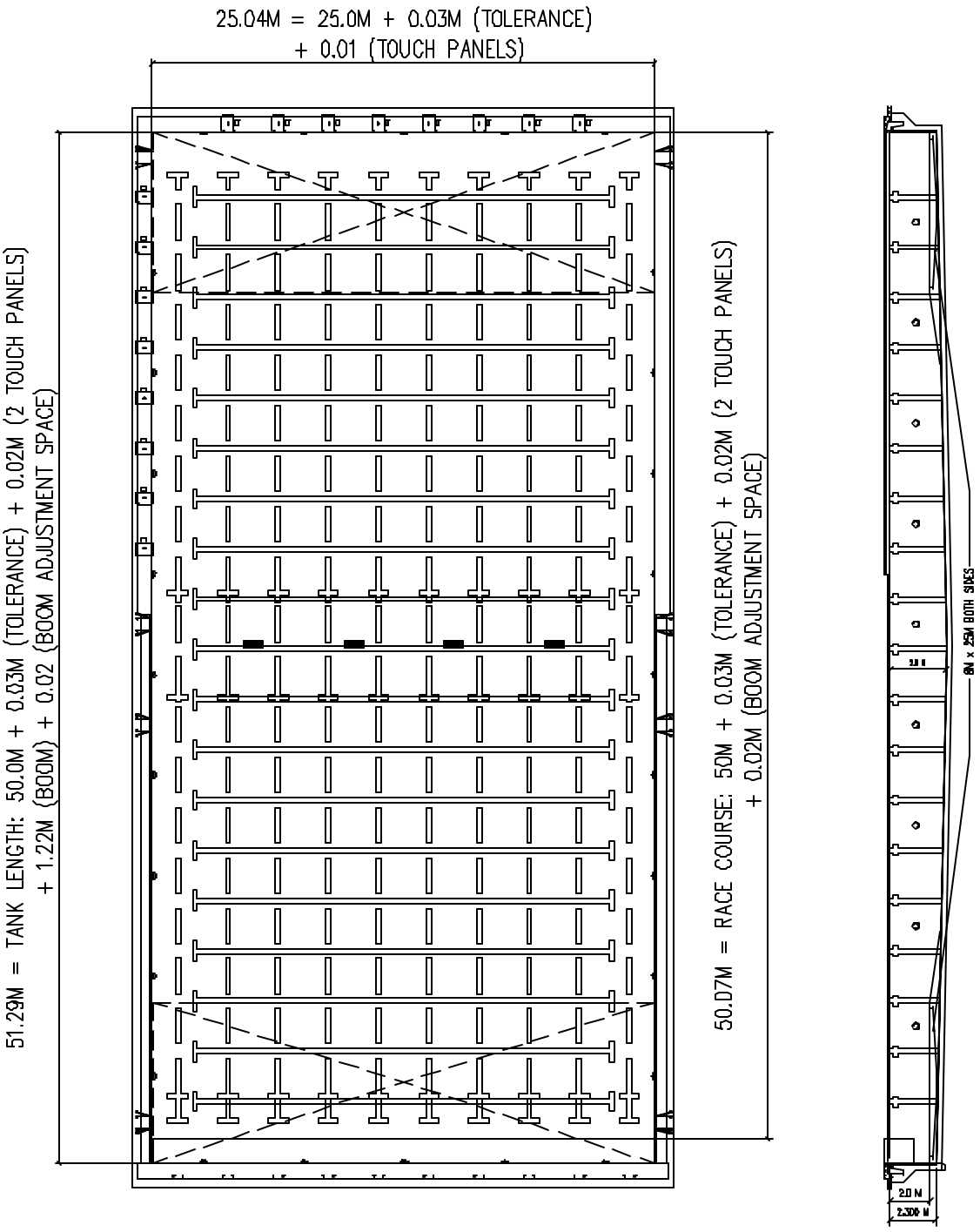
1037.1-A7



INDOOR AND OUTDOOR LEISURE POOL
AND OUTDOOR LAP POOL

DRAFT

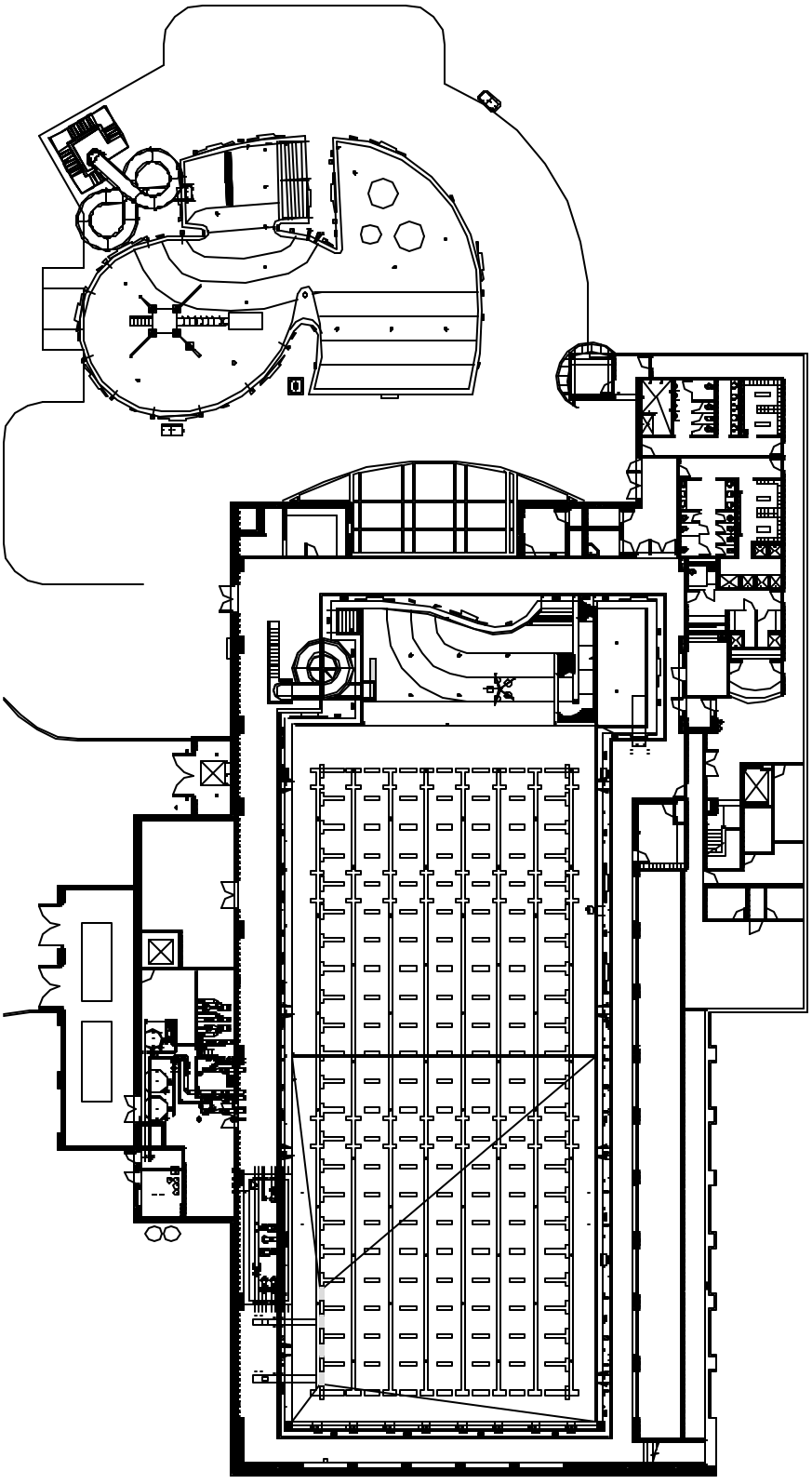
1037.1-A8



COMPETITION POOL

DRAFT

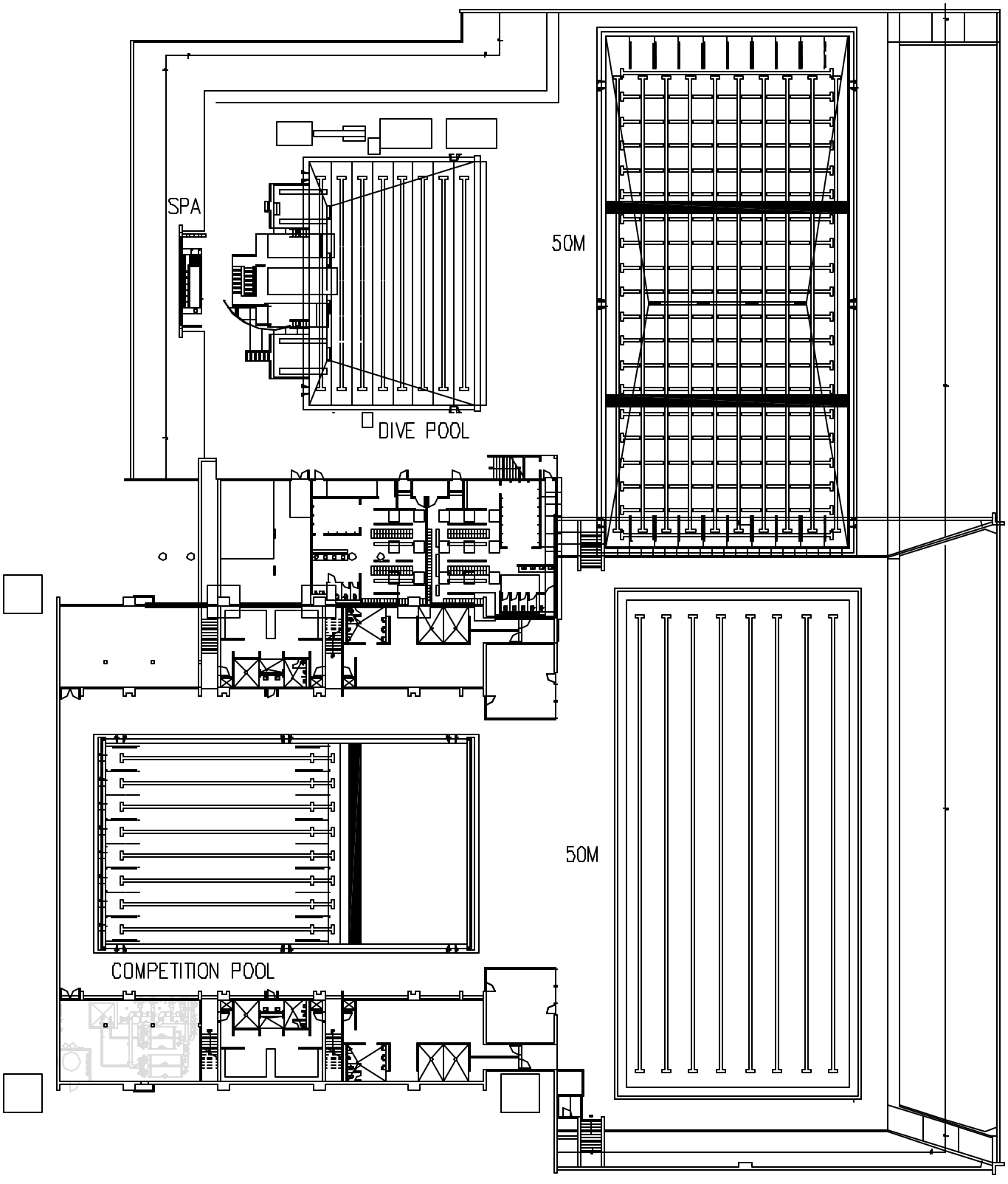
1037.1-A9



INDOOR 50mm POOL WITH LEISURE FEATURES
PLUS OUTDOOR LEISURE POOL

DRAFT

1037.1-A10



AQUATIC TRAINING CENTER

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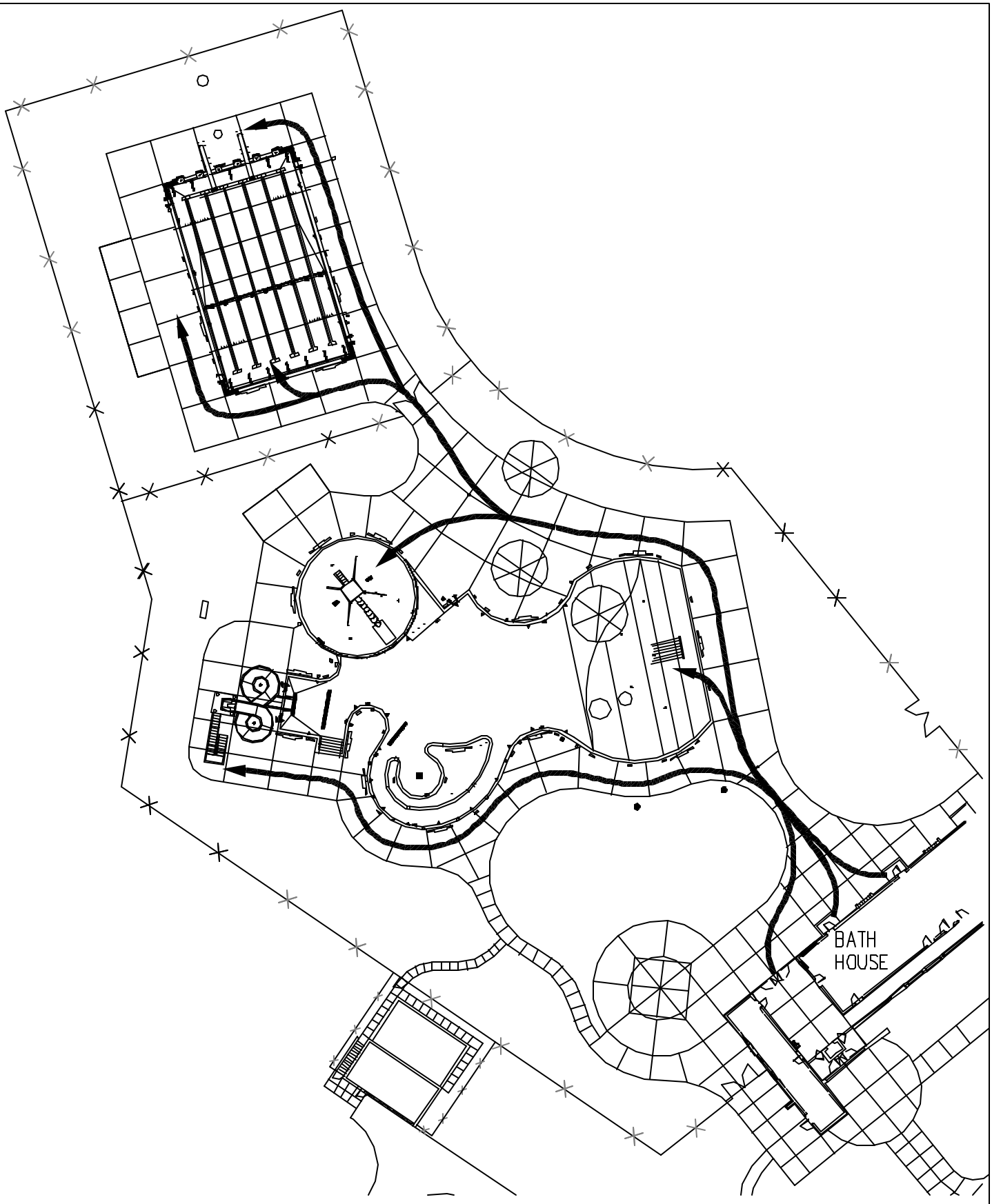
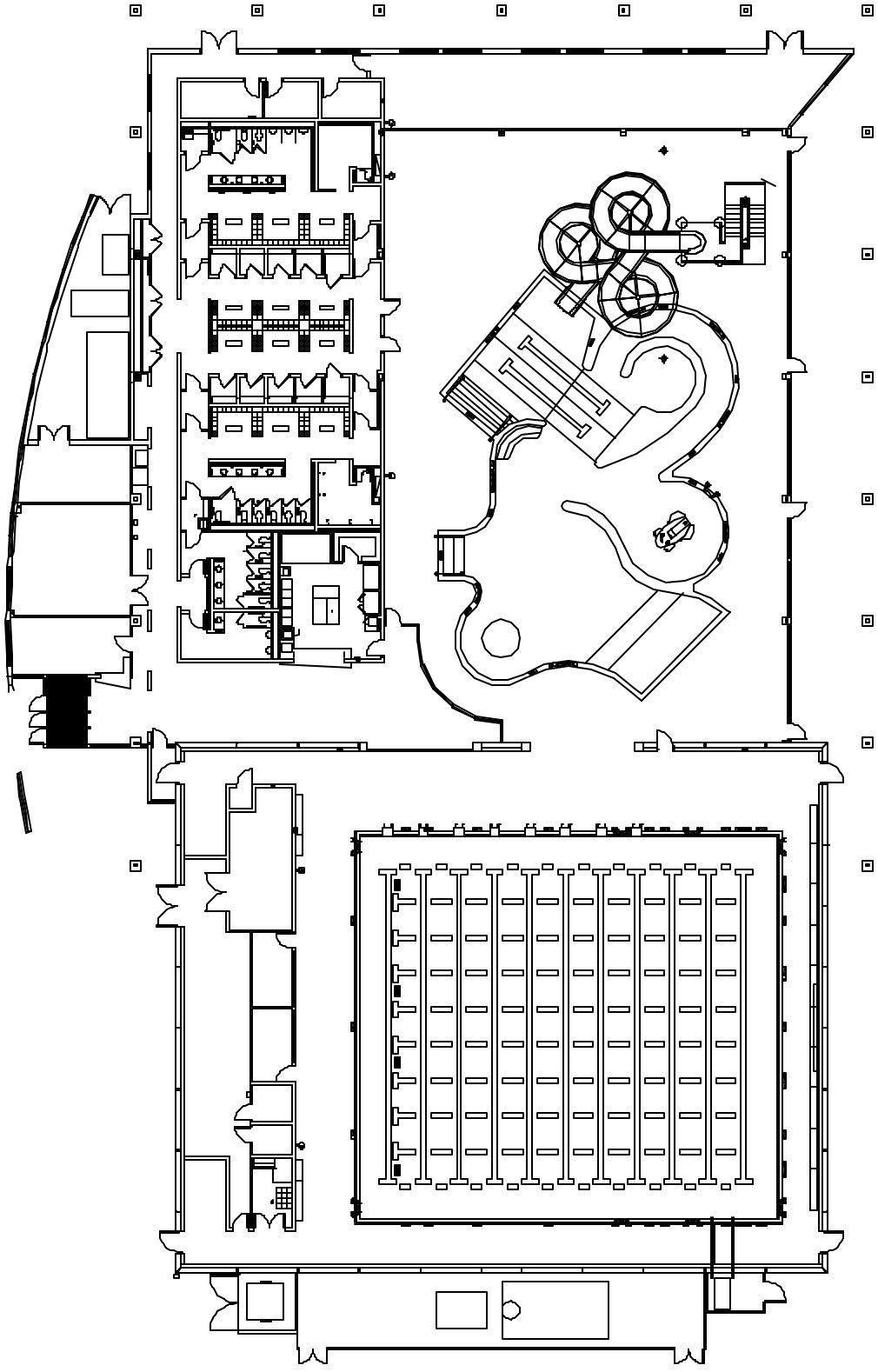
1037.1-A11



OUTDOOR LEISURE POOL AND TRAINING POOL

DRAFT

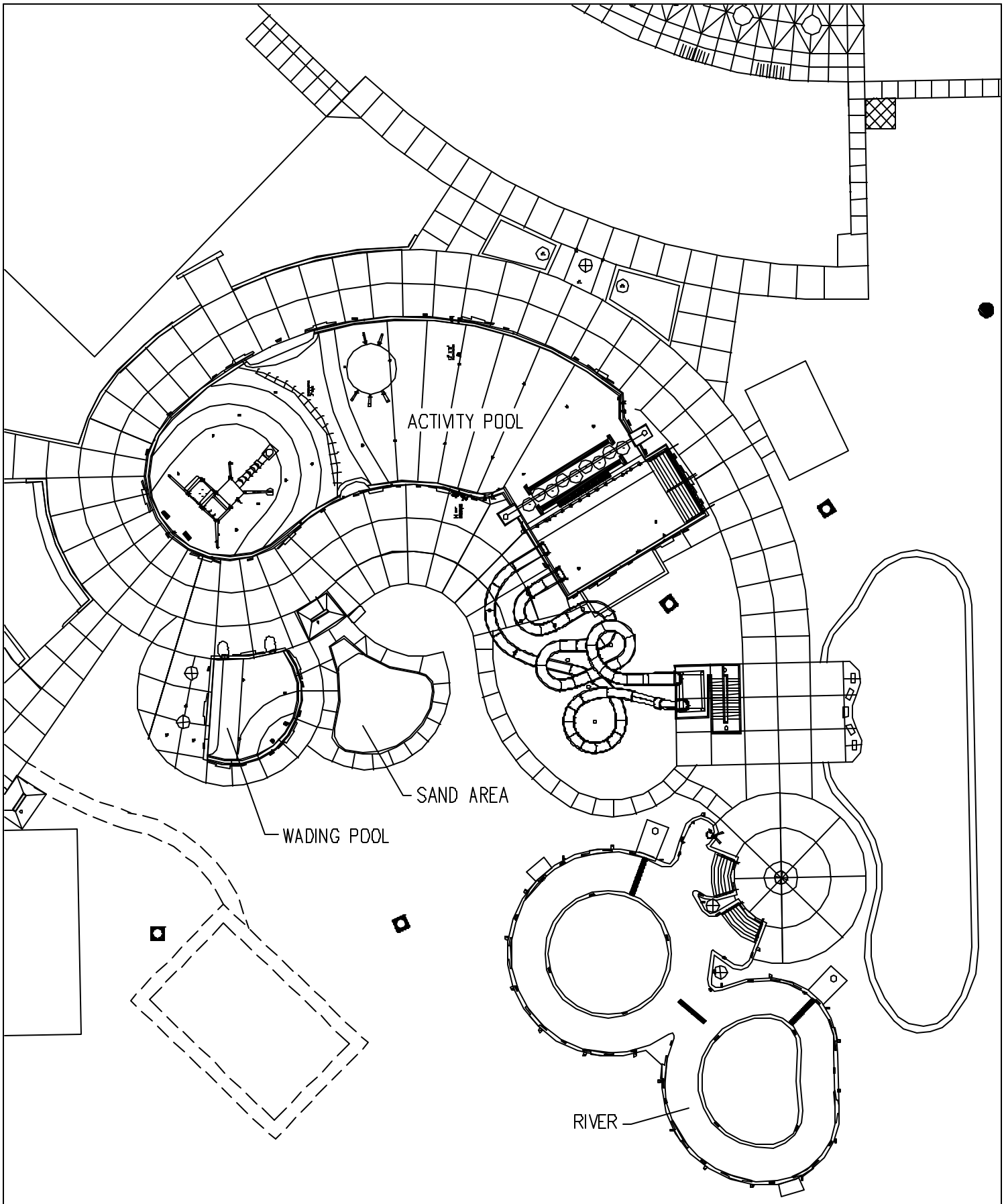
1037.1-A12



INDOOR AQUTIC CENTER

DRAFT

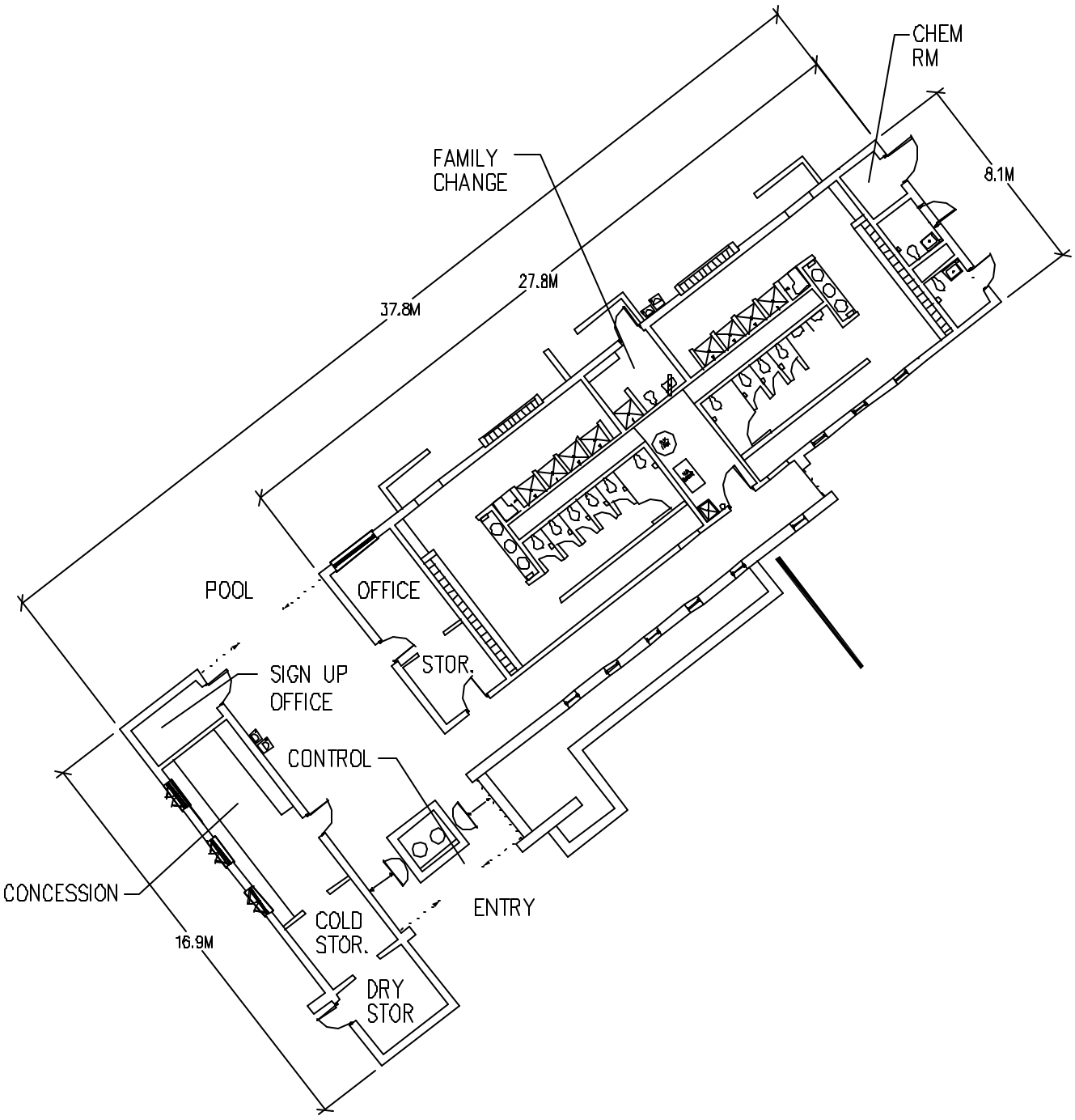
1037.1-A13



OUTDOOR LEISURE POOL COMPLEX

DRAFT

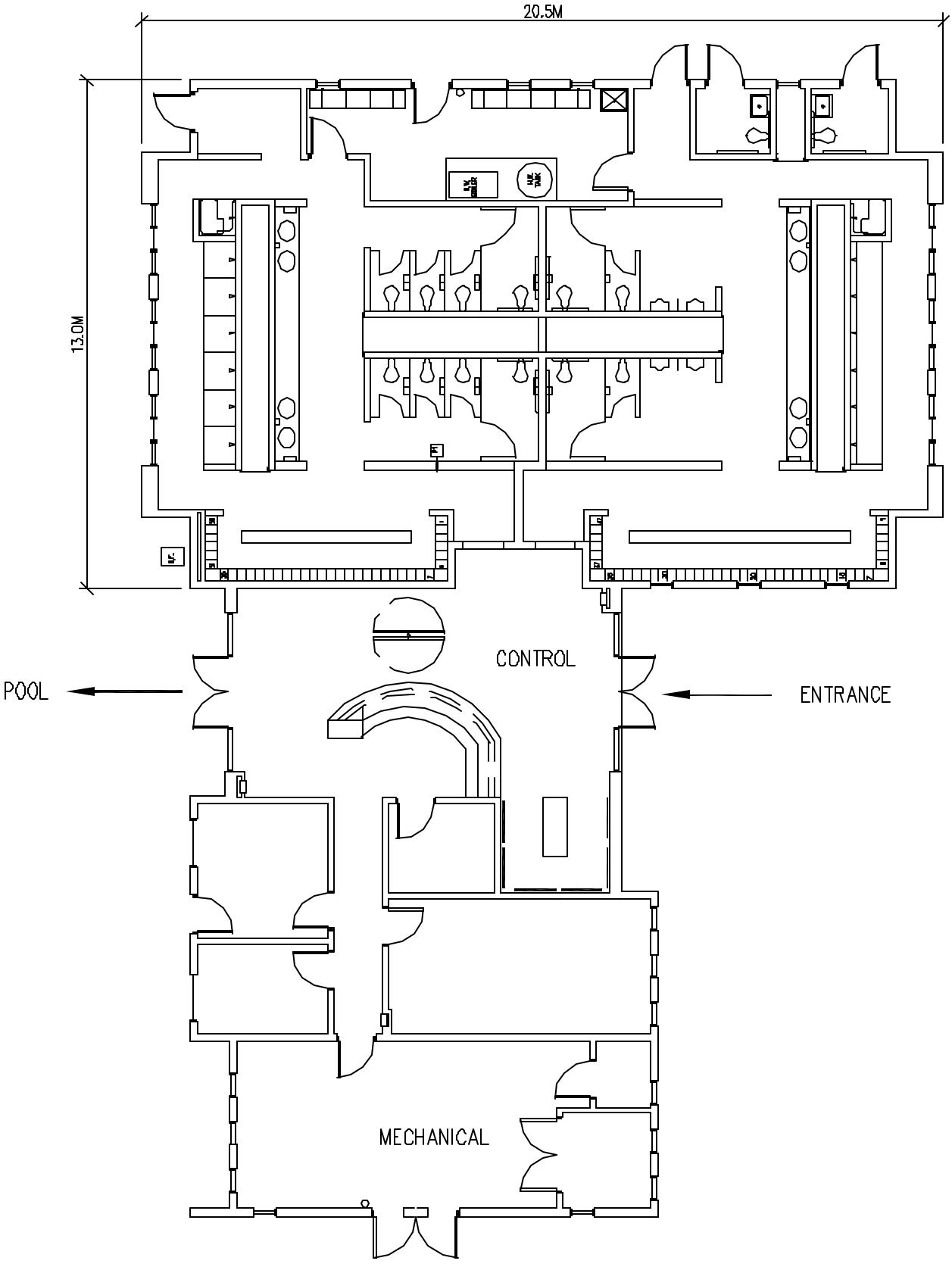
1037.1-A14



BATH HOUSE EXAMPLE

DRAFT

1037.1–A15



BATH HOUSE EXAMPLE

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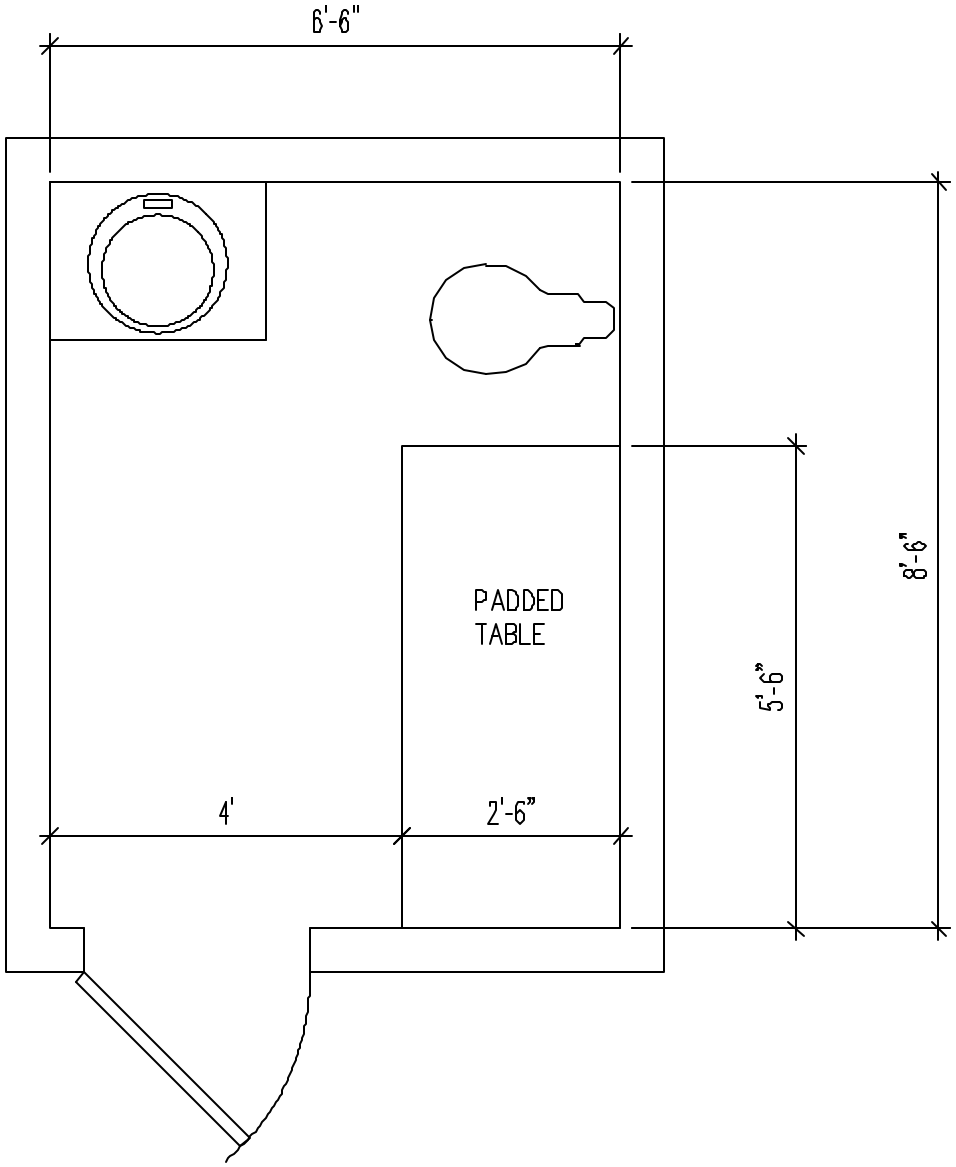
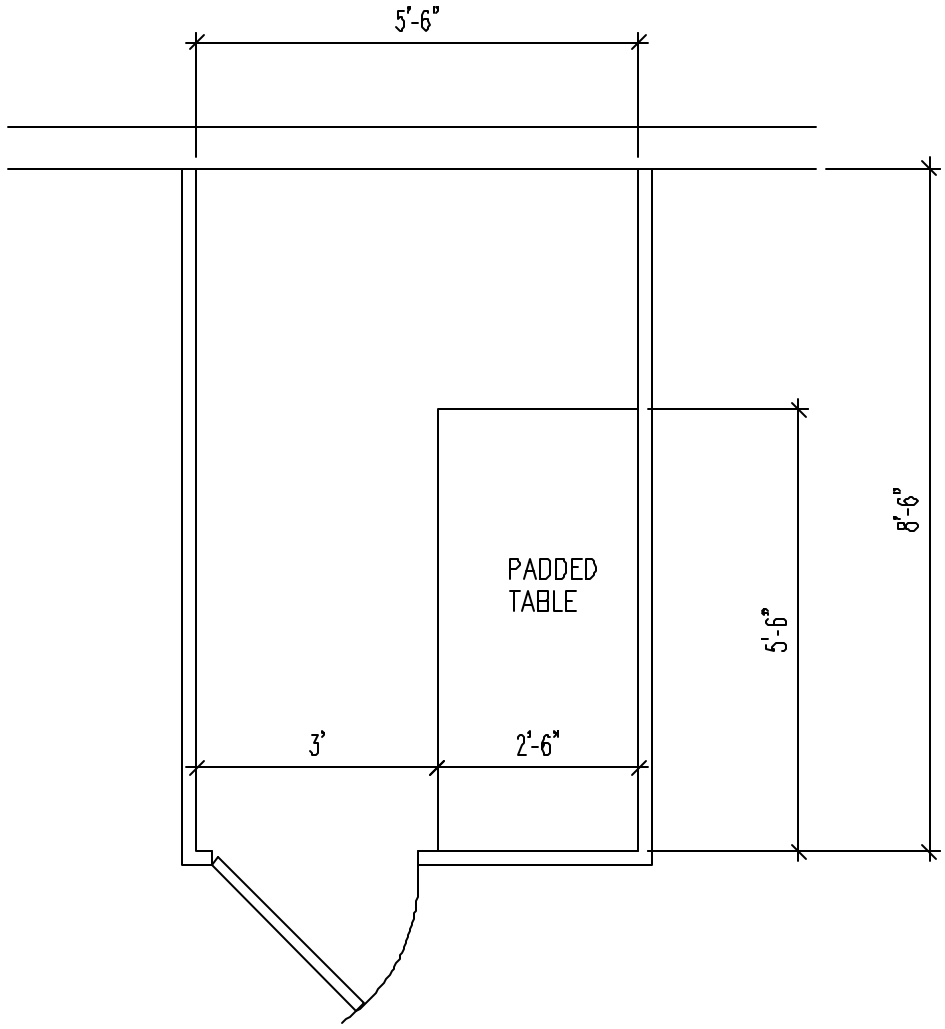
1037.1-A16



DRESSING ROOM FOR PHYSICALLY DISABLED PERSON (OUTSIDE OF LOCKER ROOM)

DRAFT

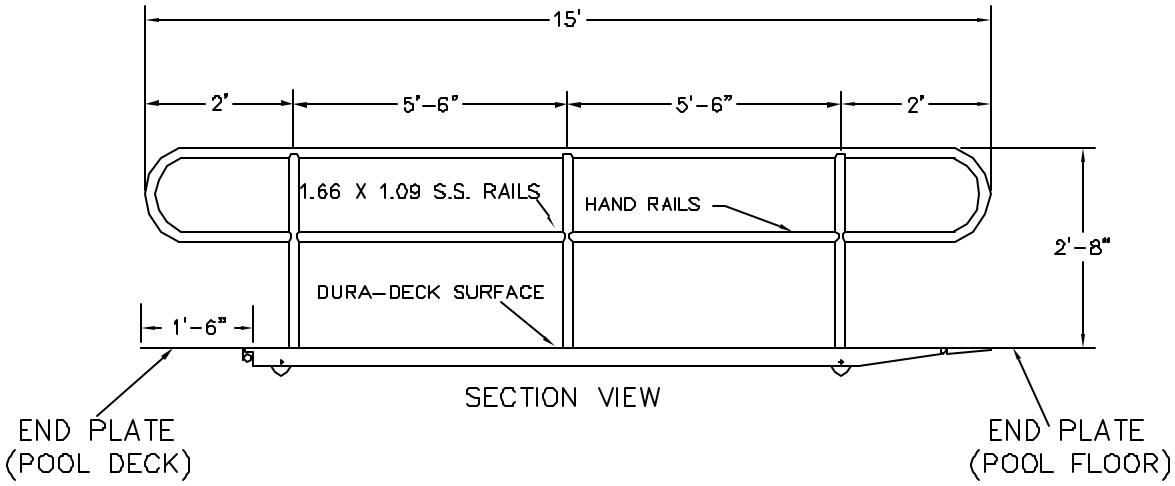
1037.1-A17



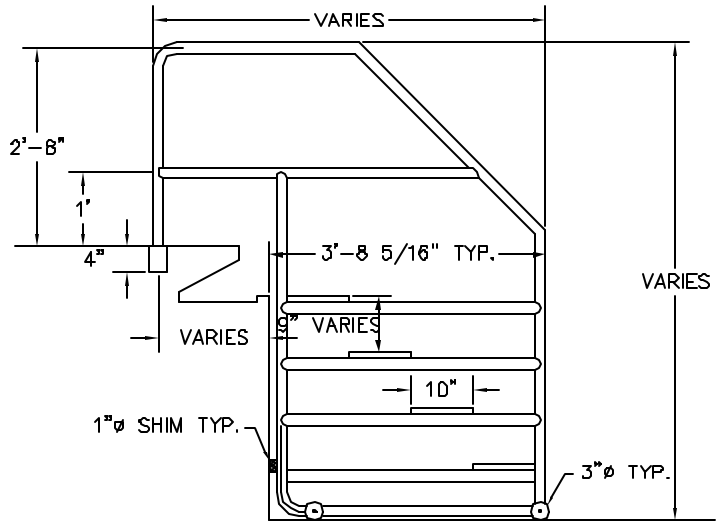
DRESSING STALL FOR PHYSICALLY DISABLED PERSON (INSIDE LOCKER ROOM)

DRAFT

1037.1-A18



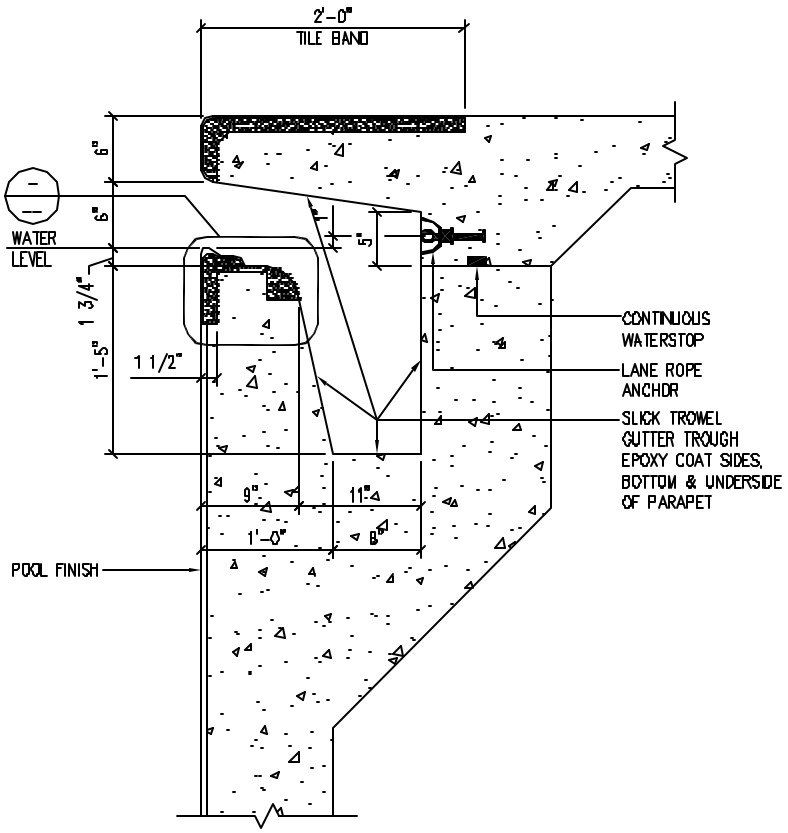
SECTION VIEW OF THERAPY RAMP



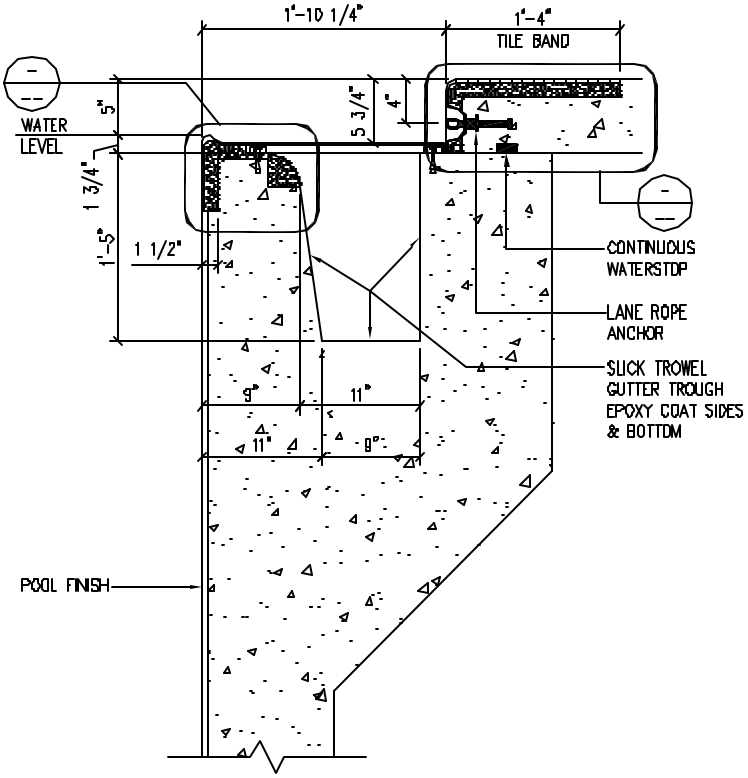
NOTE: SOME DIMENSIONS WILL VARY ACCORDING TO DEPTH OF POOL AT LADDER LOCATION AND GUTTER CONFIGURATION.

ELEVATION VIEW OF THERAPY STAIRS

DRAFT



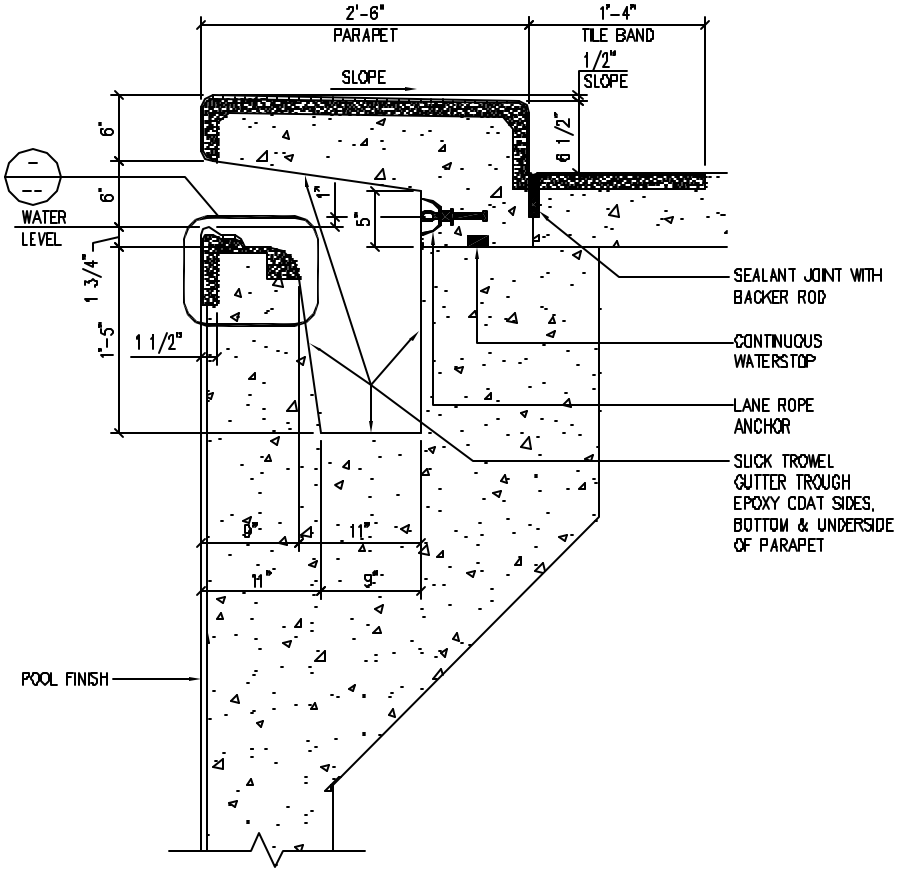
FULLY RECESSED GUTTER



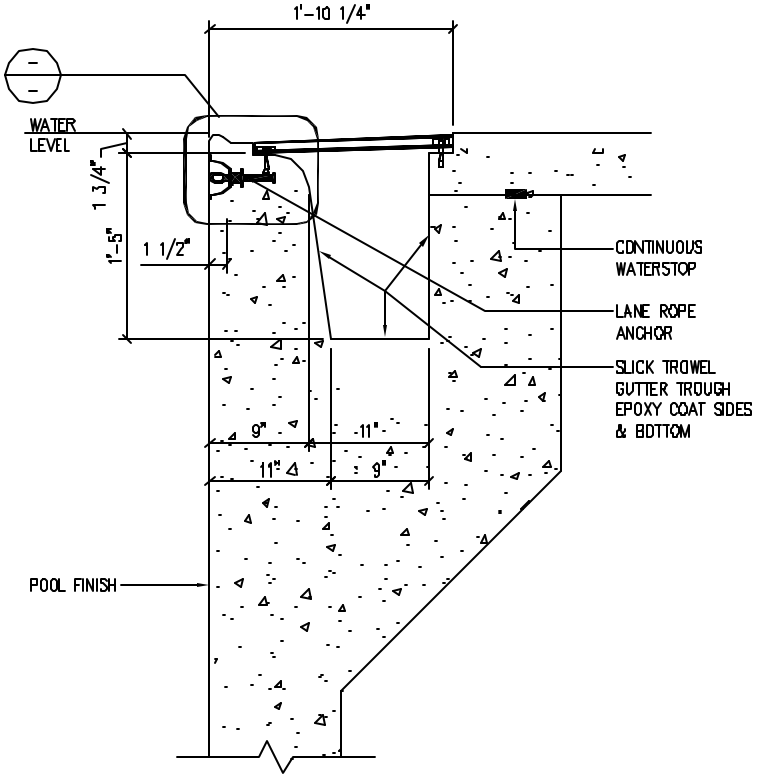
ROLLOUT GUTTER

DRAFT

1037.1-A20



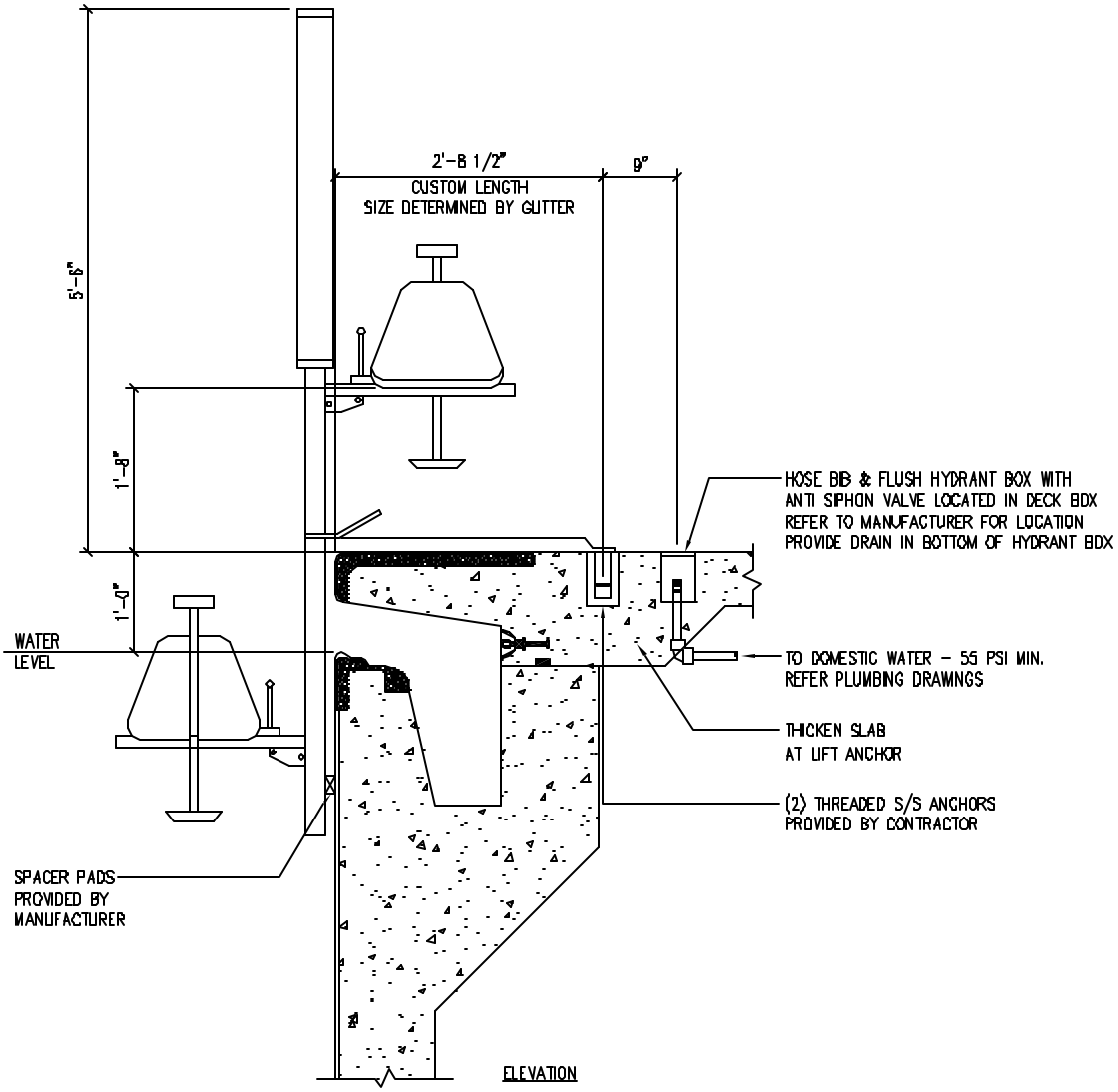
PARAPET GUTTER

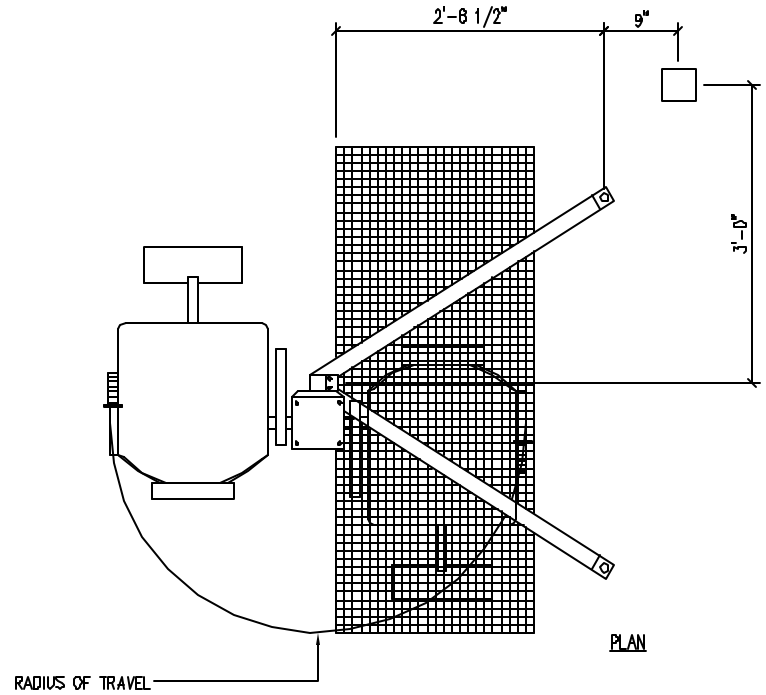


DECK LEVEL GUTTER

DRAFT

1037.1-A21

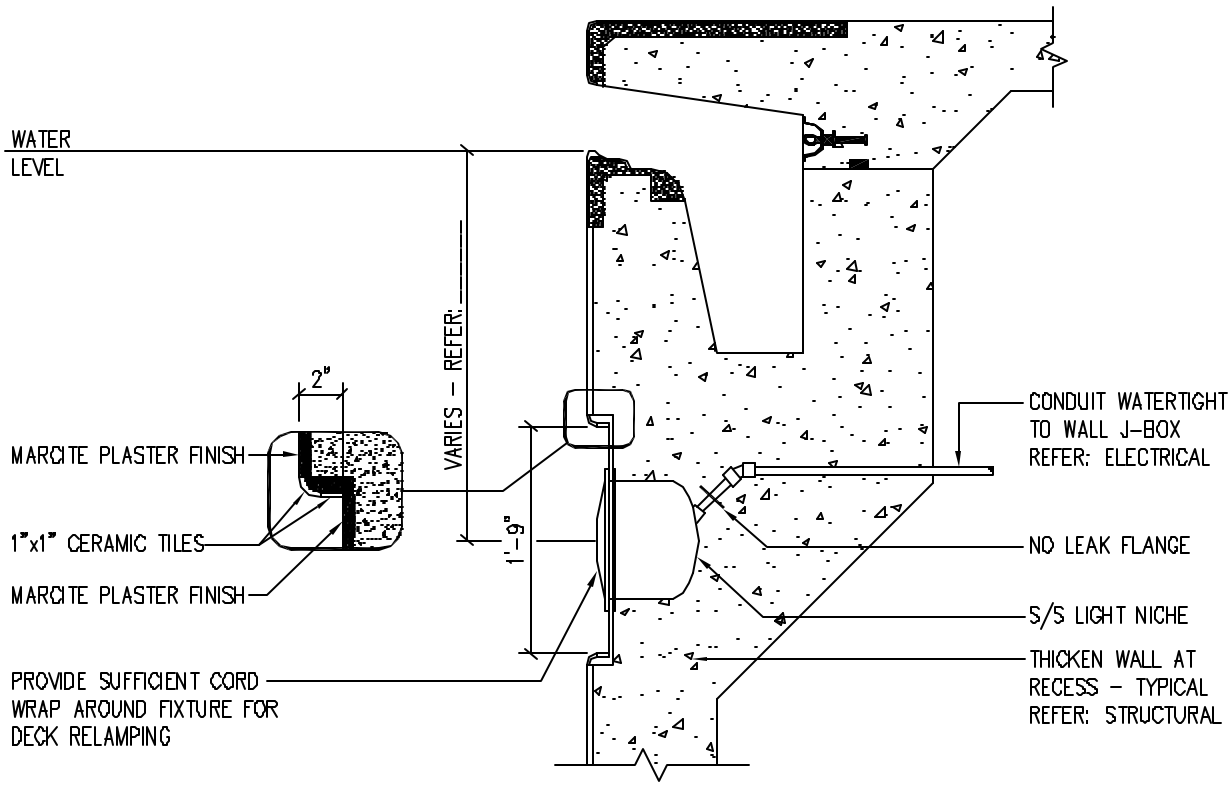




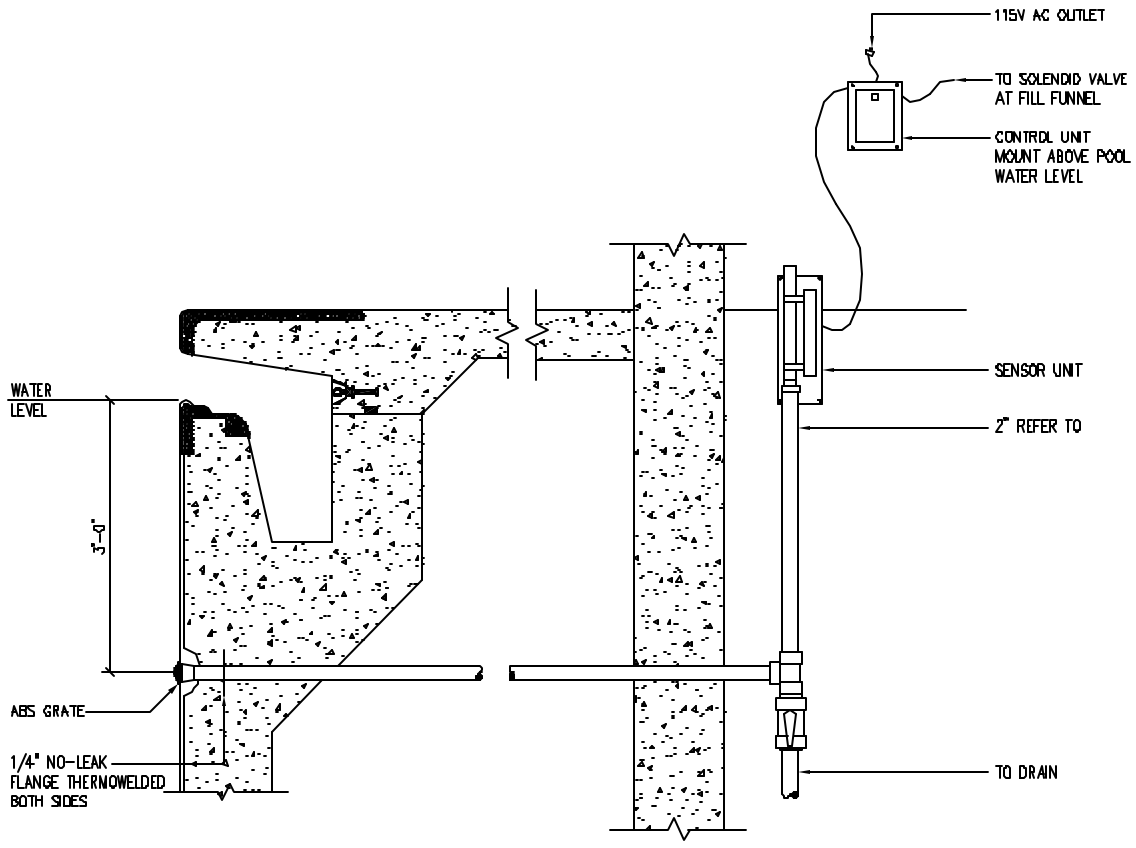
HYDRAULIC LIFT FOR DISABLED

DRAFT

1037.1-A22



RECESSED UNDERWATER LIGHT



WATER LEVEL CONTROLLER

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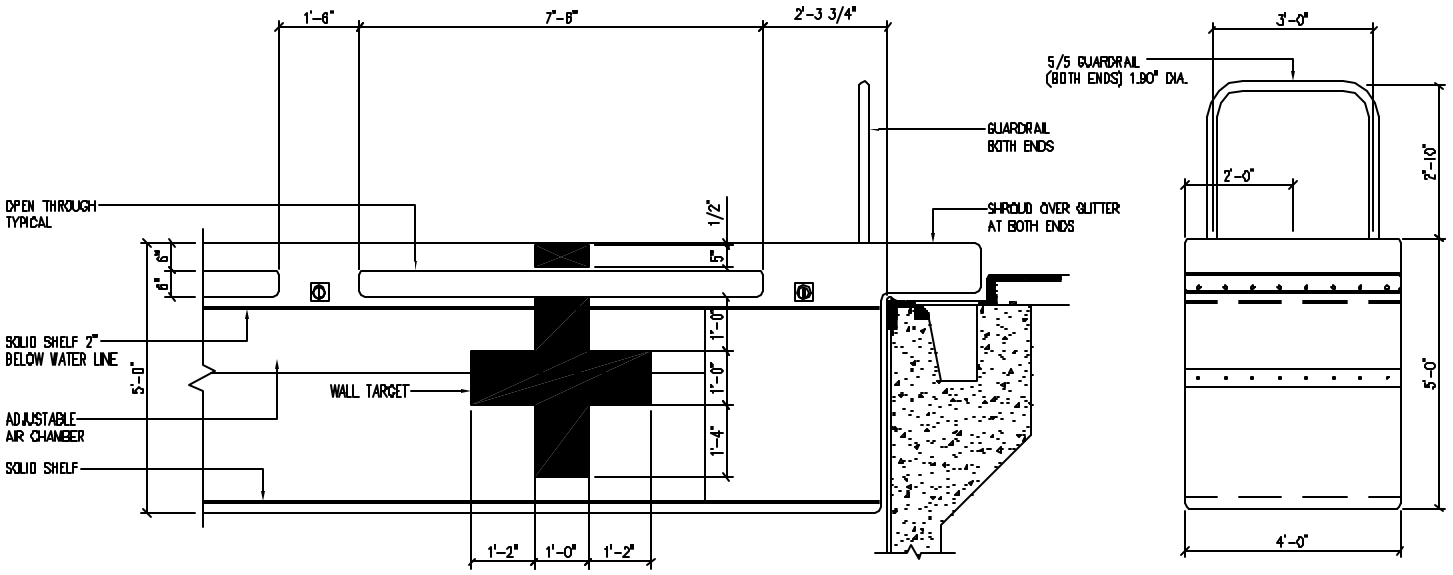
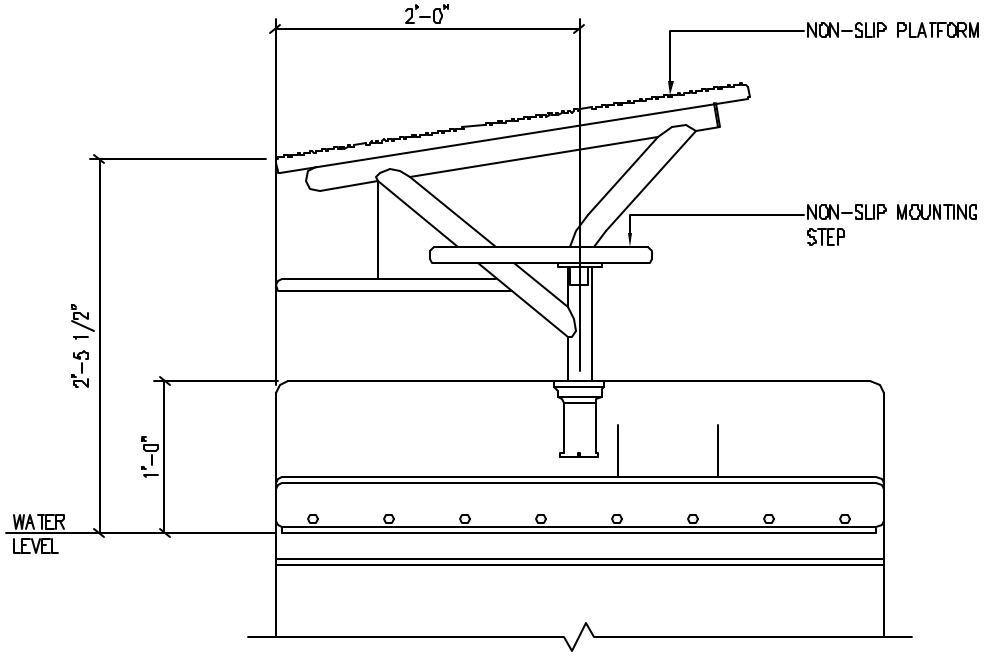
1037.1-A23



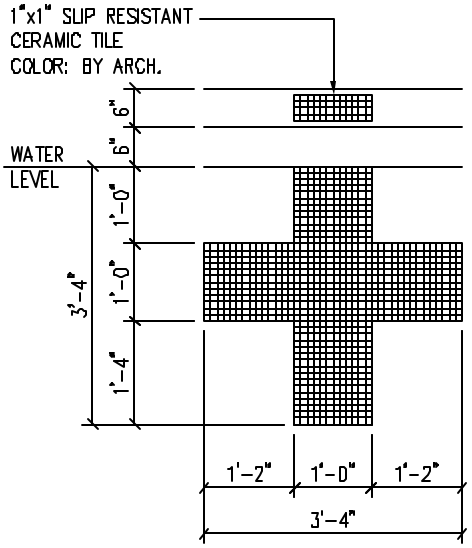
BULKHEAD ELEVATIONS



STARTING BLOCK ON BULKHEAD

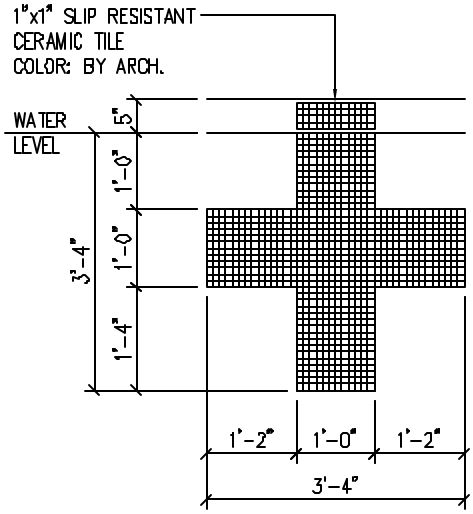
DRAFT

1037.1-A24



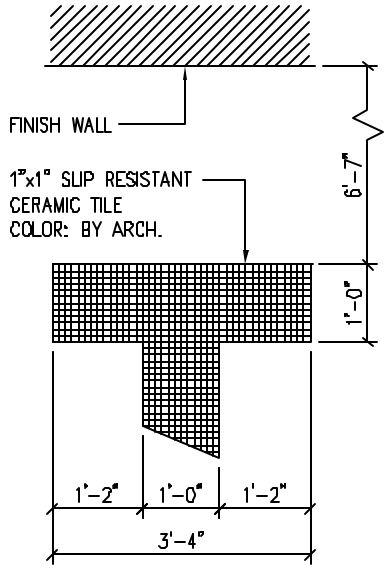
TARGET ELEVATION

AT FULLY RECESSED GUTTER



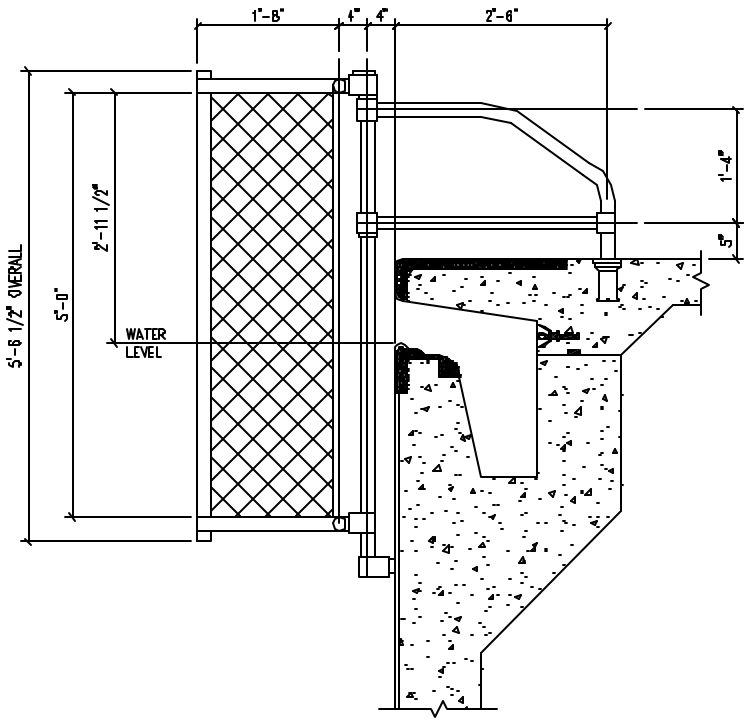
TARGET ELEVATION

AT ROLLOUT GUTTER



FLOOR MARKER PLAN

WALL TARGETS & FLOOR MARKERS



WATER POLO GOAL

DRAFT

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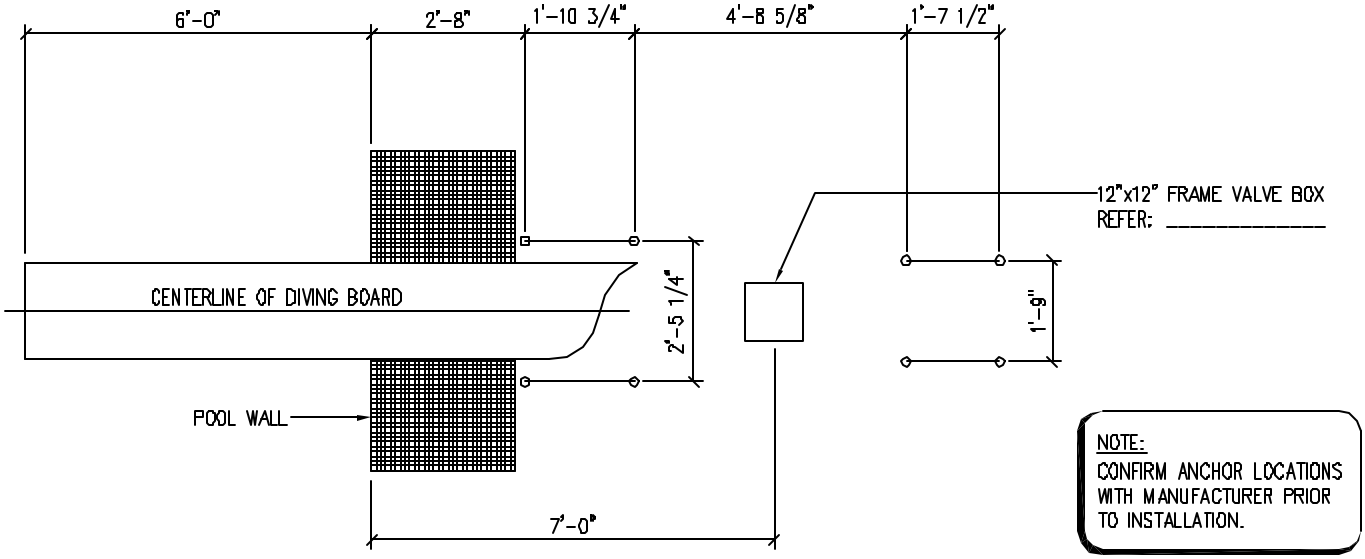
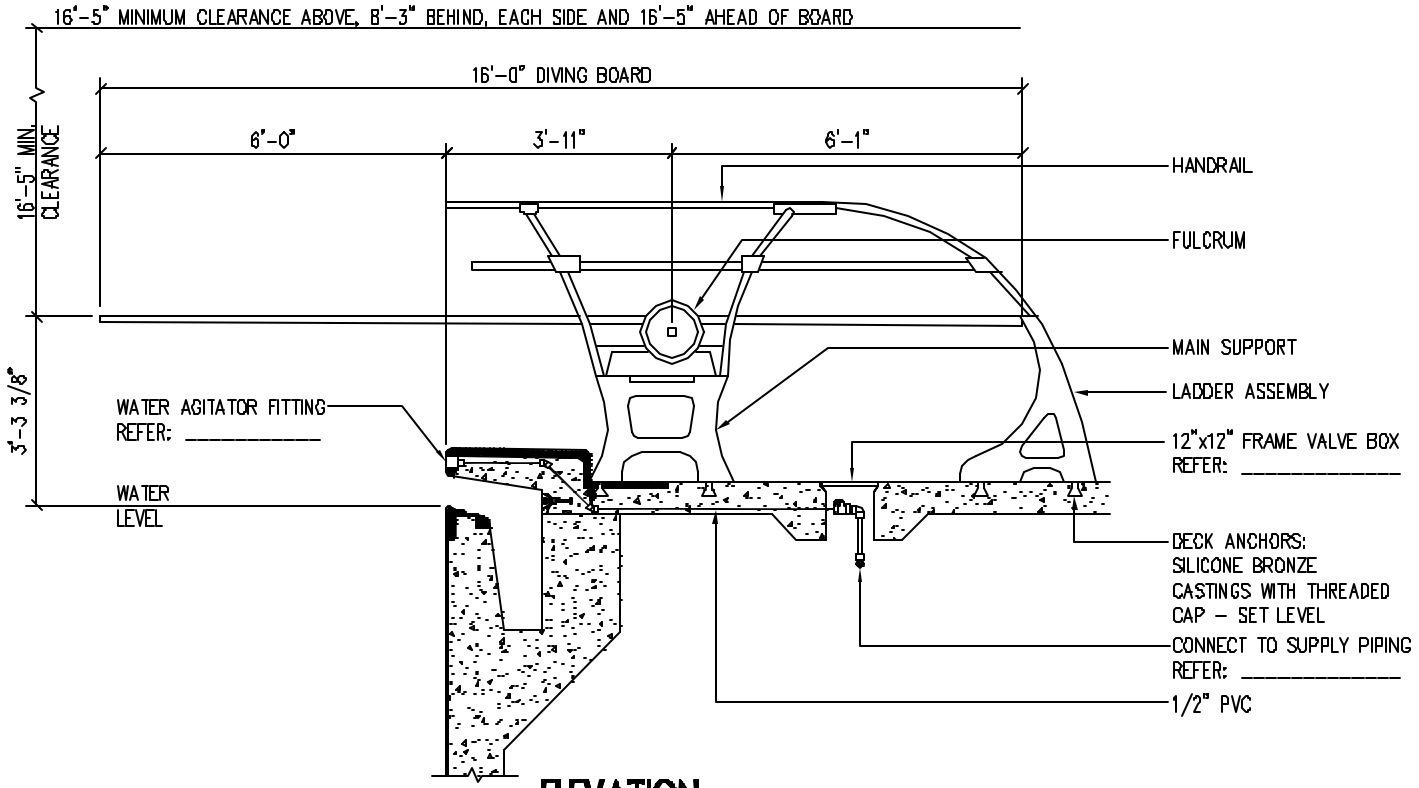


PLAN

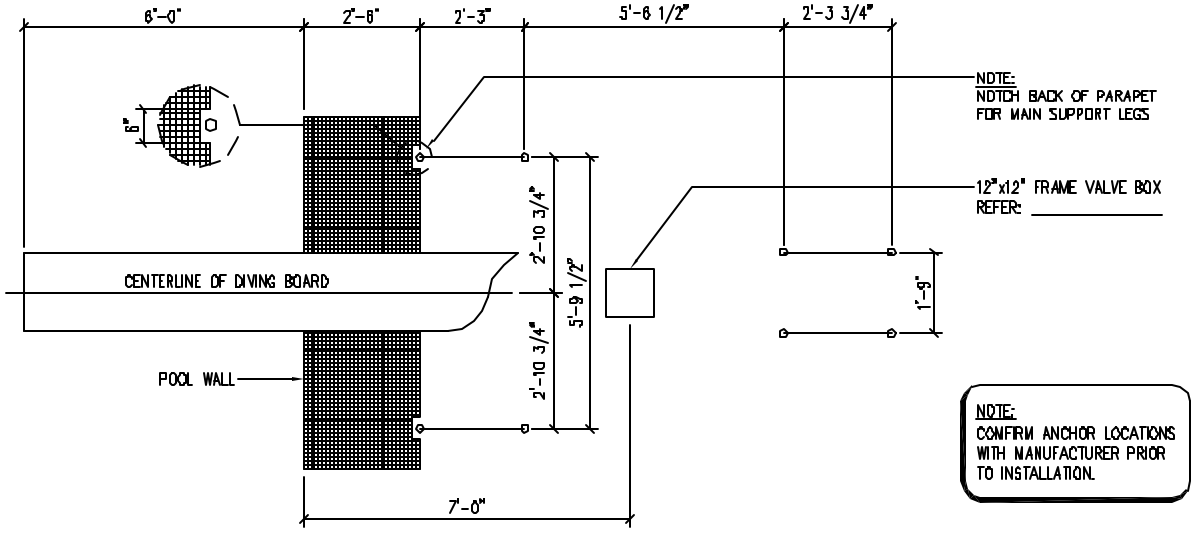


ELEVATION

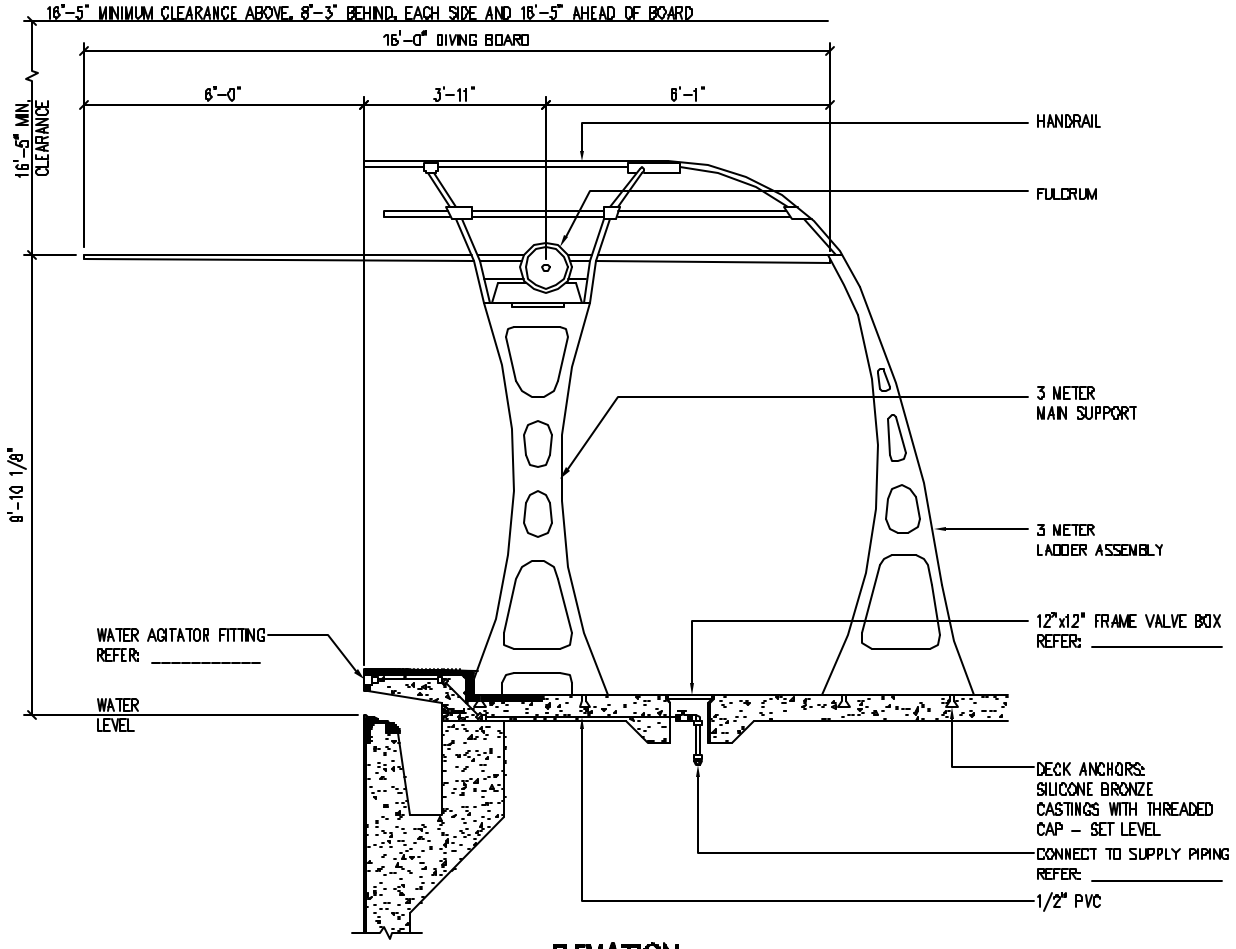
1 METER DIVING BOARD SUPPORT

DRAFT

1037.1-A26



PLAN

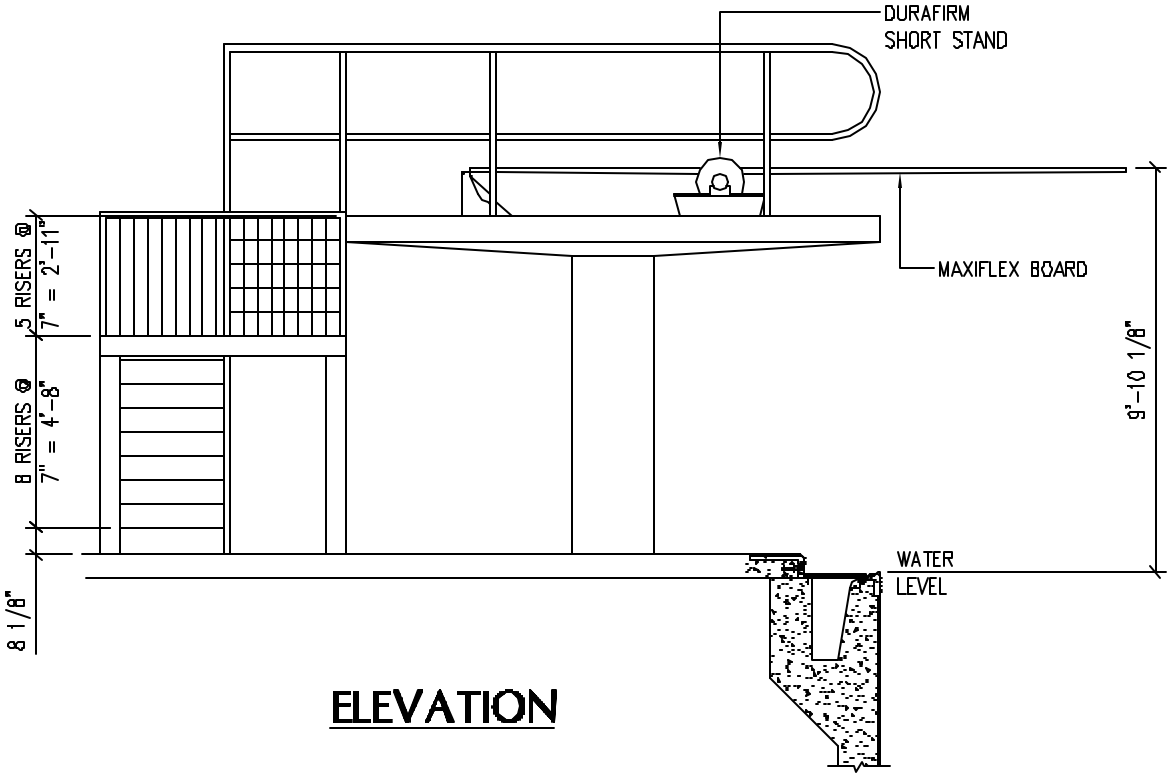


ELEVATION

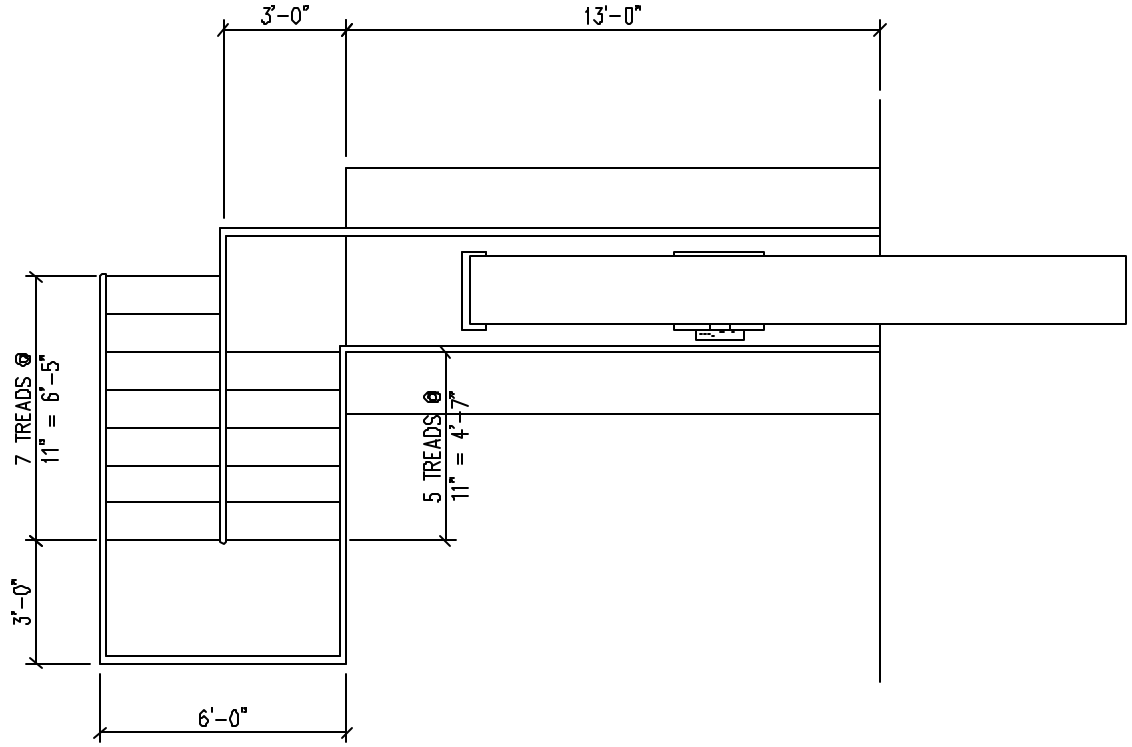
3 METER DIVING BOARD SUPPORT

DRAFT

1037.1-A27



ELEVATION

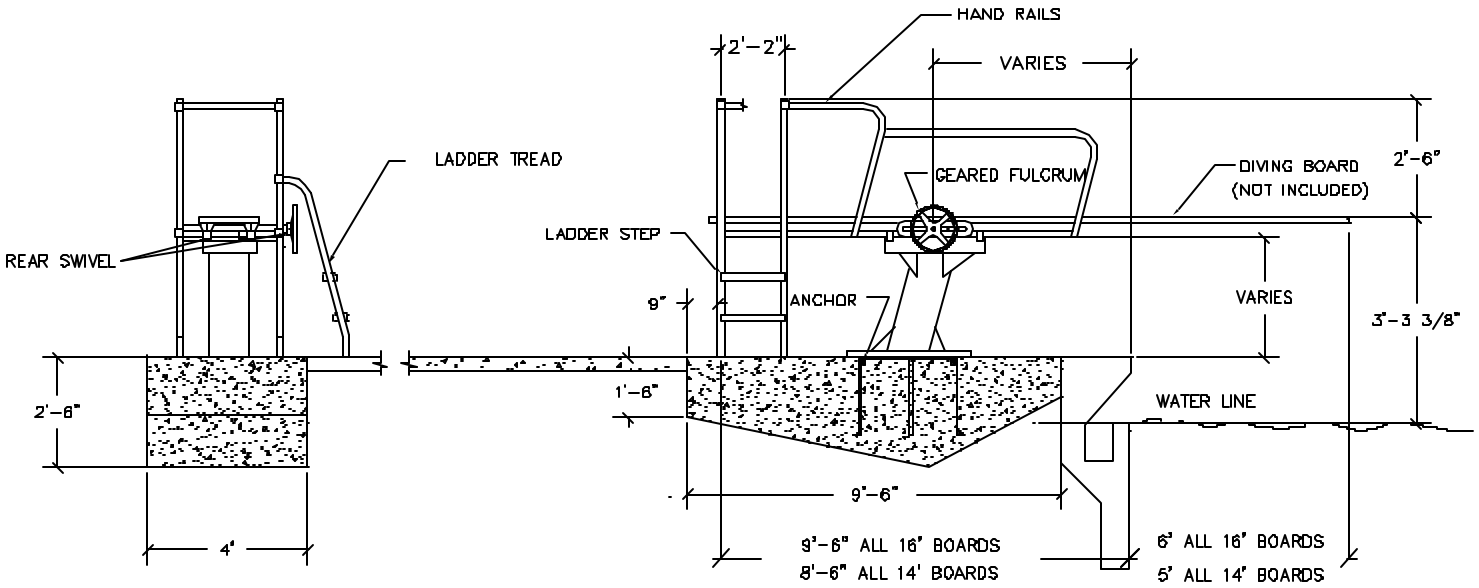


PLAN

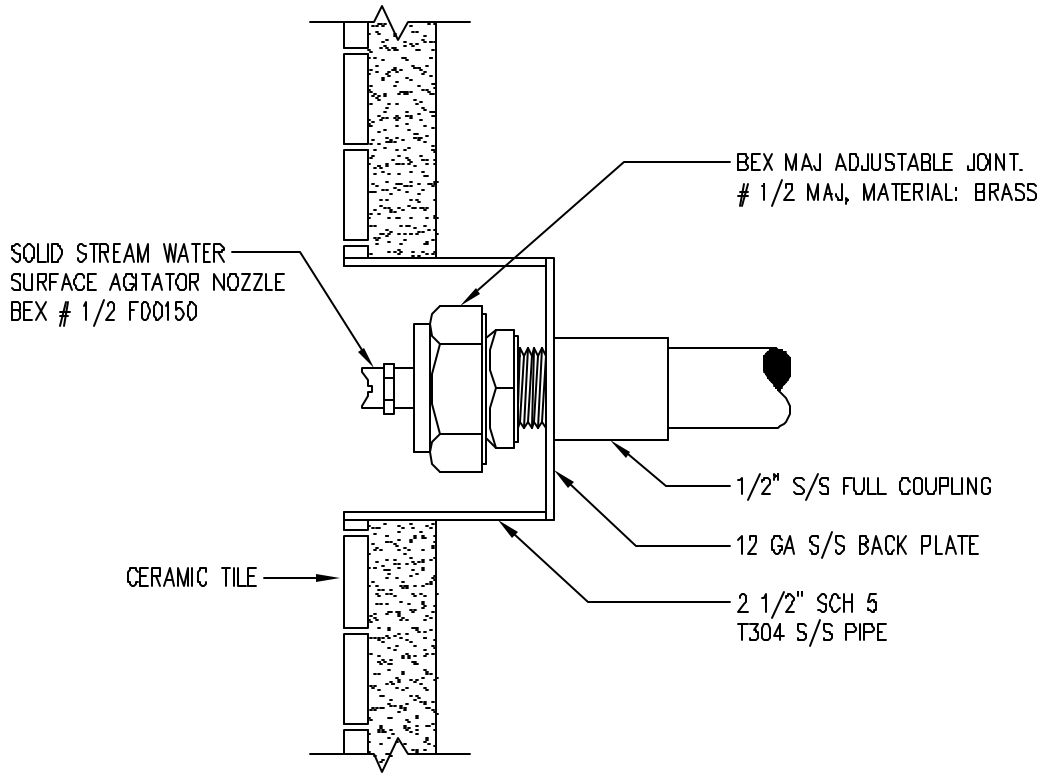
3 METER DIVING BOARD SUPPORT WITH STAIRS

DRAFT

1037.1-A28

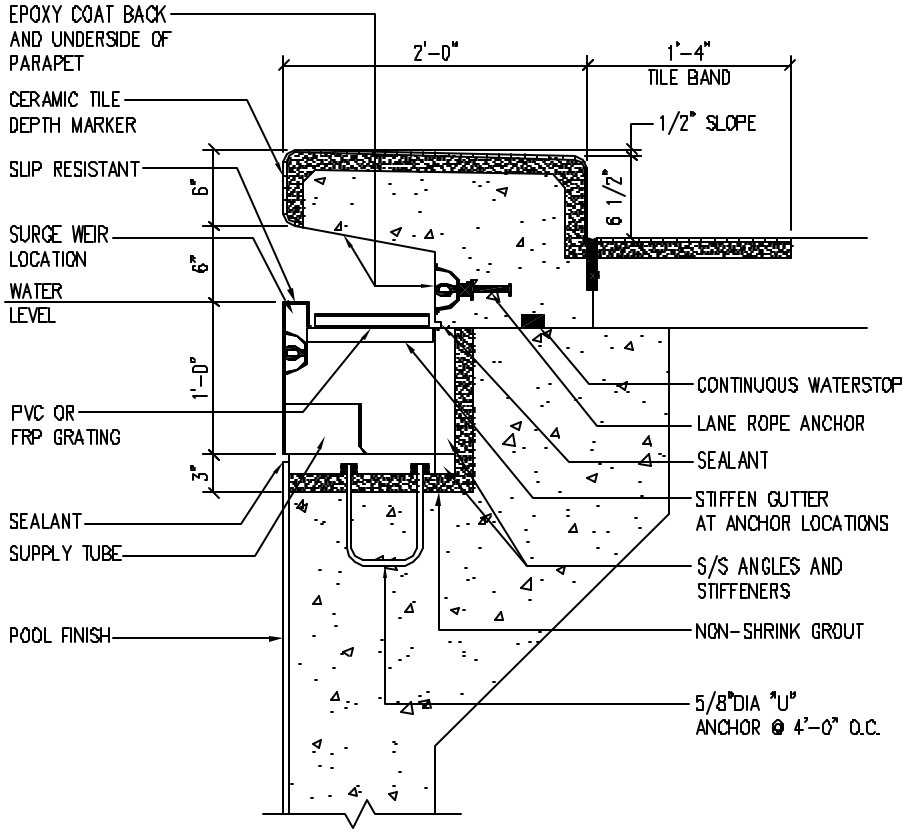


1 METER DIVING BOARD STAND WITH SIDE MOUNT

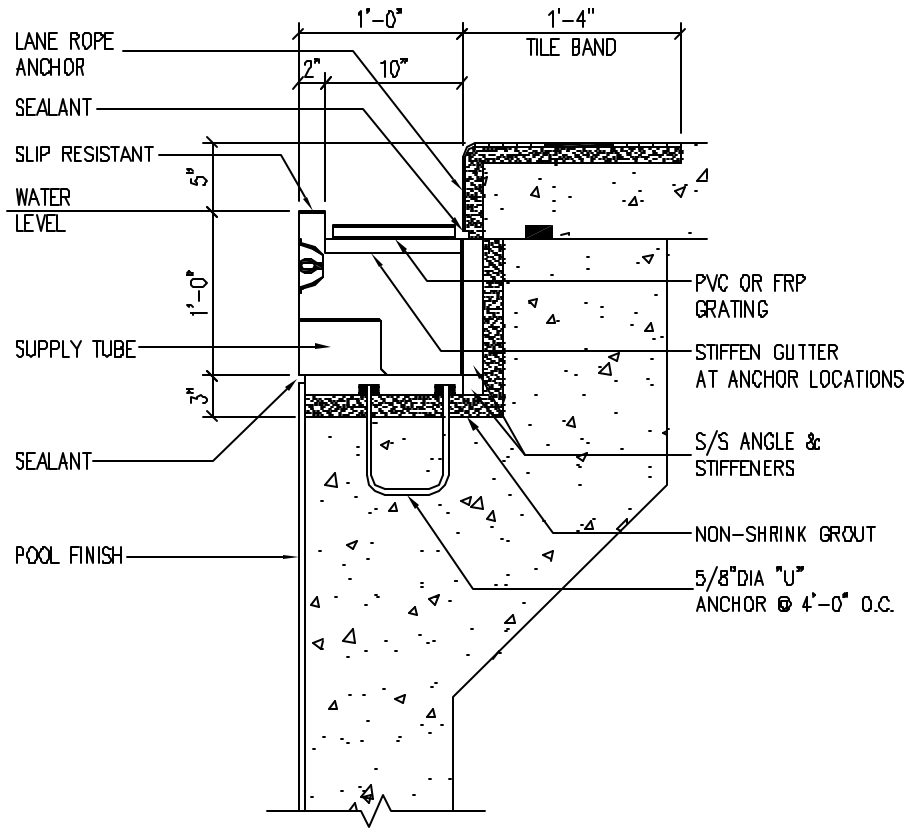


DIVING BOARD SURFACE AGITATOR SPRAY NOZZLE

DRAFT

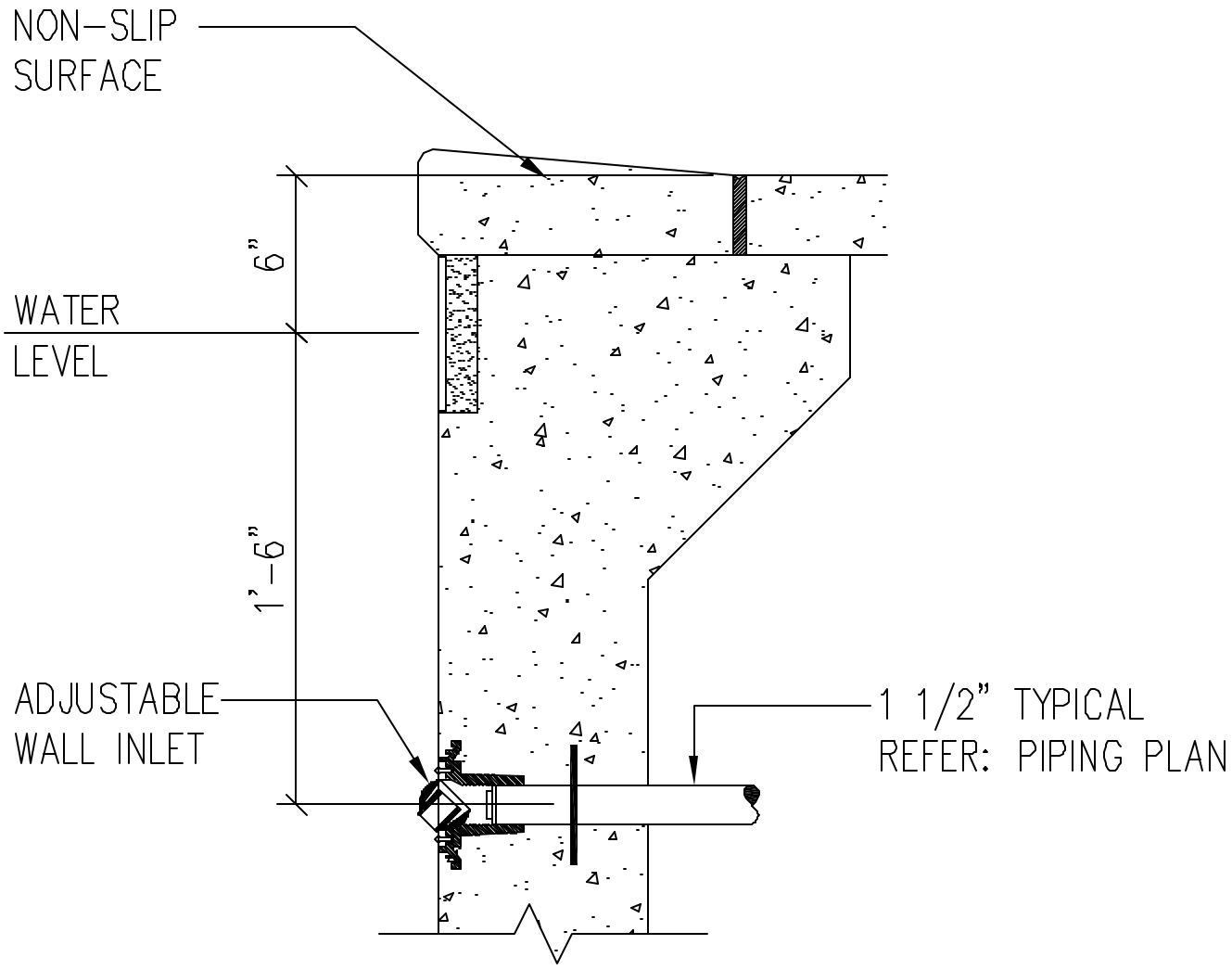


STAINLESS STEEL RECESSED GUTTER



STAINLESS STEEL ROLLOUT GUTTER

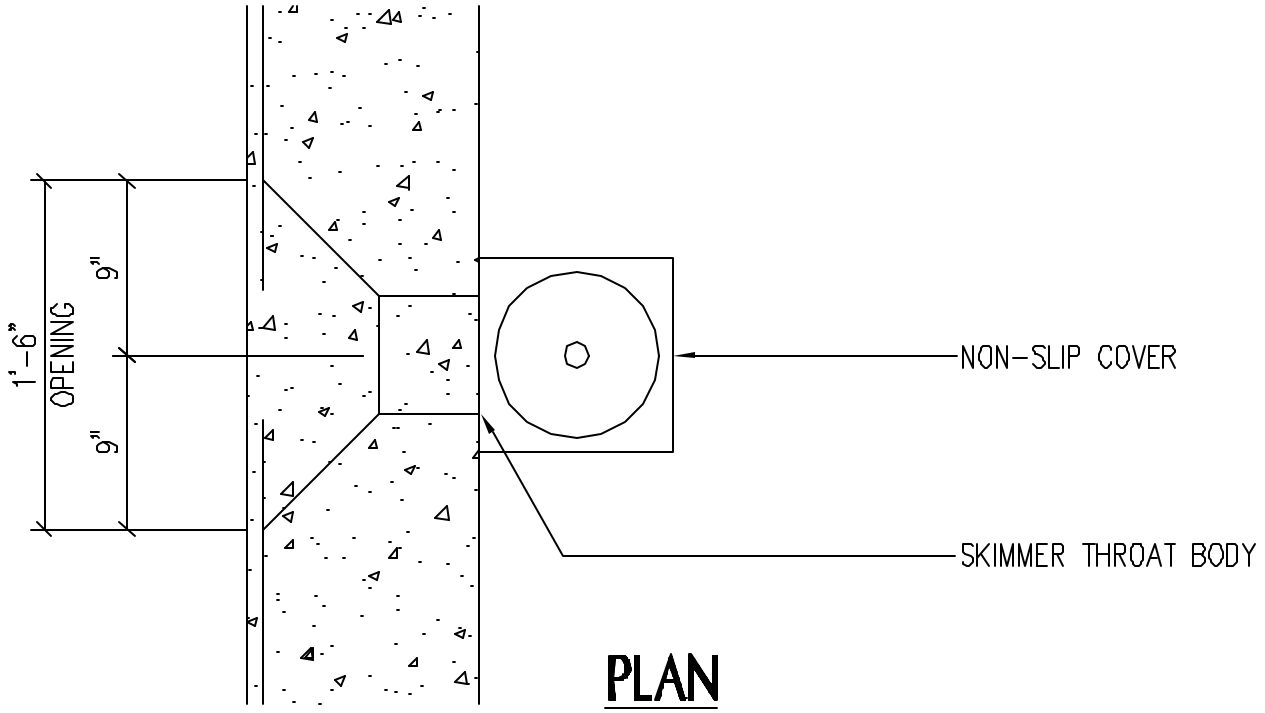
DRAFT



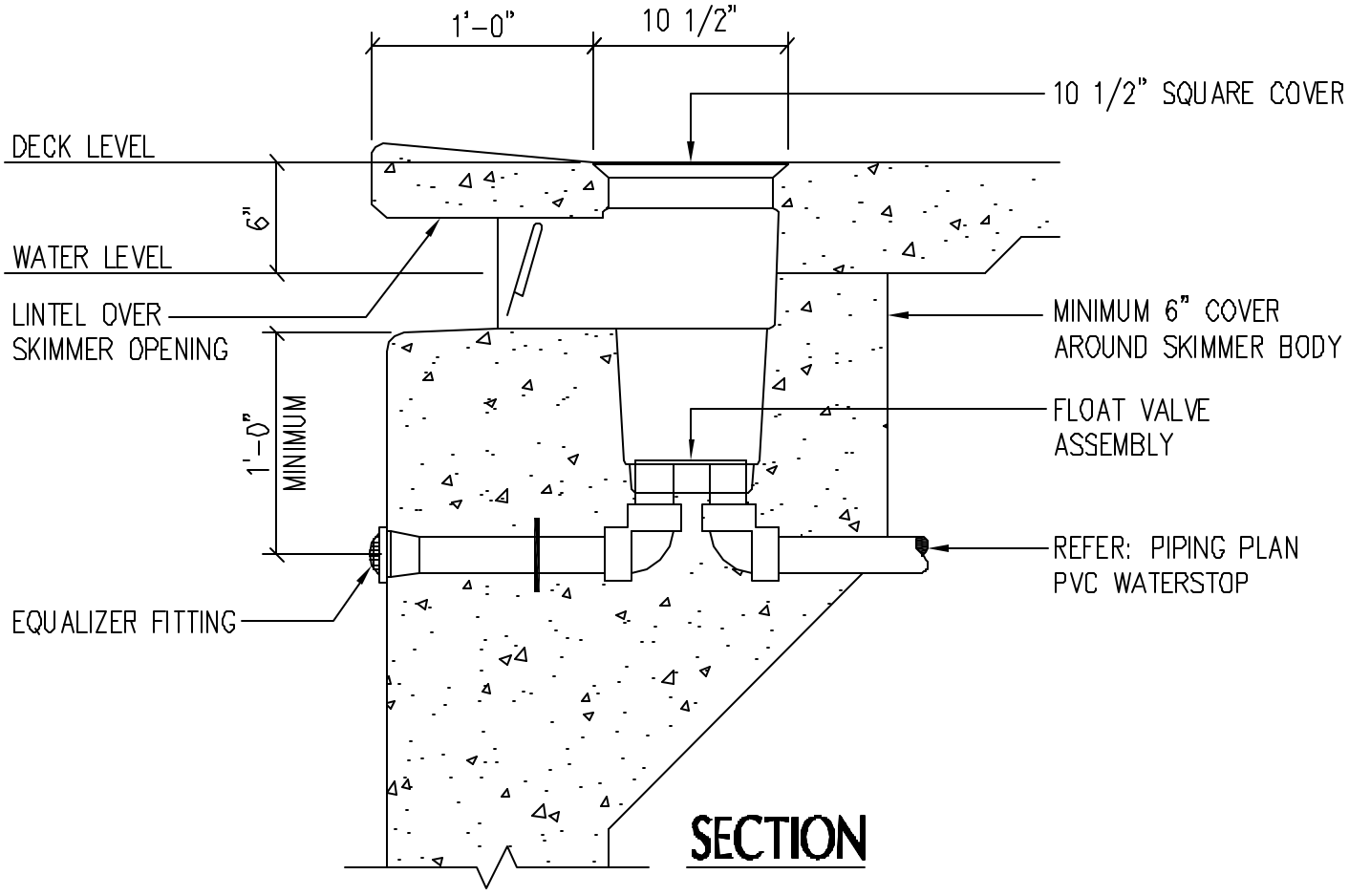
COPING, TILE BAND AT WATER LINE AND WALL INLET

DRAFT

1037.1-A31



PLAN

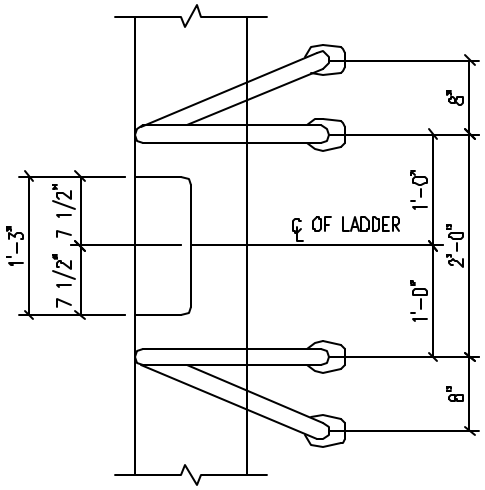


SECTION

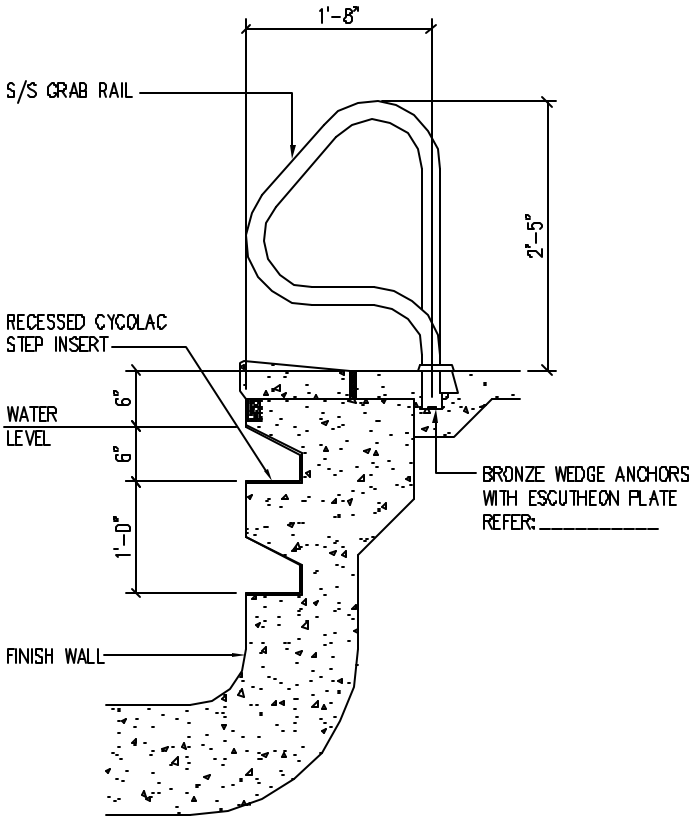
SURFACE SKIMMER WITH CONCRETE COPING

DRAFT

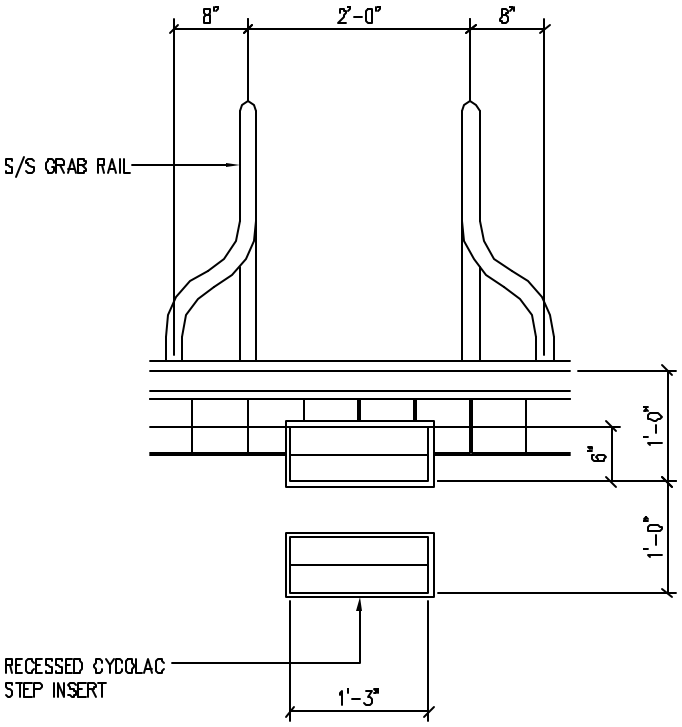
1037.1-A32



PLAN



SECTION

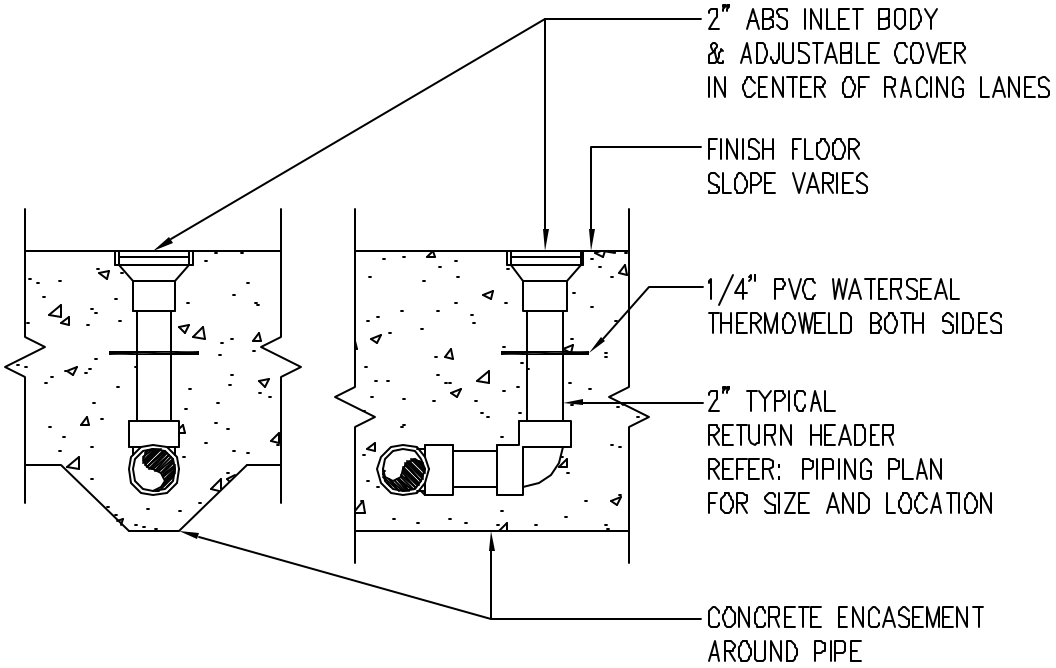


ELEVATION

S/S GRAB RAILS & RECESSED STEPS AT CONCRETE COPING

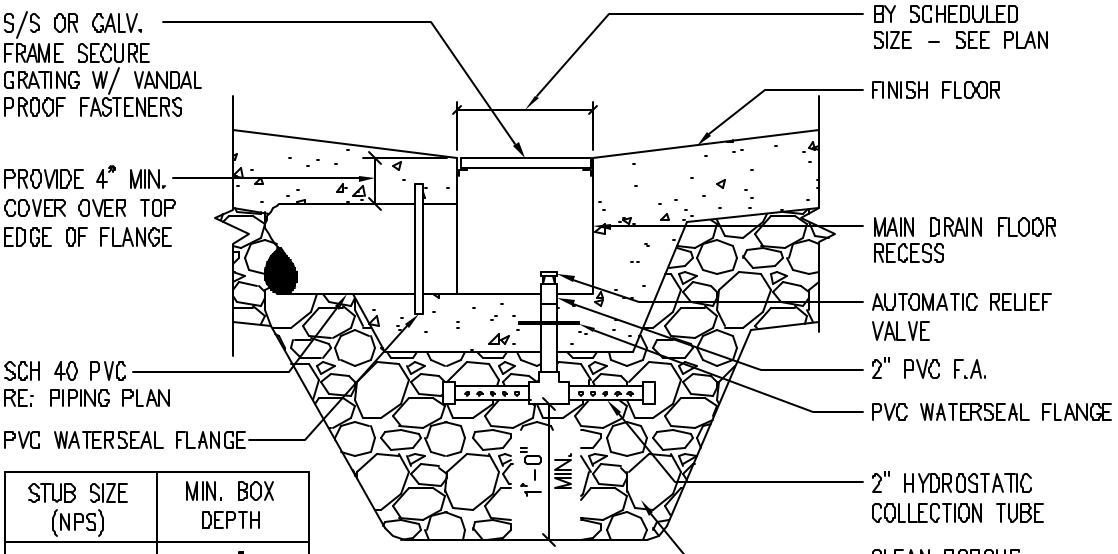
DRAFT

1037.1-A33



NOTE:
SET INLET FLUSH WITH
FINISH POOL FLOOR

FLOOR INLETS

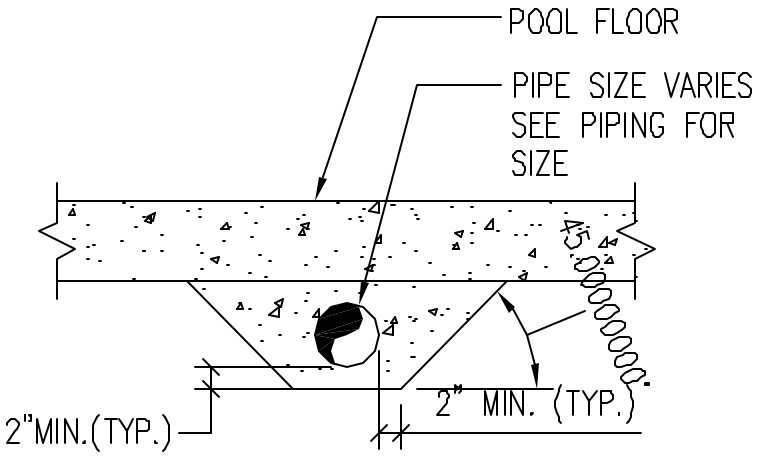


STUB SIZE (NPS)	MIN. BOX DEPTH
3	12"
4	12"
6	14"
8	16"
10	18"
12	20"

MAIN OUTLET SUMP, FRAME & GRATE

DRAFT

1037.1-A34

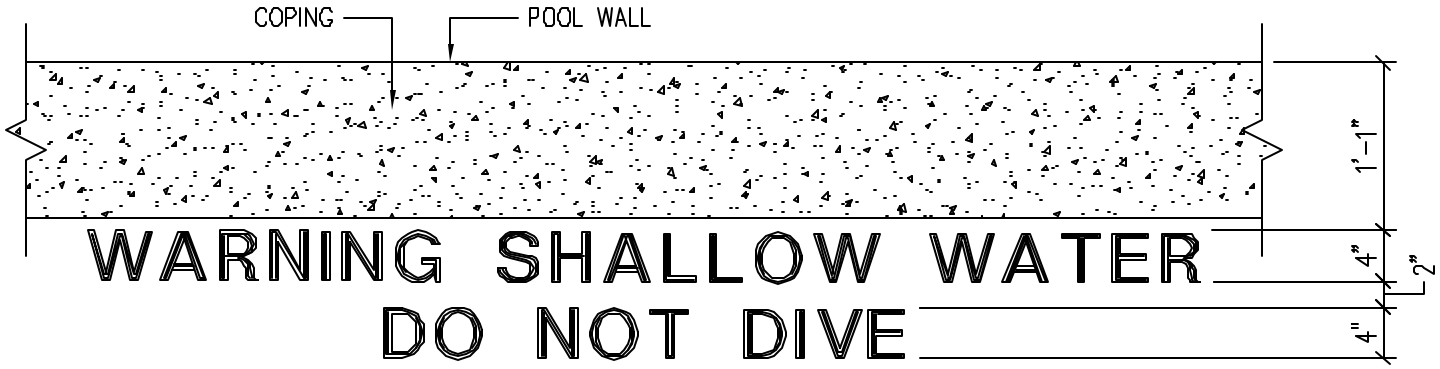


NOTES:

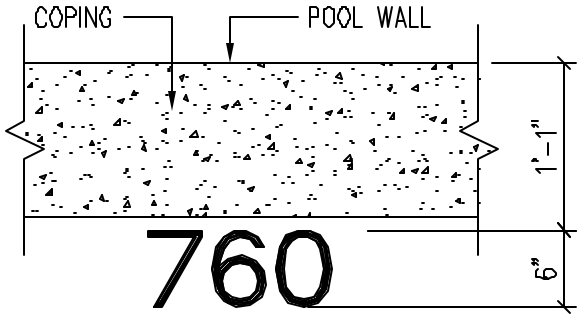
1. THIS IS A MINIMUM ENCASEMENT FOR UNDER POOL PIPING
2. REFER TO STRUCTURAL FOR MORE DETAIL.
3. ENCASEMENT MAY BE DONE PRIOR TO THE POUR OF THE POOL FLOOR AND STRUCTURALLY TIED TO THE POOL FLOOR.

CONCRETE ENCASED PIPE

DRAFT

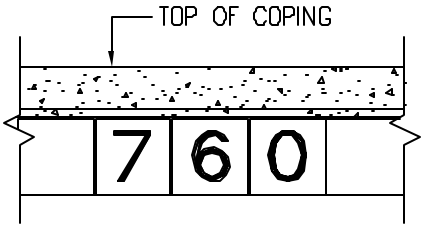


WARNING SIGN PLAN

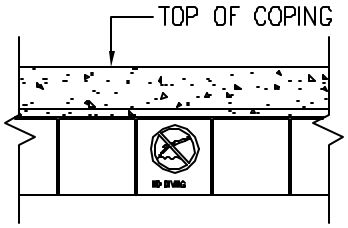


DEPTH MARKER PLAN

NOTE:
DEPTH MARKINGS & WARNING SIGNS ON DECK TO BE PAINTED WITH SLIP RESISTANT EPOXY – PAINT IN CONTRASTING COLOR



DEPTH MARKER ELEVATION

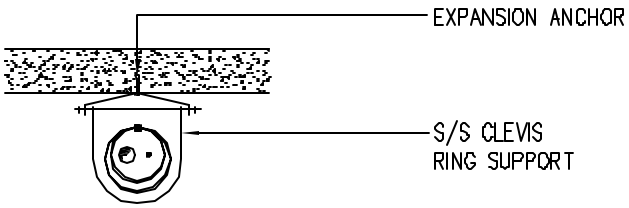


WARNING SIGN ELEVATION

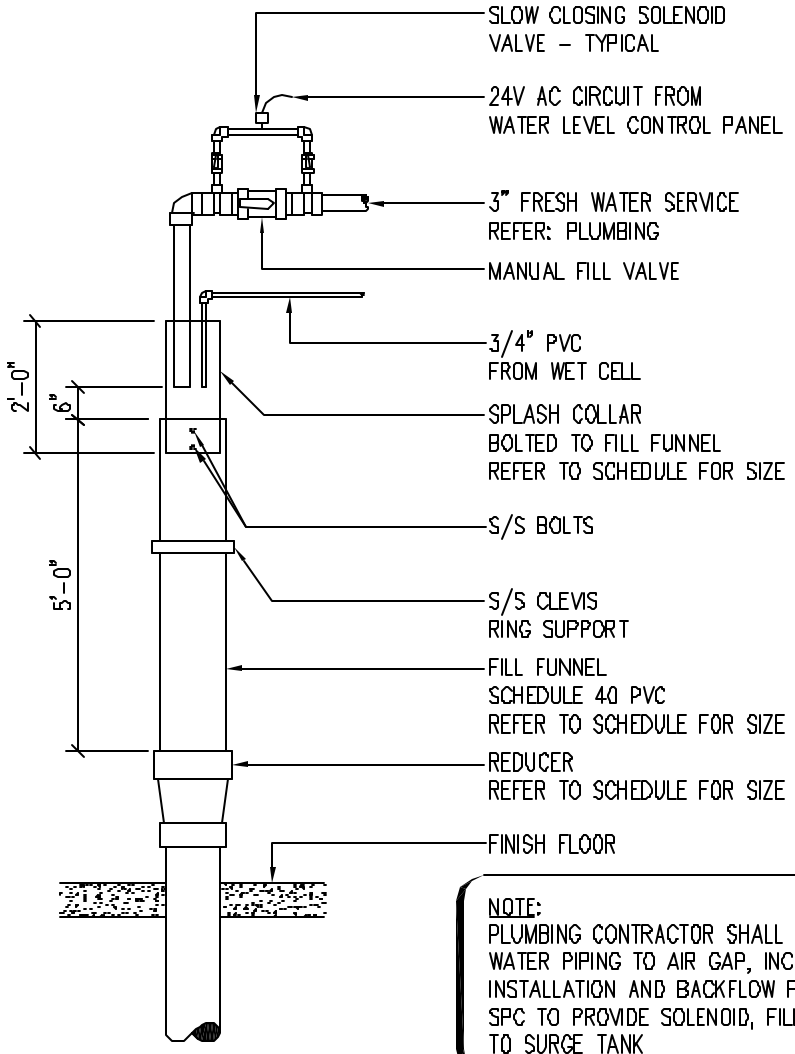
DEPTH SIGNAGE

DRAFT

1037.1-A36



PLAN



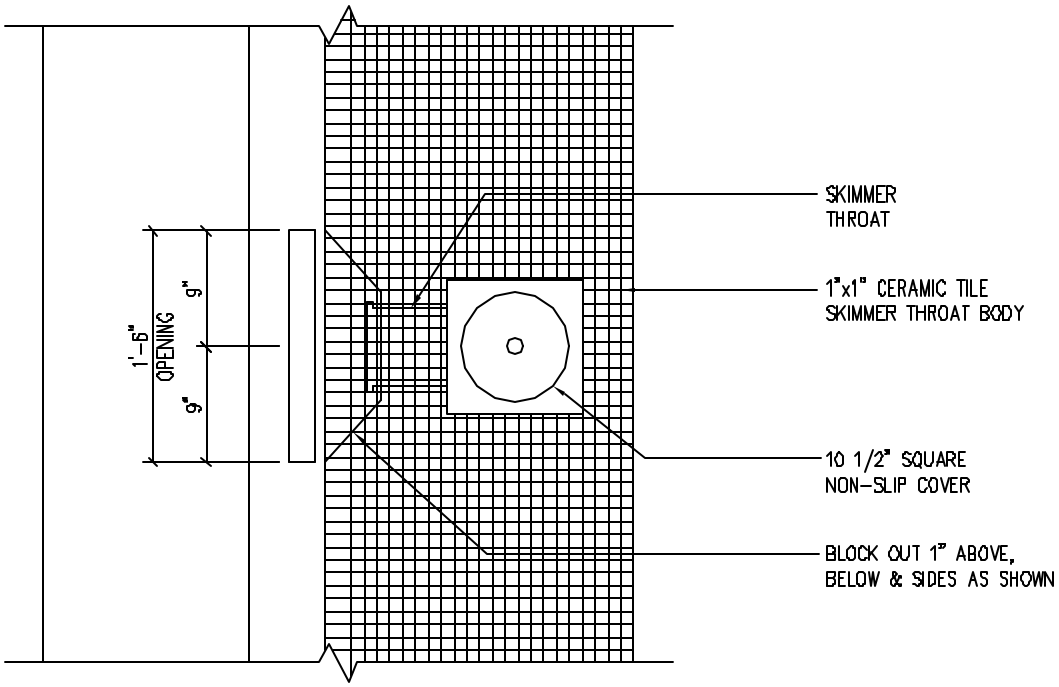
NOTE:
PLUMBING CONTRACTOR SHALL FURNISH MAKE-UP WATER PIPING TO AIR GAP, INCLUDING SOLENOID VALVE INSTALLATION AND BACKFLOW PREVENTER IF REQUIRED. SPC TO PROVIDE SOLENOID, FILL FUNNEL AND PIPING TO SURGE TANK

ELEVATION

FILL FUNNEL SCHEDULE			
POOL	FILL FUNNEL SIZE	REDUCER SIZE	SPLASH COLLAR SIZE
–	–	–	–
–	–	–	–
–	–	–	–

FILL FUNNEL

DRAFT



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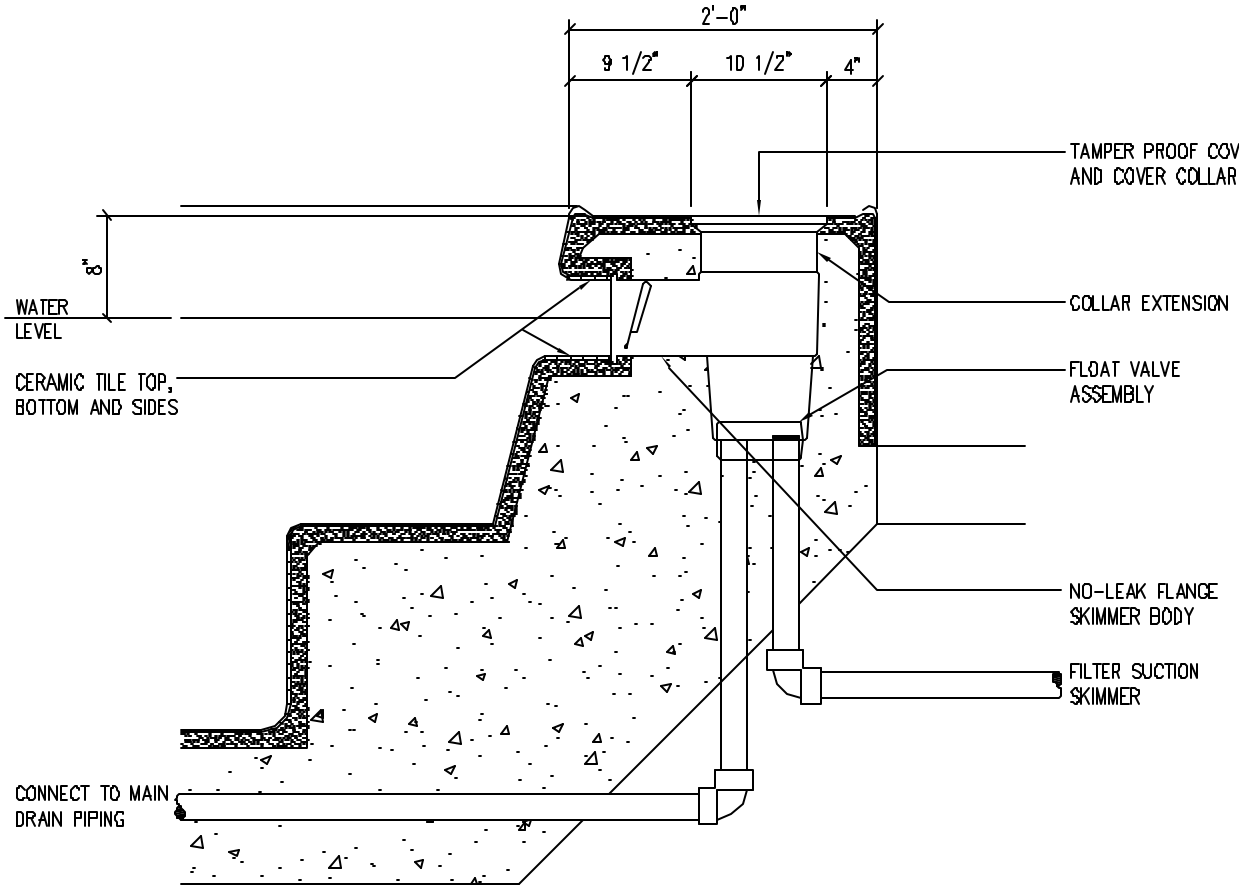
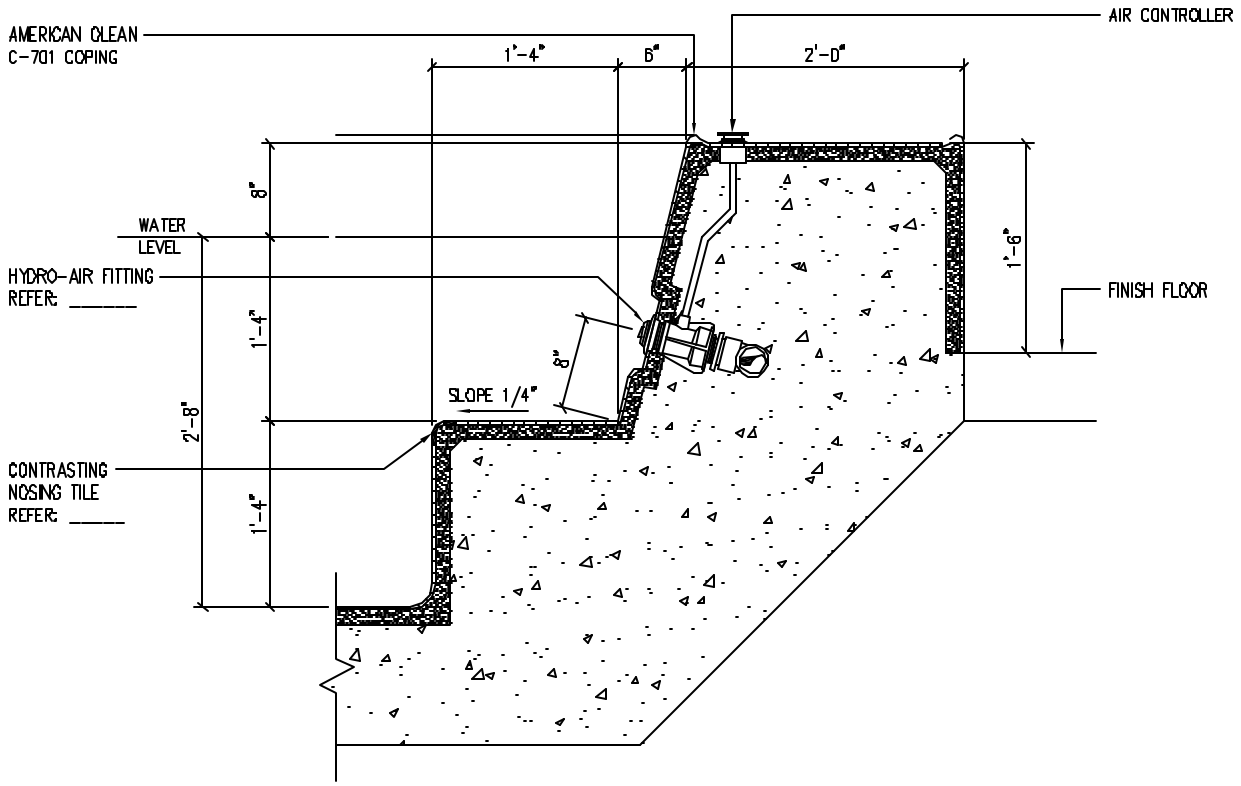


SECTION

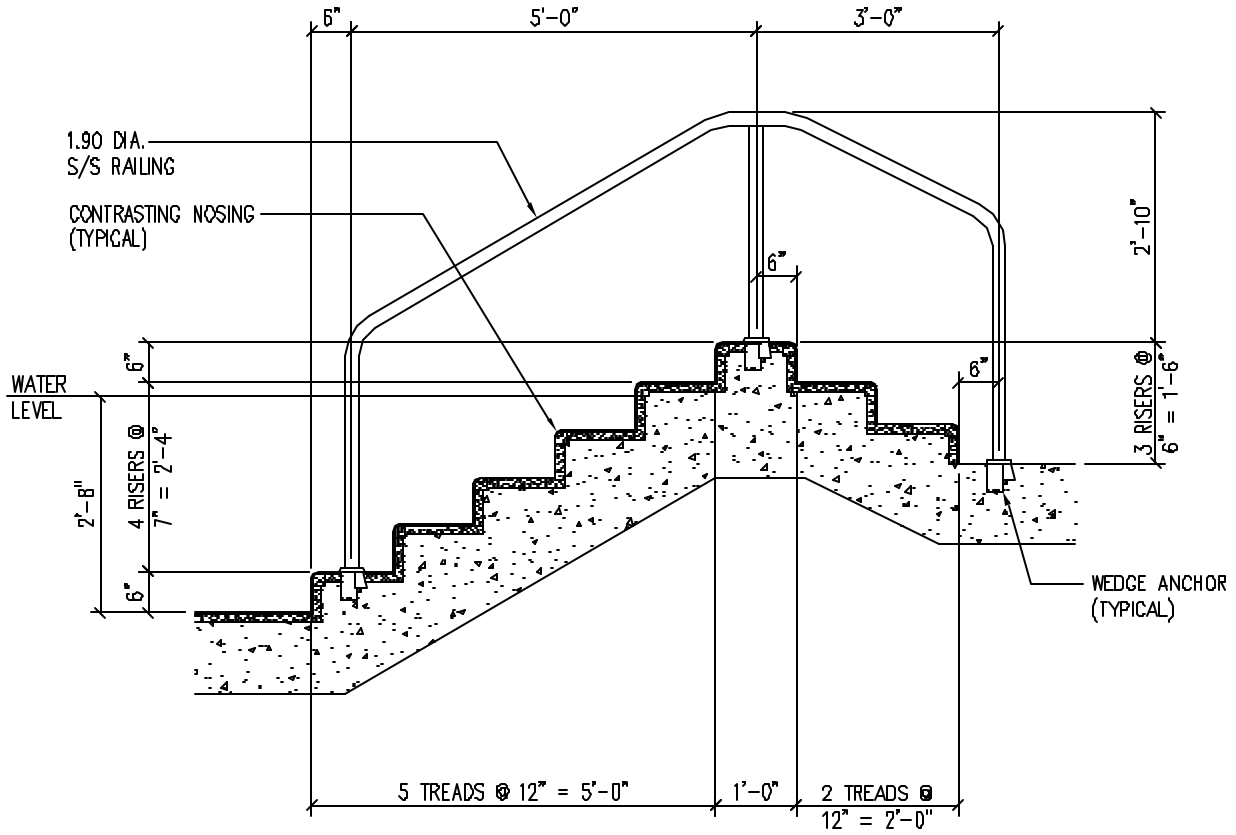
SPA SEAT & SKIMMER

DRAFT

1037.1-A38



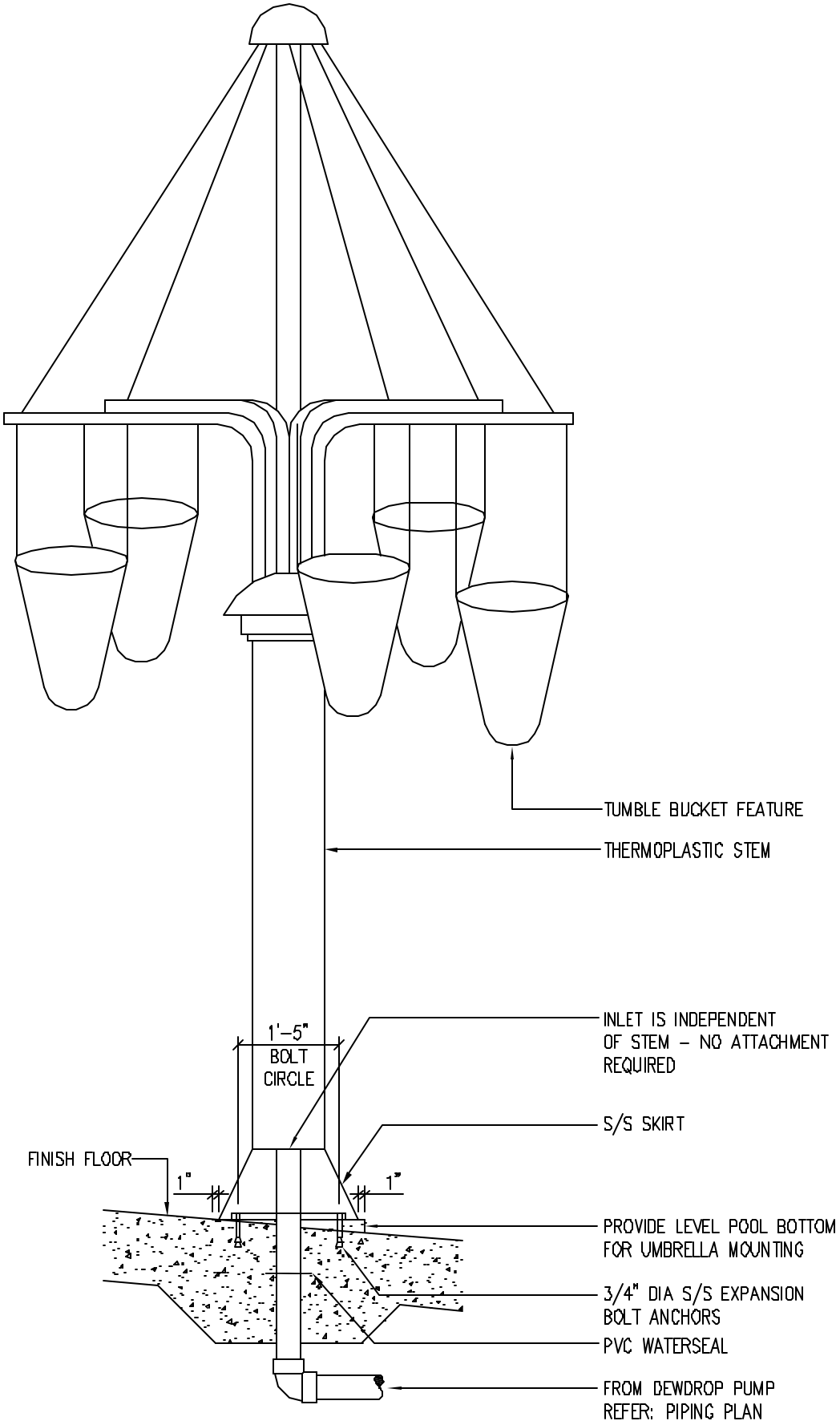
SPA SEAT WITH HYDROJET



SPA STAIR

DRAFT

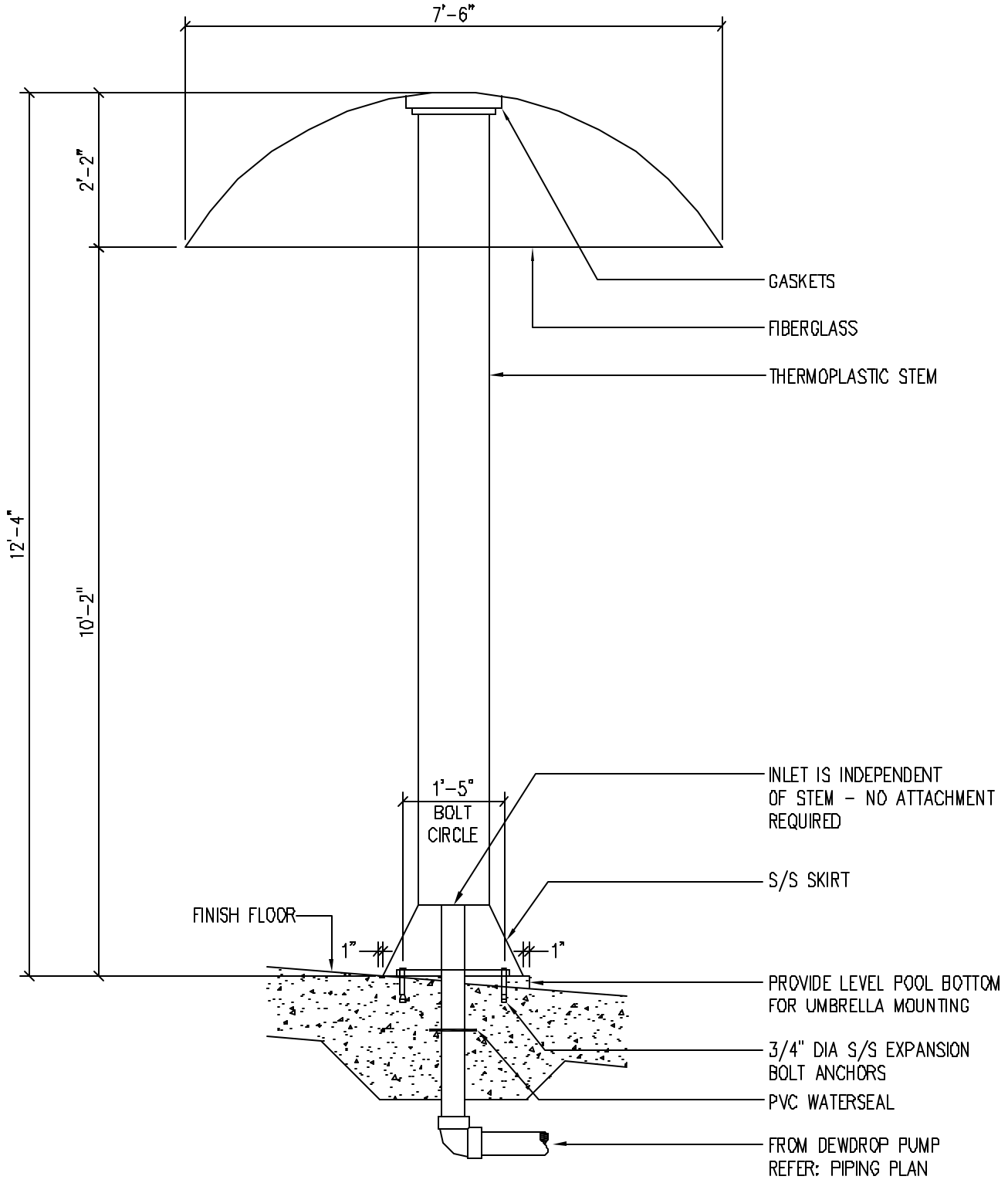
1037.1-A39



TUMBLE BUCKETS

DRAFT

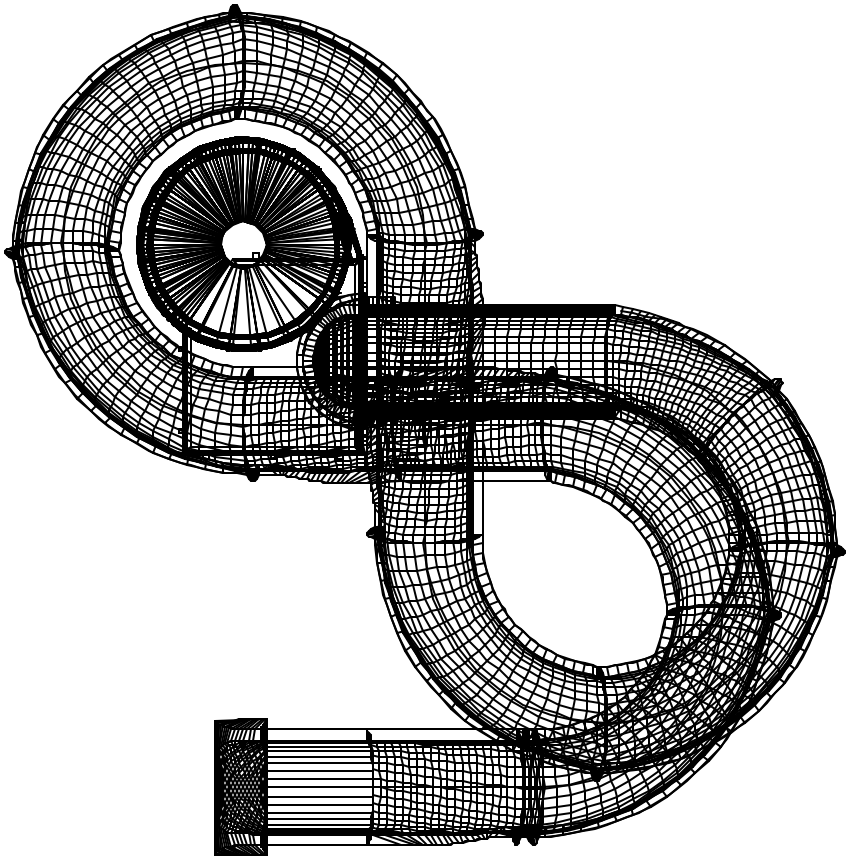
1037.1-A40



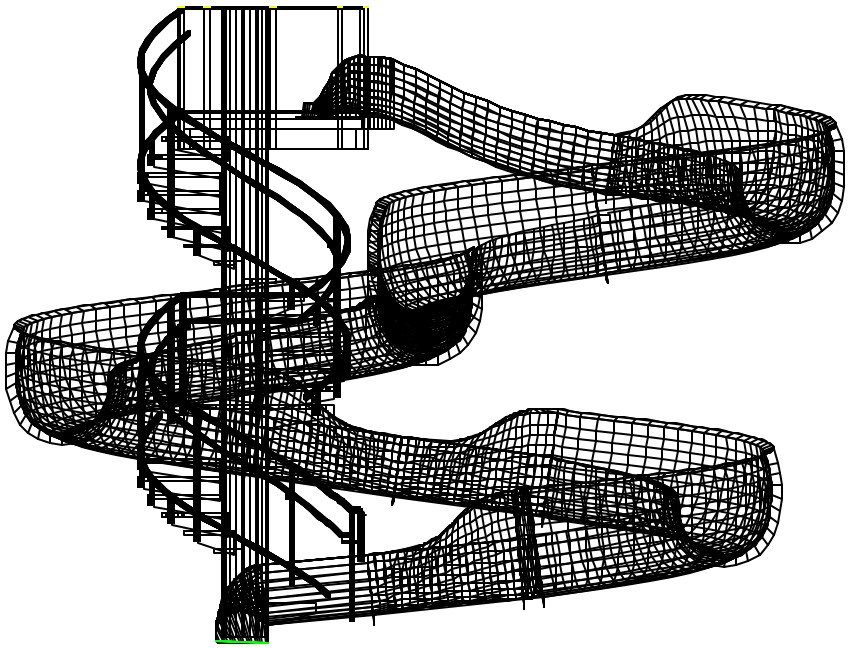
FOUNTAIN

DRAFT

1037.1-A41



PLAN

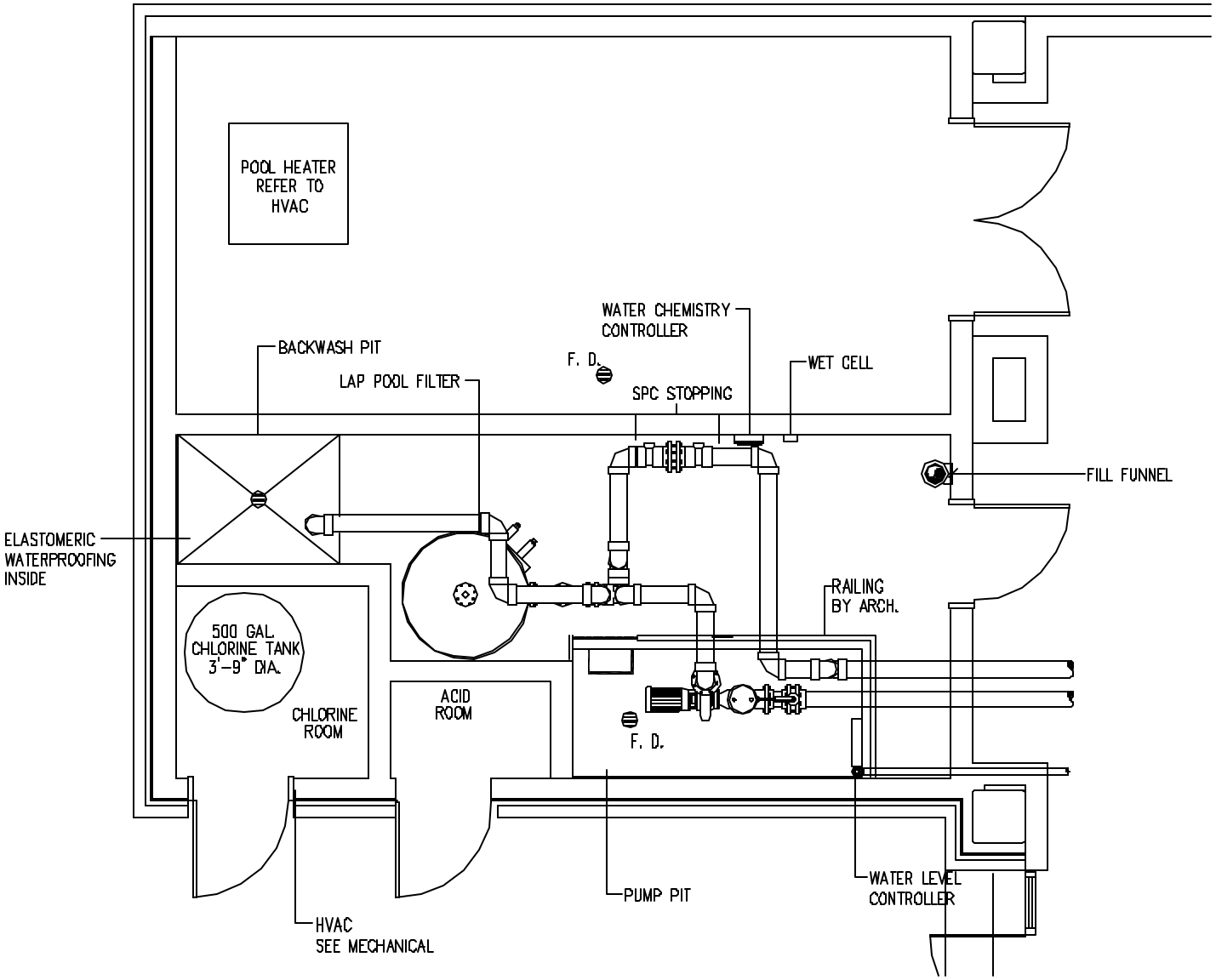


ELEVATION

3 SPIRAL WATER SLIDE

DRAFT

1037.1-A42



FILTER ROOM

DRAFT

1037.1-A43

ANSI/NSPI-1.1991

STANDARD FOR PUBLIC SWIMMING POOLS

TABLE OF CONTENTS

Standard For Public Swimming Pools

ARTICLE I

1. SCOPE

1.1 This standard is intended to cover public pools to be used for bathing and operated by an owner, licensee, or concessionaire, regardless of whether a fee is charged for use.

1.1.1 This standard is intended to cover certain aspects of the design, equipment, operation, installation, new construction and rehabilitation of pools. This standard does not cover warning signs for public pools. This standard may be met notwithstanding certain variations in equipment, materials, and design.

1.2 This standard is not meant to cover pools for competitive diving or swimming, permanently installed residential pools, aboveground/onground pools, portable spas, hot tubs, or other pools or spas, such as those operated for medical treatment, physical therapy, or other special purposes.

1.3 Other standards are referenced in this standard for items not covered.

ARTICLE II

2. MATERIALS OF CONSTRUCTION

2.1 Swimming pools and all appurtenances thereto shall be constructed of materials which are nontoxic to man and the environment; which are impervious and enduring; which can withstand the design stresses; and which will provide a watertight structure with a smooth and easily cleaned surface without cracks or joints, excluding structural joints, or to which a smooth, easily cleaned surface finish is applied or attached.

ARTICLE III

3. STRUCTURAL DESIGN

3.1 Prior to construction, rehabilitation, or alteration of a permanently installed public swimming pool, plans and specifications shall be submitted to the (state or local) authority for review, approval, and issuance of a permit to construct or rehabilitate as

may be required.

3.2 The structural design and materials used shall be in accordance with generally accepted good structural engineering practices.

3.3 Sand or earth shall not be permitted as an interior finish in a swimming pool.

3.4 In climates subject to freezing temperatures, the pool shell and appurtenances, piping, filter system, pump and motor, and other components shall be so designed and constructed to facilitate protection from damage due to freezing.

3.5 The surfaces within the pool intended to provide footing for users shall be designed to provide a slip-resisting surface. The roughness or irregularity of such surfaces shall not cause injury or discomfort to the feet during normal use.

3.6 The colors, patterns, or finishes of the pool interior shall not be such as to obscure the existence or presence of objects or surfaces within the pool.

3.7 The swimming pool shall be built in compliance with the plans as approved unless subsequent written approval of changes has been given by the (state or local) authority.

3.8 The swimming pool owner or agent shall notify the (state or local) authority at specific, predetermined stages of construction, and at the time of completion of the pool, to permit inspections.

3.9 In areas where the (state or local) authority cannot provide the plan review and inspections, and where local government does not require building inspections, the owner or his agent may be required to hire a third party inspector with the approval of the (state or local) authority to make the required plan review and inspections.

ARTICLE IV

4. DIMENSIONAL DESIGN

4.1 No limits are specified for the shape of swimming pools except that consideration shall be given to shape from the standpoint of safety and circulation of the swimming pool water.

4.1.1 There shall be no protrusions, extensions, means of entanglement, or other obstructions in the swimming area which can cause the entrapment or injury of the user.

4.1.2 There shall be construction tolerances allowed on all dimensional designs.

Overall length, width, and depth in the deep end may vary plus or minus three inches (± 3”). All other overall dimensions may vary plus or minus two inches (±2”), unless otherwise specified (such as in a Class A pool). The designed waterline shall have a maximum construction tolerance at the time of completion of the work of plus or minus one-fourth inch (±¼”) for pools with adjustable weir surface skimming systems, and of plus or minus one-eighth inch (±1/8”) for pools with nonadjustable surface skimming systems.

4.1.3 The size of Class A or D pools shall be governed by the requirements of the activities for which the installation is intended.

4.2 Walls: Walls in Class B and C pools shall not be greater than 11 deg. from plumb (see Article 4.6.2) for a minimum depth of two feet nine inches (2’9”) from the waterline in deep areas, or two feet three inches (2’3”) in the shallow areas. Below these depths, the wall may be radiused to join the floor. Class A pools, where racing lanes terminate, shall have plumb walls. (A maximum 1 deg. from plumb construction tolerance shall be allowed.)

4.3 Floor Slopes: Floor slopes shall, as a minimum, be in compliance with Articles 4.3.1
through *4.3.5*.

4.3.1 All slopes shall be uniform.

4.3.2 The slope of the floor from the shallow end wall towards the deep end shall not exceed one foot in twelve feet (1’ :12’) to the point of the first slope change for Class A and B pools, or one foot in ten feet (l’:1O’) for Class C pools.

4.3.3 The point of the first slope change shall be defined as the point at which the floor slope exceeds one foot in twelve feet (1’:12’) for Class A and B pools, or one foot in ten feet (1’:1O’) for Class C pools.

4.3.4 The slope of the floor from the point of the first slope change to the deep end shall not exceed one foot in three feet (l’:3’). Such slopes are not intended to provide any less water depth than those specified if the pool is intended for diving.

4.3.5 Transitional radius from wall to floor where floor slopes join the wall shall comply with Articles *4.3.5.1* through *4.3.5.3*.

4.3.5.1 The radius shall have its center no less than two feet nine inches (2’9”) below the waterline in deep areas or two feet six inches (2’6”) in the shallow area.

4.3.5.2 The radius shall be tangent at the point where the radius either meets the wall or the floor.

4.3.5.3 The radius shall be at least equal to, or greater than, the depth of the pool minus the vertical wall depth measured from the waterline (or tolerance allowed in Article 4.2) minus three inches (-3") to allow draining to the main drain. (R minimum = Pool depth - Vertical wall depth -3")

4.4 Water Depths: Water depths at the shallow end of the swimming area shall be three feet (3') minimum, with a three feet six inches (3'6") minimum for racing pools. Exceptions may be made in a recessed area of the main swimming pool, outside of the competitive and/or swimming course, when the pool is an irregular shape with the permission of the (state or local) authority.

4.4.1 The beginners' area of a pool shall be visually set apart from, but may be adjoined to, the shallow area and shall not adjoin the deep area.

4.4.2 The transition point of the pool from the beginners' area to the shallow area and from the shallow area to the deep area shall be visually set apart with a rope and float line, depth markers, and a four inch (4") minimum width row of floor tile, painted line, or similar means of a color contrasting with the bottom. In diving pools with a constant slope, the shallow area shall be visually set apart from the deep area with a rope and float line, depth markers, and a four inch (4") minimum width row of floor tile, painted line, or similar means of a color contrasting with the bottom.

4.4.3 Class A pools intended for competitive diving and swimming shall be designed and constructed so as to provide the water depths specified by Federation Internationale de Natation Amateur (FINA), U.S. Swimming, and U.S. Diving.

4.5 **Diving:** Diving intended for Class B and C pools shall conform to the minimum water depths, areas, slopes, and other dimensions shown in Article 4.6.1. If a wall exists, then it shall conform with the 3:1 slope in the Point D dimension and the L1.2.3.4 dimensions.

4.5.1 When diving equipment is installed, it shall conform to the specifications set forth in Article 5.7 and shall be located in the diving area of the pool so as to provide the minimum dimensions as shown in Article 4.6.1. Competitive diving equipment shall not be installed on Class B and C pools.

4.5.2 The tip of the diving equipment shall be located at Point A, which is the reference point of all other dimensions.

4.5.3 There shall be a completely unobstructed clear vertical distance of thirteen feet (13') above any diving board measured from the center of the front end of the board. This area shall extend horizontally at least eight feet (8') behind, eight feet (8') to each side and sixteen feet (16') ahead of Point A.

4.5.4 Public pools with diving facilities in excess of three (3) meters in height or pools designed for platform diving, shall comply with the dimensional design

requirements of FINA, U.S. Diving, National Federation of State High School Associations (NFSHSA), etc.

4.6 and 4.6.2 Not Included.

4.7 Offset **Ledges:** Offset ledges, when provided, shall fall within 11 deg. from plumb starting at the junction of the pool wall and waterline, and shall have a slip-resisting surface. Maximum width shall be eight inches (8”). The typical allowable dimensions are based on the depths shown below:

4.8 **Underwater Seat Benches:** Underwater seat benches, when provided, shall have a maximum horizontal seat bench depth of twenty inches (20”) below the waterline, be visually set apart, have a slip-resisting surface, and shall be located fully outside of the required minimum diving water envelope if the pool is intended for use with diving equipment.

4.8.1 Underwater seat benches shall be permitted in the deep end of the pool only if they are either completely recessed, shaped to be compatible with the shape of the pool wall, or in a corner of the pool.

4.9 **Maximum User Load**: Maximum user load at Class B or C pools shall be in accordance with the following table:

4.9.1 Where there is an anticipated maximum load in the swimming pool, there shall not be less than fifteen (15) square feet per user. Consideration shall be taken by the designer/operator to make certain that there is adequate room for the users.

4.10 **Wading Pools:** Wading pools shall be separate and physically set apart from beginning or shallow water areas of swimming pools by at least six feet (6’) of deck at Class B pools or four feet (4’) of deck at Class C pools. Where a wading pool is adjacent to any deep water area, a minimum four feet (4’) high barrier shall be installed separating the two pools.

4.10.1 Wading pools shall have a maximum water depth of twenty-four inches (24”). The water depth at the perimeter shall not exceed eighteen inches (18”). Water depths may be reduced from the above maximums and brought to zero at the most shallow point.

4.10.2 Walls in wading pools shall be vertical or within 11 deg. of vertical except for the lower six inches (6”) which shall be radiused to the floor. Walls shall not extend more than six inches (6”) above the waterline at any point.

4.10.3 Floors of wading pools shall be uniform, sloped to drain with a maximum slope of 1 foot in 12 feet (1’:12’).

ARTICLE V

5. DECKS AND DECK EQUIPMENT

5.1 These requirements shall be for decks and deck equipment used by users and shall apply at the time of construction.

5.1.1 Deck(s) shall be designed and installed in accordance with the engineering practices required in the area of installation. This includes the design and quality of subbase when required, concrete mix design, reinforcing, joints, etc. If a concrete deck is selected, in the absence of specific local engineering practices, the work shall be performed in accordance with the recommended practices of the latest edition of American Concrete Institute (ACI) Standard 302. 1R-80, "Guide for Concrete Floor and Slab Construction."

5.1.2 Decks, ramps, coping and similar step surfaces shall be slip-resisting and easily cleanable.

5.1.3 Special features in or on deck(s) such as markers, brand insignias or similar shall conform to this article.

5.1.4 Risers for steps for the deck shall be uniform and have a minimum height of three and three-fourths inches (3¾) and a maximum height of seven and one-half inches *(7-1/2").* The minimum tread depth shall be ten inches (10").

5.1.5 Excavation areas shall be adequately compacted when they support the deck(s).

5.1.6 The minimum continuous, unobstructed deck width, including the coping, shall conform to Articles *5.1.6.1* through 5.1.6.5, as appropriate.

5.1.6.1 Class A pool - As recommended by the appropriate activity (FINA, U.S. Swimming, U.S. Diving).

5.1.6.2 Class B pool - Six feet (6') minimum.

5.1.6.3 Class C pool - Four feet (4') minimum.

5.1.6.4 Class D pool - Three feet (3') minimum where provided.

5.1.6.5 **A** minimum four feet (4') deck width shall be provided on the sides and rear of any diving equipment. A deck clearance of twenty-four inches (24") shall be provided around any other deck equipment that is thirty-six inches (36") or less in height above the deck. A deck clearance of thirty-six inches (36") shall be provided around all other deck equipment.

5.1.7 The minimum slope of the deck(s) shall be one-eighth inch per one foot (1/8":1') for textured, hand-finished concrete decks; one-fourth inch per one foot *(1/4":1')* for exposed aggregate concrete decks; and one-half inch per one foot (1/2":1') for indoor/outdoor carpeting decks, unless an alternate drainage method is provided.

5.1.8 The maximum slope of all decks, other than wood decks, shall be one inch per foot (1":1') except for ramps. The maximum slope for wood decks shall be one-eighth inch per foot (1/8":1'). Gaps shall be based on good engineering practices with respect to the type of wood used.

5.1.9 The maximum voids between adjoining concrete slabs, and/or between concrete slabs and expansion joint material, shall be three-sixteenths inch (3/16") of horizontal clearance with a maximum difference in vertical elevation of one-fourth inch (¼").

5.1.10 Construction joints where pool coping meets concrete deck(s) shall be watertight and shall not allow water to pass to the ground beneath.

5.1.11 The areas where the deck(s) join pool coping shall be designed and installed so as to protect the coping and its mortar bed from damage as a result of reasonable movement of adjoining deck(s).

5.1.12 Joints in deck(s) shall be provided to minimize the potential for cracks due to a change in elevations, separation of surfaces or movement of the slab.

5.1.13 The areas where deck(s) join concrete work shall be protected by expansion joints to protect the pool adequately from the pressures of relative movements.

5.1.14 Deck(s) shall be edged, have a radius, or be otherwise relieved to eliminate sharp corners.

5.1.15 Deck(s) shall be sloped to effectively drain either to perimeter areas or to deck drains. Drainage shall remove pool splash water, deck cleaning water, and rain water without leaving standing water.

5.1.16 Site drainage shall be provided so as to direct all perimeter deck drainage as well as general site and roof drainage away from the pool. When required, yard drains shall be installed to prevent the accumulation or puddling of site water in the general area of the deck(s) and related improvements.

5.1.17 If used, an open pit or leaching design for backwash sump purposes shall be located so that it falls completely below adjacent deck(s) and fully outside a line projected 45 deg. downward and away from such deck(s), or shall be designed to accommodate local soil conditions and the volume of backwash (see figure below).

5.1.18 Circulation system piping, other than that integrally included in the manufacture of the pool, shall be subject to an induced static hydraulic pressure test (sealed system) at twenty-five (25) pounds per square inch (psi) for thirty (30) minutes. This test shall be performed before the deck is poured, and the pressure shall be maintained through the deck pour.

5.1.19 Valves installed in or under any deck(s) shall provide a minimum ten inches (10") diameter access cover and valve pit to facilitate servicing.

5.1.20 A hose bibb and a vacuum breaker shall be provided for washing down the entire deck area.

5.2 **Entry/Exit:** All pools shall have at least two (2) means of entry/exit located so as to serve both ends of the pool. These shall consist of ladders, stairs, or recessed treads and may be used in combination. All treads shall have slip-resisting surfaces.

5.2.1 Where water depths are twenty-four inches (24") or less at the pool wall, such areas shall be considered as providing their own natural mode for entry/exit.

5.2.2 For pools or water areas over thirty feet (30') in width, both sides of the deep portions of the pool shall have entries/exits provided.

5.2.3 A means of entry/exit for the shallow end shall be located between the shallow end wall and the cross section at Point D, while a means of entry/exit for the deep end shall be between the deep end wall and the cross section at Point B. (Refer to Figure 4.6.1.)

5.2.4 A means of entry/exit shall be provided at a minimum of every seventy-five (75) linear feet of pool wall or fraction thereof.

5.2.5 Stairs, ladders, and recessed treads shall be located so as not to interfere with racing lanes if applicable.

5.3 **Pool Stairs:** The design and construction of protruding and recessed pool stairs shall conform to Articles 5.3.1 through 5.3.4.

5.3.1 Step treads shall have a minimum unobstructed horizontal depth of ten inches (10") and a minimum unobstructed surface area of two hundred forty (240) square inches.

5.3.2 Risers at the centerline of the treads shall have a maximum uniform height of twelve inches (12"), with the bottom riser height allowed to vary plus or minus two inches (±2") from the uniform riser height.

5.3.3 Each set of stairs shall be provided with at least one (1) handrail to serve all

treads and risers. Handrails shall conform to Articles 5.3.3.1 through 5.3.3.3.

5.3.3.1 Handrails, if removable, shall be installed in such a way that they cannot be removed without the use of tools.

5.3.3.2 The leading edge of handrails facilitating stairs and pool entry/exit shall be no more than eighteen inches (18") plus or minus three inches (±3"), horizontally from the vertical plane of the bottom riser (where applicable).

5.3.3.3 The outside diameter of handrails shall be between one inch (1") and one and nine-tenths inches (1.9").

5.3.4 Underwater seats, benches or swimouts may be provided as part of the stairs or recessed treads.

5.4 **Pool Ladders:** The design and construction of pool ladder(s) shall conform to Articles 5.4.1 through 5.4.6.

5.4.1 Pool ladders shall be made entirely of corrosion-resisting materials.

5.4.2 Ladders shall provide two (2) handholds or two (2) handrails.

5.4.3 Below the water level, there shall be a clearance of not more than six inches (6") nor less than three inches (3") between any ladder tread edge, measured from the pool wall side of the tread, and the pool wall.

5.4.4 The clear distance between ladder handrails shall be a minimum of seventeen inches (17") and a maximum of twenty-four inches (24").

5.4.5 There shall be a uniform height between ladder treads, with a seven inch (7") minimum distance and a twelve inch (12") maximum distance.

5.4.6 Ladder treads shall have a minimum horizontal depth of one and one-half inches (1-1/2").

5.5 **Recessed Treads: The** design and construction of recessed treads in the pool wall shall conform to Articles 5.5.1 through 5.5.5.

5.5.1 Recessed treads at the centerline shall have a uniform vertical spacing of twelve inches (12") maximum and seven inches (7") minimum.

5.5.2 The vertical distance between the pool coping edge, deck, or step surface and the uppermost recessed tread shall be a maximum of twelve inches (12").

5.5.3 Recessed treads shall have a minimum depth of five inches (5") and a minimum width of twelve inches (12").

5.5.4 Recessed treads shall drain into the pool to prevent the accumulation of dirt.

5.5.5 Each set of recessed treads shall be provided with a set of handrails/grabrails/ handholds to serve all treads and risers.

5.6 Supports for Diving Equipment: Supports, platforms, stairs, and ladders for diving equipment shall be designed to carry the anticipated loads. Stairs and ladders shall be of corrosion-resisting material, easily cleanable and with slip-resisting tread. All diving stands higher than twenty-one inches (21") measured from the deck to the top butt end of the board shall be provided with stairs and/or a ladder. Step treads shall be self-draining.

5.6.1 Platforms and diving equipment of one (1) meter or higher shall be protected with guard rails which shall be at least thirty inches (30") above the diving board and extend to the edge of the pool wall. All platforms or diving equipment higher than one (1) meter shall have guard rails which are at least thirty-six inches (36") above the diving board and extend to the edge of the pool wall.

5.7 **Diving Equipment**: Diving equipment shall be designed for swimming pool use and shall be installed in accordance with the manufacturer's recommendations.

5.7.1 Diving equipment manufacturers shall provide installation instructions and specifications with each unit.

5.7.2 A label shall be permanently affixed to the diving equipment or jump board and shall include:

- manufacturer's name and address,
- board equipment length,
- identification as to diving or jump board,
- fulcrum setting specifications (if applicable),
- reference to the current year of the applicable NSPI standard,
- reference to the applicable article(s) in this standard.

5.7.3 Diving equipment suitable for installation on a lower pool type may be installed on any higher pool type providing no less a water envelope is provided from the tip of the board than called for in the lower type. Diving equipment of a greater type, e.g., Type VIII, shall not be installed on a pool of lesser type, e.g., Type VII. Should diving equipment be installed at any greater height than specified for the lower type pool, water surface area and geometry shall be provided for

the type pool which permits board installation at that height.

5.7.4 Diving equipment shall have slip-resisting tread surfaces.

5.7.5 Diving equipment shall be permanently anchored to the pool deck. The edge of the board at the tip end shall be level with the water surface. The tip end of the board over the pool water surface may be higher than the butt end of the board. Refer to manufacturer's recommendations.

5.7.6 Maximum board height over the water shall have plus three inches (+ 3") tolerance to allow for construction variances only on Class B and C pools.

5.7.7 The maximum construction tolerance of the tip of the board from Point A shall be plus or minus three inches (±3") on Class B and C pools. The diving equipment shall be in compliance with Article 4.5.2.

5.8 The requirements of the U.S. Consumer Product Safety Commission (CPSC) Standard for Swimming Pool Slides as published in the Code of Federal Regulations, 16 CFR, Part 1207, shall be used for standards relating to swimming pool slides. Installation and use instructions shall be provided with each unit by the manufacturer.

ARTICLE VI

6. CIRCULATION SYSTEMS

6.1 A circulation system consisting of pumps, piping, return inlets and suction outlets, filters, and other necessary equipment shall be provided for complete circulation of water through all parts of the pool.

6.1.1 The equipment shall be of adequate size to turn over the entire pool water capacity at least once every eight (8) hours. This system shall be designed to give the proper turnover rate based on the manufacturer's recommended maximum pressure flow of the filter in clean media condition of the filter. Water clarity shall be maintained. (Clarity is a function of proper filtration and maintenance of proper chemical operational parameters. See Appendix A.) When standing at the pool's edge at the deep end, the deepest portion of the pool floor shall be visible.

6.1.2 Circulation system components which require replacement or servicing shall be accessible for inspection, repair, or replacement, and shall be installed in accordance with the manufacturer's instructions.

6.1.3 Where equipment sizing falls within the scope of National Sanitation Foundation (NSF) testing, materials and equipment used in the circulation

system shall comply with the appropriate requirements of NSF Standard 50.

6.1.4 Pool equipment shall be properly supported to prevent damage from misalignment, settlement, etc. The equipment shall be mounted so as to minimize the potential for the accumulation of debris and moisture, following manufacturer's instructions.

6.2 Water Velocity: The water velocity in the pool piping shall not exceed ten feet (10') per second for discharge piping (except for copper pipe where the velocity should not exceed eight feet (8') per second), and six feet (6') per second for suction piping, unless summary calculations are provided to show that the greater flow is possible with the pump and piping provided. Pool piping shall be sized to permit the rated flows for filtering and cleaning without exceeding the maximum head of the pump.

6.2.1 A wading pool shall have a separate circulation system of adequate size to turn over the entire pool water capacity at least once every two (2) hours.

6.3 **Piping and Fittings:** The circulation system piping and fittings shall be nontoxic, shall be considered to be process piping, and shall be of material able to withstand operating pressures and operating conditions.

6.3.1 Pool piping subject to damage by freezing shall have a uniform slope in one direction equipped with valves for adequate drainage. Pool piping shall be supported at sufficient intervals to prevent entrapment of air, water or dirt. Provision shall be made for expansion or contraction of pipes.

6.3.2 Equipment shall be designed and fabricated to drain the pool water from the equipment, together with exposed face piping, by removal of drain plugs and manipulating valves, or by other methods. Refer to manufacturer's recommendations for specific information on draining the system.

6.4 System Condition: A pressure or vacuum gauge or other means of indicating system condition shall be provided in the circulation system in an easily readable location (see Articles 8.10 through 8.10.2).

6.4.1 Class A, B, and C public pools shall be provided with an indicator measuring the rate of flow through the filter system with an appropriate range readable in gallons per minute and accurate within ten (10) percent actual flow.

6.5 Water Clarity and Chemistry: The circulation system shall be capable of maintaining water clarity and water chemistry requirements (see Appendix A). Time clocks may be used to set the operating period. When time clocks are used, they shall also govern the operating time of appurtenant devices such as chemical/disinfectant feeders, slurry feeders, heaters, etc., that are dependent upon circulation pump flow.

6.6 Instructions: Operation and maintenance instructions shall be provided for the circulation system.

ARTICLE VII

7. FILTERS

7.1 **Design**: Filters shall be designed so that after cleaning per manufacturer's instructions the system can provide the water clarity noted in Article 6.1.1.

7.1.1 Filters shall be designed so that filtration surfaces can be inspected and serviced.

7.2 **Internal Pressure:** On pressure-type filters, a means shall be provided to permit the release of internal pressure.

7.2.1 Any filter incorporating an automatic internal air release as its principal means of air release shall have lids which provide a slow and safe release of pressure as a part of its design.

7.2.2 Any separation tank used in conjunction with any filter tank shall have a manual means of air release or a lid which provides a slow and safe release of pressure as it is opened as a part of its design.

7.3 **Instructions:** Pressure filters and separation tanks shall have operation and maintenance instructions permanently installed on the filter or separation tank and shall include a precautionary statement warning not to start up the system after maintenance without first opening the air release and proper reassembly of the filter and separation tank. The statement shall be visible and noticeable within the area of the air release.

7.4 Piping: Piping furnished with the filter shall be of suitable material capable of withstanding one and one-half (1-1/2) times the working pressure. The suction piping shall not collapse when there is a complete shutoff of flow on the suction side of the pump.

ARTICLE VIII

8. PUMPS AND MOTORS

8.1 A pump and motor shall be provided for circulation of the pool water. Performance

of all pumps shall meet or exceed the conditions of flow required for filtering and cleaning (if applicable) the filters against the total dynamic head developed by the complete system.

8.2 With all pressure filter systems, a cleanable strainer or screen shall be provided upstream of the circulation pump(s) to remove solids, debris, hair, lint, etc.

8.3 Pump(s) and motor(s) shall be accessible for inspection and service.

8.4 The design and construction of the pump(s) and component parts shall provide safe operation.

8.5 Where a mechanical pump seal is provided, components of the seal shall be corrosion-resisting and capable of operating under conditions normally encountered in pool operation.

8.6 All motors shall have as minimum an open, drip-proof enclosure (as defined by the latest National Electrical Manufacturers Association [NEMA] Standard ANSI/NEMA-MG1) and be constructed electrically and mechanically to perform satisfactorily and safely under the conditions of load and environment normally encountered in swimming pool installations.

8.7 Motor(s) shall be capable of operating the pump under full load with a voltage variation of plus or minus ten (± 10) percent from the nameplate rating. If the maximum service factor of the motor is exceeded (at full voltage), the manufacturer shall indicate this on the pump curve.

8.8 All motors shall have thermal or current overload protection, either built in or in the line starter, to provide locked rotor and running protection.

8.9 When the pump is below the waterline, valves shall be installed on permanently connected suction and discharge lines, located in an accessible place outside the walls of the pool, where they shall be readily and easily accessible for maintenance and removal of the pump.

8.10 Pressure and vacuum gauges shall be installed on all public pools.

8.10.1 The vacuum gauge shall be installed as close to the pump return inlet as possible and still maintain an accurate reading.

8.10.2 The pressure gauge shall be installed on the face piping ahead of the filter or on top of the filter in the area of greatest filter pressure.

ARTICLE IX

9. RETURN INLETS AND SUCTION OUTLETS

9.1 Return inlet(s) and suction outlet(s) shall be provided and arranged to produce a uniform circulation of water and maintain a uniform disinfectant residual throughout the pool. Where skimmers are used, the return inlet(s) shall be located so as to help bring floating particles within range of the skimmers.

9.1.1 Suction outlets shall be provided with a cover that has been tested and approved by a nationally recognized testing laboratory and comply with ANSI/ASME A112.19.8M-1987, Suction Fittings For Use in Swimming Pools, Wading Pools, Spas, Hot Tubs, and Whirlpool Bathtub Appliances.

9.2 A public pool shall have a minimum of two (2) return inlets regardless of pool size. The number of return inlets shall be based on either two (2) inlets per six hundred (600) square feet of pool surface area, or fraction thereof.

9.2.1 Return inlet(s) from the circulation system shall be designed so as not to constitute a hazard to the user.

9.3 The pool shall not be operated if the outlet grate is missing, broken, or secured in such a way that it can be removed without the use of tools.

9.3.1 All pools shall be provided with main drain suction outlet(s) in the lowest point of the pool floor. The spacing of the main drain(s) for suction outlet(s) shall not be greater than twenty feet (20') on centers nor more than fifteen feet (15') from each side wall.

9.4 If the suction outlet system, such as a filtration system, booster system, automatic cleaning system, solar system, etc., has a single suction outlet, or multiple suction outlets which can be isolated by valves, each suction outlet shall protect against user entrapment by either:

a. An antivortex cover,

b. A twelve inch by twelve inch (12" x 12") grate or larger,

c. Other means.

9.5 Where provided, the vacuum cleaner fitting(s) shall be located in an accessible position(s) at least six inches (6") and no greater than eighteen inches (18") below the minimum operating water level or as an attachment to the skimmer(s).

ARTICLE X

10. SURFACE SKIMMER SYSTEMS

10.1 A surface skimming system shall be provided on all public swimming pools, and shall be designed and constructed to skim the pool surface when the water level is maintained within the operational parameters of the system's rim or weir device.

10.2 Skimming devices shall be designed and installed so as not to constitute a hazard to the user.

10.3 Where automatic surface skimmers are used as the sole overflow system, at least one (1) surface skimmer shall be provided for each five hundred *(*500*)* square feet or fraction thereof of the water surface area. Nominal recessed areas such as stairs, swimouts, spas, etc., shall not be considered in the calculation. When skimmers are used, they shall be located to maintain effective skimming action over the entire surface of the pool.

10.4 Where a perimeter-type surface skimming system is used as the sole surface skimming system, this system shall extend around a minimum fifty *(*50*)* percent of the perimeter of the pool.

10.4.1 Where perimeter surface skimming systems are used, they shall be connected to the circulation system with a system surge capacity of not less than one (1) gallon for each square foot of pool surface.

10.5 The hydraulic capacity of the overflow system shall be capable of handling one hundred (100) percent of the circulation flow.

ARTICLE XI

11. ELECTRICAL REQUIREMENTS

11.1 The requirements of the latest National Electrical Code (NEC) ®, as published by the National Fire Protection Association, shall be followed.

ARTICLE XII

12. HEATERS

12.1 This section pertains to appliances using either fossil fuels such as natural gas, propane **(LPG), and #2** Fuel Oil, or electric heating equipment for heating pool

water.

12.2 Heaters shall be tested and comply with the requirements of ANSI-Z21.56a-1990 for gas application, or UL 1261 for electrical applications. Heat pumps shall comply with the UL 559 specifications and be accepted by a recognized testing facility.

12.3 Owner/operator shall routinely check the in-pool water to ensure that the temperature does not exceed 104^0F. If adjustments are necessary, those adjustments shall be performed in accordance with manufacturer's instructions or by a qualified technician.

12.4 **Sizing**: For efficient and economical operation, it is important that the heater be properly sized. Determine the proper size heater by first determining the area of the swimming pool in square feet. Then select from the manufacturer's charts the heater that is properly sized for that particular pool.

12.5 **Installation**: The heater(s) shall be installed in accordance with all federal, state, and local codes as well as the manufacturer's recommendations.

12.5.1 **Support** - Heater shall be installed on a surface with sufficient structural strength to support the heater when it is full of water and operating. The heater shall be level and not able to move after plumbing, gas and/or electrical connections are completed.

12.5.2 **Combustible Surfaces:** If the heater requires a non- combustible surface per the manufacturer, it shall be placed on a cement or other accepted surface per ANSI-Z21.56.1990 or federal, state and local codes.

12.5.3 **Clearances** - When installing a heater, adequate clearances shall be maintained on all sides and over the top of the unit. Consult manufacturer's instructions for proper clearances.

12.5.4 **Ventilation**- The heater shall have adequate ventilation in order to assure proper operation.

12.5.5 **Make Up Air** - When installing a fossil fuel heater indoors, proper openings to the room are a necessity. The heater shall be installed in accordance with federal, state, or local codes and the manufacturer's recommendations.

12.6 Heating Energy Source

12.6.1 Natural Gas Energy Supply - The heater gas supply piping shall comply with manufacturer's recommendations and ANSI/NFPA 54-1984.

12.6.1.1 IMPORTANT SAFETY NOTE: Install a gas cock, properly sized and readily accessible outside the jacket, to stop the flow of natural gas at the

heater for service or emergency shutdown.

12.6.2 **Propane Energy Supply**- Whenever a propane (LPG) appliance is installed, special attention shall be given to ensure that the Storage Tank, Supply Piping, and Regulator shall be adequately sized to ensure operating fuel pressures as specified by the appliance manufacturer. Consult the fuel supply company and ensure that the system is installed in accordance with the National Fuel Gas Code (ANSI Z223.1/NFPA 58-1989).

12.6.2.1 IMPORTANT SAFETY NOTE: Propane gas is heavier than air and therefore can create an extreme hazard of suffocation or explosion if the heater is installed in a pit or enclosed area. NFPA 58-1989 contains provisions for installing valves and other controls in pits and similar areas.

12.6.2.2 IMPORTANT SAFETY NOTE: Install a gas cock, properly sized and readily accessible outside the jacket, to stop the flow of propane (LPG) at the heater for service or emergency shutdown.

12.6.3 Electrical Energy Supply - Electric heating appliances shall be installed in accordance with the National Electrical Code (NEC)® and any federal, state or local codes.

12.6.3.1 IMPORTANT SAFETY NOTE: Grounding and Bonding - The requirements for grounding and bonding are particularly important and shall be adhered to if the hazard of electrical shock is to be reduced.

12.7 Heater Circulation System

12.7.1 Water flow through the heater, any bypass plumbing installed, any back-siphoning protection, and the use of heat sinks shall be done in accordance with the manufacturer's recommendations and local codes, if any.

SPECIAL CONSIDERATION:

12.7.2 Some manufacturers recommend that the heater be turned off prior to stopping the water flow. Mechanisms such as a "fireman's switch" adapted to the time clock will turn the heater off long enough for it to cool down before the time clock turns the pump off.

12.7.2.1 NOTE: The "fireman's switch" does not protect against a manual override or a system shut down in the event of power failure.

ARTICLE XIII

13. WATER SUPPLY

13.1 The water supply serving the pool, which may come from a variety of sources, shall meet the requirements of Appendix A before the user uses the pool.

13.2 No direct mechanical connection shall be made between the potable water supply and the swimming pool, chlorinating equipment, or the system of piping for the pool, unless it is protected against backflow and back-siphonage in a manner approved by the (state or local) authority, or through an air gap meeting the latest American National Standards Institute Standard A112.1.2, or other equivalent means approved by the (state or local) authority.

13.3 An over-the-rim spout, if used, shall be located under a diving board, adjacent to a ladder, or otherwise properly shielded so as not to create a hazard. Its open end shall have no sharp edges and shall not protrude more than two inches (2") beyond the edge of the pool.

ARTICLE XIV

14. WASTE WATER DISPOSAL

14.1 Backwash water may be discharged into a sanitary sewer through an approved air gap, or into an approved subsurface disposal system or by other means approved by the (state or local) authority.

ARTICLE XV

15. DISINFECTANT EQUIPMENT AND CHEMICAL FEEDERS

15.1 Disinfectant equipment and chemical feeders, hereafter referred to jointly as "equipment," shall comply with the requirements of NSF Standard 50. The disinfection equipment shall be capable of precisely introducing a sufficient quantity of an approved disinfecting agent to maintain the appropriate recommended guidelines as outlined in Appendix A.

15.1.1 Every pool shall be required to have at least one (1) unit of disinfectant agent equipment in compliance with Article 15.1.2. Additional units may be required to maintain chemical and physical parameters of the pool water.

15.1.2 The pool water shall be continuously disinfected by a disinfecting agent that imparts an easily measured residual. The disinfecting agent used shall be subject to field testing procedures that are simple and accurate. Gaseous chlorine, chlorine compounds, bromine compounds, or other bactericidal agents shall be acceptable when meeting the disinfectant level parameters outlined in Appendix A. Bactericidal agents shall be registered by the U.S. Environmental Protection Agency (EPA).

15.2 Chemical Feeders: The installation and use of chemical feeders shall conform to Articles 15.2.1 through 15.2.3.

15.2.1 When using chemical feeders, it is extremely important that they be installed downstream from the filter and heater. Erosion- type feeders shall be allowed to feed their solution to the suction side of the pump.

15.2.2 If the chemical feeder is equipped with its own pump, it shall be installed so it introduces the gas or solution downstream from the heater and, if possible, at a position lower than the heater outlet fitting.

15.2.3 Chemical feed pumps shall be wired so they cannot operate unless the filter pump is running. If the chlorinator has an independent timer, the filter and chemical feed pump timers shall be interlocked.

15.3 **Training:** Personnel responsible for the operation of the disinfection agent equipment shall be properly trained in the operation of that equipment, the procedure for performing and interpreting the necessary chemical field tests, and the appropriate emergency procedures (see Appendix D, Use of Elemental Chlorine).

15.4 Test Kit: Every public pool shall be supplied with a chemical test kit for the determination of pH, chlorine or bromine residuals, cyanuric acid (if used), total alkalinity, and calcium hardness. The test kit shall be capable of at least measuring pH and disinfectant residual ranges, as detailed in Appendix A. The method used in determining the free available chlorine residual shall be such that chloramines or other chlorine compounds that may be present in the pool do not affect the determination.

ARTICLE XVI

16. SPECIFIC SAFETY FEATURES

16.1 Handholds: Handholds shall conform to Articles 16.1.1 through 16.1.1.3.

16.1.1 A public pool shall be provided with a suitable handhold around its perimeter in

areas where depths exceed three feet six inches (3'6"). Handholds shall be provided no further apart than four feet (4') and shall consist of any one (1) or a combination of the items listed in Articles 16.1.1.1 through 16.1.1.3.

16.1.1.1 Coping, ledge, or deck along the immediate top edge of the pool which provides a slip-resisting surface of at least four inches (4") minimum horizontal width and located at or not more than twelve inches (12") above the waterline; or

16.1.1.2 Ladders, stairs, or seat ledges; or

16.1.1.3 A secured rope or railing placed at or not more than twelve inches (12") above the waterline.

16.2 **Rope and Float Line:** A rope and float line shall conform to Articles 16.2.1 through 16.2.3.

16.2.1 A rope and float line shall be provided between one foot (1') and two feet (2') on the shallow side of the break in grade between the shallow and deep portions of the swimming pool, with its position marked with visible floats at not greater than seven foot (7') intervals.

16.2.2 The rope and float line shall be securely fastened to wall anchors of corrosion-resisting materials and of the type which shall be recessed or have no projection that will constitute a hazard when the line is removed.

16.2.3 The line shall be of sufficient size and strength to offer a good handhold and support loads normally imposed by users.

16.3 Depth Markers: Depth markers shall conform to Articles 16.3.1 through 16.3.7.

16.3.1 Depth of water in feet shall be plainly and conspicuously marked at or above the waterline on the vertical pool wall and on the top of the coping or edge of the deck or walk next to the pool.

16.3.1.1 Depth markers on the vertical pool wall shall be positioned to be read from the water side.

16.3.1.2 Depth markers on the deck shall be within eighteen inches (18") of the water edge and positioned to be read while standing on the deck facing the water.

16.3.2 Depth markers shall be slip-resisting.

16.3.3 Depth markers shall be installed at the maximum and minimum water depths and at all points of slope change.

16.3.4 Depth markers shall be installed at intermediate increments of water depth not to exceed two feet (2'), nor spaced at distances greater than twenty-five foot (25') intervals.

16.3.5 Depth markers shall be arranged uniformly on both sides and both ends of the pool.

16.3.6 Depth markers on irregularly shaped pools shall designate depths at all major deviations in shape as well as conform to the foregoing articles.

16.3.7 Depth markers shall have a four inch (4") minimum height. Numbers shall be of contrasting color to the background on which they are applied, and the color shall be of a permanent nature.

16.4 Lifeguard Chairs: Lifeguard chairs shall conform to Article 16.4.1.

16.4.1 Class B and C pools with over eighteen hundred (1800) square feet of water surface area shall have at least one (1) elevated lifeguard chair for each three thousand (3000) square feet of pool surface or fraction thereof. Where a pool is provided with more than one (1) lifeguard chair, and pool width is forty-five feet (45') or more, they shall be located on each side of the pool.

16.5 Lifesaving Equipment: Lifesaving equipment shall conform to Articles 16.5.1 through 16.5.1.3.

16.5.1 Class A, B, and C swimming pools shall have lifesaving equipment conspicuously and conveniently on hand at all times that conforms with Articles 16.5.1.1 through 16.5.1.3.

16.5.1.1 Alight, strong pole not less than twelve feet (12') long, including a body hook.

16.5.1.2 A minimum one-fourth inch (¼") diameter throwing rope as long as one and one-half (1-1/2) times the maximum width of the pool or fifty feet *(*50'*),* whichever is less, to which has been firmly attached a ring buoy with an outside diameter of approximately fifteen inches (15") or a similar flotation device.

16.5.1.3 A telephone with posted names and phone numbers of the nearest available police, fire, ambulance service and/or rescue unit, and/or 911, if available.

16.6 ` **Barriers**: Barriers shall conform with the requirements of Article 16.6.1.

16.6.1 Class A or B public swimming pools shall be protected by a fence, wall, building, enclosure, or solid wall of durable material of which the pool itself

may be constructed, or any combination thereof. Natural or artificial barriers shall be provided so as to afford no external handholds or footholds, be at least four feet (4') in height, and be equipped with a self-closing and positive self-latching closure mechanism at a height of at least forty-five inches (45") above the ground and provided with hardware for locking.

ARTICLE XVII

17. DRESSING FACILITIES FOR CLASS A AND B PUBLIC POOLS

17.1 Adequate dressing and sanitary facilities shall be provided unless these facilities are provided in connection with the general development for other purposes and are of adequate capacity and number and in close proximity to the pool.

17.1.1 Where there is a requirement for the dressing and sanitary facility to be made available to the handicapped, the design of the structure shall be in accordance with (state or local) authority handicap ramp, handrail and door size requirements.

17.2 Dressing and sanitary facilities shall be provided with separations for each sex with no interconnection. The rooms shall be well-lighted, drained, ventilated, and of good construction, with impervious materials. They shall be developed and planned so that good sanitation can be maintained throughout the building at all times.

17.3 Partitions between portions of the dressing room area, screen partitions, shower, toilet, and dressing room booths shall be of durable material not subject to damage by water and shall be designed so that a waterway is provided between partitions and floor to permit thorough cleaning of the walls and floor areas with hoses and brooms.

17.4 Shower and dressing booths shall be provided in female dressing space. Dressing booths shall be provided with curtains or other means of seclusion. This condition may be subject to variation for schools and other institutional use where a pool may be open to one (1) sex at a time.

17.5 Floors of the dressing facility shall be free of joints or openings and shall be continuous throughout the areas. Floors shall have a slip-resisting surface that shall be relatively smooth to insure complete and ease in cleaning. Floor drains shall be provided, and floors shall be sloped not less than one-fourth inch (¼") per foot toward the drains to insure positive drainage.

17.6 An adequate number of three-fourths inch (¾) hose bibbs shall be provided for flushing down the dressing facility interior.

17.7 No less than one (1) drinking fountain shall be provided and available to users at the pool site.

17.8 Lavatories: Lavatories, Showers, and Toilets for Class A and B Public Pools

17.8.1 Lavatories, showers, and toilets for Class A and B public pools shall meet or exceed the following general requirements:

17.8. 1.1 The minimum criteria for bathhouse sanitary facilities shall be based upon dressing and the anticipated maximum attendance of users and their sexes.

17.8.2 One (1) water closet combination, and one (1) lavatory, and one (1) urinal shall be provided for the first one hundred (100) male users. One (1) additional water closet, lavatory, and urinal shall be provided for each additional two hundred (200) male users or major fraction thereof.

17.8.3 Two (2) water closets and two (2) lavatories shall be provided for the first one hundred (100) female users. One (1) additional water closet and lavatory shall be provided for each additional one hundred (100) female users or major fraction thereof.

17.8.4 A minimum of two (2) shower heads shall be provided for each sex. One (1) additional shower head for each sex shall be added for each additional fifty *(50)* male or female users.

17.8.5 Tempered water only shall be provided at all shower heads. The water heater and thermostatically-controlled mixing valves shall be inaccessible to users and shall be capable of providing two (2) gallons per minute of 90^0F water to each shower head.

17.8.6 Soap dispensers for providing either liquid or powdered soap shall be provided at each lavatory. The dispenser shall be of all metal or plastic type with no glass permitted in these units.

17.8.7 An unbreakable mirror shall be provided over each lavatory.

17.8.8 Toilet paper holders shall be provided at each water closet combination.

17.8.9 Fixtures shall be installed in accordance with local plumbing codes and shall be properly protected against back-siphonage.

17.8.10 Fixtures shall be designed so that they may be readily cleaned. Frequent cleaning and disinfecting shall not cause damage.

17.8.11 Sanitary napkin dispensers shall be installed in toilet and/or shower areas designated for female users.

ARTICLE XVIII

18. VISITOR AND SPECTATOR AREA

18.1 There shall be separation between the spaces used by visitors and spectators in street clothes and those spaces used by users. The visitor and spectator area may be within the pool perimeter enclosure if it is in a separate area segregated from the space used by users.

18.2 Separate toilets shall be provided for spectators.

ARTICLE XIX

19. FOOD SERVICE FOR CLASS A AND B PUBLIC POOLS

19.1 Eating, drinking, and smoking shall not be permitted within the pool and deck enclosure.

19.1.1 Exception to 19.1 may be made to allow food and beverage(s) in the visitor and spectator area or in a similarly separated snack bar area for users which has been approved by the (state or local) authority.

19.2 Food and beverage(s) shall only be served in nonbreakable containers.

19.3 Trash containers shall be provided where food and/or beverage(s) are available.

ARTICLE XX

20. OPERATION AND MANAGEMENT

20.1 Public pools shall be maintained under the supervision and direction of a properly trained operator who shall be responsible for the sanitation, safety, and proper maintenance of the pool, and all physical and mechanical equipment and records. (Training can be obtained by completion of the National Swimming Pool Foundation's Swimming Pool/Spa Operator's Training Course or state or local training course, if available.)

20.2 Lifeguards and safety assistants shall be attired so that they are readily identifiable as members of the lifeguard staff. Individuals shall be considered qualified in life-saving and first aid if they hold the appropriate Red Cross certificate or equivalent.

20.3 Instructions

20.3.1 Upon completion of any swimming pool, the manager and his operators shall be given complete written and oral instructions by the builder as well as operational guidance of the pool, all equipment, and the maintenance of the swimming pool water.

20.3.2 Rules and regulations for users shall be posted in a conspicuous place to inform pool patrons.

20.3.3 The bathing load limit shall be observed by the management. The maximum number of users to be allowed in the pool at one (1) time will depend on a number of factors, such as the type of pool, indoor or outdoor location, surface area, operating characteristics of the water, purification system, quality of the pool water, etc., the significant factors being the pool area and the sanitary and physical condition of the pooi water. (Refer to Article 4.9.)

20.4 Operating Permits

20.4.1 A public pool shall not operate until such time as the appropriate application has been submitted to the (state or local) authority, or the prescribed forms provided, and the valid operating permit has been issued by the (state or local) authority. The permit shall be renewed annually.

20.4.2 The swimming pool shall not be placed in operation until appropriate inspections show compliance with the requirements of this standard. (Refer to Articles 3.8 and 3.9.)

20.4.3 The (state or local) authority shall inspect the pool annually for compliance, prior to the issuance of the annual operating permit. The pool operator shall receive a copy of the inspection.

20.4.4 Should inspections determine that the operation or maintenance of the pool is such as to constitute a health or safety hazard for the user, the operating permit shall be revoked or suspended. The pool operation in such a case shall be suspended immediately.

20.4.5 The revoked or suspended permit may be reissued or reinstated upon presentation of evidence that the deficiencies which caused the revocation or suspension have been corrected. Such evidence may be in the form of a reinspection by the (state or local) authority, or by acceptable evidence being presented at a hearing before the authority issuing the permit.

ARTICLE XXI

21. NSPI GLOSSARY OF INDUSTRY TERMS

The following is a list of definitions used by the swimming pool and spa industry. Some of the definitions listed may not apply to this particular standard.

ABRASION HAZARD:
A sharp or rough surface that would scrape the skin by chance during normal use.

ACCESSIBLE:
Easily exposed for inspection and the replacement of materials and/or parts with the use of tools.

ACID:
A liquid or dry compound used to reduce the pH of swimming pool or spa water. See SODIUM BISULFATE, MURIATIC ACID.

ACTIVATED CARBON:
Usually granulated, activated carbon, used to remove excessive oxidizers (e.g. ozone), colors and odors in water.

AIR INDUCTION SYSTEM:
A system whereby a volume of air (only) is induced into a hollow ducting in a spa floor, bench, or other location. The air induction system is activated by a separate air power blower.

AIR PUMP ASSIST BACKWASH:
The compressing of a volume of air in the filter effluent chamber (by means of an air compressor or by the water pressure from the recirculating pump) which, when released, rapidly decompresses and forces water in the filter chamber through the elements in reverse, dislodging the filter aid and accumulated dirt, carrying it to waste.

ALGAE:
Microscopic plant-like organisms that contain chlorophyll. Algae are nourished by sunlight (carrying out photosynthesis). They are introduced by rain or wind and grow in colonies producing nuisance masses. These organisms include green, blue-green or black, brown, and yellow-green (mustard) algae. Pink/red colored algae-like organisms exist but are bacteria and not algae. There are 21,000 known species of algae.

ALGAECIDE (also spelled ALGICIDE):
A natural or synthetic substance used for killing, destroying, or controlling algae.

ALGICIDAL:
Being capable of killing algae.

ALGISTAT:
Any substance or agent that inhibits the growth of algae.

ALGISTATIC:
Being able to inhibit the growth of algae.

ALKALINITY:
The amount of bicarbonate, carbonate or hydroxide compounds present in water **solution. See also TOTAL ALKALIN1TY.**

ALUM (Aluminum Sulfate) (Alz (S04)3):
An aluminum sulfate compound, used to cause suspended solids in the water to congeal into filterable masses (flocculate).

ALUMINUM SULFATE:
See ALUM.

APPURTENANCE:
A subordinate part or adjunct; accessory object.

AVAILABLE CHLORINE:
A term used in rating chlorine containing products as to their total oxidizing power.
(See FREE AVAILABLE CHLORINE.)

BACKWASH:
The process of thoroughly cleansing the filter medium and/or elements by the reverse flow of water through the filter.

BACKWASH CYCLE:
The time required to backwash thoroughly the filter medium and/or elements and the contents of the filter vessel.

BACKWASH PIPING:
The pipe or hose going from the backwash outlet of a filter system to a disposal point.

BACKWASH RATE:
The rate of flow of water through a filter during the backwash cycle, normally expressed in U.S. gallons per minute per square foot of effective filter area.

BACTERIA:
Single-celled microorganisms of various forms, some of which can cause infections or disease.

BAND:
See HOOP.

BATHER:
See USER.

BATHER LOAD:
See USER LOAD.

BEGINNER'S AREA:
Those water areas in pools which are three feet (3') or less in water depth.

BOOSTER PUMP SYSTEM:
A system whereby one or more hydrotherapy jets is activated by the use of a pump which is completely independent of the filtration and heating system of a spa.

Also, a device used to provide hydraulic support for certain types of equipment such as cleaning systems, gas chlorinators, and solar systems.

BOTTOM RAIL:
The lower portion of the pool frame that guides the aboveground pool wall in place.

BREAKPOINT:
See SUPERCHLORINATION.

BREAKPOINT CHLORINATION:
The addition of a sufficient amount of chlorine to water to destroy the combined chlorine present.

BROADCAST:
A method of putting granular or powdered chemicals into a pool by spreading them widely over the surface of the water.

BROMINATOR:
A device to apply or to deliver a bromine disinfectant to water at a controlled rate.

BROMINE (Br2):
A chemical element that exists as a liquid in its elemental form or as a part of a chemical compound which is an oxidant and a biocidal agent used to disinfect pool or spa water.

Surface Type Cartridge - A filter cartridge with a media relying on the retention of particles on the surface of the cartridge for removal.

CASUAL CONTACT:

Contact of any body part occurring by normal use modes.

CHEMICAL FEEDER:

A mechanical device for applying chemicals to pool or spa water.

CHINE:

That portion of the stave of a hot tub below the bottom of the croze.

CHINE JOIST:

A brace that provides support to the floor of a hot tub.

CHLORAMINE:

A compound formed when chlorine combines with nitrogen or ammonia which causes eye and skin irritation and has a strong, objectionable odor.

CHLORINATOR:

A device to apply or to deliver a chlorine disinfectant to water at a controlled rate.

CHLORINE (C12):

A chemical element that exists as a gas in its elemental form or as a part of a chemical compound which is an oxidant and a biocidal agent used in pool or spa water disinfection. See also HYPOCHLORITE.

CHLORINE GENERATOR:

Equipment that generates chlorine, hypochlorous acid, or hypo- chlorite on site for disinfection and oxidation of water contaminants.

CIRCULATION EQUIPMENT:

The mechanical components which are a part of a circulation system on a pool or spa. Circulation equipment may be, but is not limited to categories of pumps, hair and lint strainers, filters, valves, gauges, meters, heaters, surface skimmers, inlet/outlet fittings, and chemical feeding devices. The components have separate functions, but when connected to each other by piping, perform as a coordinated system for purposes of maintaining pool or spa water in a clear, sanitary, and desirable condition for using.

CIRCULATION SYSTEM:

An arrangement of mechanical equipment or components, connected by piping to a pool or spa in a closed circuit. The function of a circulation system is to direct water from the pool or spa, causing it to flow through the various system components for purposes of clarifying, heating, purifying, and returning the water back to the

original body of water.

CLARIFIER:

Also called COAGULANT or FLOCCULANT- A chemical that coagulates and neutralizes suspended particles in water. There are two types: inorganic salts of aluminum or iron, and water-soluble organic polyelectrolyte polymers.

COLD CRACK (Vinyl Liner):

Tested by the Masland Test Method. The vinyl specimen is folded in half, mounted on a test plate, and subjected to the test temperature for one hour. Then it is impacted with a calibrated anvil.

COMBINED CHLORINE:

The portion of the total chlorine existing in water in chemical combination with ammonia, nitrogen, and/or organic compounds; mostly comprised of chloramines.

CONTACT CONCENTRATION:

The concentration of a chemical in a flow of water. This concentration depends on the rate of addition, the flow rate of the water, and the efficiency of the mixing. It is calculated using the equation (assumes complete mixing):

Amount of Chemical (grams/hour)/Water Flow Rate (gpm) X 4.41 = Contact Concentration (mg/L).

COPING:

The cap on the pool or spa wall that provides a finishing edge around the pool or spa. Can be formed, cast in place or pre-cast, or pre-fabricated from metal or plastic materials. It may be used as part of the system that secures a vinyl liner to the top of the pool wall.

CORROSION:

The etching, pitting, or eating away of a material by chemical action.

COVE:

The radius between the pool or spa wall and the pool or spa floor.

COVERS:

Something that covers, protects or shelters, or a combination thereof, a swimming pool, spa, or hot tub.

Hard top cover - a cover used on pools, spas or tubs that rests on the lip of the pool or spa deck, not a flotation cover, used as a barrier to users, for maintenance and thermal protection.

Winter cover - a cover that is secured around the perimeter of a pool or spa that provides a barrier to debris, when the pool or spa is closed for the season.

Solar cover - a cover that when placed on a pool or spa surface, increases the water temperature by solar activity, and reduces evaporation.

Thermal cover - an insulating cover used to help prevent evaporation and heat loss from pools or spas.

Safety cover - As defined by ASTM in ES 13-89, Emergency Standard Performance Specification for Safety Covers and Labeling Requirements for All Covers for Swimming Pools, Spas and Hot Tubs , a barrier (intended to be completely removed before entry of users), for swimming pools, spas, hot tubs or wading pools, attendant appurtenances and/or anchoring mechanisms which will-when properly labeled, installed, used and maintained in accordance with the manufacturer's published instructions-reduce the risk of drowning of children under five years of age, by inhibiting their access to the contained body of water, and by providing for the removal of any substantially hazardous level of collected surface water. (These covers may be power or manual.)

CROZE:

The milled grooves in the stave of a wooden hot tub that accommodate the floor boards.

CYANURIC ACID:

Also called STABILIZER, ISOCYANURIC ACID, CONDITIONER, or TRIAZINETRIONE - A chemical that helps reduce the excess loss of chlorine in water due to the ultraviolet rays of the sun.

DECKS:

Those areas immediately adjacent to or attached to a pool or spa that are specifically constructed or installed for use by users for sitting, standing, or walking.

Cantilever-type: A deck structure which relies on the pool structure for support.

Free Standing-type: A deck structure which does not rely on the pool structure for support.

DEEP AREAS:

Water depths in excess of five feet *(5')* (1.42 **in).**

DIATOMITE:

The filtering medium of a diatomaceous earth filter composed of microscopic fossil skeletons of the "diatom,1' a tiny freshwater marine plankton.

DISINFECTANT:

Energy or chemicals to kill undesirable or pathogenic (disease-causing) organisms, and having a measurable residual at a level adequate to make the desired kill.

DISSOLVED SOLIDS:

See TDS (TOTAL DISSOLVED SOLIDS).

DIVING BOARD.

A recreational mechanism for entering a swimming pool, consisting of a semirigid board that derives its elasticity through the use of a fulcrum mounted below the board.

Jump Board - A recreational mechanism that has a coil spring, leaf spring or comparable device located beneath the board which is activated by the force exerted in jumping on the board.

Stationary Diving Platform - Stationary diving platforms are used for diving and are constructed or located on site. They may be natural or artificial rocks, pedestals, or other items constructed on site.

DIVING EQUIPMENT, COMPETITIVE:

Competitive diving equipment shall include competitive diving boards and fulcrum-setting diving stands intended to provide adjustment for competitive diving.

DIVING EQUIPMENT, MANUFACTURED:

Manufactured diving equipment shall include diving boards, jump boards, spring boards, and starting platforms. Architectural features such as decorative rocks and elevated bond beams are not considered to be manufactured diving equipment.

DPD (DIETHYL-P-PHENYLENE DIAMINE):

A reagent and test method that specifically measures bromine or free available and total chlorine; produces a series of colors from pale pink to dark red.

EDGE GUARDS:

Shields designed to cover sharp edges in aboveground swimming pools.

EFFECTIVE FILTER AREA:

Total surface area through which designed flow rate will be maintained during filtration.

Permanent Medium Type - The effective filter area is the filter surface that is perpendicular to the flow direction.

Cartridge Type - The total effective filter area is the cartridge area that is exposed to the direct flow of water. This excludes cartridge ends, seals, supports and other areas where flow is impaired.

Diatomaceous Earth (DE) Type - The actual area of the element is the total effective area of the septum, less any area of a septum support member greater than one-fourth inch (1/4") wide contacting the septum during filtration.

Sand Filtration Type - The projected top surface area of the sand within the filter in square inches or square feet.

EFFLUENT:

The water that flows out of a filter, pump, or other device.

FACTOR OF SAFETY:

The ultimate load divided by the safe load or the ultimate strength divided by the allowable stress.

FEET OF HEAD:

A basis for indicating the resistance in a hydraulic system, equivalent to the height of a
column of water that would cause the same resistance (100 feet of head equals 43 pounds per square inch).

The **TOTAL DYNAMIC HEAD** is the sum of all resistances in a complete operating system.

FENCE, ABOVEGROUND SWIMMING POOLS:

Intended to mark the boundary between the pool area and the outside, to deter unauthorized entry from outside, and is not intended as a structural barrier to be sat, walked, or climbed on.

FILTER:

A device that removes undissolved particles from water by recirculating the water through a porous substance (a filter medium or element).

Permanent Medium Filter: A filter that utilizes a medium, e.g. sand, that under normal use will not have to be replaced.

Diatomaceous Earth Filter: A filter that utilizes a thin coating of diatomaceous earth (D.E.) over a porous fabric as its filter medium that periodically must be replaced.

Cartridge Filter: A filter that utilizes a porous element that acts as a filter medium. The cartridge is disposable.

Vacuum Filter: A filter that operates under a vacuum from the suction of a pump.

FILTER AGITATION:

The mechanical or manual movement to dislodge the filter aid and dirt from the filter element.

FILTER AID:

Usually refers to powder-like substances such as diatomaceous earth or volcanic ash used to coat a septum type filter. Can also be used as an aid to sand filters.

FILTER CYCLE:

The operating time between cleaning or backwash cycles.

FILTER ELEMENT:

A device within a filter tank designed to entrap solids and conduct water to a manifold, collection header, pipe, or similar conduit and return it to the pool or spa. A filter element usually consists of a septum and septum support, or a cartridge.

FILTER MEDIUM:

A finely graded material (such as sand, diatomaceous earth, polyester fabric, anthracite, etc.) that removes filterable particles from the water.

FILTRATION FLOW:

The design rate of flow, in volume per time (gpm, gph), through the filter system installed per manufacturer's instructions with a new, clean filter medium.

FILTRATION RATE:

The rate of filtration of water flowing through a filter during the filter cycle expressed in U.S. gallons per minute per square foot of effective filter area.

FIREMAN'S SWITCH:

A mechanism adapted to the time clock which will turn the heater off long enough for it to cool down before the time clock turns the pump off.

FLOCCULATING AGENT (FLOCCULANT~:

A chemical substance or compound that promotes the combination, agglomeration, or coagulation of suspended particles in water.

FLOOR:

Shall refer to the interior bottom surface of a pool or spa.

FRAME:

That structure that defines and/or supports the outline or shape of the aboveground pool wall.

FREE AVAILABLE CHLORINE:

That portion of the total chlorine remaining in chlorinated water that is not combined with ammonia or nitrogen compounds and will react chemically with undesirable or pathogenic organisms.

FREEBOARD:

The clear vertical distance between the top of the filter medium and the lowest outlet of the upper distribution system in a permanent medium filter.

FREE CHLORINE:

See FREE AVAILABLE CHLORINE.

GRAB RAIL:

Tubular rails used to enter or leave a pool or spa, usually made of stainless steel or chrome-plated brass. See also HANDHOLD/HANDRAIL.

GUNITE:

A dry mixture of cement and sand, sprayed onto contoured and supported surfaces to build a pool or spa. Water is added to the dry mixture at the nozzle.

HANDHOLD/HANDRAIL:

A device that can be gripped by a user for the purpose of resting and/or steadying him/herself. It is not limited to but may be located within or without the pool or spa or as part of a set of steps or deck-installed equipment.

HARDNESS:

The amount of calcium and magnesium dissolved in water; measured by a test kit and expressed as parts per million (ppm) of equivalent calcium carbonate.

HEATER:

A fossil-fueled, electric or solar device to heat the water of a pool or spa.
Fossil-fueled heaters use natural, propane gas or fuel oil and utilize an open-flame to heat a heat exchanger.

Electric heaters utilize a heating element immersed in water.

Solar heaters utilize ultraviolet rays of the sun to heat the water.

Other ways to categorize heaters include:

Direct heaters heat the tubes in which water circulates.

Indirect heaters circulate steam or hot water inside a heat exchanger through which

water flows.

HEAT EXCHANGER:

A device with coils, tubes or plates that takes heat from any fluid, liquid or air, and transfers that heat to another fluid without intermixing the fluids.

HEAT PUMP:

A refrigeration compressor usually electrically driven, that is operated in reverse. To obtain heat, the evaporator side (cooling coil) is exposed to water, air or ground. The coil takes the heat from this source and transfers it to the condenser coil where it discharges the heat to the pool or spa to be heated.

HOOP:

A circumferential constraint that prohibits the staves of a hot tub from separating. Also, device used to secure two halves of a filter together. See BAND.

HOOP CONNECTOR:

A tightening and connecting device.

HOT TUB:

A spa constructed of wood with sides and bottoms formed separately; and the whole shaped to join together by pressure from the surrounding hoops, bands, or rods; as distinct from spa units formed of plastic, concrete, metal, or other materials.

HYDROCHLORIC ACID (HCl):

Also called muriatic acid when diluted. A very strong acid used in pools or spas for pH control and for certain specific cleaning needs. A by-product of the addition of chlorine gas to water. Use extreme caution in handling. See also MURIATIC ACID.

HYDROTHERAPY JETS:

A fitting that blends air and water creating a high-velocity, turbulent stream of air-enriched water.

HYDROTHERAPY SPA:

A unit that may have a therapeutic use but which is not drained, cleaned or refilled for each individual. It may include, but not be limited to, hydrotherapy jet circulation, hot water, cold water mineral baths, air induction bubbles, or any combination thereof. Industry terminology for a spa includes, but is not limited to, “therapeutic pool,” “hydrotherapy pool,” “whirlpool,” “hot spa,” etc. NSPI Standards exclude facilities used or under the direct supervision and control of licensed medical personnel.

HYPOBROMOUS ACID (HOBr):

The most powerful disinfecting form of bromine in water.

HYPOCHLORITE:

A family of chemical compounds including CALCIUM HYPOCHLORITE, LITHIUM HYPOCHLORITE, SODIUM HYPOCHLORITE, etc., found in various forms for use as a chlorine carrier in pool and spa water.

HYPOCHLOROUS ACID (HOCl):

The most powerful disinfecting form of chlorine in water.

IMPELLER:

The rotating vanes of a centrifugal pump; its action creates the flow of the water.

INFLUENT:

The water entering a filter or other device.

INLET, RETURN:

See RETURN INLET.

IODINE (12):

A chemical element that exists as a grayish-black granule in its normal state, or as a part of a chemical compound, which is a biocidal agent used to disinfect pool and spa water.

The spa disinfectant is in the form of liquid iodine and in iodide compounds. Chlorine used with iodides releases elemental iodine.

ISOCYANURATES (also ISOs):

Families of pool sanitizer products that are self stabilizing by containing cyanuric acid. Also called STABILIZED CULORINES.

JETS:

See HYDROTHERAPY JETS.

JOIST:

See CHINE JOIST.

LADDERS:

A-Frame Ladder - An entry ladder that straddles an aboveground pool wall and is either removable or has a built-in entry limiting feature.

Limited Access **Ladder** - Any ladder with provision for making entry inaccessible when a pool or spa is not in use (i.e., swing-up, slide-up, “pick off’ or equivalent).

Double Access Ladder - A ladder that straddles the pool wall of an

aboveground pool and provides pool ingress and egress, and is intended to be removed when not in use.

Deck Ladder - A ladder ascending from ground level outside the pool to the level of a deck.

In-Pool or Spa Ladder - A ladder located in a pool or spa to provide ingress and egress from the deck.

Staircase Ladder - A ladder that allows access to an aboveground pool deck and has a built-in entry limiting feature.

LINER:

See VINYL LINER.

LITHIUM HYPOCHLORITE (LiOCl):

A solid white granular form of inorganic chlorine that has a pH of approximately 9 and contains an Available Chlorine Content (ACC) of *35%*.

LOWER DISTRIBUTION SYSTEM (Underdrain):

Those devices used in the bottom of a permanent medium filter to collect the water during filtering and distribute the water during backwashing.

MAKE-UP WATER:

Fresh water used to fill or refill the pool or spa. See also SOURCE WATER.

MANUFACTURED DIVING EQUIPMENT:

See DIVING EQUIPMENT, MANUFACTURED.

MARCITE:

See PLASTER.

MULTIPLE FILTER-CONTROL VALVE:

A multiport valve having a number of control positions for various filter operations that combines in one unit the function of two or more single valves.

MURLATIC ACID (HYDROCHLORIC ACID) (HCI):

Used to lower pH and/or total alkalinity in pool and spa water.

NEW POOL AND! OR SPA CONSTRUCTION:

The activity of building or installing a pool and/ or spa structure, and its component parts, where no such structure has previously existed.

NONSWIMMING AREA:

Any portion of a pool where water depth, offset ledges, or similar irregularities would prevent normal swimming activities.

ORGANIC MATTER:

Perspiration, urine, saliva, suntan oil, cosmetics, lotions, dead skin, and similar debris introduced to water by users and the environment.

ORP (Also called **REDOX):**

The OXIDATION REDUCTION POTENTIAL produced by strong oxidizing agents in a water solution. It is a measure of the oxidation level measured in millivolts by an ORP METER.

ORTHOTOLIDINE:

See OTO.

OTO (ORTHOTOLIDINE):

A colorless reagent that reacts with chlorine or bromine to produce a series of yellow-to-orange colors which indicate the amount of chlorine or bromine in water. Effectively measures total chlorine.

OUTLET, SUCTION:

See SUCTION OUTLET.

OVERFLOW SYSTEM:

Refers to removal of pool/spa surface water through the use of overflows, surface skimmers, and surface water collection systems of various design and manufacture.

OZONE (03):

A gaseous molecule composed of three (3) atoms of oxygen that is generated on site and used for oxidation of water contaminants.

OZONE, LOW OUTPUT GENERATING EQUIPMENT (OZONATOR):

Refers to units which will produce ozone in air at a concentration less than 500 ppm. Usually this term will refer to ultraviolet (UV) generators.

PASS THROUGH:

Referring to openings between vertical pickets of a fence.

pH:

A value expressing the relative acidity or basicity of a substance, such as water, as indicated by the hydrogen ion concentration. pH is expressed as a number on the scale of 0 to 14, 0 being most acidic, 1 to 7 being acidic, 7 being neutral, 7 to 14 being basic and 14 being most basic.

PHENOL RED:

A dye that is used to measure pH.

PINCHING HAZARD:

Any configuration of components that would pinch or entrap the user.

PLASTER:

A type of interior finish (a mixture of white cement and aggregate, which can be tinted or colored) which is applied to a concrete pool or spa. Also called Marcite or Marblite.

POOLS:

Permanently Installed Swimming Pool - A pool that is constructed in the ground or in
a building in such a manner that it cannot be readily disassembled for storage (refer to
NSPI-1 Standard For Public Swimming Pools or NSPI-5 Standard For Residential Swimming Pools as applicable).

Aboveground Pool - Type 0- A removable pool of any shape that has a minimum water depth of thirty-six inches (36") and maximum water depth of forty-eight inches (48") at the wall. The wall is located on the surrounding earth and maybe, readily disassembled or stored and reassembled to its original integrity. Diving and the use of a water slide are prohibited. (Refer to NSPI-4 Standard For Aboveground/Onground Residential Swimming Pools.)

Onground Residential Swimming Pool - Type 0 - A removable pool package whose walls rest fully on the surrounding earth and has an excavated area below the ground level where diving and the use of a water slide are prohibited. (Refer to NSPI-4 Standard For Aboveground/Onground Residential Swimming Pools.) The slope adjacent to the shallow area shall have a maximum slope of 3:1, and the slope adjacent to the side walls shall have a maximum slope of 1:1.

Inground Swimming Pool - Any pool whose sides rest in partial or full contact with the earth. (Refer to NSPI-5 Standard For Residential Swimming Pools or NSPI-1 Standard For Public Swimming Pools, as applicable.)

Residential Pool - A residential pool shall be defined as any constructed pool, permanent or nonportable, that is intended for noncommercial use as a swimming pool by not more than three (3) owner families and their guests and that is over twenty-four inches (24") in depth, has a surface area exceeding 250 square feet and/or a volume over 3,250 gallons. (Refer to NSPI-5 Standard For Residential Swimming Pools.)

Residential pools shall be further classified into types as an indication of the suitability of a pool for use with diving equipment.

Type 0: Any residential pool where the installation of diving equipment is prohibited.

Type I-V: Residential pools suitable for the installation of diving equipment by type. Diving equipment classified at a higher type may not be used on a pool of lesser type (i.e., Type III equipment on a type II pool).

Commercial/Public Pool - Any pool, other than a residential pool, which is intended to be used for swimming or bathing and is operated by an owner, lessee, operator, licensee or concessionaire, regardless of whether a fee is charged for use. References within the standard to various types of public pools (refer to NSPI-1 Standard For Public Swimming Pools) are defined by the following categories:

Class A: Competition Pool - Any pool intended for use for accredited competitive aquatic events such as Federation Internationale de Natation Amateur (FINA), U.S. Swimming, U.S. Diving, National Collegiate Athletic Association (NCAA), National Federation of State High School Associations (NFSHSA), etc. The pool may also be used for recreation.

Class B: Public Pool - Any pool intended for public recreational use.

Class C: Semi-Public Pool - Any pool operated solely for and in conjunction with lodgings such as hotels, motels, apartments, condominiums, etc.

Class D: Other Pool - Any pool operated for medical treatment, therapy, exercise, lap swimming, recreational play, and other special purposes, including, but not limited to, wave or surf action pools, activity pools, splash pools, kiddie pools and play areas. These pools are not intended to be covered within the scope of NSPI standards.

Public pools may be diving or nondiving. If diving, they shall be further classified into types as an indication of the suitability of a pool for use with diving equipment.

Type VI-XI:Public pools suitable for the installation of diving equipment by type. Diving equipment classified at a higher type may not be used on a pool of lesser type (i.e., Type VIII equipment on a Type VI pool).

Type N: A non-diving public pool (no diving allowed).

Splasher (Wader) Pools- A splasher pool shall have a minimum water depth of twenty-four inches (24”) and a maximum water depth of thirty-six inches (36”).

Wading Pool - A pool that has a shallow depth used for wading. There are no requirements for residential wading pools. (Refer to NSPI-1 Standard For Public Swimming Pools for public wading pools.)

POOL UPRIGHT SUPPORT:

That portion of the frame that is adjacent to the aboveground pool in a vertical position which supports the top rail and braces the wall.

POTABLE WATER:

Any water, such as an approved domestic water supply, which is bacteriologically safe and otherwise suitable for drinking.

An abbreviation for PARTS PER MILLION. The unit of measurement used in chemical testing which indicates the parts by weight in relation to one million parts by weight of water. It is essentially identical to the term milligrams per liter (mg/L).

PRECIPITATE:

A solid material which is forced out of a solution by some chemical reaction and which may settle out or remain as a haze in suspension (turbidity).

PRE-COAT:

The coating of filter aid on the septum of a diatomaceous earth type filter at the beginning of each filter cycle.

PRE-COAT FEEDER:

A chemical feeder designed to inject diatomaceous earth into a filter in sufficient quantity to coat the filter septum at the start of a filter run.

PRESSURE CHECK:

A test for the rate of water flow; also a test for leaks in a system.

PRESSURE DIFFERENTIAL:

The difference in pressure between two parts of a hydraulic system, such as the influent and effluent of a filter.

PRIMARY STRUCTURAL MEMBERS:

Any part of the aboveground pool structure that carries or retains any static load or stress caused by water pressure, surge and/or natural forces, and for reasonable foreseeable use.

PSI:

An abbreviation for pounds per square inch.

PUMP:

A mechanical device, usually powered by an electric motor, which causes hydraulic flow and pressure for the purpose of filtration, heating, and circulation of pool and spa water. Typically, a centrifugal pump design is used for pools and spas.

PUNCTURE HAZARD:

Any surface or protrusion that would puncture a user's skin under casual contact.

QUATERNARYAMMONIUM (also QUATS):

Organic compounds of ammonia used as algaestat and germicide.

RATE OF FLOW:

The quantity of water flowing past a designated point within a specified time, such as the number of gallons flowing in one minute (gpm).

RATED PRESSURE:

That pressure that is equal to or less than the designed pressure and appears on the data plate of the equipment.

REHABILITATION:

The activity of restoring all or part of a pool or spa structure, and its component parts, back into good condition, including the rebuilding and/or replacing of worn and broken parts or components.

REMOVABLE:

Capable of being disassembled with the use of only simple tools such as a screwdriver, pliers, or wrench.

RETURN INLET:

The aperture or fitting through which the water under positive pressure returns into a pool or spa.

RETURN PIPING:

That piping which is referred to as effluent.

RING BUOY:

A ring-shaped floating buoy capable of supporting a user.

ROPE AND FLOAT LINE:

A continuous line not less than one-fourth inch (1/4") in diameter, which is supported by buoys and attached to opposite sides of a pool to separate the deep and shallow ends.

SCALE:

The precipitate that forms on surfaces in contact with water when the calcium hardness, pH, or total alkalinity levels are too high.

SECONDARY STRUCTURAL MEMBERS:

Any part of the aboveground pool structure that is not subject to load caused by water pressure.

SEPTUM:

That part of the filter element consisting of cloth, wire screen, or other porous material on which the filter medium or aid is deposited.

SEQUESTERING AGENT:

Synonymous with CHELATING or METAL COMPLEXATION AGENT, a sequestering agent reacts with potential stain-producing metal ions (i.e., copper, iron, etc.) to reduce staining of pool/spa surfaces and associated colored water.

SHALLOW AREAS:

Portions of a pool or spa with water depths less than five feet (5').

SHOCK TREATMENT:

The practice of adding significant amounts of an oxidizing chemical to water to destroy ammonia and nitrogenous and organic contaminants in water.

SHOTCRETE:

A mixture of cement and sand, applied onto contoured and supported surfaces to build a pool or spa. Shotcrete is premixed and pumped wet to the construction site.

SIGHT BARRIER:

Available opening space in any given or total fence area.

SKIMMER (See also SURFACE SKIMMING SYSTEM):

Thru-wall - a device installed in the wall of an inground pool or spa or aboveground/onground pool that permits the continuous removal of floating debris and surface water to the filter.

Over-the-wall - a device installed over the wall of an aboveground/onground pool that allows for continuous removal of debris and surface water to the filter.

SKIMMER WEIR:

Part of a skimmer which adjusts automatically to small changes in water level to assure a continuous flow of water to the skimmer. See WEIR.

SLIP RESISTING:

A surface that has been so treated or constructed as to significantly reduce the chance of a user slipping. The surface should not be an abrasion hazard.

SLOPE:

An inclined surface.

SODA ASH (also SODIUM CARBONATE) (Na2CO3):
A white powder used to raise pH of the water.

SODIUM BICARBONATE (also BAKING **SODA) (NaHCO3):**
A white powder used to raise total alkalinity in water.

SODIUM BISULFATE (also DRY ACID) (NaHSO4):

A granule used to lower pH and/or the total alkalinity in water.

SODIUM CARBONATE (Na2CO3):

See SODA ASH.

SODIUM HYPOCHLORITE (NaOCl):
A clear liquid form of an inorganic chlorine compound obtainable in concentrations of *5* to 16% available chlorine.

SODIUM DICHLORO-ISOCYANURATE (C3N3O3Cl2Na):
Also known as SODIUM DICHLORO-S-TRIAZINETRIONE. An organic chlorine, granular in form, approximately 62% chlorine; in the dihydrate form, approximately 56% chlorine. It contains *58.7%* stabilizer by weight and has a pH of 6.0. (See also ORGANIC CHLORINE.)

SOURCE WATER:
Water used to fill or refill the pool or spa. (See also MAKE UP WATER.)

SPA:

A hydrotherapy unit of irregular or geometric shell design. (See also

HYDROTHERAPY SPA.)

Permanent Residential Spa - A spa in which the water heating and water circulating equipment is not an integral part of the product. The spa shall be intended as a permanent plumbing fixture and shall not be intended to be moved. (Refer to NSPI-3 Standard For Permanently Installed Residential Spas.)

Public Spa - Any spa other than a permanent residential spa or residential portable spa which is intended to be used for bathing and is operated by an owner, licensee, or concessionaire, regardless of whether a fee is charged for use. (Refer to NSPI-2 Standard For Public Spas.)

Residential Portable Spa - either Self-Contained or Non-Self-Contained:

Self-Contained Spa - A spa in which all control, water heating, and

water circulating equipment is an integral part of the product. Self-contained spas may be permanently wired or cord connected.

Non-Self-Contained Spa - A spa in which the water heating and circulating equipment is not an integral part of the product. Non-self-contained spas may employ separate components such as an individual filter, pump, heater, and controls, or they may employ assembled combinations of various components. (Refer to NSPI-6 Standard For Residential Portable Spas.)

STABILIZER:

See CYANURIC ACID.

STEPS, RECESSED STEPS, LADDERS, AND RECESSED TREADS:

Means of pool and spa ingress and egress that may be used in conjunction with one another.

Steps - A riser/tread or series of risers/treads extending down from the deck and terminating at the pool or spa floor. May be recessed so that all risers are located outside of user areas.

Ladders - A series of vertically separated treads or rungs connected by vertical rail members or independently fastened to an adjacent vertical pool wall (see LADDERS for definitions of particular ladder types).

Deck Ladder - A ladder for deck access from outside the pool or spa.

Recessed Treads - a series of vertically spaced cavities in the pool or spa wall creating tread areas for stepholes.

SUCTION OUTLET:

The aperture or fitting through which the water under negative pressure is drawn from the pool or spa.

SUCTION PIPING:

That piping which is referred to as influent.

SUPERCHLORINATION:

The practice of adding a sufficient amount of chlorinating compound to water to destroy chlorine demand compounds and any combined chlorine which may be present. Generally, the level of chlorine added is 10 times the level of combined chlorine in the water. (See BREAKPOINT CHLORINATION.)

SURFACE SKIMMING SYSTEM:

This term encompasses perimeter-type overflows, surface skimmers, and surface water collection systems of various design and manufacture. See SKIMMER.

TAMPERPROOF:

Meaning that tools are required to alter or remove portions of the equipment.

TEST KIT:

A device used to monitor specific chemical residual or demands in pool or spa water.

TIME CLOCK:

A mechanical device that automatically controls the periods that a pump, filter, heater, blower and other electrical devices are on.

TOP RAIL:

That frame part located on top of or adjacent to the outer edges of the aboveground pool wall.

TOTAL ALKALINITY:

The ability or capacity of water to resist change in PH; also known as the buffering capacity of water. Measured with a test kit and expressed as ppm.

TOTAL CHLORINE:

The sum of both the free available and combined chlorines.

TOTAL DISSOLVED SOLIDS (TDS):

A measure of the total amount of dissolved matter in water, e.g. calcium, magnesium, carbonates, bicarbonates, metallic compounds, etc.

TOTAL DYNAMIC HEAD: See FEET OF HEAD.

TOXIC:

Meaning that a given substance has an adverse physiological effect on human beings or other living organisms.

TREAD CONTACT SURFACE:

Foot contact surfaces of a ladder, step, stair, or ramp.

TRICHLORO-ISOCYANURATE (C3N303C13):

Also known as TRICHLORO-S-TRIAZINETRIONE. A form of organic chlorine, most common in compressed form (tablets or sticks), with 90% or more available chlorine, approximately 55.5% stabilizer byweight, and with an approximate pH of 2.9. See also ORGANIC CHLORINE and SODIUM DICHLORO-ISOCYANURATE.

TURBIDITY:

Cloudy condition of water due to the presence of extremely fine particulate materials in suspension that interfere with the passage of light.

TURNOVER RATE:

The period of time (usually in hours) required to circulate a volume of water equal to the pool or spa capacity.

UNDERWATER LIGHT:

A fixture designed to illuminate a pool or spa from beneath the water surface. Types:

Wet Niche Light - A watertight and water-cooled light unit placed in a submerged, wet niche in the pool or spa wall and accessible only from the pool or spa.

Dry Niche Light - A light unit placed behind a watertight window in the pool or spa wall.

UPPER DISTRIBUTION SYSTEM:

Those devices designed to distribute the water entering a permanent medium filter in a manner so as to prevent movement or migration of the filter medium. This system shall also properly collect water during filter backwashing unless other means are provided.

UPRIGHT SUPPORT:

That portion of the frame that is adjacent to the aboveground wall in a vertical position which supports the top rail and braces the wall.

USER:

Any person using a pool or spa and adjoining deck area for the purpose of water sports, recreation therapy or related activities.

USER LOAD:

The number of persons in the pool/spa area at any given moment, or during any stated period of time.

VACUUM:

The reduction of atmospheric pressure within a pipe, tank, pump, or other vessel.

Vacuum is measured in inches of mercury. One inch of mercury is equivalent to 1.13

feet of Head. The practical maximum vacuum is 30 inches of mercury, or 33.9 feet of Head.

VALVE:

Any device in a pipe that can partially or totally obstruct the flow of water (as in a ball, gate or globe valve) or permit flow in one direction only (as in a check or foot valve).

Bleeder valve - a device that allows air to be vented from a system.

Multi-port valve - a device that allows for the multi-directional control of the passage or flow of water through a system.

Push-pull valve - a device that allows for the dual directional control or flow of water through a system.
Multi-port valve - a device that allows for the multi-directional control of the passage or flow of water through a system.

Push-pull valve - a device that allows for the dual directional control or flow of water through a system.

VELOCITY:

The speed at which a liquid flows between two specified points, expressed in feet per second.

VERTICAL WALL:

Shall refer to the wall up to a positive 110 angle towards the pool's interior from plumb.

VENTURI JET:

See HYDROTHERAPY JETS.

VINYL LINER:

That plastic membrane constructed of vinyl or vinyl compounds that acts as a container for the water.

Expandable Liner - A liner that is constructed of a material that has the capability of stretching into a shape other than the original construction dimensions.

Hopper Liner - The liner that is used to obtain greater depth by geometrical pattern construction on the liner bottom or floor to fit a predetermined size and shape.

WALL CLOSURE:

The fastening device(s) that connect the aboveground wall ends together.

WALLS:

The interior pool or spa wall surfaces consisting of surfaces from the plumb to a 450 slope.

WASTE WATER DISPOSAL SYSTEM:

All water disposal systems approved by (state or local) authority, such as a storm sewer, sanitary sewer, open pit, leach field, or irrigation system.

WATERLINE:

The waterline shall be defined in one of the following ways:

Skimmer System - The waterline shall be at the midpoint of the operating range of the skimmers when there are no users in the pool or spa.

WET NICHE:

See UNDERWATER LIGHT.

WINTERIZED LINER:

A plastic liner that is manufactured with sufficient plasticizers to withstand exposure to its rated lowest temperature of -200F.

WINTERIZING:

The procedure of preparing pools and spas for freezing weather. Includes chemical treatment of the standing water, plus physical and chemical protection of the pool or spa and its equipment against freezing.