

Chapter

Aquatic Facilities

Tom Griffiths, Michael W. Edwards, and Richard T. Scott

23

The major growth in aquatic facilities took place in this country shortly after World War II. With a stronger economy and a new interest in aquatics generated by successful swimming training programs in the military, a significant increase in swimming pools occurred in schools, universities, and agencies throughout the United States. Most pools designed and constructed during the 1950s through the 1970s were built to competitive swimming and diving standards. Those wishing to take lessons or engage in aquatics recreation simply did their thing in these rectangular, deep pools. However, with the advent of the water slide and water parks in the 1980s, a whole new thought process evolved for those designing and building pools. The leisure pool concept or family aquatic centers that origi-

nated in Europe and then migrated to Canada and other countries before coming to the United States called for a great amount of shallow water, much of it moving with currents, waves and slides. This continues to be a positive and popular trend because while the traditional, competitive rectangular pool may recover 20 to 40% of its operating expenses, leisure pool designs usually can recover more than 50% of their operating costs with many recovering up to 85%.

This chapter will cover both competitive and recreational aquatic facilities; however, the emphasis will specifically be on aquatic design planning rather than some of the ancillary topics (e.g., locker rooms, spectator areas, mechanicals, etc.) already discussed in this text. The chapter will progress from the older, more traditional public pools to the newer aquatic facilities including the family aquatic centers. Also, special attention will be given to particularly troublesome areas like nonslip flooring and ventilation.



The overall planning process for a facility can be found in Chapters 3 and 4. Linked to planning process for an aquatic facility, as well as other facilities, is a market analysis. This is an excellent tool to have in place when planning a project. The market analysis will determine if there is a demand for a new aquatic facility. Some considerations for market analysis should be, but are not necessarily limited to, organizational support, geography, demographic survey, customer profile, economy, any dominant industries, and the competition.

Further, a successful project rests upon how well an architect and operator initially reach an understanding of the most important issues, including the building program, a definition of multipurpose use, the operational design for the facility, space utilization, and a design that will accommodate new trends in aquatics. The operator must decide which activities can be combined and which activities must be separated. The operator must foresee who will use, how many different uses will be included, and how many users are anticipated. The program is based on these projections. The architect can help provide a reality check for what the operator envisions. The best possible result of the program phase is producing a program where budget, quality, and size are not compromised.

Furthermore, with any financial analysis, a total understanding of the operational costs is needed. This is sometimes not factored into a project and will affect the end result. Raising the money to build the project is much easier than funding the building operation over the expected lifetime of the building. Operational costs to be considered are utilities, maintenance, additional staffing, and repair and replacement. Before developing an operational cost analysis, the organization should consider the future as it pertains to growth in staffing and programming. Many times these important areas

Aquatic Facilities

are overlooked. Neglecting these areas will cost more to the organization in the future than if they are planned for in the present. It is sometimes better to have help in this area from an outside consultant who is able to ask the hard questions and provide guidance.

Finally, the programming phase of a project is very important. This is the phase that will determine what spaces will go into your building and their relationship to each other and the overall operation of the building itself. The entire project will be based on this phase, design, cost, and construction. If it does not appear in the program, it will not be designed or constructed. If additional items or changes to the program in the latter stages of design or construction are requested, it will cost extra.

Before starting the program phase, a firm understanding of the current operation and future growth is imperative. Visiting as many facilities around the country as possible to obtain ideas for the new facility is of paramount importance. Before going on these tours, a list of questions should be developed beforehand to ask the operators of these facilities. Pictures and videos are beneficial and developing a catalog of these images helps demonstrate the specific desires in an aquatic facility to the architect.



Children enjoying leisure pool activities.

Learning Objectives

After reading this chapter, the student should be able to

- identify the latest trends in aquatic facilities,
- describe typical design problems associated with aquatic facilities, and
- list safety considerations when planning aquatic facilities.

Planning Issues

Priority User Groups

Prior to planning any type of aquatic facility, perhaps the first and most important task is to itemize priority user groups that will frequent the facility. If most of the patrons will be serious competitive swimmers and divers then a more traditional pool may be appropriate. If most of the pool patrons tend to be recreational, instructional, and therapeutic users, undoubtedly a more diverse type of aquatic facility should be designed. If all types of users will be using the pools, including competitive swimmers as well as younger and older persons and individuals with disabilities, it is possible to have it all under one roof by designing both competitive and recreational vessels in close proximity to one another.

Outdoor Versus Indoor Aquatic Facilities

Comparatively speaking, outdoor aquatic facilities are much easier to plan and build than indoor facilities and, of course are much less expensive. Perhaps the biggest problem to overcome in indoor aquatic facilities is poor air quality caused by recirculating chloramines produced in the pool. Outdoor pools do not have this problem because the outside environment rids the pool area of chloramine odors. Likewise, lighting is an expensive and comprehensive task to tackle indoors; however, it is not required outdoors. Several light fixtures on high poles can be added at a modest cost to extend outdoor pool usage beyond 8:30 p.m. Windows, heating, and dehumidification are just a few areas not considered in outdoor environments.

Regardless of the warmth provided by the geography, outdoor pools tend to be open only three months a year. Even in our warmer climates in the United States, many swimmers only swim outdoors “in-season” that is, between Memorial Day and Labor Day.

Lawns or sun turf areas are both aesthetically pleasing and user friendly, they often are maintenance headaches for the pool managers/operators and are attractive to Canadian geese. Today’s outdoor aquatic facilities do require more shaded areas because of the heightened awareness of skin cancer caused by exposure to the sun.

A variety of large, colorful shade structures are now available. Skin damage is not the only disadvantage of an outdoor pool, however. With the sunlight comes algae growth at outdoor facilities, which is typically not the case indoors. Higher levels of chlorine, algaecides, and daily brushing are all recommended for outdoor aquatic facilities to combat algae growth, particularly for those below the Mason-Dixon Line. The sunlight also dissipates chlorine rapidly. For this reason, stabilized chlorines are often used outdoors because they are resistant to the ultraviolet rays of the sun and last longer in the water.

Notes

Stabilized chlorines do save significant sums of money compared to the traditional, non-stabilized chlorines used in indoor pools. Stabilized chlorines do come with some disadvantages however, and the cyanuric acid they contain must be kept below 100 parts per million (PPM) in pool water.

Vacuums and housekeeping equipment is a more vital consideration outdoors because more debris finds its way into the pool as opposed to indoor facilities. Pool furniture, shade structures, and food concessions are just a few of the considerations for outdoor facilities that are not considered for indoor facilities.

Security is another important factor when planning outdoor aquatic facilities. When darkness comes and the facility is locked for the evening, trespassers are often tempted to sneak in. Although chain-link fence may be the most popular and least expensive to install around the perimeter of an aquatic facility, it is perhaps the easiest to climb. Fencing with electronic security systems and security personnel may be required at the outdoor aquatic facility, depending on the demographics surrounding the pool. Finally, for a myriad of safety and maintenance reasons, outdoor pools should not be emptied during the off-season, winter months. The following discussions will focus on indoor aquatic facilities.



Traditional Public Pool Configurations

The predominant type of swimming pools constructed in the 1950s through the 1970s was more competitive and rectangular in nature. These pools continue to be constructed today in facilities that have competitive swimming and diving as their priority. It is possible, however, to construct a pool that caters to both the competitive and recreational interests of the pool patrons. Traditional, competitive pools are somewhat easier to plan because so many have already been constructed over decades and rule books with specifications are provided by the governing sports bodies such as YMCA, NCAA (see Figures 23.2 and 23.3), USA Swimming, and Federal Internationale de Natation (FINA).

The traditional eight-lane, 25-yard competitive pool with the starting blocks located at the shallow end and diving boards placed at the opposite, deep end are currently being challenged by more creative and innovative designs catering to a wider population. First and foremost, springboard diving and competitive swimming should not be planned for the same vessel; too many programming conflicts quickly result when both venues are placed in the same pool. It is best to have a separate diving well for springboard diving, SCUBA, synchronized swimming, water polo and deep water walking, but if this is not possible, a T- or L-shaped pool is a good compromise with the deep portion located away and out of the racing course.

A “Stretch 25-meter” or “Stretch 50-meter” pool is a good alternative to T- or L-shaped pools. They consist of 25 yards or meters or 50 yards or meters swim course with a movable bulkhead that can adjust distances. While competitive swimming takes place in the racing course, other activities such as springboard diving or water aerobics can take place in the stretched portion of the pool beyond the swimming course. If diving boards do remain in the racing course, numerous visual and tactile cues must be developed so that novice recreational swimmers do not unwittingly slip from the shallow portion of the pool down the traditional slope and into the deeper diving well. Unless the competition pool will host Olympic trials or perhaps NCAA championships, most competitive swimming pools do not need more than five to six feet of water. This saves considerable construction and operating costs while increasing programming and attendance; and besides, most people prefer shallow water. The trend continues today for large, Stretch 25-meter and 50-meter pools with movable bulkheads.



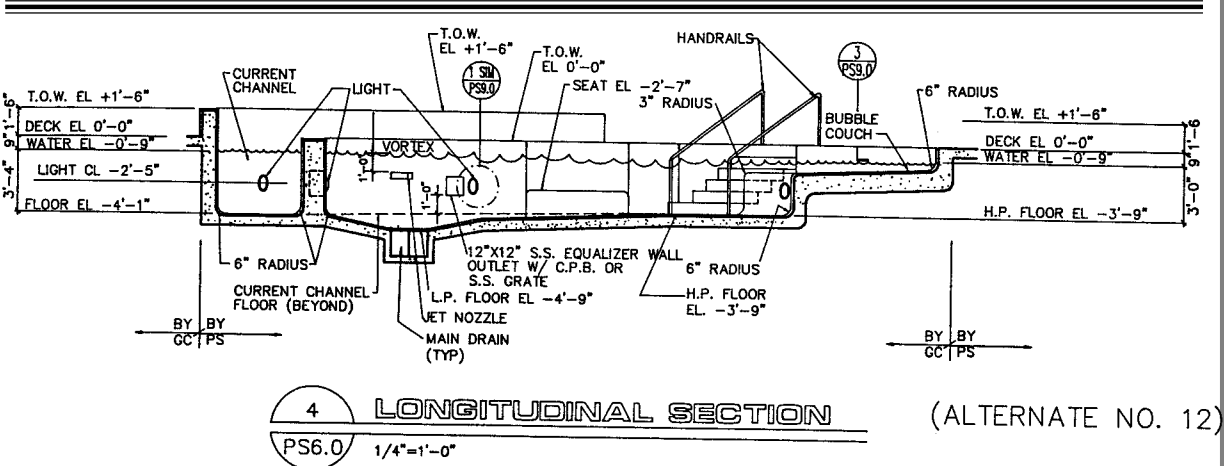


The use of movable bulkheads (see Figure 23.4) allows for maximum flexibility and simultaneous programming. All movable bulkheads are not equal, so a great deal of research should be conducted in this area to find the bulkhead that meets your needs. Bulkheads generally come in two different materials, stainless steel and fiberglass. Both are excellent materials, providing both strength and durability. When researching bulkheads, you should take into consideration the movement of them. How easy or difficult is it to move them into the position needed? How many times will you have to move them in your operation and who

will be moving them? What will be the position needed in your various situations? Will starting blocks be mounted on them? Will touch pads or automatic timing systems be mounted on them? And how will they need to be mounted? Answers to these questions will help you decide on the type of bulkhead to use. Remember, a bulkhead is going to stretch across your 50-meter pool and may be 45, 50, 75, or 82 feet in length, so moving them will be time and labor intensive. Most bulkheads come with some type of inflatable chamber for variable buoyancy. Typically, the pool operator inflates a large air chamber inside the bulkhead, which floats the bulkhead to allow relatively easy movement. Bulkheads are positioned (stored) in different ways around the country; the most common is constructing the pool length to allow for the positioning on the either end and still have a 50-meter competition course. There are pools, however, that store the bulkheads in the ceiling by hoisting them up with cables (University of Texas) or pulling them down into the floor (U.S. Military Academy); however, this is rare. Another consideration is the anchoring device used once the bulkhead is in place. This anchor device must be able to withstand the torque that 6, 8, or 10 lane lines will place on it. If used in a competition setting, the bulkhead must maintain its position during the competition with no movement so that no swimmer is given an advantage during the competition.

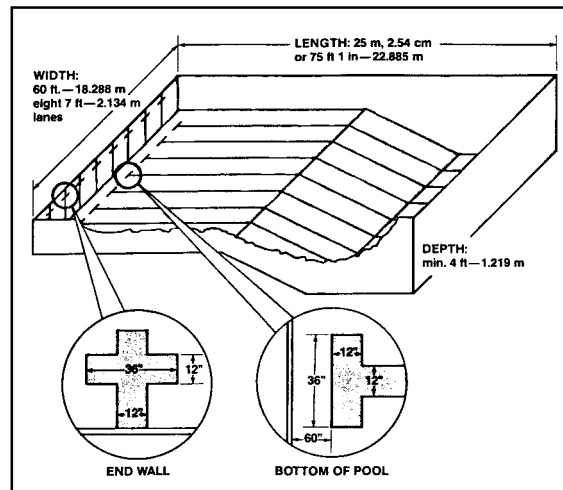


Figure 23.1
Longitudinal Section of a Pool



Notes

Figure 23.2
NCAA Pool Diagram, Dimensions, and Equipment Requirements



While one large swimming vessel to support many aquatic activities is both a popular and economical approach, all aquatic activities in the same pool are subject to the same water temperature which no doubt will be detrimental to some. The beauty of having completely separate pools under the same roof is that significantly different water temperatures can be maintained for each vessel. While this is a tremendous bonus for participants, it is a more costly approach, because separate heating, filtering, and circulation systems are required for each pool. While the filter area required will not change, a second set of piping manifolds on the filters will increase the cost as well as require additional pump(s) and heater(s). The greatest increase in cost comes from the building enclosure that must be expanded to cover the decks that separates the pools. A common approach to the separate pool concept is to have separate competitive swimming pools; a separate deep, warm-water diving well; and a shallow water warm-up, cool-down, and instructional pool. Most aquatic facility managers consider the appropriate temperatures provided by specialized pools vital to their pool programming. Temperatures used for different aquatic activities include:

- Race Swimming and Water Polo = 78 to 80° F.
- Swim Team Practice = 81° F, plus or minus 1°.
- Multi-purpose pool for many user groups = 82 to 84° F.
- Leisure Pool = 84 to 86° F.
- Therapy Pool = 88 to 90° F.
- Whirlpool Spa = 102 to 104° F.

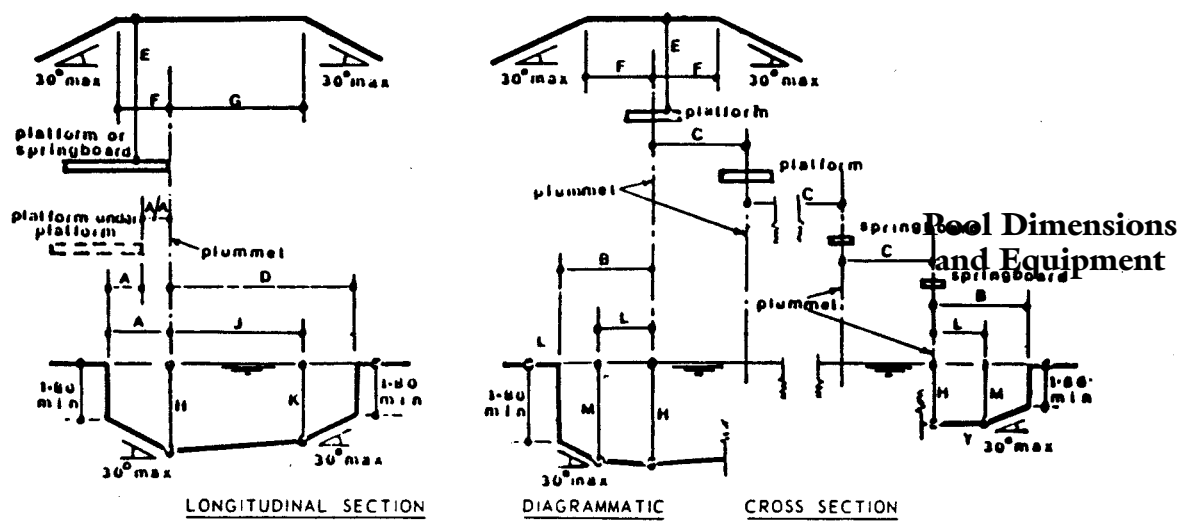
Specific Elements of Facilities

Springboard Diving

Contrary to popular belief, springboard diving is an extremely safe sport and, statistically speaking, safer than most other sports. Having said that, three-meter diving boards have been disappearing for decades in existing aquatic facilities. This is not because of injuries occurring in the water or on the bottom of the pool, but rather from falls onto the deck from the board, more often from the ladder. For these reasons, when installing diving boards, regardless of the height of the board, rails should be extended further out over the water and additional railings should be installed to minimize the gaps on either side of the board. Finally, for diving boards and towers three-meters in height or greater, stairways with landings should be installed instead of vertical ladders.



Figure 23.3
NCAA Pool Dimensions and Equipment Requirements



NCAA Dimensions for Diving Facilities		Dimensions are in Feet	SPRINGBOARD				PLATFORM							
			1 Metre		3 Metres		5 Metres		7.5 Metres		10 Metres			
			LENGTH		16'		16'		20'		20'		20'	
		WIDTH	1'8"		1'8"		20'		5'		6'7"			
		HEIGHT	3'4"		10'		16'5"		24'8"		32'10"			
Revised to 1st Jan. 1987				Horiz.	Vert.	Horiz.	Vert.	Horiz.	Vert.	Horiz.	Vert.	Horiz.	Vert.	
A	From plummet BACK TO POOL WALL	Designation	A-1		A-3		A-5		A-7.5		A-10			
		Minimum	6'		6'		4'2"		5'		5'			
AA	From plummet BACK TO PLATFORM plummet directly below	Designation					AA5/1		AA7.5/3/1		AA10/5/3/1			
		Minimum					5'		5'		5'			
B	From plummet to POOL WALL AT SIDE	Designation	B-1		B-3		B-5		B-7.5		B-10			
		Minimum	8'3"		11'6"		14'		14'10"		17'3"			
C	From plummet to ADJACENT PLUMMET	Designation	C-1/1		C-3/3/1		C-5/3/1		C-7.5/5/3/1		C-10/7.5/5/3/1			
		Minimum	8'		8'6"		8'6"		8'6"		9'			
D	From plummet to POOL WALL AHEAD	Designation	D-1		D-3		D-5		D-7.5		D-10			
		Minimum	29'		34'		34'		36'		45'			
E	On plummet, from BOARD TO CEILING	Designation	E-1		E-3		E-5		E-7.5		E-10			
		Minimum	16'5"		16'5"		11'6"		11'6"		16'5"			
F	CLEAR OVERHEAD behind and each side of plummet	Designation	F-1	E-1	F-3	E-3	F-5	E-5	F-7.5	E-7.5	F-10	E-10		
		Minimum	8'3"	16'6"	8'3"	16'6"	9'	11'6"	9'	11'6"	9'	16'6"		
G	CLEAR OVERHEAD ahead of plummet	Designation	G-1	E-1	G-3	E-3	G-5	E-5	G-7.5	E-7.5	G-10	E-10		
		Minimum	16'5"	16'5"	16'5"	16'5"	16'5"	11'6"	16'5"	11'6"	19'8"	16'5"		
H	DEPTH OF WATER at plummet	Designation	H-1		H-3		H-5		H-7.5		H-10			
		Minimum	11'		12'		14'2"		15'		16'			
J-K	DISTANCE AND DEPTH ahead of plummet	Designation	J-1	K-1	J-3	K-3	J-5	K-5	J-7.5	K-7.5	J-10	K-10		
		Minimum	16'5"	11'8"	20'	12'2"	20'	12'10"	26'3"	14'6"	36'2"	15'6"		
L-M	DISTANCE AND DEPTH each side of plummet	Designation	L-1	M-1	L-3	M-3	L-5	M-5	L-7.5	M-7.5	L-10	M-10		
		Minimum	5'	11'2"	6'7"	12'2"	14'	12'10"	14'10"	14'6"	17'2"	15'6"		
N	MAXIMUM SLOPE TO REDUCE DIMENSIONS beyond full requirements													
		Pool depth	30 degrees											
		Ceiling Ht	30 degrees		NOTE: Dimensions C (plummet to adjacent plummet) apply for Platforms with widths as detailed. For wider Platform increase C by half the additional width(s).									

Vertical ladders, whether used to climb onto a diving board or into a lifeguard chair, have no place in the wet environment found in aquatic facilities. Of course, the diving section of the pool vessel should meet all depth and distance requirements by the governing competitive body (e.g., NCAA, YMCA, U.S. Diving, etc.). More on safe sport diving can be found in the U.S. Diving position paper.

Pool Decks

Perhaps more than any other feature, the spaciousness of the pool deck makes the facility user-friendly; the larger the pool deck, the more comfortable the user groups are in the facility. As one might expect, the larger the pool deck, the more costly construction is, because the footprint of the entire building is necessarily enlarged as the width of the deck grows. However, a large deck provides smooth pedestrian traffic flow for large events such as swimming meets and reduces conflicts. A large swimming pool deck would be one approximately 20 feet in width or greater. A deck width of 10 feet or less would be considered too narrow and anywhere within 10 feet of the swimming pool walls should be considered the "wet zone."

Notes

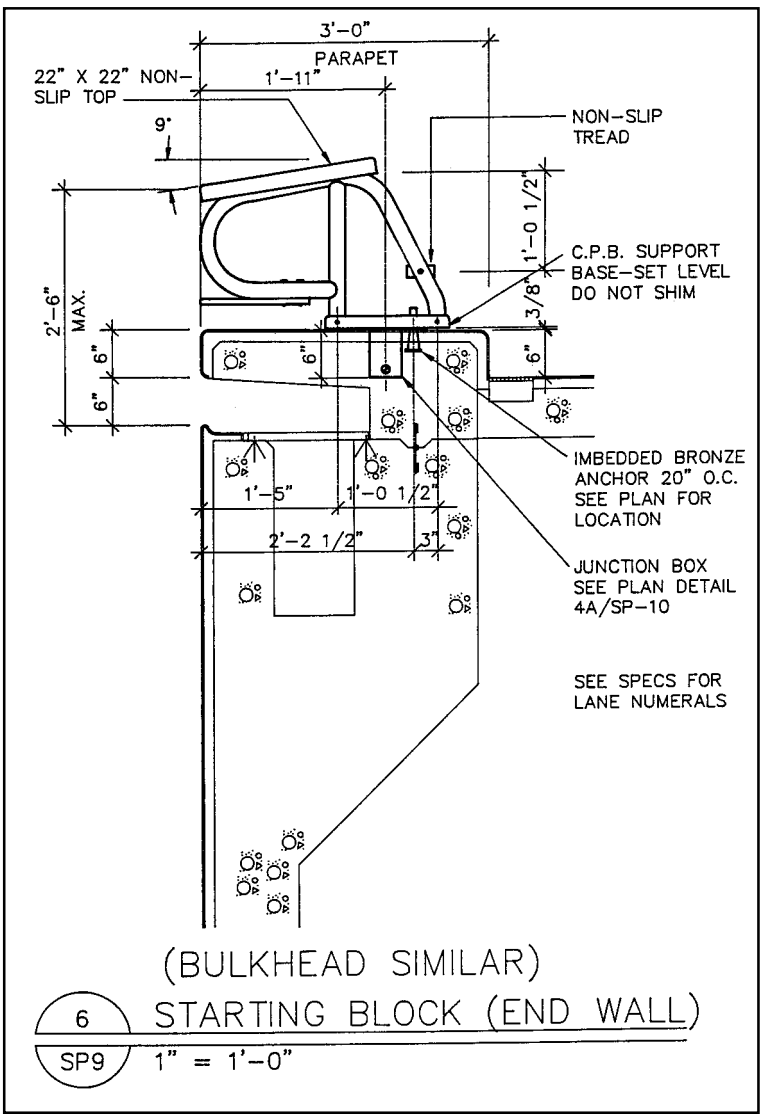
Of course, all swimming pool decks must be nonslip, and with tile decks, the size of the tile often determines the slipperiness of the deck; the smaller the tile, the more nonslip the surface should be. The grout between the tiles makes the tile nonslip by removing water off the surface of the tile so that the foot cannot hydroplane. One-by-one inch tiles provide the best nonslip surface followed by two-by-two inch tiles. Both of these mosaic tile sizes come with 7.5 abrasiveness for greater nonslip surface. As the tiles of the surface become larger, the likelihood of slippage is increased. Larger European tiles that have patterned and textured surfaces may also be used successfully.

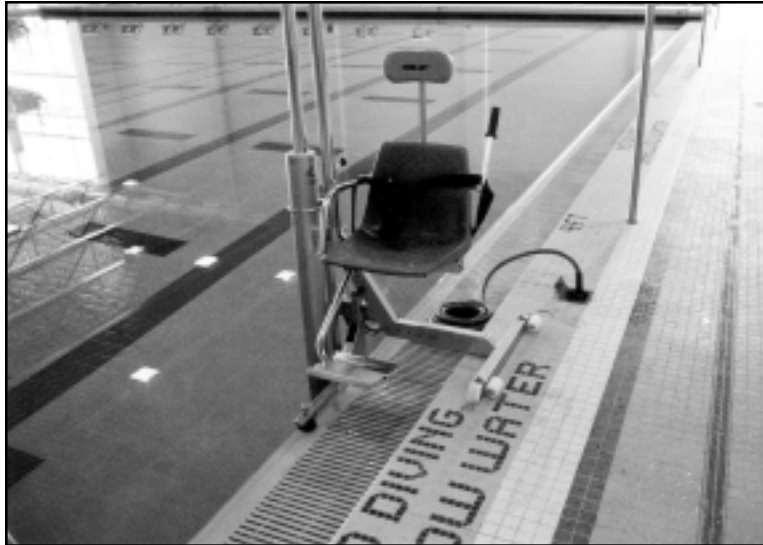


Coefficients of friction that rate nonslip surfaces can be very misleading in swimming pool environments. Tiled decks are perhaps the most desirous deck surface at indoor aquatic facilities but, not surprisingly, they are by far the most expensive.

Other pool deck materials include: brick, brushed concrete, pebble finish, stone, pavers, wood, painted decks, and epoxy-coated decks. All of these finishes have potential problems and should be

Figure 23.4
Bulkhead Diagram





analyzed by an expert before purchasing. Whenever considering alternatives to tile, inspecting other deck surfaces already in place at other aquatic facilities is a must. Do not use carpeting or other fabric floor finishes in wet areas of aquatic facilities; they harbor moisture and thus produce mold, mildew, bacteria, and other undesirables. Large, tile depth markers and “No Diving” warnings embedded into the pool deck must also be non-slip but often, are not.

Efficient deck drainage and properly placed drains can make or break the cleanliness, upkeep, and slipperiness of a swimming pool deck. A growing trend is to install a continuous trench deck drain that

completely encircles the pool perimeter. This typically provides better drainage than intermittent drains placed at various locations; however, the trench must be sufficiently wide (four to six inches) to collect water efficiently and allow for easy cleaning. Plus, the deck itself must be sufficiently sloped to the drain. Too many perimeter trench trains are too narrow to function properly. Slot deck drains placed too close to the side of the pool will allow dirty deck water to wash into the pool gutters and end up in the swimming pool water during cleaning operations and may contaminate the clean pool water. Area drains with the decks sloping to the intermittent drains are still used and may be more economical than slot drains for low budget projects; however, the deck must be warped four ways rather than two for good drainage. Widely varying deck widths may require area drains or multiple trench drains.

Lighting

A crucial consideration for indoor aquatic facilities is lighting. When it comes to illumination, competitive facilities have stricter lighting requirements than recreational facilities. For highly competitive facilities (those holding large championship meets), the NCAA and USA Swimming national governing bodies require 125 to 150-foot candles at water level for their televised events.

These levels provide good uniform lighting and color-value illumination at the deck and water surface. For mixed-use facilities, that are competitive/recreational facilities, a minimum average of 60-foot candles at water level is highly



recommended. To conserve energy, the ability to change from recreational to competitive levels is also recommended. For purely recreational facilities, 30-foot candles may be sufficient. It should be emphasized that the brightness of bulbs diminishes quickly (around 20%); therefore, regular maintenance and re-lamping should be established and scheduled. Changing from competitive to recreational levels may be accomplished easily and economically through separate circuiting or using dimmers.

When researching lighting requirements for aquatic facilities it may be best to contact the lighting experts with experience in your



Notes

lighting requirements, such as the Engineering Electrical Society of North America located in New York. The NCAA, USA Swimming, and U.S. Diving have written specifications for lighting for hosting events. It would be wise to contact them as well.

Lamp replacement in an indoor aquatic facility can be challenging to say the least, particularly if not properly planned for in the design phase. Although lighting fixtures are usually placed above the pool deck rather than over the water in the pool, there is a good reason for that. Lighting fixtures strategically placed above the pool deck allow for a high-reach bucket to drive around the deck to change the lamps. When the lights are located directly over the water, catwalks suspended from the ceiling are expensive but make the changing of bulbs easy. Lowering the lights on cables also works well, but even stainless steel cables will need to be replaced every 10 years due to corrosion. Unfortunately, there have been too many aquatic facilities constructed in North America without a practical or affordable way of changing light bulbs. All light bulbs lose their brilliance quickly and should be changed at least once a year, if not sooner.

Although architects and swimmers alike love windows and skylights that allow ambient light to enter the facilities and liven up the facility, this concept is nearly taboo in serious competitive pools. If windows are a must, every precaution must be made not to allow direct sunlight and glare to hit the competition portion of the pools.

Windows in competitive pools also promotes glare on the water, creating difficulties for competitive swimmers, spectators, and lifeguards. To the contrary, even competitive swimmers like lots of bright, natural light, which seems to keep them happier and thereby working longer and harder. Further, recreational type leisure pool facilities successfully use an abundance of glass and windows not only to allow sunlight in, but also to give views of the surrounding areas.

Whenever windows are planned for an indoor aquatic facility, algae growth is more likely to occur; glare on the surface of the water could become a safety problem for lifeguards. With the use of video cameras and computers, drowning detection systems can now be affordably purchased and installed. This technology allows lifeguards to see the bottom clearly and automatically detect near-drowning victims quickly. This, of course, helps to minimize any surface glare issues.

Skylights are generally advantageous. They provide light from above with little glare if manufactured and installed properly.

Underwater lights are another issue. When there is surface glare on the water many architects recommend underwater lighting to illuminate the bottom of the pool. For safety reasons, it is also thought that these lights will illuminate any objects or humans that may be located underwater but obscured by glare adversely affecting the lifeguard's vision of the bottom. Others suggest underwater lighting simply for aesthetics. The truth is, when underwater lights are installed in a new aquatic facility, they are rarely if ever used and, to make matters worse, often leak and malfunction as well. Conversely, some high-end facilities that use underwater cameras may need underwater lights to enhance the quality of the underwater video. While underwater lights may sound like a good idea, it would be wise to consider whether the benefits outweigh the cost and maintenance problems.

Interior Finishes

Like deck surfaces, the most versatile interior finish for the pool vessel is tile, but plaster is the most popular pool finish, particularly when it comes to concrete pools. Not surprisingly, tile is also the most expensive. Plastered pools are often referred to as marbledust, Marcite®, and Marbledite®. Unlike a tiled pool, which lasts indefinitely, plaster pools are often replastered every 8 to 10 years. A good combination is to tile gutter edges at the water lines and racing lanes with contrasting colored tiles, usually blue or black tiles, while the majority of the interior surface is plastered white. This is one compromise that saves a significant sum of money.

Regardless of the type of finish used in the aquatic facility, it should be white or light in color to help surveillance of the bottom, particularly by lifeguards. White floors are preferable in competition and leisure pools but diving pools need a darker floor like navy blue. This is important for diver safety, allowing the diver to find the water better with a darker finish. The navy bottom should be contrasted with a white ceiling and white walls so the diver can tell the difference while spinning at a high rate of speed. Other finishes include epoxy and chlorinated rubber-based paints, vinyl-lined, and stainless steel coated with epoxy.

A relatively new trend in pool construction, especially for those interested in traditional competitive pools, is pre-engineered modular swimming pools that combine stainless steel construction with polyvinyl chloride (PVC) membranes to construct on-ground competitive pools that do not require extensive excavation and may cost less for temporary uses. Another advantage of stainless steel pools is that the pool walls may also be buried in the ground or have basement spaces around them like concrete pools. These types of pools have even been constructed for the major aquatic events such as World Championships and Olympic Games and then have been sold and moved afterwards.

Movable Floors

Competitive swimming and diving facilities require fast water, which means deeper water. Recreational and therapeutic activities require shallow water. This conflict can be rectified with the design and installation of a movable floor. Movable or "false" floors allow for maximum flexibility in aquatic programming. The floors are capable of moving from seven to nine feet deep for competition to zero depth and anywhere in between for other aquatic activities such as therapy, aquacize, shallow water jogging, and even for dry-land activities like aerobics or yoga. There are different types of movable floor designs

in both the material the floor is made of and the system that adjusts the floor depth. Floors are generally made of concrete, metal, or polymer type material coming in various sizes. Movement of the floor is accomplished in a number of ways but most common are hydraulically powered with one or more hydraulic lifts located underneath the floor. Another method uses scissor jacks located beneath the floor with the motors located outside the pool wall. Other methods include externally mounted motors or hydraulic arms with pulleys and cables moving the floor.



Air Quality Considerations

One of the greatest challenges when planning an indoor aquatic facility is handling and providing healthy air. Even the best managed pools can produce chloramines and when this does happen, as it often does particularly in heavily used pools, a good air-handling system needs to rid the building quickly of the noxious odors. While good water chemistry, frequent filter turnovers, volcanic ash in the filters, ozone, ultraviolet (UV) light, granulated activated carbon filters, and regular shocking and super-chlorination can all be used to help rid an aquatic facility of chloramines, there is no substitute for good ventilation. Energy efficient air handling systems that became popular in the mid-1970s and continue to be installed today, while saving significant sums of money due to conservation, recycle bad air and contribute to asthma.

Regardless of what ventilation system is selected for indoor aquatic facilities, it is imperative that the system be able to deliver 100% fresh air whenever necessary to purge the facility of bad, chloramine-laden air. A good air-handling system is even more important for indoor leisure pools where the patron load is higher. Although there are numerous recommended ventilation rates varying from two cubic feet per minute (cfm) per square foot of total natatorium floor area in a modestly used traditional pool to 10 cfm per square foot in a heavily used leisure pool, often these figures are simply too conservative, and poor air quality is the result. Likewise, fresh air requirements like 25 to 35 cfm fresh outside air per person may again be insufficient for good air quality. The important message here for those planning new indoor aquatic facilities is to hire a good, reputable heating, ventilating, and air-conditioning (HVAC) consultant who specializes in indoor pool ventilation.

HVAC systems are essential elements that are vitally important to the success of the facility. Higher water temperatures (85 to 90° F) also mean higher evaporation rates, higher bacteriological activity, higher heat loss, and, if not properly exhausted, poor air quality, leading to adverse health affects to both staff and patrons. For heavily used indoor aquatic facilities, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) standards may not be adequate and should be surpassed whenever possible. Indoor aquatic facilities should also be designed to keep a negative pressure inside the building by exhausting slightly more air than is supplied. When this is done, moisture and odor migration to other portions of the building will be kept to a minimum.

The lowest initial cost systems are designed with 100% outside air using rooftop units. Typically, this type of design does not have good energy performance, because the units must operate on 100% outside air all the time. No air can be returned through the units because they have little or no protection against the natatorium environment. This system provides high indoor air quality at low initial cost with higher operating costs. For projects in some climates, this type of design may be reasonable.

Higher cost units with stainless steel construction or coated steel have been used successfully on some projects. In this case, a portion of the air is exhausted and a portion returned through the unit, approximately 50%. The outside air is used to reduce humidity, so large volumes for ventilation and outside air are required. In most climates, air conditioning is also required. These units must also have the capability to provide 100% outside air when superchlorination is being performed or when high swimmer loads occur, such as large swim meets. These units provide excellent air quality, low initial cost, and higher operating cost.

While expensive, the use of mechanical dehumidification systems is an efficient way to manage humidity and contribute to better air quality and potentially may be an energy-saving tactic. These systems also afford great opportunities for heating pool water with waste heat extracted in the dehumidification process. Airside economizer HVAC equipment is often used. This allows cool outside air to be brought into the building, when temperatures allow, rather than mechanically conditioning the air.

These units are built to withstand the natatorium air but are costly, complex and have more frequent maintenance problems than the simpler units. The manufacturers usually recommend four or five air changes per hour and 15 to 25% outside air. We know from experience that they have taken care of the humidity and condensation problems very well, especially in lap or competition pool installations. However, their record is imperfect in leisure pool projects.

Notes

What should be the first priority in any indoor aquatic facility, indoor air quality, has often been neglected.

Using the criteria of six air changes per hour and 30 percent minimum outside air, these units will work in the natatorium but are expensive. If this is the design approach taken by the mechanical engineer, a minimum of two units is recommended. When one unit is disabled, the natatorium may keep operating with partial HVAC capability. Many operators who have had units down for replacement of circuit boards or compressors were thankful they could keep operating because they had two units.

There are two main approaches to supply and return air ducts: supply low and return high or supply high and return low. Both systems have their advantages and will work. Most projects use a design that supplies high and returns or exhausts low because the chlorinated air just above the water surface has the worst air quality of anywhere in the natatorium. Taking a large portion of the exhaust or return air from this level ensures that the poor air quality at this level will be diluted. Other approaches will work. Ducts set part way up the walls is a variation of the high supply approach. It is critical that the circulation of air through the space is complete and not short-circuited as happens when the supply and return are both high. Unfortunately, to have good air quality in a heavily used, highly competitive pool, large volumes of air must be moved across the surface of the water at the expense of swimmer comfort.

When it comes to air-handling ducts, aluminum spiral ducts are recommended. Galvanized ducts will work but run the risk of rust stains at screw holes where the galvanizing is compromised. Stainless steel and fiberglass ducts cost a premium and may not be as desirable as aluminum. All metallic ducts should be coated with Tnemec's high build epoxy coatings. Stainless steel will pit and corrode if not coated. Another cost-saving alternative is fabric ducts. Fabric ducts reduce the risk of rust or corrosion without the cost premium.

In the design of the air supply ducts, caution needs to be exercised to avoid blowing air at a velocity that would chill bathers on the pool deck. Usually the velocity of the air across the deck should be below 25 feet per minute. Although conventional wisdom avoids directing air flow on the water to reduce evaporation, it improves air quality to direct air onto the water to move the poorer quality air on the surface into the return air stream.

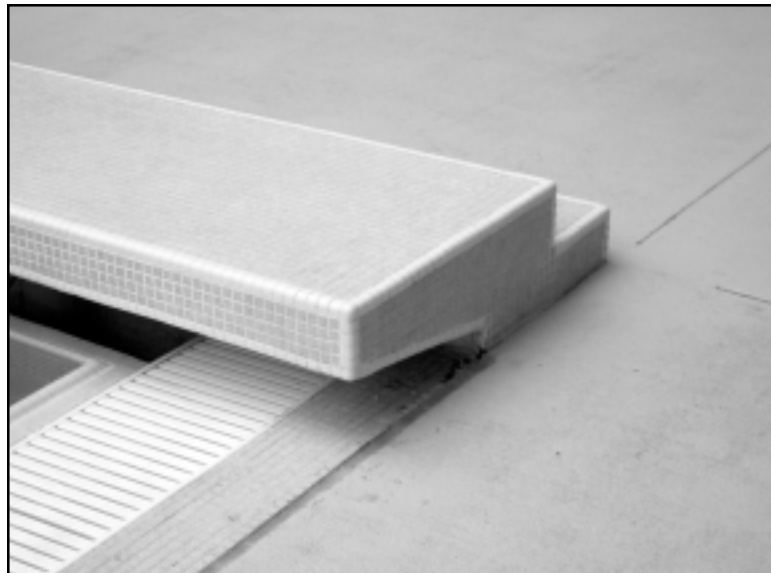
Too often during the recent past, many natatoriums have been designed with inadequate heating and ventilating systems. If the designs for these systems are based on code minimums or other industry guidelines like ASHRAE standards, indoor pools are almost guaranteed to have air quality problems. The solution to these problems is to provide supplemental water treatment and to increase the amounts of outside air into the facility. A variety of equipment can work successfully at different levels of project budgets.

Filtration

Recently, there have been advances in swimming pool filtration that improve not only water clarity but air quality as well. While sand has been the most popular swimming pool filtration medium for decades, diatomaceous earth, recycled glass, volcanic ash (zeolite), and other filter media are now becoming more common. Regardless of the type of filter medium, both the size of the filter bed and the flow of water through the medium are extremely important. Basically, the larger the filter bed and the slower the water flow through it, the better the entrapment of particular matter, therefore, the cleaner and clearer the water.

While there are many types of swimming pool filtration systems available, basically there are variations of three filter media: sand, diatomaceous earth (DE), and cartridge. In summary, sand is the most popular because it is the easiest to maintain and operate while producing good water clarity. By way of comparison, DE offers excellent water clarity but is more labor intensive to run. Finally, cartridge filtration saves much water during the filter cleaning process and offers outstanding water clarity, but the cartridges need to be replaced often. Cartridge filtration is perhaps best suited for small volume pools and spas. For more in-depth analysis of the advantages and disadvantages of specific filter types and applications, refer to any Aquatic Facility Operator (AFO) Manual, the Certified Park Operator (CPO) Manual, or the *Complete Swimming Pool Reference* also published by Sagamore Publishing.

The turnover rate is the time it takes the entire volume of water in the pool to circulate through the filters and return back to the pool vessel. Turnover rates are also improving (getting faster). While the recommended turnover rates for traditional pools during the '50s, '60s, and '70s was eight hours, facilities are now turning over in six hours or less. Leisure pools, flumes,



and slides have incredibly fast turnovers of one to two hours. In essence, the more heavily used a vessel will be, the faster the turnovers, and smaller volume vessels typically need faster turnovers than larger vessels.

Returning the water from the pool vessel back to filters can be accomplished through a variety of surface skimmers and gutters and bottom outlets. First and foremost, every vessel recirculating water must have a minimum of two bottom outlets that are protected with anti-vortex covers and have a flow rate of six feet per second or less. Some jurisdictions now require flow rates of five feet per second.

Single bottom outlets and covers that can come off or are not protected by anti-vortex covers can entrap unsuspecting victims at the bottom. Worse yet, children sitting on unprotected drains in shallow water pools can be quickly eviscerated. Lawsuits in this regard can approach \$35 million dollar settlements. It pays to do the research to ensure that every swimming or soaking vessel has a minimum of two protected bottom outlets.

Surface collection systems are also important. When designing an aquatic facility, choosing between skimmers, recessed gutter, and deck level gutter can appear to be a daunting task. Skimmers work fairly well in collecting surface water and are relatively inexpensive to install.

On the other hand, gutters are much better collectors of surface water and make for much faster competitive pools but, naturally, are more expensive to install. When building highly competitive pools, the choice becomes whether to choose a recessed gutter below deck level or a deck level gutter system. Most very fast competitive pools side with big, deep recessed gutters while pools that have recreational aspects in addition to competitive venues often consider deck level gutters for easier and safer ingress and egress.

Water Chemistry

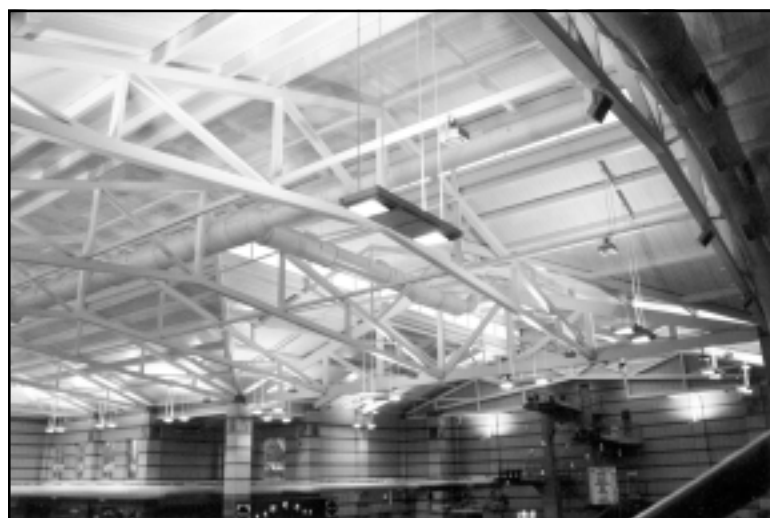
Although chlorine has been the standard for pool water treatment in the United States, alternative sanitizers used in Europe and Canada are now challenging the use of chlorine in this country. Before considering alternatives to chlorines, readers should consider why chlorine has been so popular in the United States. Although it does have some disadvantages, chlorine is perhaps the only swimming pool sanitizer that 1) provides excellent oxidation, 2) sanitizes well, and 3) has residual properties, meaning it lasts for longer periods of time in the water. Among the challengers to chlorine, perhaps of most importance, is ozone. Ozone is a particularly strong oxidizer that oxidizes pool water better than chlorine without the bleaching and smell that characterizes many chlorinated pools. In order to provide sufficient levels of ozone for pool use, very large and expensive ozone generator plants are required on site and the corona discharge method of producing ozone is much preferred in large aquatic facilities rather than other methods such as UV light production. Ozone does not have residual properties however, so in this country, a residual chemical like bromine or chlorine must be added in low levels.

Especially in large aquatic facilities, other alternatives to chlorine have not been as successful as ozone or chlorine. UV light also shows great promise in supplementing traditional chlorination in swimming pools. UV light has been used successfully in Europe and is just recently becoming more popular in the United States. When anticipating large numbers in the pool and chloramines may be a problem, the use of UV light should also be researched.

Chlorine generation that produces chlorine at the aquatic facility with a combination of salt water and electrolytic cells also shows potential without purchasing and transporting hazardous pool chemicals to the site. It should also be mentioned here with worldwide terrorism on the rise, safe purchasing, transporting, handling, and storing pool chemicals is becoming more of a concern.

Automation

Automation of pool chemical applications and filtration is no longer a concept for future consideration. Automation saves time, money, and keeps the pool water in a much better condition and is a requirement for today's pools. Pool water is sampled and analyzed electronically by a microprocessor.



Once the pool operator has established two set points (pH & chlorine), the electronic analysis is compared to those base levels. When the analyzer samples the pool water from a sample stream that bypasses much of the recirculation system, it compares the result of the set point for the desired level. When the pH or chlorine reads low, the analyzer prompts the feed pumps to add the appropriate chemical to raise it to the appropriate level. Modern automatic water chemistry analyzers can provide for remote readouts, meaning that the pool operator can read the chemical levels in his office or even while at home through computer modem or even by telephone. The analyzers

Notes

also keep wonderful records of chemical readings with dates and time to help better maintain the water as well as defend in lawsuits.

Heating

A major cost and consideration for all pools, but particularly outdoor pools subjected to winds, is heating the pool water. While the conventional way to heat both indoor and outdoor pools has been with natural or propane gas, the growing trend for larger facilities is combining energy saving solar heating systems with traditional gas heating systems used to supplement the solar. The traditional gas heating system is desirable when environmental conditions (clouds) do not allow for adequate production of solar heat. The challenge of this combination heating system is to optimize the solar system while relying on the gas system only when absolutely necessary.

Dual gas/solar heating systems will save energy costs as well as extend the season for outdoor pools. The solar source is clean, renewable, and free. Another challenge is the placement of solar panels, which should be a reasonable distance from the equipment room but should not require an overabundance of space. For an outdoor pool, the total area of the solar collectors should equal the approximate pool surface area. When designed correctly, solar/gas systems can save 30 to 50% in heating costs.

Planning the Leisure Pool Facility

The advent of leisure aquatics in the United States originated in the late 1980s as European-inspired pools were built in Western Canada and Oregon. From there they have spread to all parts of North America. The leisure pool differs from traditional American pools in its free-form shape, shallow water, warmer temperature, and water features. American pools were rectangular, deeper, cooler, and usually devoid of recreational features to suit competitive swimming and aquatic instruction.

When planning indoor leisure pools, the primary focus is on the social aspects of recreational swimming. There should be benches and games areas in the water, beach, or zero depth entries, waterfalls, lazy rivers, vortexes, whirlpool spas, and seating areas around the pool. In municipal aquatic centers, there are interactive water features, water slides, kid's slides, floating water features, and other possible attractions. These are not usually present in university leisure pools.



Outdoor Leisure Pools

The first outdoor leisure pools in the United States were pools designed by Carl Fuerst and Claude Rogers that were similar to wave pools without the wave action. Over time, these pools evolved to include many more features as listed above. When planning a municipal facility, aquatic consultants have developed proprietary formulas to determine a recommended size of bather capacity for communities of different sizes.

In broad terms, smaller communities of up to 5,000 people build outdoor leisure pools of a size based more on cost than on the popula-

tion to be served. Often the limits of construction cost are in the \$1 to \$2 million range with pools of 5,000 to 8,000 square feet. Pools for communities of up to 15,000 people often are in the \$2 to 3.5 million range with areas of 7,000 to 13,000 square feet. Larger communities often build similar-sized pools at multiple locations; however, cost recovery will usually be better if a larger single facility is built rather than multiple smaller facilities. Pools of 15,000 to 24,000 square feet with budgets of \$4.5 to \$9.5 million usually achieve a positive cash flow if the population is sufficient in size and the facility is designed for market conditions and managed properly.





Every community does not have the goal of 100% cost recovery or positive cash flow. For those that do have these goals, it is important to do a market analysis, design for the market, advertise and market the facility aggressively, and manage the facility as a business enterprise with service-oriented staff. Even the best-managed and marketed aquatic facilities have a difficult time turning a profit.

Elements of facility planning include the following: changing facility, swimming pool, pool deck with drainage, sun turf and landscaping, parking, security fencing, and mechanical building.

The changing facility combines the functions of admission, bather changing, food service, facility administration, storage, and program registration. It may also include maintenance and pool equipment operations, which are often located in a separate building on the site. The building usually requires 4,000 to 5,000 square feet to include all of the above functions, including pool equipment. For larger pools, the bathhouse may have a space requirement of 5,500 to 6,500 square feet. Architects for this type of building have designed many different layouts. Some utilize an open area for admissions between bather changing rooms; others use an enclosed area with changing rooms on one side and program registration on the other; still others utilize a multiple pod approach to the buildings.

Particular attention should be paid to concessions spaces so that short travel to food and beverage equipment allows efficiency in operations. A consultant who specializes in selecting menu items and planning food service areas is a valuable member of the design team in addition to the architect and aquatics consultant. Including an area for temporary trash bag storage behind a low exterior wall allows staff to wait until a more convenient time for a trip to the trash disposal unit.

While the importance of the design of the swimming pool cannot be minimized, the deck areas, sun turf, concessions seating area, sand play areas, shade pavilions, and landscaping areas are also very important to the success of the facility. These amenities create highly aesthetic areas that attract bathers and reduce congestion in the swimming pool.

The swimming pool deck is usually constructed of concrete. In high heat southern regions, coating systems may be required to lower deck temperatures. These require maintenance and recoating and, therefore, should be avoided unless absolutely necessary. The drainage of the deck-to-deck drains is very important.

Planning the location of decks for the best solar orientation through the morning, afternoon, and evening is very important. Bathers will often move or locate their chaise lounges for a more perpendicular angle to the sun. For this reason, a circular deck pattern centered on the shallow end of the pool or zero depth area is a beneficial design. Locating the changing facility north of the zero depth area is the best solar orientation.

A lap area of six to eight lanes for competitive swimming, instruction, fitness lap swimming, open recreation, and games should be considered for most facilities. Where other pools of this type exist nearby, it is not always necessary to duplicate lanes.

A waterslide of 150 to 160 linear feet of flume should be provided for most leisure pools. For large facilities over 12,000 square feet, longer flume runs and multiple flumes should be considered. A body slide should usually be provided for the first slide. After that basic type of slide, an enclosed flume or tube slide may be considered. Tube slides will serve a larger capacity of bathers per hour. The aquatic consultant will therefore recommend the types of slides for different areas of the pool. For example, a long lazy river may include one or two tube slides that have a plunge pool feeding the tubes into the river.

Lazy rivers are recommended to be at least 1,000 linear feet in length and 15 feet in width. These may be reduced to 10 to 12 feet in width to meet budget limitations; however, they are not an ideal size.



Notes



Lazy rivers may vary from 500 to 1,500 or more linear feet. For facilities that cannot afford to build a lazy river in their initial development, they offer an option for expansion that can double the capacity of the facility.

Water features are important for the leisure pool in adding excitement, interactivity and theming. There are trends in municipal pools toward increasing use of theming, “dumping buckets,” and expandable water features.

Parking requirements for outdoor swimming pools may be dictated by local ordinances. Where these are not specific, the facility designers may be able to negotiate

a parking requirement equal to one car for every four bathers. This number recognizes that families come in groups to this type of swimming pool and that other bathers arrive by bicycle or are dropped off.

Indoor Leisure Pools

Indoor leisure pools in the United States are more directly descended from European and Canadian leisure pools than American outdoor leisure pools. They are usually 3,000 square feet to 8,000 square feet in size in municipal facilities. University leisure pools are usually smaller than their municipal counterparts.

For indoor facilities, budgets more frequently determine the size of the pool than does programming or community population. For large community recreation centers of 70,000 to 130,000 square feet, the leisure pool should be 5,500 to 8,500 square feet with an eight lane by 25 yard lap pool and a whirlpool. This would require a natatorium of 15,000 to 25,000 square feet. Because of the need for other recreational facilities other than aquatics, it usually is necessary to restrict the aquatics in some way for a better-balanced center. This may require the lap pool to be a six lane by 25 yard pool and the leisure pool to be 4,000 to 4,800 square feet with a total natatorium area of 14,000 to 17,000 square feet. This is unfortunate since the pools will be overcrowded.

Smaller recreation centers and private facilities (e.g., YMCAs, JCCs, and health clubs) may be built in the 50,000 to 80,000 square feet size. These may increase attendance and membership with smaller leisure pools in the 3,000 to 4,500 square feet size. Their natatoria often include a six-lane lap pool and whirlpool with a total area of 12,000 to 15,000 square feet.



The use of separation walls between lap pools and leisure pools is beneficial to allow swim meets with little inconvenience to recreational swimmers. The wall will increase the deck area required and cost a significant amount in construction dollars; therefore, communities need to consider the costs and benefits very seriously before deciding to include this feature.

Trends for indoor leisure pools include theming, lazy rivers, “dumping buckets”, expandability of water features, multiple pools based on water temperatures (i.e., lap, leisure, and spa), waterslide flumes running outside of buildings, and the use of UV light to eliminate chloramines.

Leisure pools have specific core components of zero depth or beach areas, interactive water features, lazy rivers, and waterslides. Other optional components include lap areas for water walking, games, warm water aerobics, and instruction; vortex area that spins bathers in a circle; bubble benches; drop slides; lily pad walks; kid's slides; and rope swings.

The aesthetic environment of leisure pools can be greatly enhanced by designing vertical elements into the space such as trees, decorative fencing, and light poles.

Safety Considerations

Whenever constructing a new aquatic facility or renovating an old one, planners must consider the latest safety technology. First and foremost, it is important to understand that we now have highly sophisticated drowning detection systems that not only save lives, but defend facilities against lawsuits. While we have depended on lifeguards solely for nearly the past century, the sad fact is that hundreds of guests drown in guarded facilities each year. We can no longer afford to rely upon lifeguards alone to protect the swimming public; computerized video systems are now available to alert the staff when a victim ends up on the bottom within 10 seconds. These computerized video systems help to overcome traditional problems of poor supervision such as lack of vigilance; distractions; and seeing through surface reflections, refractions, and glare. In addition, the latest research in the area of perceptual blindness (change blindness, inattention blindness) explains why lifeguards, pilots, and car drivers often miss the obvious leading to catastrophic accidents and injuries. The latest technology is so sophisticated it can alert lifeguards of suspicious situations under the surface of the water and detect potential drowners, thereby saving lives as well as reducing liability. Having a real-time video recording of an actual near-drowning situation goes a long way in defending against a lawsuit. Although some aquatic professionals consider these systems expensive, compared to the total cost of a facility, they are actually very affordable. Plus, if they save one life, they become extremely cost effective and they are inexpensive compared to the cost of a lawsuit.



Lifeguard Stations

Another new trend in lifeguarding is the replacing of tall, narrow, permanent lifeguard chairs installed in the pool deck with wider, lower, portable lifeguard stations that promote standing and patrolling while on duty. These stations are not only portable, but because they have eliminated the ladder on the back of the chair, the lifeguard station has been made safer. It also encourages movement, thereby increasing attention and concentration while reducing boredom. Older, traditional pools have tall, permanent lifeguard chairs installed right into the pool deck which cannot be removed and often create a climbing hazard for lifeguards.

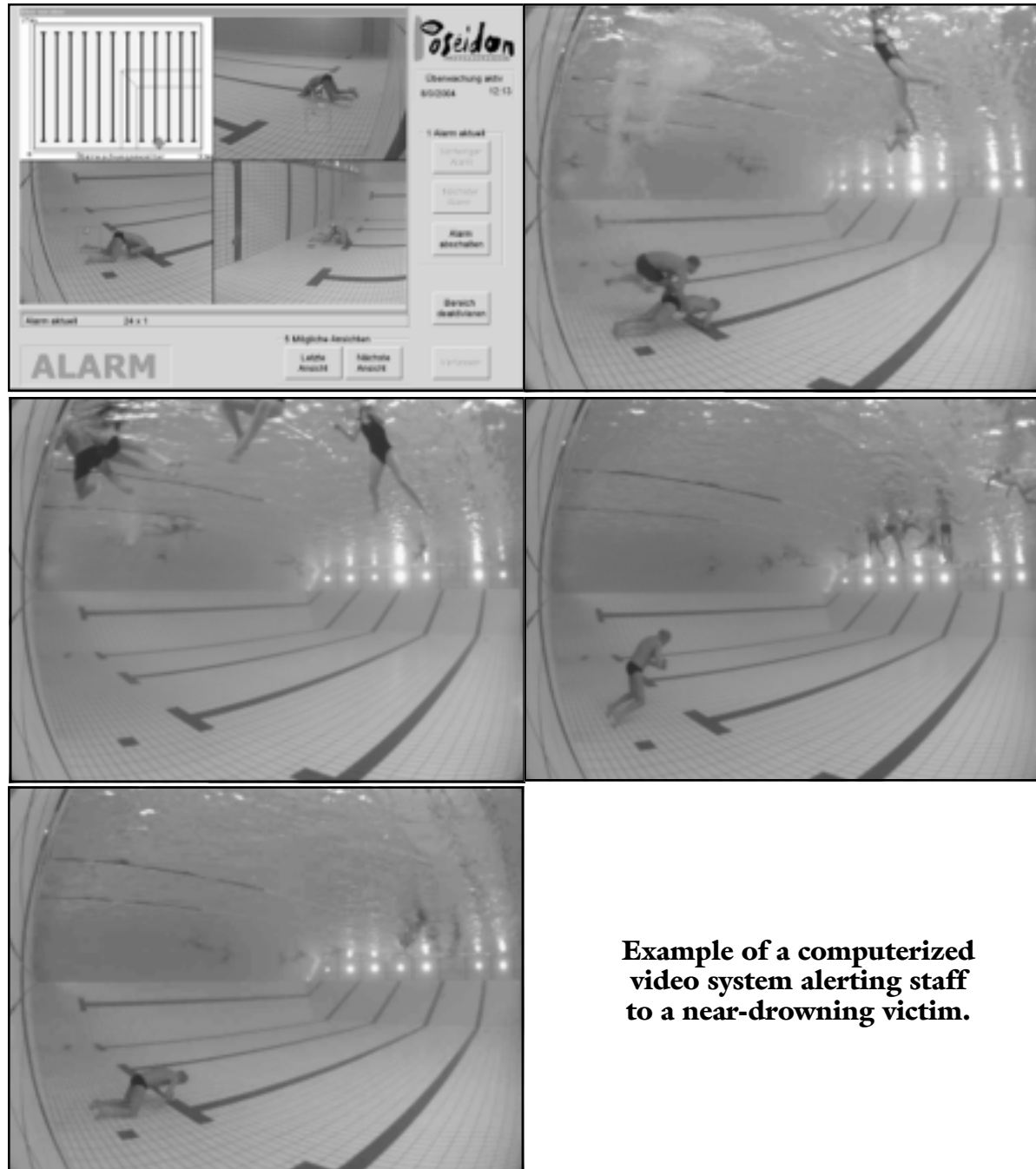
5/30 Model of Aquatic Accountability

In order to keep lifeguards vigilant and focused on-task while on-duty, the 5/30 model of accountability comes highly recommended. The “five” in this formula represents the Five-Minute Scanning Strategy for the lifeguards, meaning that they are required to move and make an accounting statement or safety check every five minutes while on duty to increase attention, concentration, and safety. The “30” refers to a management check of the lifeguards and the facility every half hour by someone in a management position at the facility. Actually walking through the facility rather



Griffs Guard Stations.

Notes



Example of a computerized video system alerting staff to a near-drowning victim.

than supervising from afar best accomplishes the management check. Some claim that when the 5/30 model is mandated at the facility, it reduces actual water rescues by 50% or more.

Automated External Defibrillators and Oxygen

Automated external defibrillators (AEDs) are now considered the standard of care in recreational and athletic facilities including aquatic facilities. The use of AEDs requires so much more than simply purchasing the machines. Comprehensive training is also required of the staff along with appropriate signage and usage protocols in the facility. The administration of oxygen should also be available at all aquatic facilities. Likewise, oxygen not only requires additional equipment but additional training for the lifeguard staff. The use of both AEDs and oxygen can significantly aid in the favorable resuscitation of near drowning victims.

Summary

It is hoped that this short chapter has stimulated the reader to try to investigate the possibilities that exist with today's new technologies in swimming pool design and construction. It should be remembered that many of the swimming pools we learned to swim in are now antiquated and would not be as inviting to today's swimming public. The new trends in aquatic facility planning today will make your facility both safer and more user-friendly. Lastly, visiting as many new aquatic facilities as possible with a notepad and video camera will greatly enhance the planning of your facility.

Copyright of Facilities Planning for Health, Fitness, Physical Activity, Recreation & Sports is the property of Sagamore Publishing, LLC and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.