SPORT ENGLAND

Design Guidance Note

Creating a sporting habit for life

Appendix 2
Servicing the building

- Energy implications
- Energy usage in swimming pool buildings
- Water efficiency
- Pool water quality
- Disinfection
- Chemical dosing
- Water softness
- Filtration systems
- Turnover rates
- Water temperature
- Air temperature and humidity
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- Size of plant rooms
- Plant room spaces
- Air distribution systems

(To be read in conjunction with the main document)

Swimming Pools

Updated Guidance for 2013

the asa funding partner

Servicing the building

A safe, comfortable and attractive internal environment is essential in order to attract and sustain high levels of use. Good conditions are also required for the lifeguards, teachers and spectators as well as achieving a reasonable life expectancy from the building [1].

The plant requirements can be considered in the following groups:

- ***Incoming services: Water, electricity, gas and meters***
- ***Pool water treatment system: Water filter(s) circulation pumps and pipework, chemical dosing equipments and backwash disposal***
- ***Foul water disposal/drainage***
- ***Heating system: To heat the pool water, areas of the building and domestic water supply including storage vessels and pressurisation systems***
- ***Energy/resource recovery equipment: Heat exchangers, CHP plant, water re-use***
- ***Air-handling plant: Heating and conditioning the pool hall air and associated spaces***
- ***Electrical distribution equipment***
- ***Water storage***
- ***Movable floor and/or bulkhead systems.***

The engineering challenge in achieving the functional requirements in a sustainable manner is substantial [2]. For example:

- Large volumes of swimming pool water need to be kept warm and continually treated to deal with the pollution from bathers
- Air temperature, moisture content and air quality in the pool hall need to be carefully controlled
- Potentially corrosive atmosphere needs to be contained and controlled in the appropriate areas
- Internal acoustic conditions and noise breakout to surrounding areas need to be moderated.

It has been estimated[3] that the building services installation can account for between 30 and 50% of the capital costs of a modern pool.

The operational sustainability is therefore critical and the full pattern of use, operation and maintenance regimes of the swimming pool should be allowed for within the services design. The operator's requirements should be obtained at an early stage in the design process.

Energy implications

Swimming pools use high levels of energy. It is imperative that the building footprint is minimised at the design stage and internal volumes carefully modulated to give an appropriate feeling of space and airiness. The building fabric should also be well-insulated and effectively sealed from the outside environment and any adjoining building elements.

Energy usage in swimming pool buildings

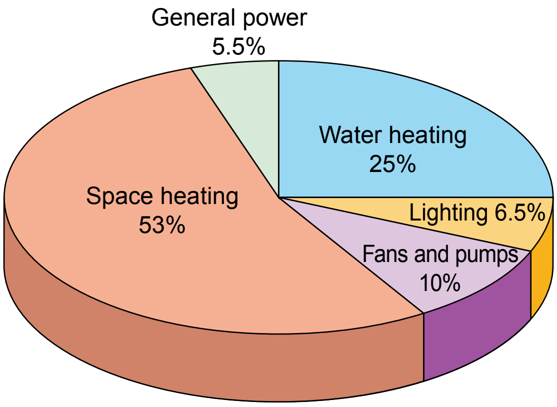
At the initial planning stages careful consideration should be given to the energy and servicing strategy for the building [4]. It is important to agree an energy strategy early in the process as it could impact on the orientation, form and external appearance of the building. A range of energy saving measures can be implemented that will reduce consumption. In deciding which is the most

[1] The HSE publication HSG179 *Managing Health and Safety in Swimming Pools* is a key reference.

[2] CIBSE *Guide G Public Health Engineering: Swimming pools.*

[3] See Sports Council Guidance Note *Swimming Pool - Building Services Nov 1994* and Sport Englands *Affordable Community Swimming Pools 2012.*

[4] The UK national planning system has recently been amended to make sustainability its underlying principle (PPS1).



Typical energy profile for a swimming pool building

appropriate, whole-life costs, rather than initial capital costs, should be considered and the minimum standards in the Building Regulations should be exceeded.

Energy usage in swimming pool buildings is generally high per square metre when compared to other building types. The proportion of energy not controlled under the Building Regulation (unregulated energy) is also very high. For example, the electricity used for the pool water treatment could amount to 50% of the total electricity consumption but is not controlled. It is important that the energy strategy deals with all of the energy usage. Compliance with Part L alone could deliver a building with unacceptable levels of energy consumption.

The table below summarises low/zero carbon techniques to be considered when establishing the energy strategy for a pool.

Be LEAN
Optimum orientation of the building and usage of glazing and/or solar shading to achieve: • Maximum benefit from natural light • Prevent glare • Optimum levels of solar gain without overheating
Ancillary accommodation to the pool hall: • Natural ventilation • Night cooling • CO_2 or humidity detection to modulate fresh air
Pool cover / reduced ventilation
Enhanced thermal envelope and air permeability, especially in the pool hall which is heated the year round to 30°C
Lighting: • High efficiency • Automatic controls • Direct lighting which is more efficient than indirect lighting
Zoning of plant to specific areas to suit type and frequency of use
Variable-speed drives on pumps and fans
Heat recuperation from extract air
Heat recovery from pool water / showers
Low water usage appliances
Power factor correction
Building and energy management systems
Pool water treatment plant: • Variable speed control of pumps to allow the turnover rate to be based on water quality • Altering UV output based on water quality
Use of appliances which have the highest available rating under the EU *Energy Efficiency Labelling Scheme*
Be CLEAN
Combined heat and power (CHP): The year round heat demand of pools makes them an ideal application for CHP – to be sized on the heat profile of the building to minimize heat being dumped
Use of energy sources beyond the site boundaries such as district heating and/or cooling schemes for the wider use in the general area (which could include the use of CHP and absorption cooling technologies).
Be GREEN
The use of on-site low/zero carbon technologies: • Photovoltaic panel • Wind turbines • Solar heating • Biomass heating • Air/ground source heat pumps

Table 1 Low/zero carbon techniques to consider

Comply with relevant local energy policies:

e.g. the Energy Hierarchy within the London Plan

- ***Use less energy - be lean***
- ***Supply energy efficiently - be clean***
- ***Use renewable energy - be green***

http://www.london.gov.uk/

Water efficiency

Swimming pools use large amounts of water through the backwashing of filters, constant fresh water make-up (30 litres per swimmer), showers and cleaning. The reduction in water usage has an indirect benefit on energy consumption since less water is used, less water has to be heated and transported using pump energy. The following should be considered:

- Low water consumption taps and flushes for toilets and urinals
- Automatic shower controls
- Rainwater harvesting
- Automated monitoring equipment for water make-up
- Grey water harvesting – collecting water from the pool filtration system and showers to be used for WC flushing
- Pool cover

Pool water quality

The quality of the pool water is of critical importance and will depend upon the design, bather load and the ongoing operation. It is a technically complex subject on which specific specialist advice must be sought for each particular project. The Pool Water Treatment Group (PWTAG) publications *Swimming Pool Water 2009* and *Code of Practice 2013* are regarded as the standard texts on the subject.

The selection of the most appropriate type of water treatment system for a swimming pool will depend upon a number of factors:

- Type and size of pool
- Bather load
- Characteristics of the source water supply
- Pool operation and maintenance.

Disinfection

A ‘conventional’ chlorine system has generally been considered to give an appropriate balance of capital costs, water and air quality, bather comfort, ease of control, maintenance and economy of operation. Sodium hypochlorite or calcium hypochlorite are commonly used to maintain a ‘free chlorine level’ in the pool water to deal with the pollution from bathers or other sources. Automatic control and dosing systems are regarded as essential to maintain safety, and give obvious staffing and operational benefits.

However, water purification based on Ultra-Violet (UV) and to a lesser extent Ozone (O^3) equipment is commonly added into modern public pool installations. They both involve additional equipment within the plant room areas, to treat the circulating water and make subsequent disinfection easier. The benefits of such systems are:

- Reduction in chlorine levels in the pool
- Improved water quality – particularly where high bather load is expected
- Improved air quality in the pool hall – through reduction in airborne chloramines associated with red eyes, sore throats aggravation of asthma and bronchitis, particularly beneficial to asthma sufferers, pool staff and long-term pool users.

However, such systems can add significantly to the capital and running costs and can also require increased expertise from the operator.

Ozone contact vessel and de-ozonising

There are particular safety and technical issues with all water treatment systems, but as a general guide, the use of purification systems are as set out in Table 2.

Pool type / bather load	Conventional disinfection	UV*	O^{3*}
Conventional / low	▼		
Conventional / medium	▼	▼	
Leisure / high	▼		▼

*Residual disinfection is required in addition to prevent cross infection in the pool.

Table 2 Common disinfection measures

Chemical dosing

Chlorine is used in the pool water to kill bacteria and prevent cross infections between bathers. The most common chlorine donors are:

- Sodium Hypochlorite (NaOCl)
- Calcium Hypochlorite (Ca (OCl)2).

These individually produce ‘free chlorine’, a chlorine compound for disinfection, and ‘combined chlorine’, when free chlorine is combined with pollutants - the cause of the typical chlorine smell in swimming pools.

It is necessary to control the acidity (pH) balance of the treated water. For example, diluted hydrochloric acid (HCl) is added when sodium hypochlorite is used.

Using other chemical treatments should be discussed in detail with the water treatment engineer. In particular, the use of Sodium BiSulphate ($NaHSO_4$) should be avoided due to the risk of sulphate attack on cementitious grouts, renders and concrete. See the PWTAG publications for more detail.

Pool water chemicals should always be dosed and monitored by automatic equipment. Additional manual testing of water samples from the pool should be undertaken regularly (at least twice a day) as an additional check on the system.

Water softness

The use of calcium hypochlorite is often preferred in areas of ‘soft water’ since it is a calcium hardness donor to the pool. This will minimise the effects of soft water on cementitious materials used in the pool construction.

See the PWTAG publications for more more details and the appropriate design standards.

UV filtration system

Filtration systems

An effective filtration system is required to maintain the clarity of the swimming pool water. For public pools, sand filters are most commonly used. In order to maintain their effectiveness, these will need to be backwashed regularly. This is achieved by reversing the flow through the sand beds and then discharging the backwash water to a foul drain.

The discharge to the drains is classified as trade effluent and the consent may place restrictions on the timing, volume and/or flow rate discharge per day. Backwash tanks to hold the backwash water may be required to allow a controlled discharge to the foul drainage system.

The overall hydraulics of the system, the rating of pumps and the position of inlet and outlet grills in the pool tank need to be carefully designed to ensure contaminants are effectively removed from the water. Deck level systems are most effective in removing contaminants from the water surface.

To assist the filtration process, chemicals known as flocculants are automatically added to the water prior to it passing through the filters. Poly aluminium chloride is most commonly used and it forms a 'floc' that helps trap fine particles, microbes and pollutants in the water.

Turnover rates

The time for the total volume of pool water to circulate through the treatment plant and return to the pool is known as the turnover rate. The period depends on the shape, size and use of the pool and should be considered early in the design process as part of the water treatment system performance requirements.

See the *PWTAG 2009* publication and *Code of Practice 2013* for more details and the appropriate design standards.

Pool Type	Depth (Metres)	Pool Turnover Rate (Hours)
Diving	Varies	4.0 - 8.0
Swimming	Varies	2.5 - 4.0
Learner/Teaching	0.5 - 1.5	0.5 - 1.5
Leisure	<0.5	0.17 - 0.75
	0.5 - 1.0	0.5 - 1.25
	1.0 - 1.5	1.0 - 2.0
	>1.5	2.0 - 2.5

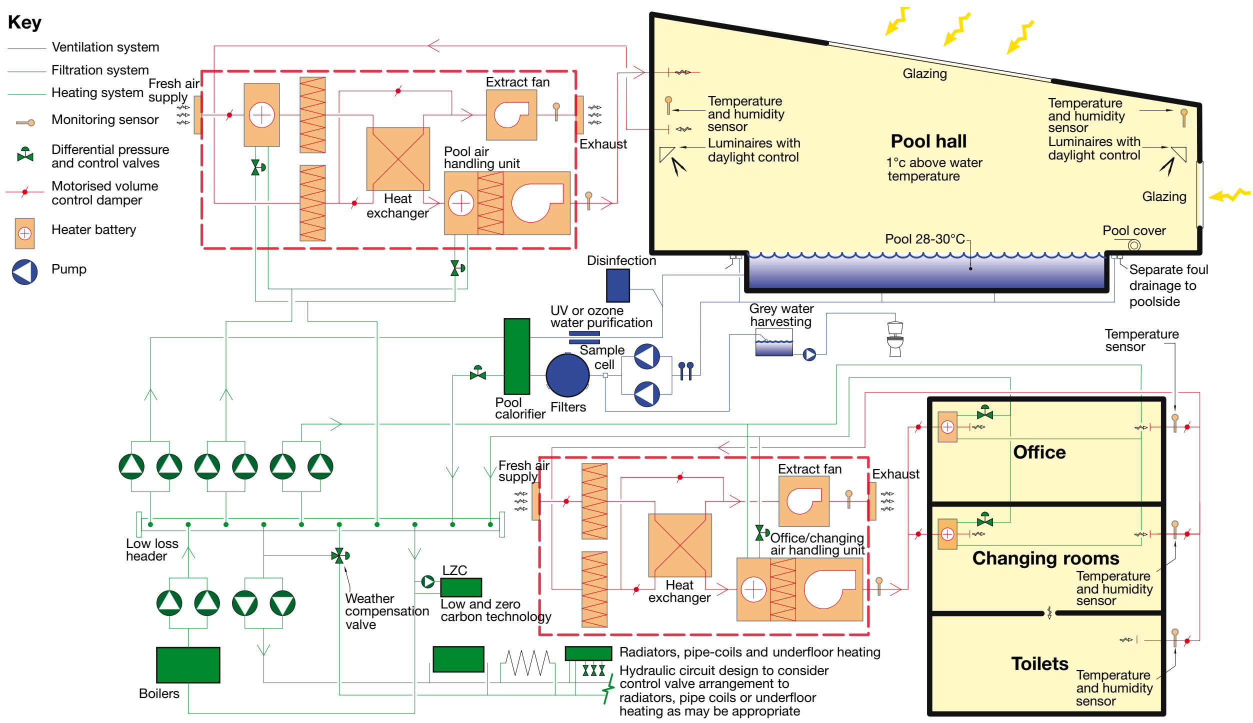
Table 3 Recommended turnover rates

The risk of contamination of the pool water can be minimised through:

- ***Careful design and location of showers and toilets***
- ***Good housekeeping***
- ***Bather education.***

(See Changing layouts in main document Section 5.0 Developed Design Considerations - Changing facilities)


Typical filter installation



Schematic services diagram for a typical small pool

Water temperature

Over the years there has been a steady trend to increase water temperatures to increase customer satisfaction. This is demonstrated in the latest update of the PWTAG publication (2009)[6] that quotes maximum temperatures for swimming pools that are 1-2 degrees higher than the previous edition of 1999 (see Table 4 below). However the energy usage implications should be carefully considered and it should be noted that the PWTAG 2009 document also advises that operators may run their pool satisfactorily at temperatures 1-2 degrees lower than the recommended maximum.

Pool types / uses	Previous / current recommended maximum pool water temperatures	
	PWTAG 1999	PWTAG 2009
Competitive swimming and diving, fitness training	27°C	28°C
Recreational, adult teaching, conventional main pool	28°C	29°C
Leisure pools	29°C	30°C
Children's swimming	As above	31°C
Babies, young children, disabled	30°C	32°C
Hydrotherapy		35°C
Spa pools		40°C

Table 4 Updated PWTAG pool water temperature recommendations

[6] *'Swimming pool water treatment and quality standards'* Pool Water Treatment Advisory Group (PWTAG 2009).

Higher water temperatures may be attractive to recreational swimmers, disability groups and children, but are likely to be less suitable for fitness swimming or competition. Higher water temperatures may also have an adverse impact on the water treatment and environmental control systems. See notes on the PWTAG web site on the problems associated with operators running pools at higher temperatures.

Sodium hypochlorite bulk and day tanks

Air temperatures and humidity

Pool hall

Temperature and humidity control is required in the pool hall to maintain comfortable conditions for bathers. Air temperatures are usually kept at one degree above the pool water temperature to minimise evaporation, relative humidity and air velocity values as follows:

- Air temperature: (assuming 29°C water temperature) — approx 30°C
- Relative humidity: — 60% ± 10%
- Air velocity: — Approx. 0.1 m/s in the occupied areas of the pool hall
- Min fresh air supply: — 4-10 air changes / hour

There should be even distribution and extraction of warm air from the pool hall so there are no draughts on the pool surrounds or in the shallow end where people may be standing up.

The above conditions assume that the mean radiant temperature is approximately equal to or slightly higher than the air temperature. The atmospheric conditions within an enclosed space are never homogeneous and vary with time and location. They are particularly influenced by bather activity.

Care should be taken that moisture and smells from the pool hall cannot pass to adjoining areas. Effective moisture vapour barriers are required and gaps should be sealed to avoid potential damage to the building elements, particularly where services and ducts pass through walls. A negative pressure difference between the pool hall and adjoining areas, such as changing areas, can be used to help contain the pool environment.

See PWTAG 2009 for the importance of the ventilation system in removing airborne disinfectant by-products and contaminants from the pool hall and ensuring an adequate distribution of fresh air.

Spectator area

Spectators in adjacent seating and viewing areas will require a lower temperature created by an increased fresh air supply as follows:

- Air temperature: — approx 25°C [7]
- Relative humidity: — 60% ± 10%
- Air velocity: — approx 0.3 m/s
- Min fresh air supply: — 10 air changes/hour

However, where such additional air supply systems are considered, care should be taken to avoid cooler air dropping into bather areas and causing discomfort.

Changing and clothes storage areas

The airflow should be evenly distributed and designed to remove smells, particularly in changing areas and toilet areas. There should be no draughts caused by airflow. In order to provide comfortable conditions as people change and move back into the public areas, the following conditions should be provided:

- Air temperature: — approx 24-25° C
- Min fresh air supply: — 10 air changes / hour

This should be arranged as a separate system from that for the main pool hall. Some additional fresh air supply within the system could be beneficial in vanity areas where people would be in their normal clothing.

Baby changing accommodation should have separate rates of ventilation.

Electrical services

Special care should be taken with electrical services in view of the damp warm and corrosive atmosphere [8]. Mains voltage must not be accessible within the pool hall.

Light fittings

For general lighting design issues, see 'Main Document' *Section 5.0 Developed Design Considerations - Pool Hall - Artificial Lighting.*

There are particular issues with underwater lighting:

- Size/type needs to suit the pool being illuminated
- Reliability
- Expected lamp life / replacement cost
- Ease of re-lamping
- Water safety – no fittings should exceed 20V operating current / need for transformers located relatively close to each fitting.

Where movable floors are used, the underwater light fittings will need to be flush with the pool wall.

Some underwater light fittings may also suffer from high temperatures at the glass lens, and in order to avoid the risk of bather injury, the

[7] 20°C is recommended for ancillary areas. See HSE document *HSG179 Managing Health and Safety in Swimming Pools.*

[8] IEE guide and HSE *Electricity at work regulation* 1989.

operational temperature of the surface of the glass should never become so hot as to be uncomfortable or dangerous.

Sizes of plant rooms

Plant rooms should be located in close proximity to the areas they serve in order to reduce service runs, system losses, and minimise fan power. They should also be sized to give good access to the equipment that they house and allow for operation, maintenance, replacement and deliveries.

Typically, the pool water treatment plant room should be between 15-30% [9] of the water area that it serves.

An economical solution is to locate the air-handling plant at high-level, providing there is adequate access. A 'rule of thumb' to calculate the overall area required is to allow approximately 15% of the pool building area.

Plant room spaces

The location, size and distribution of the plant within the building needs to be considered early in the design process along with the operation and maintenance factors.

The plant room spaces should:

- Allow the plant and equipment to be installed, commissioned, operated and maintained safely and efficiently
- Allow for service access and removal/ replacement of all individual elements including bulky items such as filters, which may require extra wide access doors or removable panels
- Minimise service runs, with water treatment plant located close to the deep end of the pool tank
- Locate pool water circulation pumps at the same level as the bottom of the deepest water so that they are continually flooded
- Allow for the delivery and storage of chemicals in a separate, ventilated area, ideally at ground floor level. Include appropriate safety arrangements such as bund walls for chemical storage tanks and dosing equipment and emergency drencher and eye wash facilities. The acid and chlorine stores will require separate ventilation system
- Ensure adequate ventilation rates to all plant room areas. If ozone treatment is used, provide an automatic ozone detection alarm system and consider the need for similar systems for chlorine and carbon dioxide
- Ensure adequate floor drainage in the plant room and provide a hosepipe point
- Provide an accessible balance tank to accommodate water displaced by bathers (for deck level pools only). Access via a lateral access way from the plant room is preferred to manholes in the pool surround floor
- Provide holding tanks if required for the main drainage system to deal with the quantity of filter backwashing water (can be separate from plant room)
- Allow space for new technology such as housings for underwater camera control panels
- Provide adequate space for a workbench, desk and chair, tools, maintenance manuals and so on
- Ensure flues, air intakes, ventilation and extract louvers/cowls are positioned away from public and residential areas
- Ensure safe access to all plant/equipment requiring regular inspection
- Allow for control equipment and underwater pool windows associated with computer assisted underwater pool supervision
- Be connected to all emergency alarms.

Access to plant rooms

Access to the plant room should be available both internally, via a controlled access point, and externally, via a delivery entrance. All doors leading to the plant room must have secure locking mechanisms fitted to prevent access by untrained staff and members of the public.

If an external service yard is provided, the external access should incorporate the provision of a steel shutter door system. The door should be fitted with a high-security locking system and be connected to the centre's security alarm. The ideal opening size is 3.0 m wide by 3.0 m high to facilitate filter replacement. There should also be an additional side door for external access to the plant room, to reduce wear and tear on the steel shutter and the probability of it being left open during a period of frequent use.

Doors in the plant room should be of a heavy-duty nature and have a minimum opening width of 1.0 m (1.5 m preferred).

[9] PWTAG / Sports Council Guidance Note: *Swimming pools Building Services.*

Air distribution systems in the pool hall

There is a marked move away from supplying air through overhead ducted systems to the use of ducts incorporated at low-level into the pool tank design. These systems either sit adjacent to the pool water overflow system or are set at low-level around the perimeter of the pool hall. If located under glazed curtain walling, they have the additional benefit of reducing the condensation that can form on the windows.

Low-level systems need to be designed to prevent ingress of water due to flooding from the pool surround or ground water. This can impact upon the pool hall environment and result in damage to the air handling plant. Integrating drainage systems may not resolve the problem as traps will inevitably dry out allowing the passage of foul air into the building.

Overhead ducting is still specified in some pool designs and as with direct lighting units, it can prove difficult to avoid positioning directly over water and maintenance becomes very problematic.

The ductwork fixings must be carefully selected as there have been several cases of ducting sections falling from height due to corrosion and subsequent failure of the fixings studs etc. Regular inspection of all ventilation ductwork and fixings must take place. This requires suitable access.

