AXTER

ACOUSTIC ADVISORY NOTE 3

AA/BG/081595/2

INDOOR SWIMMING POOLS

WHY DO WE NEED TO CONTROL NOISE IN SWIMMING POOLS?

Indoor covered swimming pools are noisy environments because the internal surfaces are extremely reflective, e.g. the water in the pools, tiled surfaces and glazing.

Reverberation time which affects the clarity with which sound is heard will be high and, due to the shouts and games of people using the facilities, decibel levels can be as much as 90 dB(A). This noise is disruptive and can have serious consequences as far as behaviour and safety are concerned:

- instructors have difficulty making themselves heard
- supervision is difficult (it is essential that safety warnings are clearly heard)
- swimming instructors who are subjected to excited children and intense noise levels for long periods become less attentive and suffer from increased nervous fatigue.

Noise then becomes an aggressive element for users when swimming pools should be enjoyable places in which to relax. Attendance numbers at pools are directly related to this problem; some swimming pools have closed due to poor attendance levels caused by noise. Furthermore The Noise at Work Regulations 1989 require action to be taken where the noise level $L_{EP,d} \geq 85$ dB(A).

Sound level reductions of 8-12 dB(A) can be achieved by increasing sound absorption, reducing the reverberation time to 1 or 2 seconds. This significant reduction has two main benefits:

- the lowering of the reverberation time reduces the general noise level
- verbal instructions are much more easily understood, therefore it is no longer necessary to shout.

For these reasons acoustic control must be considered at the design stage of a building.

CONTROLLING NOISE

INTERNAL CORRECTION

This concerns the internal comfort of the swimming pool.

The Sports Council recommends a reverberation time range of 1.8 - 3 seconds (mid frequency values, without occupants) depending on swimming pool volume. Department for Education guidelines recommend a maximum generated noise level from activity within the building ($LA_{eq,8hr}$) of 85.

The table below gives ideal reverberation times (Tr), mid frequency values, for various building volumes as defined by French codes of practice.

Swimming pool volume, m^3	2000	3000	4000	5000	6000	7000	8000	S000	10000	15000	20000
Low frequencies (125 to 250Hz)	1.6	1.9	2.1	2.2	2.4	2.5	2.6	2.7	2.8	3.2	3.5
Medium & high frequencies (500 to 4000 Hz)	1.3	1.4	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.5	2.7

These are only guideline figures for rectangular buildings. Because reverberation time is determined by the shape and composition of the internal surfaces it is recommended that an acoustic analysis is undertaken using computer simulation techniques.

INSULATION WITH RESPECT TO THE EXTERNAL ENVIRONMENT

This concerns the transmission of noise from the inside to the outside of the building and vice versa. Department for Education guidelines recommend a maximum background noise level from adjacent areas, ventilation and traffic noise (LAeq,8hr) of 50 and minimum insulation between similar rooms (D_W(dB)) of 33. Local planning requirements are likely to further limit the amount of sound escaping from the building in order to protect people living nearby.

Such characteristics depend. upon the type of materials used in the building's construction and the distance from its neighbours.

The performance of a roof or wall is limited by weak points (doors, windows, ducts, chimneys, etc....) and therefore specifying even the highest quality cladding could prove to be a futile exercise. (A concrete wall one metre thick will be completely ineffective if the doors and windows are left open).

An acoustic analysis will identify the optimum achievable performance and the most suitable materials to be specified.

ESSENTIAL INFORMATION REQUIRED FOR AN ACOUSTIC ANALYSIS

Internal Correction

- plans and sections showing the internal layout of the premises
- type and composition of the internal surfaces - walls, floor and roof
- report on any existing acoustic control measures - particularly important when renovating a building
- report on any previous acoustic studies
- any specific aesthetic requirements

Insulation with respect to the exterior of the building

- plans and sections showing the external layout and its environment
- type and composition of all external surfaces - doors, windows , walls, ventilation units...
- report on any measures already undertaken or previous acoustic studies
- any specific aesthetic requirements

MATERIAL CHARACTERISTICS

The materials to be used in the construction must:

- be as absorbent as possible, especially at frequencies of 500 to 2000 Hz which is the level of children's shouts
- be resistant to moisture and to other elements, such as chlorine
- be non-combustible
- be designed to eliminate the problems caused by condensation

Priority:

Because of its large surface area treatment of the roof or ceiling is vital.
In some cases treatment of the cladding near the roof junction will also be required.

SOLUTIONS FROM AXTER

Internal correction

The following roofing systems meet the conditions commonly required in swimming pools:

AQUALPHA
TYMPAN

Internal correction + insulation

In the majority of cases the above named systems are sufficient.

EXAMPLE

SAINT BONNET SWIMMING POOL AT VILLEFONTAINE (Isère)

Composition of the interior:

- Floor — 1500m² surface, kidney-shaped
  Two pools of 312m² and 243m² with slopes on three sides
- Walls — Glazing + perforated blocks + masonry
- Roof — Average height 6m with a section of openable daylighting.

History:

The St-Bonnet swimming pool had serious problems with the roof and a total refurbishment was necessary. After an acoustic analysis of the building, AQUALPHA was specified for the roof.

Results:

Measures to control the acoustics were made at the same time as a total interior refurbishment in December 1991.

- Reverberation Time

The anticipated and actual reverberation times (in seconds) are shown below:

Mid Frequency (Hz)	125	250	500	1000	2000	4000
Anticipated Tr	—	2.9	1.5	1.3	1.2	1.2
Measured Tr on site	2.0	1.7	1.4	1.2	1.2	1.1

- Equivalent continuous sound level (L_{eq}):

Measurements taken during a swimming lesson given to 30 children aged between 7 and 9 years old.

Measured L_{eq} = 74 dB(A)

In general, the maximum Leq found in well-designed swimming pools is about 80 dB(A).

Conclusion:

The renovation and re-roofing of the swimming pool had beneficial results for both the users and the swimming instructors, confirmed by subsequent testing. A study carried out at 6 swimming pools showed that more than 90% of users were satisfied with the comfort levels similar to the above.

Bibliography:

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2. Templeton, D W and Saunders D - Acoustic Design - Architectural Press
3. Department for Education - Building Bulletin 51 (draft) - Acoustics in Education Buildings
4. Nuisances Sonores dans les Piscines Couvertes - Echo Bruit - July 1987