POOL CONCOURSE *GUIDELINES*

DESIGN
CONSTRUCTION
MANAGEMENT
MAINTENANCE
CONSIDERATIONS

JULY 2011

AQUATICS & RECREATION VICTORIA

State Government Victoria

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INTRODUCTION

THE POOL CONCOURSE GUIDELINES – DESIGN, CONSTRUCTION, MANAGEMENT AND MAINTENANCE CONSIDERATIONS ARE PRESENTED IN FOUR SECTIONS:

SECTION 1

Includes an Executive Summary and outlines the context for the development of guidelines for the installation and managements of pool concourses.

SECTION 2

Provides an outline of the operational issues that are faced by facility managers on a regular basis in managing concourse performance. This section looks at a variety of management issues including cleaning, drainage, slips, falls, first aid, type and cost of concourse maintenance, resources, performance management of previous retro-fit applications, staff retention and operational knowledge, staff training and risk management.

SECTION 3

Outlines the general processes of producing a concourse to the required standard, including the management of the design and construction and the ongoing performance of the surface over its lifetime. It highlights the relationship between these elements and the effect on producing the required outcomes for the client and provides a check-list for guidance and information.

It also identifies the various elements of concourse procurement and the responsibilities of those controlling the outcomes; in effect a process of good project management. It highlights the benefits of investing the greatest amount of time in the initial design of the concourse, the relationship between capital cost and ongoing operational costs and ultimately the impacts for both client and end user.

SECTION 4

Provides a summary of outcomes and recommendations based on the industry research undertaken during the development of these Guidelines.

The documents contained in the Appendices Section are designed to provide further advice on specific areas, including a Technical Report, a table of common surfaces and inherent issues, providing a quick reference when contemplating the appropriate surface to be included in a pool concourse design.

POOL CONCOURSE *GUIDELINES* SECTION 1

SECTION 1

Context

For local councils the cost of building or refurbishing community aquatic and recreation facilities is the single largest capital investment they will make.

Community aquatic and recreation facilities are used by a large proportion of the population for a broad range of aquatic, recreation, sport and leisure activities. When designed thoughtfully, they become vibrant hubs of community activity, providing opportunities for the development of invaluable social connections and community engagement, are significant economic entities and are pivotal to the provision of community health, wellbeing and fitness.

The safety and design of the pool concourse becomes a key element that contributes to both the overall satisfaction and safety the community experiences at these facilities and the successful management of significant visitation levels over the lifetime of a centre.

To ensure sound and well informed decisions are made by clients, designers and operators, Sport and Recreation Victoria (SRV) in partnership with Aquatics and Recreation Victoria, commissioned the development of these Pool Concourse Guidelines.

These Guidelines seek to address issues associated with the design, procurement, construction and management of pool concourses. A selection of sites were visited to obtain first-hand knowledge of the operational performance of a variety of different pool concourse surfaces, including monolithic concrete (broomed or exposed aggregate) and applied surfaces (tiles and proprietary products).

A collaborative approach to the development of the Guidelines was undertaken by industry representatives and specialists, a process that was led by Aquatics and Recreation Victoria. The aim of this document is to elevate industry awareness and appreciation of matters that impact on the performance outcomes of pool concourses, minimising negative experiences, including trips, slips and falls.

Acknowledgements

The valuable support and assistance provided by the following, is gratefully acknowledged by both Aquatics and Recreation Victoria and Sport and Recreation Victoria:

- University of Ballarat
- Williams Ross Architects
- Suters Architects
- Irwin Consult Engineers
- Meinhardt Consulting Engineers
- Mornington Peninsula Shire Council
- YMCA Victoria

Executive Summary

This document highlights the critical importance that the design and construction of a pool concourse has in relation to the overall performance of new, redeveloped or refurbished aquatic and recreation centres. It also raises the inter-related nature of pool concourse design and construction, with the effective on-going operational performance of the finished product and management of public safety.

In describing the relationship between design, performance and operational management, the Guidelines seek to provide advice on the quality controls and design processes that can be implemented to limit compromises that may be experienced during construction and the need for the 'client', architect, contractor and facility manager(s) to understand their respective roles in producing a quality outcome.

A range of issues are canvassed in the Guidelines to elevate the understanding of the industry and facility owners in maximising the appropriate performance of a concourse and hence, minimising slips and falls. This includes, managing pressure on the construction program, concourse design, construction, finishes, safety obligations, workmanship, concourse surface selection, the role and responsibilities of the supervising architect, design tolerances, cleaning, maintenance and operational management requirements, amongst others.

Comment is also provided on the current adequacy, or appropriateness of the Australian Standards that are generally employed to provide a measure of objectivity and control to the slip testing and performance of the final concourse surface. This also includes general commentary on the level of current research and literature available on the issue of pool concourse design and slips and falls.

The two key messages contained in the Guidelines are:

- that it is prudent that there should be a hierarchy of control implemented over the design, specification, construction and delivery of a pool concourse, with shared responsibilities clearly outlined; and
- that sufficient time should be invested at the beginning of a project to ensure the client and those responsible for managing the new or refurbished facility, are fully informed and have satisfied themselves that the final product/concourse surface will be able to be effectively maintained and cleaned and perform to expectations over the long term.

Disclaimer

The implementation of a uniform set of guidelines for the design, construction, management and maintenance of pool concourses for application across Victoria is not practicable. However, the following guidelines and considerations are relevant to all Victorian community aquatic and recreation centres (Centres). Based on these Guidelines, those responsible for the drafting of design criteria and the specification of pool concourse performance of such Centres should develop individual policies or procedures as appropriate to their Centre and circumstances, taking into account all sources of information and advice available prior to the drafting and endorsement of specifications associated with a new or refurbished pool concourse.

POOL CONCOURSE *GUIDELINES* SECTION 2

SECTION 2
Common Facility Based Operational Issues

Slips / Falls and First Aid

Over the course of this project, it was found that the documentation of risks in this area is generally not recorded in any great detail, unless a specific risk has been identified or evidence is required to support or defend a claim in relation to concourse performance.

Proactive risk assessment prior to the likely occurrence of any significant incident or first aid event is an operational matter that should be an integral component of Centre management manuals and undertaken on a regular basis.

Detailed concourse risk assessments and incident reporting can assist in mitigating costly settlements for medical expenses or litigation, whilst also providing a sound basis for managing this key operational area.

Comprehensive documentation of any existing risks associated with a newly constructed or refurbished concourse prior to handover from the builder to facility managers, can play a critical role in mitigating risk transfer. Any existing insurance matters and/or liability claims should be managed and settled prior to occupancy to lessen the assumption of these risks being 'passed on' or accepted by the council or facility owner.

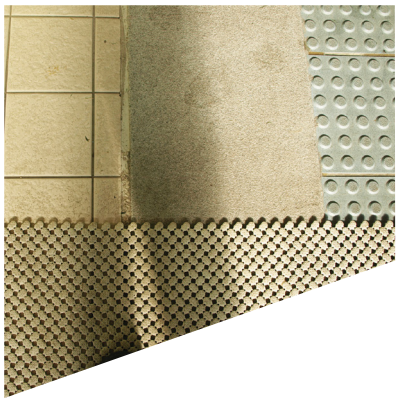
The consequences of a slip or fall on a person's health can include the following, which would need to be subsequently managed:

- Fractures
- Dislocations
- Minor bumps and abrasions
- Soft tissue damage
- Permanent disability
- Personal costs associated with insurance claims and litigation
- Financial loss
- Stress and anxiety
- Loss of physical health

A slip on an abrasive 'non slip' surface can also cause additional injuries including:

- Significant grazing or burning
- Cuts and extensive bleeding

Comprehensive documentation of all slips and falls and first aid that is based on cumulative data and evidence can provide a valuable tool to assist councils and facility managers to track incidents more effectively and identify problem concourse areas, so that a co-ordinated response to managing any high risk areas can be implemented.



Multiple surface and slip resistance change from tile/ applied surface/ rubber matting/ tactile sensors

Multiple surface and slip resistance change from tactile sensors / applied surface to rubber matting

Surface and slip resistance change from pool deck shower tile to machined concrete

Surface and slip resistance change from matting / applied surface / tile / grating

Mixed tile slip resistance from non slip to polished surface

Occupational Health and Safety

It should be noted that relevant Occupational Health and Safety Acts generally have specific requirements to provide a safe workplace and may include:

- The concept of ensuring health and safety in the workplace that eliminates or reduces as far as possible or practicable, risks to health and safety;
- Duties of employers to employees to maintain as far as is reasonably practicable, a working environment that is safe and without risks to health;
- Duties of employers to other people to ensure that they are not, as far as reasonably practicable, exposed to risks to their health or safety that may have arisen from their activities or conduct;
- Duties of people who manage or control workplaces (whether as an owner or otherwise) to ensure, as far as is reasonably practicable, that the workplace and the means of entering and leaving it are safe and without risks to health; and
- Duties of employees to safeguard their own health and safety.

Water Ponding and Drainage

The adequacy of the concourse gradient is an integral element of the design and an appropriate level of consideration and design time should be given to producing gradients that will effectively drain the concourse, without leaving any ponding or excess water for the operator to remove at a later time.

Similarly, the pool surrounds and corridors or areas where water is likely to be present or tracked by patrons, should also be non-slip, non-abrasive and well drained with a surface that is easily cleaned.

Water pooling can create a slippery surface which may lead to safety issues, discolouration of the concourse surface and poor aesthetics for the facility. Cleaning can also be affected by inadequate drainage and may require additional staff to mop or direct water into drains.

The pool surrounds and facilities should also be designed to incorporate wet/dry zones and clean/dirty areas with appropriate drainage for street shoes, wheelchairs or mobility aids. Suitable storage facilities for personal belongings should be provided so that these items do not clutter the concourse or pedestrian traffic areas and restrict drainage or cause water ponding following cleaning.

Where a design standard exists, the brief for the design team should require that the pool, the concourse and the surrounds are designed and constructed in accordance with the appropriate Standard(s).

Incorrect broomed concrete surface grading and subsequent water ponding

Incorrect gradient, water seepage under concourse seal, resulting in mould and rust build up

rusting drainage grate

water tracked by wheelchairs

Operating Expenses

Operating expenses can be directly associated with the type of concourse surface, its applied finish, concourse design and its construction. The cleaning and maintenance specifications associated with applied finishes to the concourse (e.g. tiles, non-slip screed, etc) or the type of finished concrete slab should be taken into account prior to agreeing on the final concourse design or selection of finishes, so that adequate operational budget allowances can be made.

A thorough knowledge and understanding of the ongoing operational requirements of the proposed concourse surface should be gained, including:

- Equipment required;
- Cleaning products (amount, types frequency);
- Cleaning schedules and methods;
- Lifespan;
- Stain resistance properties; and
- Likely build up of mould.

These are all key issues that should be addressed during the design phase. Minimising attention to this detail and/or cutting costs at the design stage may impact adversely on the ongoing annual operating, maintenance and cleaning budgets.

The future allocation and rostering requirements of facility staff should also be considered, to ensure realistic and cost effective operational budgets can be estimated. Poorly considered concourse designs and consequent ongoing management issues can be directly reflected in increased resource requirements and operational expenses following occupancy.

The requirements to purchase and store the appropriate equipment to clean and maintain the concourse can be a significant expense and one that may be overlooked in its design or the Furniture, Fit-out and Equipment (FF&E) budget process.

Varying cleaning requirements – dirt and grime build up on broomed concrete adjacent to applied finish, compared to low use area under seating

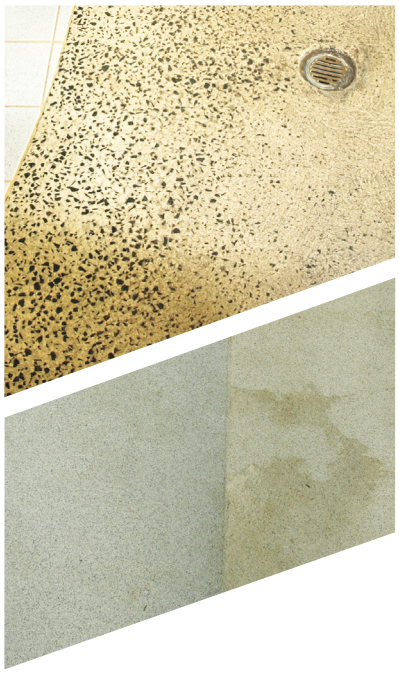
Alternate surface cleaning requirements for polished concrete and adjacent non-slip tile

Relationships

An effective working relationship between the builders, architects, council/owners and/or the management group can be crucial to the success of any project. A good relationship between the management/operators and manufacturers of any proprietary concourse surface applications and products can also be of great benefit. This may also ensure that subsequent comprehensive maintenance manuals clearly outline procedures for maintaining all aspects of the concourse and that they are understood and implemented.

De-lamination of sealer over applied concourse material

Reflection cracking in concourse affected by steel reinforcement design and concourse slab tensions



Grinding of concrete to rectify incorrect finished floor levels between pool deck shower tile and broomed concrete concourse

Colour matching problems with applied surface

Use of Machinery and Limitations on Surface Type and Slip Resistance

The concourse design and any associated finish should make allowances for the specified type of cleaning, maintenance machinery and associated materials and products. Design considerations should take into account any weight restrictions or use of machinery and surface protection required to ensure longevity of the concourse and any applied finish.

Maintenance manuals and manufacturer's or product warranties should be supplied prior to building handover and commissioning of the concourse and should include any limitations regarding the proper use of machinery, the performance and maintenance of the concourse and the use of any equipment that may compromise slip resistance.

Retention of Staff/Operational Knowledge

The predominance of casual workers across the industry can effect staff retention and knowledge. It is therefore beneficial that clear and concise information is included in all operating manuals so that when staff leave, knowledge is retained and can be passed on through appropriate training.

To ensure operating knowledge is not lost, manuals should include all cleaning procedures and maintenance plans that typically cover the following programmed intervals: daily, weekly, monthly, bi-monthly, quarterly and yearly. In this way, accurate operational procedures and technical knowledge can be successfully communicated as required. Work instructions can also be developed and included in the appropriate training manuals.

Managing Concourse Performance

Cleaning

Different surfaces may require different and particular cleaning procedures. Product manufacturers should provide specifications for all products and applied concourse surfaces. It is important to ensure a rigorous cleaning regime conforms to the manufacturer's specifications, uses only recommended products and equipment and is implemented to insure warranties or guarantees are maintained and the life of the concourse is prolonged.

Detailed processes for the cleaning of concourse surfaces should be included in all staff training and operational manuals. This can include documented work instructions on the correct handling and application of specified cleaning products and the procedures required to maintain the quality, integrity and performance of the nonslip surface.

Results from lack of cleaning, incorrect product use or application or not following correct cleaning procedures may result in, amongst other issues:

- Accumulation of body fats on the concourse;
- Build up of dirt and grime on the concourse;
- Potential growth of mould (depending on the surface); and
- Staining of the concourse.

All of the above (excluding concourse staining) can result in the pool concourse becoming slippery, with a consequent loss of slip resistance, which may be difficult to manage or restore and may become a significant risk. Inefficient or incorrect cleaning may also result in an unsightly, untidy, unsafe facility that in some instances may also have an unpleasant odour.

Once left for a period of time in poor condition, repair of the concourse may require expensive corrective applications or intensive and costly maintenance or capital works to rectify. All of these can impact on customer satisfaction, a facility's reputation, retention rates, operational budgets and future marketability and reliability of the facility.

Staining, fading or discolouration of the concourse or its applied surface can also occur if the cleaning regime is not maintained. Some surfaces can stain more easily than others, therefore the cleaning specifications and application regime should be checked prior to the design team selecting the concourse finish.

Some of the most common stains on a pool concourse can be attributed to rust residue, build up of mineral contamination, oil from mechanical equipment (including booms), or an inadequate gradient of pool concourse that results in water pooling or ponding. Any potential spill or placement of equipment that is likely to result in a permanent stain should be dealt with immediately and effectively.

Varying cleaning regimes required to manage grime, dirt and calcium build up on concourse tile and rubberised surface, grouting and wall tiles

Additional management of cleaning under rubber mats over tile around pool concourse

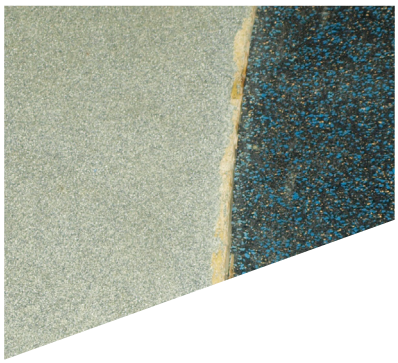
Cleaning effects on coloured non-slip tile

Variation in cleaning effects on broomed concrete to remove dirt, grime and body fats build up – varying quality of expansion joint sealing/caulking

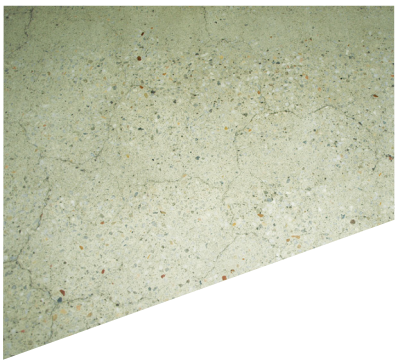
Concourse Maintenance

The concourse should be maintained to the manufacturer's specifications to ensure the quality and integrity of the finish and compliance with all warranties. It is important to understand the maintenance requirements for each product or applied surface prior to deciding on a final concourse finish during the design stage. This should include consideration of any operational maintenance costs, resources required to ensure correct and consistent maintenance and any special products, chemicals or machinery that may be required to maintain the slip resistance performance of the product.

The life span and durability of the product can also be dependent on the adherence to correct maintenance procedures. A recommended regular daily, monthly and yearly maintenance schedule should be included in the specifications supplied by the manufacturer.



Varying maintenance requirements needed for adjacent applied concourse and rubberised surface finishes and expansion joint interface

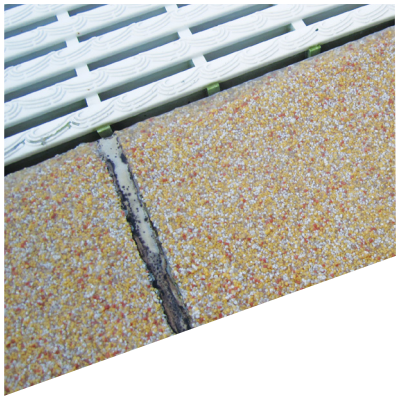


cracking polished slab

Managing Mould

A strict cleaning regime should minimise the infestation of mould on a pool concourse. If mould does infiltrate a pool concourse it can be extremely difficult to remove and on more porous surfaces, almost impossible to eradicate. Particular reference should be made to the manufacturer's specifications for cleaning requirements to inhibit mould growth.

Sufficient consideration should also be required by the design team when assessing the orientation of any new building works to ensure the concourse is exposed to maximum natural light, appropriate ventilation and adequate drainage to prevent mould build up in the first instance.



mould build up in ineffectively sealed/ calked expansion joint

Requirements from Contractors or Suppliers

Accurate manuals and instructions provided by the builder prior to the handover of the facility and its concourse should detail:

- Manufacturers' specifications;
- Cleaning regimes;
- Equipment requirements;
- Chemical requirements;
- Product or cleaning and maintenance restrictions;
- Detailed maintenance requirements;
- Personal Protective Equipment (PPE) requirements; and
- Product Material Safety Data Sheets.

The builder should also be required to provide appropriate training for key staff team members prior to facility handover, so that advice on all aspects of any concourse design and its associated performance, cleaning and maintenance procedures (including any applied surface details and expected lifespan), can be imparted.

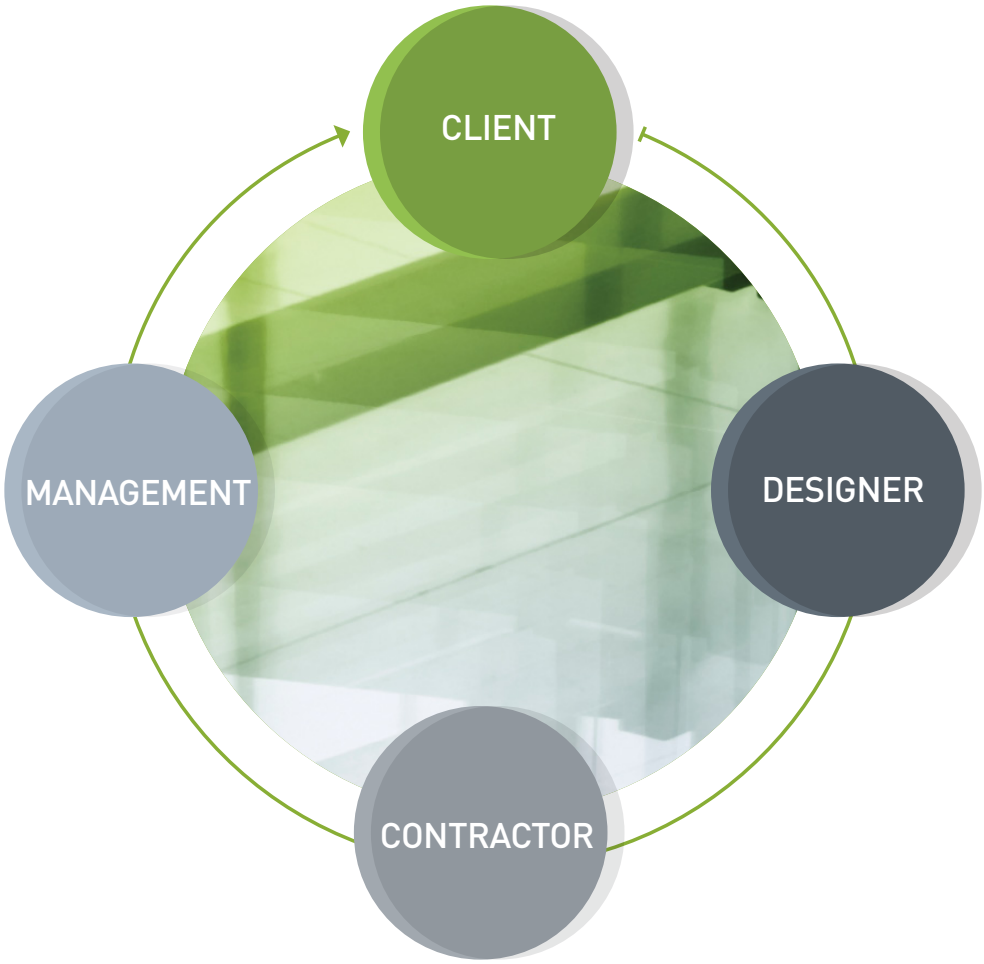
POOL CONCOURSE *GUIDELINES* SECTION 3

SECTION 3

Shared Responsibilities and Risk Management

The graphic below illustrates the relationships that exist between the various groups involved in the design and end use of the concourse. For example, the decisions made by the client in relation to design output, costs and delivery expectations (the program) will influence how the designer approaches the task and specifies the work that the contractor will undertake. The way the contractor undertakes the project and how it is delivered will affect how the management group or staff will operate and manage the concourse so that the end user's risk is minimised and positive experiences at the centre are maximised.

The graphic demonstrates the interrelated elements, responsibilities and accountabilities each group has and how the consequences of any failure to act will ultimately impact on the management of risk. The graphic can also be viewed as a method of controlling quality and outcome.



STAGE	SHARED RESPONSIBILITY				ACTION / CHECKPOINT	IMPACT OF FAILURE TO ACT	IMPACT ON RISK MANAGEMENT
	CLIENT	DESIGNER	CONTRACTOR	OPERATOR	● PRIMARY RESPONSIBILITY ● SECONDARY RESPONSIBILITY		
DESIGN BRIEF	●				1) The client should develop a client project team with first-hand knowledge of aquatic facility operation, facility maintenance and project procurement.	Lack of design direction and expectation may set the basis for a sub-standard project outcome and ongoing concourse problems.	
	●			●	2) The client should establish project expectations and priorities – good design is finding the optimum balance of the project aims and objectives that respond to the design brief. Discuss design criteria, i.e. is the concourse appearance a high, medium or low level priority in comparison to other project components?		CRITICAL
	●			●	3) The client should develop a design brief that details the functional and technical requirements for the project including: – a preferred concourse surface material – how the facility is to be operated (e.g. cleaning regimes, cleaning by external contract or facility staff, maintenance by others or client, supervision of user behaviour) – operators to be involved in the development of the design brief with the client (particularly if contracted to operate the facility on completion) – identify relevant design standards (noting that reference alone to Australian Standards such as AS/NZS 4663:2004 & AS/NZS 3661.2:1994 on Slip Resistance does not specifically address pool concourse issues. (These Standards consider all floor surfaces and common slip resistance issues and as noted separately in these guidelines, there are limitations to the testing procedures and results) – Client to also refer to RLSSA guidelines	Insufficient time, poor information and project development may result in a design that does not reflect operational requirements, leading to future operational issues	CRITICAL
FEASIBILITY STUDY	●			●	4) The client should establish early cost and time planning (prior to any design work) to provide project allowances that include: – flexibility in deciding on concourse material selection – adequate time and resources for surface material investigation, testing and review – determining adequate concourse area and ancillary amenities in line with total pool and leisure water areas – consultation with recreation planners and designers to assist with facility study analysis	Inadequate budgets may lead to focusing on limited funding to project elements and exposing the client to long term concourse problems	CRITICAL
	●				5) The client should develop an appropriate overall project budget.		
SELECTION OF CONSULTANT TEAM	●			●	6) The client should shortlist design consultant teams for consideration who have experience and knowledge in aquatic facility design and detailing – review previous consultant aquatic project work and seek feedback from users, operators and owners.	Consultants engaged to undertake the design and documentation on the basis of low price alone, without a proven capability to produce the required outcome, may lead to an unsatisfactory result.	CRITICAL
	●			●	7) The client should provide selected design consultants with a clear scope of service and direction to allow sufficient time and resources to provide a comprehensive design and documentation process. This should include sufficient weekly hours for site attendance by design team during construction to inspect the progress of the works.	Consultants' proposals may not address the required time allowances and cost implications, leading to poor outcomes and increased time pressures.	HIGH
	●	●			8) The client should discuss or obtain submissions from selected design consultants prior to engagement that demonstrates experience and knowledge. Request a summary of design considerations for the concourse.	Without conducting appropriate checks on previous knowledge, consultants may be engaged on false premises.	HIGH

	●	●			9) The client should conclude a clear scope of consultant service as the basis of the engagement (in order for the consultant fees to remain competitive, design consultants will not allow to provide a specific service or extent of service, unless it is asked for).	Insufficient time and resourcing by consultants may lead to poorly resolved design and inadequate documentation, hence poor outcomes and ongoing concourse problems.	CRITICAL
PRE-DESIGN	●	●		●	10) There should be adequate engagement by the selected consultant/designer with both the client and user groups during design phase to: – consider initial thoughts on surface material options – ensure the client is informed about any advantages and disadvantages of product or construction options – allow the designer to understand client's expectations of concourse performance	Finished product may not be to client expectations or able to function as intended, leading to future problems and management of risk.	CRITICAL
	●	●			11) Project cost planning should allow for an appropriate rates and quantity for concourse area to provide sufficient range for budgeting: – area x High / Medium / Low cost rates per m2	Insufficient budget allowances and a restriction on surface selection options may compromise outcomes.	CRITICAL
	●	●		●	12) The client and designer should visit at least 5 comparable aquatic facilities to view, amongst other aspects, different concourse surface material types (new and older), maintenance, cleaning and access issues.	Lack of understanding the design context and real circumstances on which opinions will be formed, may compromise results.	CRITICAL
	●	●		●	13) The client should utilise existing networks (e.g. other Councils or operators) to obtain first hand advice on concourse performance (slip resistance, cleaning, durability, appearance, user comments).	Consideration of surface selection without real user or operator feedback may lead to unsatisfactory concourse performance.	HIGH
SCHEMATIC DESIGN	●	●		●	14) The designer and client to identify concourse surface material options and consider how the concept design addresses or impacts upon: – concourse widths, falls, activity and circulation requirements, intended movement and traffic flow of users, spectators and staff – ease of cleaning and maintenance – pool water being walked to 'dry' areas – user (and owner) perception of material palette i.e. high quality or basic compliance (high end vs low end options) – drainage grades and capacities – adequate lighting levels to be achieved – control of sun glare – appropriate circulation areas – appropriate space for furniture and equipment	Ongoing management of issues and non compliance of the end product, issues with ponding of water, limited visibility, non compliance with Royal Life Saving Guidelines, circulation and egress may be compromised and management of risk may be exacerbated.	CRITICAL
	●	●			15) Samples should be obtained from manufacturers and current performance, compliance and installation data to be reviewed, including: – slip resistance rating information (testing wet and dry) and compliance with relevant standards (note that this may only consider maximum effective slip resistance at 'day one' of installation - i.e. slip resistance reduces with wear) – provision of manufacturer/supplier data on accelerated wear test (to consider 'ultimate' slip resistance after initial period of wear and tear e.g. 6 months).	Poor or incomplete documentation may lead to issues of buildability, design matters may not addressed sufficiently and outcomes not clearly expressed, which may compromise the client's ability to manage risk.	CRITICAL
	●	●		●	16) Discussions between designer and client should be undertaken to review and respond to surface material options, e.g. selection criteria for review to include: – material composition (and stability) – slip resistance qualities – durability & longevity (user wear and tear and damage from cleaning processes) – ease of cleaning (typically this is inversely proportional to higher slip resistance) – resistance to growth of mould and organic contaminants – appearance (is it more or less likely to show dirt and grime?) – drainage (low falls and high profile surface will retain more surface water and increase the risk of aquaplaning)	Inadequate consideration of all requirements and needs may lead to selection of a surface that fails to meet all client and user expectations	CRITICAL

DESIGN DEVELOPMENT	●	●		●	17) The designer and client to obtain, review and assess the performance of both recent and longer term installations proven to have been successful (or failed).	Poor or unproven product selection may lead to a compromised outcome or inappropriate surface for the intended use.	CRITICAL
	●	●			18) The designer and client to obtain, review and assess the manufacturer's installation recommendations.		HIGH
	●	●			19) The designer and client to determine if the surface material will require a nominated contractor to achieve quality control (and/or material and installation warranties).	Inexperienced contractors and poor supervision may lead to product failure.	HIGH
	●	●		●	20) Concourse plans should address drainage and migration of pool water, including: – set-out of high and low points to adequately resolve surface falls – locations, type and distribution of drains – extent of concourse materials and the wet/dry transition (avoiding foot traffic walking pool water into 'dry' areas that may have less slip resistance).	Poorly resolved design may lead to a compromised outcome or additional costs to be incurred during the construction period to rectify the works.	HIGH
	●	●		●	21) Discussions between designer and client should be undertaken to finalise the surface material selection.	Inadequate communication prior to final documentation and the resultant works tender may lead to compromised outcomes or additional costs during the construction period to vary the works and rectify problems.	HIGH
CONTRACT DOCUMENTING	●	●			22) Materials and workmanship should be clearly documented and project specific i.e. not a generic document applied across several different projects or project types.	Poor or incomplete documentation may lead to issues of buildability, design matters not addressed sufficiently and outcomes not clearly expressed, compromising the client's ability to manage risk	CRITICAL
	●	●			23) The concourse specification should detail (as appropriate) the: – selected surface material – supplier (and/or manufacturer), colour, grade, thickness, substrate, profile, jointing, etc – required standard of workmanship to be achieved by an experienced contractor in aquatic facility works.		CRITICAL
	●	●			24) The selected concourse surface details should be fully documented, including: – floor to wall junctions, coves, cove fillets, skirtings, sealant caulking, movement joints, construction joints – floor junctions, level transitions, drain to floor junction, pool edge junction.		CRITICAL
	●	●			25) Contract documents should define the responsibilities and deliverables of the building contractor, where relevant to the selected concourse surface, including: – nominated installers or construction specialists – Australian Standards as applicable to the workmanship – warranty periods and obligations – defects liability period – substrate preparation – hold points in the building process for review of works by designer – protection of the surface during the works – provision of maintenance manuals by the installing contractor		CRITICAL

BUILDING PROCUREMENT AND CONSTRUCTION	●	●			26) Building contractors that have experience and knowledge in aquatic facility construction should be shortlisted for consideration – review previous aquatic project work and seek feedback from users, operators and owners.	Contractors engaged to undertake the works on the basis of low price only, without a proven capability to produce the required outcome, may lead to substandard results.	CRITICAL
	●	●	●		27) Prior to building contractor selection, submissions that demonstrate knowledge in aquatic facility and concourse design should be obtained – request a summary of the approach to achieving the quality control as required for the selected concourse surface.	A fault in one part of the process may impact subsequent works, compromising the project outcomes and overall concourse performance.	CRITICAL
			●		28) Building contractor should be aware of the interdependent relationship between each step of the construction process in achieving the concourse's design intent.		HIGH
	●	●	●	●	29) Alternate concourse surfaces, if proposed by the building contractor, should be considered very carefully– there is a risk that whilst some benefits of the alternative may be demonstrated, it may also be likely that several disadvantages are similarly highlighted. (Note – there is a high risk that all of the review and assessment over the previous months of planning to this point, maybe lost or not given equal consideration in the comparatively short time of a Tender Review and/or Contract negotiation.)	Use of unproven alternatives may result in poor performance, long term maintenance issues, jeopardise whole of life use and exacerbate management of risk.	HIGH
	●	●	●		30) Building contractor should develop, monitor and update building works programme such that the concourse works are not on the critical works path – i.e. the concourse works are independent from critical building works, so that a delay in the concourse will not delay the overall completion of the project (reducing the risk of time pressure that may compromise the concourse workmanship and outcomes). The designer to periodically review the progress of the works.	A fault in one part of the process may impact subsequent works, placing undue programme pressure on completion of the works and compromising the project outcomes and concourse performance.	HIGH
	●	●	●	●	31) Building contractor should provide an on-site prototype (min. 2m2) of the concourse surface for the client and designer's approval before proceeding with the in-situ concourse works – this prototype should be to be retained as a control sample of acceptable material and workmanship.	By not producing a sample as a tangible reference point, monitoring the standard of works that may be below that which is considered acceptable may be harder to enforce.	HIGH
	●	●	●		32) The building contractor should oversee the supervision of the installation the works to ensure consistent supply of materials and workmanship to the approved standard. The designer to undertake periodic inspections (including works hold points), to review project quality control. The building contractor to construct in accordance with contract document requirements to achieve the design intent.	The built outcome may be compromised, leading to increased future operational problems and ongoing client expense.	CRITICAL
	●	●	●		33) Proprietary surface materials that are manufactured off-site should to be jointly inspected and approved by the manufacturer's representative on completion of the works.	Should the contractor and manufacturer fail to achieve the required standard of works, material and workmanship warranties may be compromised.	HIGH
	●	●	●		34) In situ surface materials (i.e. those constructed on site, including monolithic concrete surfaces), should be jointly inspected and approved by the designer and building contractor's representatives on completion of the works.		HIGH
	●	●	●		35) Maintain and protect the concourse surface and substrate during construction of other building elements.	Insufficient surface protection or flexibility built into the construction program may compromise final concourse surface performance.	HIGH

BUILDING HANDOVER / COMMENCE USE	●	●	●		36) On completion of the building works the concourse surface should be clean – the building works will typically create contaminants, dirt and marks unique to the building works process (e.g. paint overspray from above, wheel marks from access platforms, protective films etc). The designer to undertake final inspection with the building contractor.	Surface performance and ability to maintain a clean surface may be compromised from day one.	HIGH
	●	●	●	●	37) Maintenance and cleaning manuals should be developed for comprehensive cleaning specification and operations and maintenance procedures.	Inadequate cleaning regime/supervision may: – increase risk of slips and falls – lead to surface damage through improper use of machinery of chemicals – expose management and client to increased claims	CRITICAL
	●			●	38) Training – ongoing staff education process should be implemented.	High staff turnover may lead to knowledge loss and increased risk of ineffective management of potential slips and falls.	MEDIUM
	●			●	39) Maintenance and cleaning regimes should be implemented, supervised and monitored: – frequency of cleaning and maintenance may change according to user numbers – procedures to be reviewed and updated to respond to patterns of use (i.e. determining appropriateness of alkaline or acid based cleaning, or both, as may be required for removal of dirt, grime, dead skin or body fats, which are typically found on concourse areas).	Non performance of required tasks may increase risk of slips and falls and compromise surface slip resistance and decrease surface durability.	CRITICAL
	●			●	40) Regular programmed maintenance and cleaning requirements should be sufficiently funded to maintain slip surface resistance of concourse.	Inadequately funded maintenance programs may: – accelerate surface wear and loss of slip resistance – restrict centre usage times during additional renovation periods leading to decreased operational revenue – increase the likelihood of slips and falls and prevalence of claims	CRITICAL
	●	●	●	●	41) Building contract works defects liability – completed works should be monitored throughout the defects liability period (typically 12 months following handover), with all defects referred to the building contractor for remedial action.	If the building contractor is not held to contractual obligations to achieve an acceptable standard of material and workmanship, the responsibility for remedial correction may be transferred to the client.	HIGH
	●			●	42) Long term maintenance may include surface renewal or resealing as applicable to minimise day to day maintenance requirements. Accordingly, it is good practice for facility programming to make provision for full or partial closure of the facility as may be required for several days of maintenance works.	Deterioration of the surface may lead to significantly reduced concourse performance.	HIGH
	●			●	43) A user code of behaviour should be applied and implemented. Patrons should observe appropriate use of the facility and concourse (i.e. no running or careless behaviour).	Uncontrolled behaviour may increase the risk of slips and falls occurring.	HIGH
	●			●	44) Patrons should be encouraged (through signage and other means) to notify facility staff of concourse issues and assist with keeping circulation areas clear of obstructions, including loose equipment, chairs, tables and bags etc.	A reduced awareness by staff of the causes of any slips and falls, including obstructed paths of travel where patrons change direction around objects, may increase the risks of slips and falls.	MEDIUM

Technical Overview, Australian Standards and Testing

The technical overview for this project involved two aspects – the collation of injury data for a number of Victorian public aquatic and recreation centres and an examination of literature related to slips, trips and falls around pools, with particular emphasis on Australian Standards. It became clear that current methods of recording injury vary widely between centres and because of this variation it was not possible to make comparisons between venues, nor to establish an accurate picture of injury incidence. It was also clear that there is a dearth of literature related to slips, trips and falls in the aquatic environment and that further evidence-based research could be undertaken to address this issue.

Currently, the relevant Australian Standard applicable to pool concourse surfaces is AS/NZS 4586, *Slip resistance classification of new pedestrian surface material*, but review of this standard reveals that it has limitations when applied to the aquatic environment and should be used with caution. The development of a standard more relevant to the pool concourse setting could be considered so that the specific characteristics of public pools are incorporated, including (but not limited to):

- use of the surface by patrons in bare feet;
- variable amounts of water on the concourse surface;
- the presence of body oils and/or soap;
- newly applied surfaces; and
- surfaces that have been subjected to wear

To accurately track injury incidence, and to facilitate comparisons of injury incidence between different venues and across different surfaces, an improved, standardised injury report form could also be developed and adopted across the industry. Data to be recorded could include (but not necessarily be limited to) factors such as:

- age;
- activity undertaken at the time of the slip/trip/fall;
- first aid or medical treatment required;
- a surface report; and
- action required to minimise a repetition of the injury

The Appendix provides a standardised version on an Incident Report Form that could be used by the industry to provide consistency of reporting and data collection. The use of this form could facilitate the analysis of industry wide slips and falls and the corresponding causes, to assist with future planning, concourse design and risk management practices.

Common Surfaces and Inherent Issues

SURFACE MATERIAL	MONOLITHIC CONCRETE
MATERIAL TYPE	PORTLAND GREY
DESCRIPTION	Concrete slab trowelled to falls when poured and either broom or exposed aggregate finish to provide a level of slip resistance. Concrete sealers sometimes used, these typically have low VOC content.
SLIP RESISTANCE	Medium to high slip resistance. Difficult to achieve uniform surface texture therefore variable slip resistance (e.g. brooming consistency, the application, broom type and state of cure across the slab). Poor workmanship may create ridges in the concrete surface that can be hazardous to bathers and cause skin grazings. Basic concrete quality issues must therefore be addressed to ensure durability of the surface. Broom direction should be perpendicular to main path of circulation to maximise slip resistance. Carborundum may be sprinkled over and trowelled into the surface before set to better non-slip finish.
APPEARANCE	Average to good appearance. Inconsistent appearance due to a number of factors such as, brooming consistency, the application, broom type and state of cure across the slab upon broom treatment. Visible wear in high traffic areas and accelerated wear along drainage propagation routes. Water can get trapped between broomed ridges causing premature surface wear/stains to the slab. May be subject to shrinkage cracks after initial cure.
COST	Low cost. Sealer additional.
DURABILITY	Medium to high durability if penetrating sealer applied to concrete surface. Sealer penetrates into the top layers of slab creating a hard durable crust layer. Penetrating sealers block pores in slab to reduce the absorption of water and salts and increase the density of the top layers of concrete. Penetrating sealers also stop dust during cleaning, increase resistance to chemical attack, improve slip resistance, easier to clean and more hygienic. If no sealer durability is low to medium. Avoid topical sealers (film forming). These tend to reduce slip resistance and are usually only used to enhance appearance 'Clear' sealer will show less wear and tear than tinted or solid colour sealer.
CLEANING	Poorly finished surface can be difficult to clean. Sealer recommended.
COMMENTS	Susceptible to damage during construction if concourse slab is finished earlier in the construction process. If slab is to be integrally coloured with select oxide, test the oxide colour when exposed to treated pool water – can lead to bleaching and other staining. Poor tolerances to adjacent surfaces and sometimes inconsistent control joints. Obtain a control sample of finished surface for approval before concourse works proceed - reject poor workmanship not meeting the control sample quality. Monolithic concrete can be subject to considerable visual inconsistency as a result of aggressive cleaning chemicals and procedures.

SURFACE MATERIAL	MONOLITHIC CONCRETE
MATERIAL TYPE	EXPOSED AGGREGATE
DESCRIPTION	Quartz pebble aggregate used in lieu of common igneous rock aggregate with surface layer removed during curing to expose the aggregate.
SLIP RESISTANCE	Medium to very high slip resistance, but can depend on type of aggregate used. Distribution of aggregate and depth of exposure must be relatively uniform to avoid variable slip resistance.
APPEARANCE	Good to very good appearance with almost unlimited colour/texture variations. Water runoff to drains maybe inhibited by uneven exposed surface. Over time aggregate may become dislodged with cleaning creating pockets for water and dirt to sit. Difficult to achieve uniform degree of aggregate exposure. Quality control an issue. Requires an experienced highly skilled contractor and skilled washing off of the retardant to achieve a uniform finish/result. The retarder (spray applied) will slow the set characteristics of the surface layer allowing the interior to harden while the exterior surface remains soft.
COST	Low to Medium cost. Sealer additional.
DURABILITY	Medium to high durability. Uneven wear and surface becomes less uniform over time. Surface should be sealed to maximise durability as above. Applying sealer will reduce tendency to produce dust and increase durability of surface as above.
CLEANING	Medium difficultly to clean. Sealer recommended.
COMMENTS	Exposed aggregate incorporated into the concrete mix is more susceptible to damage during construction and requires protection until works are complete. Sealer application needs to be carefully controlled.

Common Surfaces and Inherent Issues (cont.)

SURFACE MATERIAL	GRANOLITHIC SCREED
MATERIAL TYPE	EXPOSED AGGREGATE SCREED
DESCRIPTION	Topping to slab, usually 50 – 60mm thickness. Any less, screed can lift when cleaned or delaminate from the structural slab below through insufficient strength in the topping. Not commonly used.
SLIP RESISTANCE	Medium slip resistance. Carborundum may be sprinkled over and trowelled into the surface before set, to improve non-slip finish.
APPEARANCE	Good appearance, however more control joints required to address shrinkage cracking during curing.
COST	Medium cost due to additional topping layer. Sealer additional.
DURABILITY	Medium to high durability with thick topping layer. Hard-wearing. Quality control is variable. Applying sealer will reduce tendency to produce dust and increase durability of surface as above.
CLEANING	Medium difficultly to clean (as per monolithic concrete).
COMMENTS	Since topping screed applied over concourse slab, finish can be applied towards the end of the construction program meaning less susceptible to damage and tighter tolerances to adjacent surfaces. Minimum period for curing for topping layer, as well as curing time for structural slab.

SURFACE MATERIAL	CERAMIC TILES
MATERIAL TYPE	HARD BISCUIT TILES ADHERED TO CONCRETE FLOOR SLAB SUBSTRATE
DESCRIPTION	Ceramic tiles with epoxy grout should be used (this is over and above Standard). Grout lines create good channels for water runoff into drains.
SLIP RESISTANCE	Medium to very high slip resistance. Up to R12 (highest slip coefficient rating for bear feet in aquatic areas). Uniform slip resistance unlike monolithic and granolithic treatments and grout lines aid in slip resistance.
APPEARANCE	Good to excellent appearance (subject to high quality workmanship and tile selection). Can appear worn and tired after a few years if coloured tiles are used.
COST	High cost due to the limited range and types of tile that can be used on pool concourses. Higher initial capital cost compared to the above treatments. Lower life cycle cost compared to monolithic concrete concourses. Epoxy grout additional.
DURABILITY	High durability (subject to high quality tile selection). Use of epoxy grout to increase durability. Use of high pressure wash will not damage the tiles / grout.
CLEANING	Medium difficulty to clean, however easier if tiles have titanium dioxide coating which assists in breaking down surface dirt. Low cost to clean.
COMMENTS	Concourse control joints can be worked in with tile layout to achieve tight joint tolerances. More difficult to lay tiles to falls if individual floor wastes are used and centred on concourse. Strip drains more expensive.

Common Surfaces and Inherent Issues (cont.)

SURFACE MATERIAL	APPLIED MMA (METHYLINETHACRYLATE) RESIN
MATERIAL TYPE	TROWEL APPLIED FLOORING SYSTEM OVER CONCRETE FLOOR SLAB SUBSTRATE
DESCRIPTION	50mm minimum compatible screed with falls built in over structural slab, with finish applied over. High VOC content compared with other treatments.
SLIP RESISTANCE	Very high slip resistance. R12 rated (highest slip coefficient rating for bare feet in aquatic areas). Uniform slip resistance across entire surface. Grazing of knees and hands is possible.
APPEARANCE	Excellent uniform appearance. Appearance will remain if cleaned regularly. If not, unsightly stains may form on the surface, which are harder to clean. Wide range of colours and coloured sand finishes. Flexible material reducing the number of control joints.
COST	High cost. Needs to be finished against a straight edge (e.g. tiled edge or steel angle) to achieve a high level finish at junctions thus adding to the cost of the flooring system. Relatively fast curing times, typically within 2 - 6 hours. Can reapply to areas as necessary.
DURABILITY	Very high durability. High abrasion, ultra-violet and chemical resistance. Use of high pressure wash will not damage surface.
CLEANING	Medium to difficult to clean. More regular cleaning required to remove dirt, grime and stains. Higher ongoing cost of cleaning compared to other treatment.
COMMENTS	Less susceptible to damage when applied towards end of construction program. Steeper falls should be built into the screeding layer to aid drainage due to textured surface. Relies on sub-contractor expertise to apply correctly.

SURFACE MATERIAL	APPLIED RUBBER
MATERIAL TYPE	EPDM RUBBER FOR WET APPLICATION BONDED TO SLAB SUBSTRATE
DESCRIPTION	Porous, granulated rubber material resistant to chemical attack.
SLIP RESISTANCE	Relatively low slip resistance. Soft under foot. Less susceptibility of patrons grazing their feet, knees and hands, etc. If outdoors, does not absorb as much heat as concrete, tiles and epoxy surfaces. Unlikely to achieve category 'C' (R12) slip resistance required by RLSSA guidelines.
APPEARANCE	Good appearance. Certain products are UV stable hence little discoloration when used outdoors. Comes in many colours. Cover all control joints.
COST	Medium cost.
DURABILITY	Low to medium durability.
CLEANING	Difficult to clean since porous. Water can become trapped between rubber granules and substrate. Difficult to flush out stale water and control bacterial growth. Cannot withstand prolonged high pressure cleaning. Usually require Blower / Vac clean and no industrial cleaners. Application of sealer to top surface not recommended.
COMMENTS	Last minute application, tight tolerances, low susceptibility to damage as a result of application at end of project. Good noise absorption properties. Produces no dust unlike unsealed concrete based surfaces. May be subject to bacterial growth for indoor use (no UV to assist with resistance as achieved with outdoor use) and the addition of a topical sealer may alter the performance of the rubber application (slip resistance, durability and appearance). Good noise absorption properties.

Common Surfaces and Inherent Issues (cont.)

SURFACE MATERIAL	RUBBER SHEETING
MATERIAL TYPE	EPDM GRANULE SIZE RUBBER SHEETING BONDED TO SUBSTRATE, VARYING THICKNESSES AS SELECTED.
DESCRIPTION	Porous product. Design falls into substrate slab to minimise the use of toppings and screeds.
SLIP RESISTANCE	Relatively low slip resistance. Soft under foot. Less susceptibility of patrons grazing their feet, knees and hands, etc. If outdoors, does not absorb as much heat as concrete, tiles and epoxy surfaces. Unlikely to achieve category 'C' (R12) slip resistance required by RLSSA guidelines.
APPEARANCE	Good appearance. Typically available in many colours. May be available to custom design patterns and/or image. Slight variations in pattern due to colour chip dispersion / shading is normal. Expansion joints are filled with a polyurethane filler at edges, giving an almost seamless appearance.
COST	Medium cost. Extra cost to supply special drains, slab prep, grinding or captive shot blasting to provide a good surface.
DURABILITY	Medium durability. Material can delaminate from substrate and come apart at joins due to hydrostatic pressures under sheets. It is therefore essential that the correct adhesives and sealers are used to minimise the risk of this occurring Difficult to properly drain. Can be subject to hydrostatic pressure lifting the material and gouging of the material by furniture / equipment.
CLEANING	Difficult to clean since porous material and water can become trapped between substrate and underside of material. This can cause the material to lift. Daily and weekly cleaning is required. Limited high pressure wash is possible. Difficult to flush out stale water and control bacterial growth.
COMMENTS	Less susceptible to damage as a result of application at the end of the works. Installation more intensive due to specific detailing at edges and at drains and expansion / control joints. Can be easily damaged during construction. Strict ambient installation temperatures need to be achieved before the rubber can be laid and warranted which can lead to time delays. Good noise absorption properties. Produces no dust unlike concrete based surfaces.

SURFACE MATERIAL	VINYL SHEETING
MATERIAL TYPE	NOMINALLY 2MM-3MM THICK FLOOR VINYL WITH TEXTURED SURFACE FINISH.
DESCRIPTION	Non porous. Textured surface with peduncles.
SLIP RESISTANCE	Relatively low slip resistance. Some manufacturers add Aluminium Oxide to material which aids slip resistance. Soft underfoot but less than rubber alternatives. Unlikely to achieve category 'C' (R12) slip resistance required by RLSSA guidelines.
APPEARANCE	Good even appearance. Comes in many colours. Can incorporate various surface textures to coordinate with other floor finishes.
COST	Medium to high cost.
DURABILITY	Medium to high subject to high quality selection and installation.
CLEANING	Usual cleaning procedure involves sweep and/or wet vacuum and mop and bucket with detergent. When required machine scrub / or deck scrubber using synthetic bushes. The use of hand scrubbers may be necessary to ensure full coverage.
COMMENTS	Less susceptible to damage as a result of application at the end of the works. Installation more intensive due to specific detailing at edges and at drains. Can be easily damaged during construction.

DEFINITIONS	
SLIP RESISTANCE	The likelihood of a person slipping on a floor surface. Measured by test methods as prescribed under the Australian standards; AS4586.
CONSTRUCTION JOINT	An expansion joint in masonry structures to accommodate movement due to expansion and contraction.
VOC	Volatile Organic Compounds. These are chemicals that can cause odours and irritation and are not conducive to a healthy indoor environment.
SCREED	A cementious layer / topping applied over a substrate, such as a structural slab to accurately level a surface.
SUBSTRATE	The material under another material e.g. tiles, EPDM rubber, vinyl over a structural slab.
EPDM	Ethylene Propylene Diene Monomer. A fully synthetic rubber with excellent colour stability properties.

POOL CONCOURSE *GUIDELINES* SECTION 4

SECTION 4
Conclusion

Through the preparation of these Guidelines it has become apparent that the initial design and construction of a pool concourse is critical to the long-term performance of aquatic and recreation facilities in mitigating the potential for slips and falls. In this regard, sufficient time and thought should be given to the key aspects of the pool concourse by the design team, including:

- protection of the concourse and its surface during construction and final fit out of other amenities within the pool hall(s);
- controlling workmanship and managing risk to ensure the integrity of the design is protected and the desired concourse performance and outcomes are delivered;
- considering how the long term slip resistance will be effectively maintained if either an applied surface or use of a monolithic slab is incorporated into the final design;
- visiting a range of facilities and selecting the preferred concourse surface from existing examples of concourses where performance over an extended period (at least 5 years), can be ascertained first hand by the design team and facility manager;
- determining if the level of slip resistance or tolerance of the selected concourse surface is still achievable after the initial period of use, i.e. its base line performance after maximum slip resistance at installation has diminished over time; and
- managing the often inverse proportional relationship between slip resistance and ease of concourse cleaning

The management of public safety and the effective on-going operational performance of the finished concourse surface is a combination of carefully managed relationships during the design, documentation and construction of any new or refurbished concourse.

These Guidelines highlight the quality controls and design processes that may be implemented to limit compromises that could be experienced during construction and the need for the 'client', architect, contractor and facility manager(s) to understand their respective roles in producing a quality outcome.

As the refurbishment or construction of community aquatic and recreation facilities is not generally undertaken by local government on a regular basis, it should be incumbent upon those delivering projects, that the broad range of issues associated with concourse performance (as highlighted in these Guidelines) are understood to maximise slip resistance and hence, minimise slips and falls.

The Guidelines also highlight that the current Australian Standard applicable to pool concourse surfaces – AS/NZS 4586, *Slip resistance classification of new pedestrian surface material*, does not appear to provide a true test of a pool concourse surface under actual 'working' conditions and that there is very little, if any, relevant research that has been undertaken on pool concourses and slip resistance, which may prove problematic for facility owners and managers.

At point of handover of a facility, sufficient information should be provided with regard to maintenance regimes to ensure that concourse surfaces can be adequately maintained to avoid changes in surface characteristics that may increase the likelihood of slips, trips and falls.

Further, to accurately track injury incidence and to facilitate comparisons of injury incidence between different venues and across different surfaces, an improved, standardised incident report form could be developed and adopted across the industry. By recording data such as age, the activity undertaken at the time of the incident, first aid or medical treatment required, a surface report and any action(s) required to minimise a repetition of the injury would be beneficial in managing concourse performance.

The two key messages that emerge from the work undertaken to establish these Guidelines are:

- that it is prudent that there should be a range of controls implemented over the design, specification, construction and delivery of a pool concourse, with shared responsibilities clearly outlined between the client, designer, building contractor and facility management; and
- that sufficient time should be invested at the beginning of a project to ensure the client and those responsible for managing the new or refurbished facility, are fully informed and have satisfied themselves that the final product/concourse surface will be able to be maintained, effectively cleaned and will perform to their expectations over the long term.

POOL CONCOURSE *GUIDELINES* APPENDIX 1

APPENDIX 1
TEMPLATE INCIDENT REPORT FORM

General Details

FACILITY DETAILS

Name:

Council/Organisation:

Incident: Date / / Time : am pm (circle)

PERSONNEL DETAILS

Casualty Name:

Gender: Male ☐ Female ☐

Date of Birth: / /

Address:

Phone:

Existing Medical Conditions:

Casualty Signature

Parent/Guardian Name [if applicable]:

Address:

Phone:

Signature:

WITNESSES

Witness Name [1]:

Address:

Phone:

Witness Name [2]:

Address:

Phone:

Injury and Treatment Details

NATURE OF INJURY

☐ Abrasion/graze	☐ Laceration/cut
☐ Bruise/contusion	☐ Muscle injury
☐ Inflammation/swelling	☐ Burn/s
☐ Loss of consciousness	☐ Poison/toxic
☐ Suspected spinal	☐ Blood nose
☐ Asthma	☐ Headache
☐ Suspected fracture	☐ Blister/s
☐ Other [specify]:	

LOCATION OF INJURY [CIRCLE/TICK]

PROBABLE CAUSE OF INJURY

- ☐ Temperature related
- ☐ Overexertion
- ☐ Inappropriate behaviour
- ☐ Collision
- ☐ Medical condition
- ☐ Slip/trip/fall
- ☐ Fall from height
- ☐ Drugs/alcohol
- ☐ Facility maintenance
- ☐ Alleged assault
- ☐ Other [specify]:

ATTENDING STAFF DETAILS

Staff Name:

Position/title:

Was consent provided for treatment? ☐ Yes ☐ No

If 'No' state reason:

TREATMENT PROVIDED

- ☐ Clean
- ☐ Gauze/Band Aid
- ☐ Conforming bandage
- ☐ Crepe Bandage
- ☐ Eye/Burns module [circle]
- ☐ Wound closure
- ☐ Oxygen therapy [length of time]:
- ☐ Ice/cold compress [length of time]:
- ☐ Defibrillation [details]:
- ☐ Other [specify]:

INCIDENT LOCATION

- ☐ Indoor pool
- ☐ Outdoor pool
- ☐ Spa
- ☐ Sauna/steam
- ☐ Concourse
- ☐ Fitness centre
- ☐ Changing areas
- ☐ Slide
- ☐ Crèche
- ☐ Wave pool
- ☐ Facility entry/exit
- ☐ Hydro pool
- ☐ Plant room
- ☐ Café
- ☐ Other [specify]:

Additional Details:

INCIDENT MANAGEMENT

INCIDENT IDENTIFIED BY

☐ Facility Staff ☐ Patron

☐ Teacher/Instructor ☐ Contractor

☐ Other [specify]:

INCIDENT RESPONDED TO BY

☐ Facility Staff ☐ Patron

☐ Teacher/Instructor ☐ Contractor

☐ Other [specify]:

QUALIFICATION OF RESPONDENT

☐ Senior First Aid ☐ Pool Lifeguard

☐ Bronze Medallion ☐ CPR

☐ Swim/Gym Instructor ☐ Nil

☐ Other [specify]:

EQUIPMENT USED

☐ Throw Bag/Rope ☐ Reach Pole

☐ Life Ring/Tube ☐ Spinal Equipment

☐ Other (specify):

INCIDENT REFERRAL

☐ Hospital by Ambulance ☐ Patron's Doctor

☐ Hospital by Car ☐ Doctor [Local]

Ambulance Called: ☐ Yes ☐ No

Time Called: Time : am pm (circle)

Hospital/Ambulance Details:

INCIDENT PREVENTION

☐ Report to Supervisor

☐ Fault report

☐ Temporary Signage

☐ Permanent Signage

☐ Hazard Report

☐ Guest Education

[Description]:

Other:

ALL ACTIONS COMPLETED AND SIGNED OFF

Centre Manager's Name:

Centre Manager's Signature:

Slip / Trip / Fall Details

PREVENTION [SLIP/TRIP/FALL]

Cause Slip/trip/fall

☐ Running

☐ Change of Direction

☐ Slippery Surface

☐ Uneven Surface

☐ Other [specify]

Surface Report Undertaken: ☐ Yes ☐ No

Area Taped Off: ☐ Yes ☐ No

Surface Report Attached: ☐ Yes ☐ No

Summary Action Required:

Staff Signature:

SLIP/TRIP/FALL FOLLOW UP

Outcome(s) of Surface Report:

Date of any Proposed Remedial Works: / /

Date of Works Completion: / /

Outcome of Remedial Works:

Follow Up Report Completed: ☐ Yes ☐ No

Details:

ALL ACTIONS COMPLETED AND SIGNED OFF

Centre Manager's Name:

Centre Manager's Signature:

POOL CONCOURSE *GUIDELINES* APPENDIX 2

APPENDIX 2

TECHNICAL REPORT PREPARED BY UNIVERSITY OF BALLARAT

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Technical Overview

Injury Data

As part of the ARV Pool Concourse project, injury and attendance data was requested from a number of community aquatic facilities in Victoria, to develop an understanding of the current injury rate from slips, trips and falls (incidents) at public pools. These data are reported in below, and show that injury data varied widely across venues, ranging from 184 incidents recorded in a three month period at one venue, to zero recorded over the four years that another venue had been in operation. For almost all venues, it was not possible to determine injury rates (e.g. the number of slips, trips and falls injuries per 100,000 visits) as attendance figures could not be matched to injury reports. Typically, attendance figures related to financial years (July-June) while injury data was collected over calendar years. In addition, the accuracy of the recorded injury data is not certain, as reporting detail appeared to vary between venues, and we are not convinced that the data provided accurately represented the actual occurrence of injury. However, despite our concerns regarding injury data accuracy, it was clear that two of the venues that provided data had a far higher frequency of injuries than the other venues.

While there is confidence that injury frequency was higher at these two venues, we are unsure of the certainty of differences between other venues. The variations in injury frequency may have been due in part to the specific focus on injury and through recording of all slips and falls data within some venues, and a less systematic approach at other venues, along with inconsistencies in what was defined as 'injury' between venues and staff at venues. Factors likely to contribute to variation in accuracy of recorded injury data include differences in the procedures in place for recording incidents, along with the motivation of staff on duty, who may not have considered some incidents serious enough to warrant documenting. A lack of standardised documentation procedures, form design, injury definitions, and training in incident recording for staff are factors that are also likely to contribute to differences between venues in injury records. Consequently, for the limited data available and various periods for which data were recorded, there appears to be little difference in injury frequency, with the exception of two venues. However, surveillance is an important factor in injury prevention and therefore it is crucial to highlight the need for accurate and consistent recording of all injury incidents.

It was not possible to perform statistical analysis, nor to make comments about relationships between concourse surface and injury data, primarily as the data were limited to one venue with each concourse surface and thus trends cannot be determined. Further, whether other factors (e.g. cleaning protocol; adequacy of maintenance; effectiveness of staff warnings; injury report procedures) may be acting as potential confounders when considering concourse surface and the frequency of incidents was not considered. When assessing injury risk, consideration should also be given to the injury trends over time, to determine whether injury increases as the quality of the pool concourse deteriorates, or whether with appropriate maintenance the performance outcomes of pool concourses are maintained.

Technical Document Information

Whilst the purpose of this technical document was to examine the literature relating to slips, trips and falls around pools, the dearth of published work based on pool settings both within Australia and internationally, necessitated a broader approach. Consequently, this review encompasses an overview and discussion of the literature of unintentional slips, trips and falls in baths and showers, environments with many features similar to the public pool setting. The published standards relating to pools are also scrutinised; and recommendations listed which have relevance for pool surface selection.

Literature Review

Unintentional slips, trips and falls in the workplace and at home constitute a large and costly public health problem (Beschorner, Redfern, Porter et al., 2007; Ozanne-Smith, Guy, Kelly et al., 2008), impacting on quality of life (Tinetti & Williams, 1997, 1998) and contributing to premature mortality (Keene, Parker & Pryor, 1993). This problem is recognised globally, with falls the second leading cause of unintentional injury related death, behind road traffic accidents (Courtney, Chang, Grönqvist et al., 2001a; Ozanne-Smith et al. 2008). In Australia, falls account for approximately one-fifth of all fatal injury and about one-third of all injury hospital admissions, and this rate increases rapidly with age (Australian Institute of Health and Welfare, 2010). A pilot study conducted in Australia reported that for 11% of injuries recorded in 18 Victorian public swimming pools over 18 month period, the mechanism of injury was categorised as 'fall' (Matthews, Thom & Franklin, 2008).

Whilst the contribution of slipperiness to the overall burden of incidents is considered to be substantial, it is not well understood (Courtney, Chang, Grönqvist et al., 2001b). This lack of understanding has been attributed to the difficulties associated with defining and measuring slipperiness in ways which are consistently relevant to different settings (Courtney et al., 2001a). In a recent publication, slipperiness was defined as "conditions underfoot which may interfere with human beings, causing a foot to slide that may result in injury or harmful loading of body tissues due to sudden release of energy" (Grönqvist, Chang, Courtney, et al., 2001, p.1102). Whilst this definition appears sound, understanding what causes slip-precipitated injuries is challenging due to its multifaceted nature and the interaction of human (gait; health of the sensory system i.e. vision, vestibular, proprioception; and health of neuromuscular system) and environmental factors (surface roughness; topography; lighting; and tread and wear properties of shoe) (Redfern, Cham, Gielo-Perczak, et al., 2001).

Further, despite the development of numerous apparatus (at least 70 cited in the literature) developed by organisations, individuals and federal agencies for the measurement of slip-resistance, no method or apparatus has achieved universal acceptance, and in the real world setting all devices have notable advantages and limitations (Lin, Chiou, Cohen, 1995). In addition, whilst guidelines and standards have been developed for measuring slip resistance of products such as bathtub and shower surfaces, ceramic tiles, floor polish and shoe soles, most guidelines and standards relate to the evaluation of new surfaces, without considering the ongoing assessment of slip-resistance throughout the lifetime of the concourse (Lin et al., 1995).

While there is an absence of slips, trips and falls literature related to pool concourses, it is well documented that bathtubs and showers are a common source of unintentional slips, trips and falls (Siegmund, Flynn, Mang et al. 2010; Spencer, Shields, Smith, 2005), with slips, trips and falls accounting for over 80% of child injuries in bathtubs and showers (Spencer, et al., 2005; Mao, McKenzie, Xiang, et al., 2009). Entering and exiting a bathtub requires individuals to step over the bath apron as they move between two dissimilar and potentially slippery surfaces (Siegmund et al., 2010), and this transition between surfaces is comparable to entering/exiting a free standing shower. Transitions between different surfaces at swimming pools can be considered to be problematic in the same way. Steps, ramps, and changes of direction due to the presence of other people further complicate

this problem. For children, whilst there has been much published on child bathtub submersions and burns/scalds, there is relatively little peer-reviewed information which investigates the underlying mechanisms of slips and falls in bathtubs and/or showers (Spencer, et al., 2005). This dearth of specific research may be attributed to the lack of an appropriate standard for bathtubs, showers and pools, and importantly, the challenges associated with measuring slip-resistance in a real world context. This measurement challenge also translates to the swimming pool environment.

In the United States, Spencer et al. (2005) used records from the emergency department of a paediatric trauma care centre (average 70,000 visits per year) to establish the epidemiology of childhood bathtub related injuries. Emergency department records over a three year period were examined, with 204 bathtub related cases identified among infants, children and youth aged 4 months to 16 years. To supplement the information available from medical records, parents of 40% of patients completed a follow up survey which contained questions about the bathing environment pre and post injury. The majority (87.1%) of injuries occurred in the home settings, and in children younger than four years (80.9%). Of the identified injuries, slips and falls were the most frequent mechanism (82.3%), followed by "other" (11.8%) which was reported to include injuries from hitting head/chins against the bathtub and/or scraping body parts against fixtures. The survey indicated that 82.3% of respondents had made changes to the bathing process or environment following the injury, including closer supervision; change in rules; and addition of slip-resistant surfaces either inside or outside the bath.

Using a retrospective design, Mao et al., (2009) investigated mechanisms associated with slip, trip and fall injuries in bathtubs and showers among US children aged 18 years or less. Bathtub and shower related injury data from 1990 to 2007 were obtained from the National Electronic Surveillance System (NEISS), using NEISS consumer product codes. The NEISS collects data from 100 emergency departments in the United States and consequently, provides a large, nationally representative sample of bathtub and shower related injuries. A limitation of this study is that it did not consider individuals who were treated in other medical settings, or did not seek medical attention and hence is likely to have underestimated the true rate of slip, trip and fall injury occurrence. Further limitations of the data were that fatalities were not well captured on the NEISS, as fatal cases are generally not treated in the emergency department. All analyses were performed with data weighted to represent national estimates, and consequently over the study period, there were an estimated 791,200 (95% CI 673,108 to 909,200) bathtub and shower related injuries, an average of 43,600 (95% CI 42,242 to 45,664) cases per year. In cases where the place of injury was known (85.2%), the majority (97.1%) occurred in the home, with most injuries (71.3%) taking place in the bathtub. As was the case in Spencer et al., (2005), the most common injury mechanism was a slip, trip or fall, accounting for 81.0% of cases (4.6 injuries per 10,000 US children per year). User impact was the second most common mechanism (9.3%), however, neither further definition nor detail was provided as to what this entailed. Not surprisingly, young children (≤ 4 years) accounted for 54.3% of all injuries, and the percentage decreased with child age (5-9 years = 22.2%; 10-14 years = 12.1%; and 15-18 years = 11.4%). Whilst these findings relate to bathtub and shower related injury, the commonalities between the bathroom environment and the swimming pool environment mean the findings are highly relevant.

In the United Sates, a voluntary standard exists for bathtub surfaces (ASTM F462-79) which stipulates that bathtub surfaces must have a static coefficient of friction (COF) of 0.04 or higher (American Society for Testing and Materials, 2007). This value, for bath and shower surfaces, was determined based on test results of 50 different bathtub and shower surfaces (e.g., porcelain enamel, ceramic tile, acrylic, cast iron, etc), and setting the standard two times the highest tested static COF of a non-textured bathtub (Friedlander, 2008; Spencer et al., 2005). However, it appears that the adequacy of the standard to prevent slip, trip and fall injuries in the real world have never been validated (Spencer et al., 2005). Perhaps because of this lack of empirical evaluation, many bathtubs are considered to meet the ASTM standard (Spencer et al., 2005), but bathtub and shower related injuries, especially those attributable to slips, trips and falls, continue to represent a common source of injuries for children, and particularly for those under the age of four years (Mao et al., 2009; Spencer et al., 2005).

In an investigation of childhood bath-related injuries, Spencer et al. (2005) identified important limitations related to the ASTM standard, and suggested that a revised voluntary standard should be considered with an aim to provide greater protection against bathtub slips, trips and falls. The identified limitations of the ASTM standard may in part, explain why slips, trips and falls continue to be the main injury mechanism in bathtubs. The major criticism identified by Spencer et al. was the relatively arbitrary method for establishing the surface performance criteria of static COF, described above. As a consequence of this somewhat subjective determination of static COF, the current ASTM standard specifies the COF for bathtub and shower surfaces as 0.04, which interestingly, is significantly lower than the widely accepted static COF of 0.50 for walking (Friedlander, 2008). It is hardly surprising that slip, trip and fall related injuries continue to occur.

Spencer et al. (2005) believed that the safety threshold for the COF should be based on demonstrated ability to prevent slip, trip, and fall injuries under real world conditions, which in a bath environment, includes wet and soapy conditions (water, soap, oil, and dirt) and consideration must be given to human movements within the bath. Spencer et al. further identified that consideration should be given to the safety threshold values for adults with long strides as opposed to children with a very short stride; and to the examination of methods to maintain the slip resistance properties of the bath throughout its lifetime. In the same light, when applying the approach of Spencer et al. to consideration of the swimming pool environment, it would be appropriate to take into account the specific circumstances of pools, such as level surfaces, ramps, steps, changes of direction and transitions between different surfaces, as well changes in surfaces over time.

Falls are also a significant and common problem among older people. It has been estimated that in Australia, 30% of community dwelling adults aged over 70 years fall each year, and this proportion increases to 40% for those aged over 80 years (Dolinis, Harrison & Andrews, 1997). Approximately 20% of people who fall require medical attention for neurological, soft tissue or fracture injuries (Bradley & Pointer, 2008; Hall & Hendrie, 2003; Mao et al., 2009). The Victoria Injury Surveillance System data shows that private homes are the most common location for falls within this age group (Day, Kent & Filfes, 1994), with the predominant mechanisms being steps and stairs; chairs; and floors and flooring materials. In the majority of cases which were attributed to flooring, slipperiness (38.8%) and wet flooring, the laundry and bathroom/toilet (24.7%) were most frequently identified locations. Whilst the home is the most frequent location for falls among older people, consideration of older adults in swimming pool environments is also important, as many older people choose swimming as a fitness activity because of the lower level of joint stress that comes from exercise in the water environment (Cress, Buchner, Prohaska et al., 2006; Macera, Hootman & Sniezek, 2003). The decrease in mobility that accompanies ageing is likely to place these older adults at even greater risk of injury at swimming pool environments. Unlike the literature regarding children, no published peer reviewed articles were retrieved which considered bathtub and shower related injuries in the older population. For this reason, Mao et al., (2009) identified this population as a priority for future research.

It is not surprising that a large proportion of slip, trip and fall injuries occur in the home, as we spend much of our time in our homes. The public swimming pool environment has many characteristics in common with bathtubs and showers, and action must be taken to minimise slip, trip and fall injuries at these venues. However, there is little published peer-reviewed information which considers slip and falls in swimming pools. The Australian publication, Guidelines for Safe Pool Operation, contains little information relating to concourse surfaces, with only one requirement which is specific to slip resistance "4.2.2 – All wet and potentially wet circulation areas should have a slip resistive and non-abrasive surface conforming to the recommendations of Standards Australia Handbook 'HB 197 – An Introductory Guide to the Slip Resistance of Pedestrian Surface Materials" (RLSSA, 1996). This is of concern as, similar to the voluntary standard for bathtubs, there appear to be a number of limitations associated with the slip resistance test methods included within the Australian/New Zealand Standard AS/NZS 4586 (Standards Australia/Standards New Zealand, 2002), particularly when applied to pool environments.

Slip Resistance Test Methods: AS/NZS 4586

The Australian/New Zealand Standard AS/NZS 4586 "*Slip resistance classification of new pedestrian surface materials*" provides four test methods (wet pendulum; dry floor friction test; wet/barefoot ramp; and wet-oil ramp) as a means of classifying slip resistance (Standards Australia/Standards New Zealand, 2002). Although three of these methods may be used for the classification of wet surfaces (wet pendulum; wet/barefoot ramp; and wet-oil ramp), it is acknowledged that some test methods will be more appropriate in specific circumstances (Bowman, 1999). When considering the suitability of the wet surface tests for pool settings, the wet-oil ramp method is problematic. The test protocol requires that the test person wears shoes (with the outsole moistened with lubricant), and that the surface being tested is evenly coated with 100 ±1 mL of engine lubricating oil. These conditions are not representative of the pool concourse, where pool users are typically bare foot, and water, not engine oil, is present on the concourse surface. Other substances, such as soap and body oils, may also be present, depending on maintenance schedules. For these reasons, further details relating to the wet-oil method of slip-resistance testing will not be provided.

The wet pendulum test method determines the wet dynamic friction between the concourse and the slider of a pendulum swinging in a vertical plane (Standards Australia/Standards New Zealand, 2002). Whilst this method appears more appropriate for pool slip resistance testing than the wet-oil ramp method, its major limitation is that rubber (used on the bottom of the pendulum) has not been shown to be analogous to human skin (Bowman, 1999). Although one type of rubber (Four S rubber) used in this test simulates a standard shoe sole (Standards Australia/Standards New Zealand, 2002), further modifications are necessary to improve the relevance of this test method for pool settings. Of importance, the surface on the bottom of the pendulum should be modified to emulate, as closely as possible, the skin on the bottom of the human foot. Synthetic skin, used as a simulated skin covering in artificial limbs, should be tested to determine whether it is appropriate for this purpose.

Because of the problems associated with the use of rubber as a skin substitute in the wet pendulum test, the wet barefoot ramp test has been recommended instead, as the best indication of slip resistance for areas such as bathrooms (Bowman, 1999). However, like the other slip resistance test methods, the protocol associated with this test also lacks relevance for pool settings. For example, the material being tested is subject to a continuous and uniform stream of water/test fluid at 6 ±1 L/min (Standards Australia/Standards New Zealand, 2002), thus not replicating the circumstances of pool concourse surface where water could be pooling in some areas, dry in others, or some combination of the two. Further, the test person's feet are soaked in water at 23±5ºC for at least 10 minutes prior to the test (Standards Australia/Standards New Zealand, 2002), which again is not realistic to a pool setting. Another major limitation identified in this test protocol is that it does not account for characteristics of individual gait or normal gait. Subjects are required to take steps about half the length of their foot (Standards Australia/Standards New Zealand, 2002) and consequently it is unlikely to reflect how people will be moving in the pool surrounds.

Unfortunately, limitations associated with slip resistance tests (for use in 'wet' or 'dry' conditions) have been poorly identified, and consequently too much faith has been placed on the accuracy of results (Bowman, 1999), particularly when applied in pool environments. Whilst the wet pendulum or wet/barefoot ramp method of testing slip-resistance appear the most appropriate of the four existing tests for assessment of pool concourses, they should not be relied upon as they do not replicate conditions which occur in pool settings. Therefore, it is imperative that the Australian/New Zealand Standard "*Slip resistance classification of new pedestrian surface materials*" be re-evaluated, specifically to cater for the slip-resistance tests in settings such as pools. Currently, the standard that is relied upon for surface selection and for legal defence for injury claims does not meet the specific needs of the pool environment. This may partially explain why some venues have higher slip/fall rates even though their surfaces have passed the slip resistance test.

Further, when assessing slip and fall related risk in pool settings, a number of additional factors beyond the surface must be accounted for, including human behaviour such as adaptation to risk, anticipation of hazards, and risk taking; environmental conditions, including lighting, state of floor surface, and tidiness; and work tasks, for example walking, carrying, lifting (Grönqvist, Hirvonen, Rajamäki, et al., 2003). These other factors notwithstanding, evaluation and improving the relevance of the current Australian/New Zealand Standard "*Slip resistance classification of new pedestrian surface materials*" to cater specifically for pool settings where bare foot motion on wet surfaces prevails, offers the best opportunity to prevent injuries associated with slips and falls in pool settings.

Comments

The review of literature confirmed that peer reviewed literature related to pool concourse injuries is non-existent. We recommend that this is an area for future research. However, based on our findings, we make the following comments:

1) The current Australian/New Zealand Standard "*Slip resistance classification of new pedestrian surface materials*" has significant limitations when applied to the swimming pool environment, and should be used with caution. The development of a standard more relevant to the pool concourse setting is recommended which should consider the characteristics of public pools, including (but not limited to) use of the surface by patrons in bare feet; variable amounts of water on the concourse surface; the presence of body oils and/or soap; newly applied surfaces, and surfaces that have been subjected to wear.

2) The yet to be developed standard should also require retesting of concourse surfaces at specified intervals for the lifespan of the surface.

3) Until a standard is developed that is more closely matched to the pool environment, advice should be sought from managers of current aquatic facilities when considering the appropriateness of various surfaces.Interested parties should visit sites and discuss with facility managers the benefits and disadvantages of the various surfaces at a range of venues, including information on injury history of that surface.

4) Aquatic centre managers should consider other factors which can impact on slip, trip and fall likelihood, such as lighting, state of floor surface and tidiness, and should act to ensure each of these is maintained at optimal levels.

5) At point of handover of a facility, sufficient information should be provided with regard to maintenance regimes, to ensure that concourse surfaces can be adequately maintained to avoid changes in surface characteristics that may increase the likelihood of slips, trips and falls.

6) To accurately track injury incidence and to facilitate comparisons of injury incidence between different venues and across different surfaces, an improved, standardised injury report form should be developed and adopted across the aquatics industry. Data to be recorded could include (but not necessarily be limited to) factors such as age; activity undertaken at the time of the slip/trip/fall; first aid or medical treatment required; a surface report; and action required to minimise a repetition of the injury.

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