TARMAC

DECORATIVE CONCRETE

SOLUTION GUIDE

CONTENTS

GLOSSARY

Slip Resistance

The ability of a surface or material to resist the movement of an object across a surface or the ability to reduce the risk of slipping. Slip resistance is determined through BS 7976-2:2002[1].

Abrasion Resistance

The ability of a material to withstand wear, determined through the test methods set out in BS 13892-4:20022[2].

Chemical Densifier

A densifier is a chemical compound which is applied to concrete surfaces that reacts with free calcium carbonate to increase surface strength[3].

Aggregate Package

The mix of constituent aggregates used to create the concrete whose composition has a fundamental effect on the final aesthetic finish.

Volatile Organic Compound (VOC)

Compounds which when released into the atmosphere have the potential to have a detrimental effect on the health of people[4].

Thermal Mass

Describes the ability of material to absorb, store and release heat energy[5].

Reflectance

Describes and defines a materials ability to reflect solar energy, also commonly referred to as albedo[6].

Thermal Comfort

Describes a person's state of mind in terms of whether they feel too hot or cold[7].

Diurnal Temperature Variation

It is the daily temperature shift that occurs between daytime and night time temperature[5].


WELCOME

Our approach to construction encompasses innovative sustainable products, efficient building systems and practical solutions. We recognise the important role we have in promoting sustainable construction by optimising our products, their use and whole life performance. This document is one of a suite that identifies specific construction solutions that can help deliver a sustainable built environment. They explore the details of each system, its performance benefits, how it can be implemented in a project and then compares its environmental performance against alternative solutions.

This document introduces our decorative concrete solutions which contribute to the construction of buildings that are that are easy to build, responsive, efficient, long lasting and robust.

Typical Applications

Any internal floor that requires an aesthetic finish.

INTRODUCTION

Decorative concrete is an ideal internal flooring solution due to the range and variety of finishes that can be achieved in combination with its inherent strength and durability. The flexibility of concrete enables unique and individual designs to be created along with the matching of new and existing materials.

Concrete floors not only offer an architecturally and visually stimulating solution but a solution which embodies all the commonly accepted beneficial properties of concrete and builds upon them.

Further benefits can be sought through the consideration of the role that materials can play in providing thermal comfort and energy savings in regards to the optimisation of thermal mass.

Location: Eastlands, Manchester
Client: Manchester City Council
Main contractor: Sir Robert McAlpine
Year: 2011
Floor surface area: 10,000m^2
Project value: £20m

THE NATIONAL INDOOR BMX CENTRE

The National Indoor BMX Centre houses a 2,000 seat arena with a column-free 70m by 100m track. It is the second largest purpose built BMX stadium in the world and the only permanent indoor track in Britain. Retail and café facilities, along with offices to form the headquarters of the British Cycling Team also formed part of the scheme.

The BMX Centre is directly linked to the Manchester Velodrome, together forming the National Cycling Centre.

Requiring an architecturally impressive linkage between the two centres the concourse area was a fundamental addition to the National Cycling Centre. Decorative concrete floors were selected due to their ability to enhance the aesthetics of the concourse space, whilst maintaining structural and performance characteristics expected of other more traditional finishes. Toptint Polish offered a unique finish due to the flexibility of concrete design through variations in cement type, aggregate package and pigment.

The completed concourse helped create a striking first impression of the BMX and National Cycling Centre. The solution provided an internal floor of high reflectance enabling light levels to be maintained and distributed throughout the internal space, whilst providing safe levels of slip resistance. Durability, low maintenance and an ease of cleaning were further requirements satisfied by this solution.

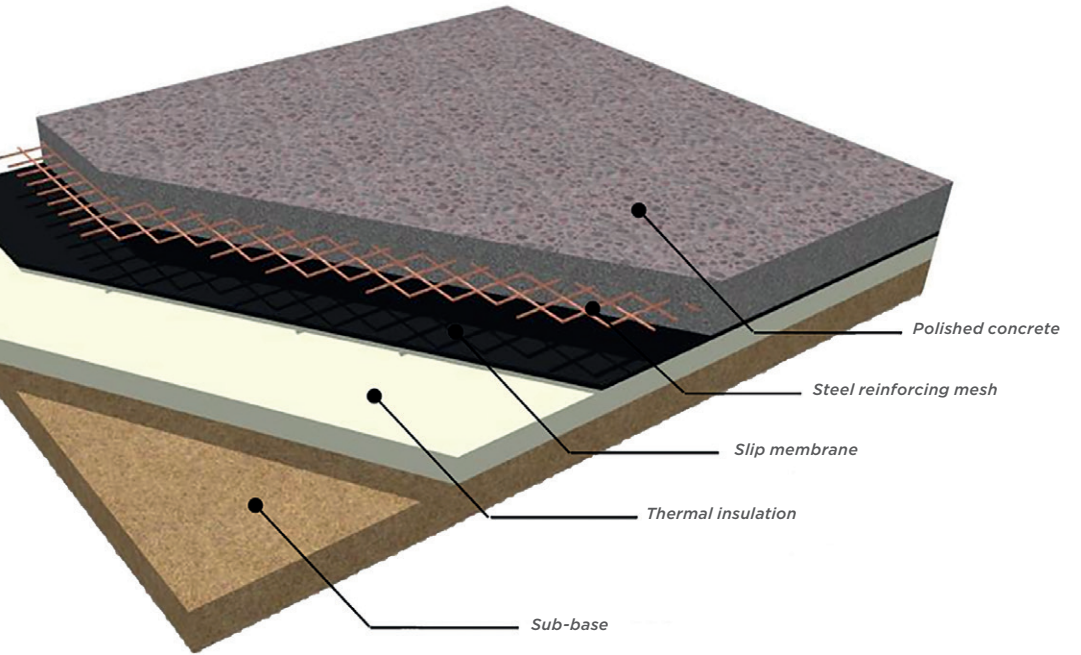
A visual link was created with the external landscape through the use of Toptint Exposed in landscaped areas. The link was achieved through the ability to use the same decorative aggregate package in both the internal and external concrete mix designs, enabling a holistic aesthetic vision.

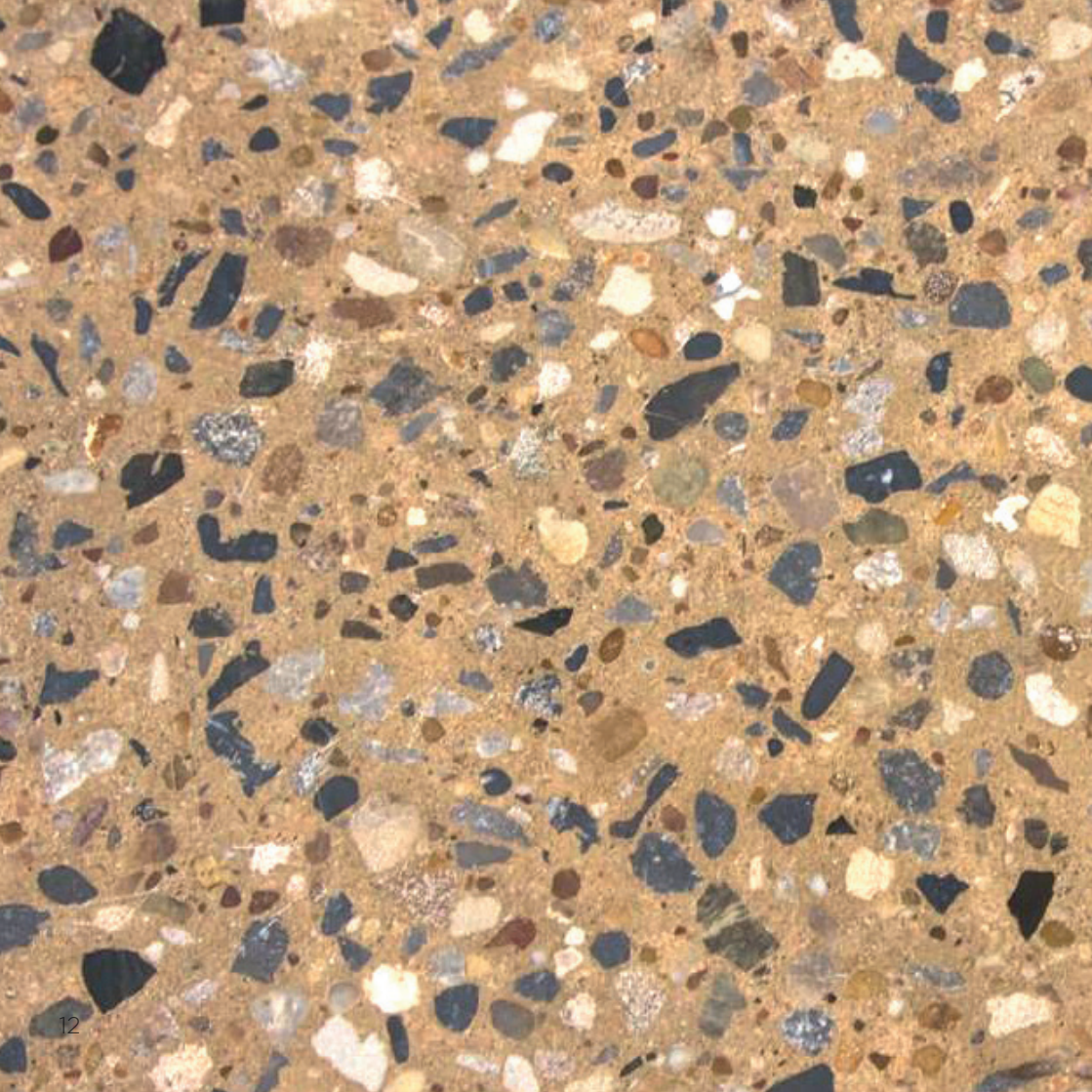
Creating a decorative polished floor requires a specially formulated mix design to achieve the highest quality finish possible for horizontal applications.

Once traditional placement activities are completed a polished finish is achieved by the grinding of the hardened concrete surface with progressively finer tools until the required polished finish is achieved. During this process chemical densifiers can be added to increase the surface durability[3].

Decorative aggregates and colour pigments can be added to create a wide variety of individual and unique options enhancing aesthetics.

This floor solution retains the beneficial properties of concrete, maintaining slip resistance whilst improving abrasion resistance and light reflectivity, in conjunction with lower maintenance requirements[9].


Polished concrete
Steel reinforcing mesh
Slip membrane
Thermal insulation
Sub-base



Aesthetic concrete is an ideal internal flooring solution due to the range and variety of visual finishes that can be achieved. The flexibility provided by concrete mix design enables unique and individual designs to be created but also the matching of new materials to existing schemes.

VARIETY OF FINISHES

Concrete can offer a range of aesthetic finishes through the adaptation of mixes to include different decorative aggregates and pigments dependent on project and client requirements. Further to this surface or deep polishing can be employed which varies the exposure of aggregates.

A surface polish only sees the very top surface of the concrete ground off o create a fine ultra smooth surface[10]. The finish exposes sand grains giving a speckled, yet mostly single coloured appearance.

Deep polishing removes several millimeters of the surface revealing the larger internal aggregates but maintaining the same fine ultra smooth surface finish achieved surface polishing[10].

DURABILTY AND LOW MAINTANCE

Polished concrete floors offer improvements in durability over more traditional floor finishes due to their inherent robustness abrasion resistance, when compared to conventionally finished concretes[11].

Durability can be further enhanced by the use of chemical densifiers which reduce the porosity of the surface[3].

Maintenance is simplified as a light clean with soapy water is satisfactory, however a number of proprietary systems exist.

LOW VOC EMISSIONS

Concrete is a relatively inert material that once in the hardened state releases relatively small amounts of VOCs into the internal environment when compared to other construction materials[12].

The use of decorative concrete also reduces the requirement for additional surface coverings which have the potential to create additional sources of VOC emissions.

ABRASION RESISTANCE

The abrasion resistance of a slab is a function of a number of different factors relating to its constituent materials and the method of placement.

Surface and deep polished slabs have been tested in accordance with BS 8204[13] to determine their abrasion resistance.

Surface polished achieved the higher classification of AR Special/DF with deep polished classified as AR1/DF[11].

SLIP RESISTANCE

Highly polished surfaces can raise concerns of slipping in both wet and dry conditions.

To alleviate these concerns Aston Services[14] were employed to undertake slip resistance testing of both deep and surface polished solutions.

Testing was carried out in line with BS 7976-2 (2002)[1] and both solutions were determined to have a 'low slip potential' in all conditions (HSE classification[15]).

OPTIMISATION OF THERMAL MASS

Decorative interior concrete floors enable the optimisation of a buildings existing thermal mass or the opportunity to add beneficial thermal mass.

A buildings thermal mass defines its energy storage potential, the more thermal mass the higher its capacity to store energy[16] and its ability to aid heating and cooling demands[17].

During the cooling season thermal mass absorbs excess heat energy generated through solar gain, equipment and occupants reducing the potential risk of overheating[5]. This can delay and reduce peak temperatures until after typical operating hours, and once external temperatures have begun to fall, improving the thermal comfort of occupants[18] whilst reducing energy demands[17].

In order to facilitate continued performance it is necessary to remove the stored energy from the mass. This can be achieved by utilising natural methods in line with the UK's night time diurnal temperature variation[5].

Further benefits can be sought during the heating season as the concretes thermal mass can capture incidental energy gains releasing the energy as internal temperatures drop to assist in maintaining internal temperatures[5].

The long term effect is that the utilisation of thermal mass can help maintain and more effectively manage a stable internal temperature, whilst reducing energy demands.

IMPROVED DAYLIGHTING

Concrete can improve natural daylighting levels due to its naturally high levels of reflectivity when compared to other traditional finishes[6]. The flexibility of concrete mix design enables the utilisation of cements and aggregates which possess characteristics that can further enhance reflectivity for example white cement[19]. Polishing interior concrete can further increase light penetration as reflectivity is increased, although care must be taken to minimise any glare issues as this can have a detrimental effect on user comfort.


WELCOME
NATIONAL CYCLING CENTRE

While traditional and conventional construction methods are used to create decorative concrete floors, some additional steps and precautions are required to ensure a high quality finish.

Please note that the Toptint colour chart is intended to provide an indication only of the colours available. As Toptint uses naturally occurring materials, the exact shade and finish achieved may vary. Please speak to your local representative who will be able to advise further.

PRE-CONSTRUCTION PLANNING	
Jointing and bay sizes	All cementious products are subject to expansion and contraction which can be exacerbated in large horizontal concrete pours. Joints should be created to accommodate expansion and shrinkage to avoid uncontrolled cracking which can have severe detrimental effects on floor life span and aesthetics. Bay sizes should be limited to 36m² and have an aspect ratio which is no greater than 2:1.
Slab formation levels	Polishing causes a reduction in slab depth reducing final finish levels, adjustments should be made to formation levels in conjunction with the polishing contractor and material to supply to allow for level changes.
Material specification and delivery	Material producers and suppliers should be included at early project stages to determine product requirements and assist in project planning. Early consultation will assist in avoiding supply and availability issues occurring if specialist aesthetic materials are required.

CONSTRUCTION PROCESS	
Final flatness	High quality aesthetic finishes require low surface flatness tolerances as unevenness can detrimentally affect the polishing process. Slabs should be laid to and satisfy the flatness criteria of SR1 in line with BS 8204:1[13], where there is less than a 3mm deviation over a 2m straight edge.
Contamination	Steps should be taken to avoid contamination by minimising and where possible avoiding the trafficking of materials and vehicles through and in the vicinity of the pour area. Access to site personnel should also be limited, as this can also increase risks of contamination and the visibility of foreign materials in the final finished floor.
Placement methodology	Appropriate concrete placement methodologies should be formulated by the flooring contractor and polishing contractor dependent on the type of finish required (surface or deep polish). Consultation should take place with the contractor to ensure that the desired aesthetics can be achieved and it is recommended that trials are carried out and a sample panel created for reference purposes.

SUSTAINABILITY

Selecting decorative concrete as final finish for floor slabs in place of more traditional floor coverings such as tiles enables further environmental improvements to be delivered.

EMBODIED ENERGY

Utilising an integral structural concrete to provide a decorative final finish over natural and processed stone tiles creates the opportunity to reduce embodied energy in constructed elements. Natural and processed stone production (i.e. marble and terrazzo) embody a similar amount of energy as concrete[26]. A decorative concrete finish requires no additional material other than that required to ensure structural performance, removing the additional embodied carbon from a constructed element related to the use of additional materials such as tiles.

RESOURCE DEPLETION

Utilising the structure of a floor to create the final finish through the specification of a decorative concrete finish can have significant positive effects on reducing material consumption. Any other finish specification will require the additional use of materials which may be from finite or virgin sources increasing resource depletion.

RECYCLING

The concrete industry has taken significant steps to improve its performance in terms of material reuse, reducing the depletion of abiotic resources, increasing energy efficiency and reducing carbon emissions. Significant improvements have already been achieved compared to the industry's 1990 baseline[20].

With respect to material reuse and the depletion of abiotic resources, concrete readily utilises recycled and secondary materials along with cement replacements. This has enabled the industry to be a net user of waste, using 47 times more waste than it generates[20], and concrete itself is also 100% recyclable[21].

BES 6001*

Tarmac has achieved an 'Excellent' rating for all its production sites and products. The independent third-party scheme assesses responsible sourcing polices and practices throughout the supply chain[22].

ISO 14001

Tarmac is fully accredited with ISO 14001, having implemented Environmental Management Systems throughout our business, maintaining our commitment to reducing our environmental impact[24].

SUSTAINABILITY ASSESSMENT SCHEMES

Concrete can play an extended role in enabling an efficient building to be created and can contribute in a number of assessment schemes and help achieve a range of credits[‡].

CREDIT/TARGET	BREEAM	LEED
	Man 03: Responsible Construction Practices Tarmac's Carbon Calculator has the capability to determine and provide data relating to the CO_2 arising from production and delivery of our products.	**MR Credit 4: Recycled content** Concrete is a versatile material whose design can be readily adapted to enable the use of recycled, secondary or replacement materials.
	Hea 01: Visual Comfort Concrete naturally offers a relatively high albedo when compared to other construction materials. Concrete is versatile so mix designs and finishes can be optimised to further improve its albedo and reflectance.	**MR Credit 5: Regional materials** Concrete is one of the few materials that is produced locally to where it is used; it can typically be supplied from within 10 miles of any given site.
	Hea 02: Indoor Air Quality Concrete can help achieve a healthy internal environment as concrete is relatively inert and emits extremely low levels of volatile organic compounds.	**IEQ 4.3 Low emitting materials – Flooring systems** As a relatively inert material concrete does not transmit odours or irritating contaminants to the air.
	Mat 03: Responsible sourcing of materials Concrete is primarily constituted of locally available materials, all concrete products produced by Tarmac are BES 6001 accredited to an 'Excellent' standard.	**IEQ 8.1 Daylight and Views – Daylight** The finishes that are achievable with concrete can offer improved reflectance characteristics, increasing daylight penetration.
	Wst 02: Recycled aggregates Concrete is a versatile material whose design can be readily adapted to enable the use of recycled, secondary or replacement materials.	

[‡] Tarmac concrete products offer the ability to conform with a wide-ranging number of assessment criteria in both BREEAM and LEED. For more information contact Tarmac sustainability team.

* Our BES 6001 certificate number for our readymix concrete products is BES 559207.


PEOPLE
Safety and health
Our people
Community involvement


PLANET
Climate change
Environmental stewardship
Resource efficiency


PERFORMANCE
Economic value
Governance and ethics
Communication


SOLUTIONS
Sustainable supply chain
Innovation and quality
Sustainable construction

OUR SUSTAINABILITY STRATEGY

Sustainability is about securing long-term success for our business, customers and communities by improving the environmental, social and economic performance of our products and solutions through their life-cycle. This means considering not only the goods we purchase, our operations and logistics but also the performance of our products in use and their reuse and recycling at the end of their life. By doing this, we can understand and take action to minimise any negative aspects, while maximising the many positive sustainability benefits our business and products bring.

Using this 'whole life' thinking we have engaged with our stakeholders to develop our sustainability strategy. The strategy defines the main sustainability themes and our key priorities, those issues which are most important to our business and our stakeholders. It sets out our commitments to transform our business under four main themes: **People, Planet, Performance and Solutions**.

Building on progress already made, we have set ambitious 2020 milestone targets for each of our key priorities. These ambitious targets have been set to take us beyond incremental improvement programmes to business transforming solutions.

FOUR THEMES

Twelve key priorities

Twelve commitments

Twelve 2020 milestones

Forty four other performance targets

Our 2020 milestones are supported by a range of other performance targets. This hierarchy helps make it easier to build understanding, drive improvement and enables us to report progress in a meaningful and measurable way.

REFERENCES

1. BS 7976-2:2002, Pendulum testers – Part 2: Method of operation
2. BS 13892-4:2002, Methods of test for screed materials – Part 4: Determination of wear resistance
3. Concrete Polishing Association – Glossary of definitions
   www.concretepolishingassociation.com/glossary.php
4. United States Environmental Protection Agency (EPA) – An Introduction to Indoor Air Quality
   www.epa.gov/iaq/voc.html
5. The Mineral Product Association and The Concrete Centre – Thermal Mass Explained (2012)
6. Marceau, M. and Vangeem, G. – Solar Reflectance Values for Concrete
   Concrete International, August 2008
7. Health and Safety Executive – Thermal Comfort
   www.hse.gov.uk/temperature/thermal/index.htm
8. Concrete Society Technical Report No. 34 - Concrete Industrial Floors: A guide to design and construction (2014)
9. Aston Services - Consulting Material Engineers
   www.astonservices.co.uk
10. Tarmac - Toptint – Contractors' Method Statement for Polished Concrete
    (Available on request)
11. Aston Services - Abrasion Resistance of Two Test Slabs: A report for Tarmac (2011)
    (Available on request)
12. Portland Cement Association: Concrete Thinking for a sustainable world – Indoor Air Quality
    www.concretethinker.com/solutions/Indoor-Air-Quality.aspx
13. BS 8204-2:2002, Screeds, bases and in situ floorings – Part 2: Concrete wearing surfaces – Code of practice
14. Aston Services – Slip Resistance of Two Test Slabs Report for Tarmac (2011)
    (Available on request)
15. Health and Safety Executive – Assessing the slip resistance of flooring: A technical information sheet (2012)
    www.hse.gov.uk/pubns/geis2.pdf
16. Reinforced Concrete Council – Fabric Energy Storage: Using concrete structures for enhanced energy efficiency (2001)

17. **European Concrete Platform – Concrete for energy-efficient buildings: The benefits of thermal mass (2007)**

18. **GreenSpec® – Thermal Mass (2013)**
www.greenspec.co.uk/thermal-mass.php

19. **The Concrete Centre – Utilisation of Thermal Mass in Non-Residential Buildings (2006)**

20. **The Mineral Product Association and The Concrete Centre on behalf of The Sustainable Concrete Forum: Concrete Indusry Sustainability Performance Report 4th Report: 2010 performance data**

21. **GreenSpec® - Reducing the Impact of Concrete**
www.greenspec.co.uk/greening-of-concrete.php

22. **Green Book Live**
www.greenbooklive.com/search/scheme.jsp?id=153

23. **The Carbon Trust**
www.carbontrust.com

24. **ISO 14001**
www.bsigroup.co.uk/en/Assessment-and-Certification-services/Management-systems/Standards-and-Schemes/ISO-14001/?gclid=CO6WrLnSgrMCFcrItAodVhwAUA

25. **GreenSpec® - Thermal Mass (2013)**
www.greenspec.co.uk/thermal-mass.php

26. **G.P.Hammond and C.I.Jones (2006) Embodied energy and carbon footprint database, Department of Mechanical Engineering, University of Bath, United Kingdom**

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