Wildflowers rule OK

Peppa Pig World is a 1.2 hectare attraction in Paultons Family Theme Park in the New Forest National Park in Hampshire. The 930m^2 main building is its first all-weather attraction, housing George's Spaceship Play Zone, retail and visitor facilities.

A huge barrel-shaped roof covers the steel and glulam structural frame, designed to mirror the contours of the landscape, rising to eight metres at its centre. A wildflower roof is a key element of the building's sustainable and carbon-neutral design by HPW Architects. Completed over four years ago, it is flourishing thanks to the clever choice of 32 indigenous plants and a computerised irrigation system. The wildflower turf covers the entire roof and from the rear, where the building is partially under a bund created using earth excavated from the site, it appears to emerge directly from the ground.

Gary Wilburn, HPW's director of design and sustainability, says: 'With the site in a national park, and in the green belt, we had to do something pretty special to get planning permission for a 10,000sq ft [930m^2] building. As a result, from the southerly aspect all you can see is a mound of earth covered in turf.'

Seven large wind catchers with built-in PV panels, positioned along the spine of the roof, are a key element of a strategy for 100% natural ventilation.

HPW specified a wildflower turf developed by Hampshire specialist James Hewetson-Brown, using only species native to the New Forest area, such as wild red clover, bird's-foot-trefoil and yellow rattle. The turf was grown in a compost mix over a membrane to create a root-like mat with an instantly mature effect, ready to be transferred to the building.

The green roof build-up was designed by Steve Vincent, project designer at Verdico, manufacturer of Verdiroof green roof systems, and supplied by SIG. It consists of a warm roof construction laid over a single-ply membrane. Designing it to cover the large and steeply pitched barrel, and to a tight budget, was arguably the biggest challenge, says Vincent: 'The traditional method of building using staggered weathered-in battens would have sent the costs over budget. Instead, a structural retainer was installed at the overhanging eaves to take the majority of the weight during construction.'

Rows of Norwegian-style sacks, filled with soil and stacked upwards from the eaves retaining girder, form the principal load on the roof. Traditionally, biodegradable hessian sacks are used, but here a non-rot plastic mesh was required to help maintain the roof's structural integrity. Further support was provided by a counter-balancing mesh sheet, laid over the top of the sacks and over the barrel of the roof from one eaves to the other.

Above Peppa Pig World's main building from the front, neatly tucked under its wildflower turf roof.
Below Excavated construction soil was used to create a bund on the rear elevation that almost hides the building.

'The wildflower turf was laid over the counterbalancing mesh sheet and roots through it into the growing medium bags to complete the structure and make it structurally sound,' Vincent explains.

A series of self-cleaning 'dripline' irrigation pipes embedded above the sacks, and under the vegetation, link into a rainwater harvesting system. Excess water is drained off through the external steel columns at the edge of the eaves and stored in a man-made lake at the rear of the building.

In dry periods, a 60mm, pressure-regulated piston pumps the water from the lake back up to the dripline. The system is computer-controlled, enabling the dripline to be activated or disabled in different parts of the roof as required.

The result, even after four years of growth, is an award-winning, nectar-rich landscape that continues to attract bees and other insects as well as encourage biodiversity across the whole park, and the only maintenance required is a 'strim' once or twice a year. ●

Walk on the wide side

There can be no leaks in the vast expanse of flat roof on Make's 5 Broadgate development

JOHN MADDEN

Left 5 Broadgate is unusually low-rise for a City building but its huge footprint means there's a lot of roof to keep watertight.

Make Architects' 5 Broadgate is a true ground scraper – a rare breed among the City of London's high-rise towers. Despite a mere 12 storeys of offices, its generous width ensures it yields over 65,000m² of high-spec office space, including four football pitch-size trading floors topped with some 7,500m² of concrete-decked roof and terraces.

Ensuring that this unusually expansive flat roof was waterproof was an absolute priority. A joint venture between British Land and Blackstone, 5 Broadgate will be occupied from next autumn by financial services firm UBS.

'When you're dealing with a project of this scale and its complexity of interfaces, water ingress is a real concern,' says Make's Ben Stuart, who was package architect for roofing, basements, structure and services. 'We had to have robust and reliable detailing delivered by contractors who could assure the highest standard of workmanship within the given timescales.'

To ensure optimum yet cost-effective waterproofing that would last a minimum of 30 years, Make worked closely with the contractor BriggsAmasco on an inverted roof system where IKO PermaTEC hot melt waterproofing was specified.

Following buildability reviews with construction manager Mace, other roof build-up options, including warm roof, were discounted because of concerns over protection of the waterproofing during construction. An important benefit of the inverted roof was that it could be installed more quickly than other systems as well as being easier to protect.

A third option was an inverted roof with cold-applied liquid plastics rather than hot melt. This was rejected for most of the main roof covering because of its shorter lifespan (20 years) and higher cost. The extra time required for hardening was also less viable in the context of the roof programme as a whole.

The speed of the hot-melt waterproofing meant Stuart was able to complete sequential quality inspections safe in the knowledge that it would then be protected immediately following the installation of the insulation and subsequent pouring of the concrete slab.

The waterproofing is part of a 600mm roof overcladding build-up consisting of a 200mm concrete slab, a 7.5mm hot-melt rubberised bitumen membrane, a 200mm thermal extruded insulation and drainage mat, and a 150mm floating slab.

The architects were advised that proper installation was vital to the success of hot-melt waterproofing and therefore increased the number of quality inspections as well as agreeing sequential sign-off inspections with Mace. This was particularly challenging for specialist contractor BriggsAmasco as installation took place in mid-winter, requiring temporary protection to ensure a dry surface.

Installation began with an independently monitored peel test before the rest of the application went ahead. First, 'latents' were ground off and the area cleaned and primed before the hot melt was applied. Twenty-four hours later, the waterproofing's bonding was tested to check that it could withstand an attempt to peel it off.

The PermaTEC system consists of high penetration primer, two coats of the 3mm PermaTEC waterproofing membrane with a PermaFLASH-R reinforcement layer in between, and the PermaGUARD-F protection sheet. All these layers were applied before the installation team began work on the next, adjacent area – unlike many cold applied liquids there is no need to wait until each hot melt layer hardens.

Leak testing

After 15 minutes, the roof was ready for the next stage. Electronic leak testing was carried out to identify any problems and localised repairs made. This was followed by installation of extruded polystyrene insulation board – Roofmate SL-A – then the IKO Plasdrain 6 loose-laid drainage mat. This was all topped by the overslab of 150mm poured concrete with pavers and ballast used in areas of light traffic.

For the roof of 5 Broadgate, the most challenging aspect was designing waterproofing solutions for about 100 vertical roof penetrations by perimeter structural steel elements and posts/columns.

Here, Make helped the contractor develop the most robust approach to a tailored 'pitch pocket' which was able to deal with each situation. Typically, a concrete upstand of 50mm was constructed around the vertical penetrations. This acts as a first line of defence and lifts the waterproofing detail out of any standing water. Then, a minimum of 50mm galvanised formwork was bonded into hot melt to form a pocket around the penetration, and the pocket filled with more PermaTEC hot melt, with protective felt on top. A key advantage of using a hot melt pitch pocket is that it remains soft, so when the steel expands in the summer, the hot melt will be able to move with the column.

Special solutions

For six tricky cross-brace connections, a special solution was required for the junction between columns and cross bracing, which might be susceptible to pooling water despite a pitch pocket detail. The solution was IKO Polimar EC/UV cold-applied liquid waterproofing around the connection plate over the PermaTEC pitch pocket.

The crucial area to solve was the 15m spliced support truss. An unexpected issue was that the bolts connecting the splice plates were cast into the structural slab at the perimeter, and so required a rethink of the waterproofing detail. The solution was a bespoke cover with base flashing over the truss followed by the PermaTEC hot melt system then a complete covering of liquid waterproofing. This was subjected to a 48-hour flood test to ensure complete water tightness and created a successful hybrid system of hot melt and cold liquid applied plastics.

Such bespoke hybrid responses to the challenges of the various roof penetrations were essential.

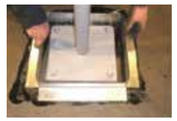
'The success of the roof waterproofing was a team effort, including contractor, architect and construction manager, in order to manage the complexity and maintain the high standard of workmanship,' says Stuart.

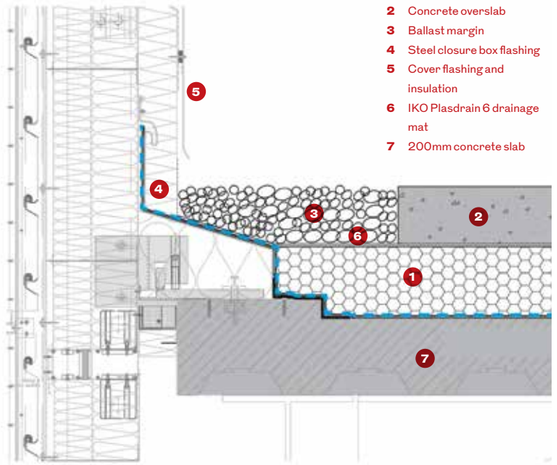
Conceived as a single cast element with glazing confined to necessary areas, it was awarded a BREEAM Excellent rating at design stage with the roof achieving a U-value of 0.20. This helps contribute to 5 Broadgate's energy conservation levels being nearly 50% better than regulations require. ●

Right The scope of 5 Broadgate's roof.

Below right A cold-applied membrane was used around the cross-bracing connection. This is cheaper than a pitch pocket and much simpler to apply in a tight area.

Below Pitch pockets used for all vertical penetrations. In sequence, from top: Minimum 50mm galvanised metal formwork bonded into hot melt.
This is then secured with more hot melt or mechanically fixed.
Filled with PermaTEC hot melt.
Protection felt then covers the pitch pocket.





1 PermaTEC primer with two coats of PermaTEC waterproofing membrane, PermaFLASH-R reinforcement, Perma-GUARD-F protection sheets
2 Concrete overslab
3 Ballast margin
4 Steel closure box flashing
5 Cover flashing and insulation
6 IKO Plasdrain 6 drainage mat
7 200mm concrete slab

Let's have some hush

Meeting BB93 guidance on noise levels in schools is so much easier if you get expert advice at the outset, says Martin Jones

Silence is golden in schools – or at least something to aspire to. Concentration levels diminish rapidly in noisy environments, so mitigating such distractions in educational settings, beyond the inevitable din of the kids themselves, is enshrined in regulation.

Guidance note BB93, governing acceptable noise levels in schools, carries with it the weight of Part E of the Building Regulations and meeting it satisfies Part E4 of the code. It's well known to Martin Jones, managing director of Colchester-based acoustic consultant Pace Consult, which has worked on 'countless schools' UK-wide to help ensure that architects meet BB93 guidance.

'Table I of BB93 advises maximum indoor ambient noise levels across school accommodation,' Jones says. 'The document also advises that rainwater noise from roofs should be no more than 25dBA over the maximum 35dBA ambient noise in a classroom, so no more than 60dBA in total.' A 5dBA relaxation on this is permitted if the building is naturally ventilated, to allow for the necessary external openings. The requirement applies to independent schools as well as public sector ones.

Jones notes that the fashion for exposed soffits and servicing, doing away with suspended ceilings, makes meeting the demand all the more onerous for architects, so early consultation on the acoustic implications of design is all the more critical. 'The main advice I'd give an architect on roof design is to make sure that you ask questions early to ensure you build the required attenuation in before pricing, as retrofitting it can prove costly,' he says. 'Perhaps you've lifted a roof from another design, which will need modifying; early consultation means that we are in a position to model it to make sure that it meets BB93.'

Jones has worked on schools with the likes of Wilmott Dixon and Kier, among many other large contractors. He notes that while there are different approaches, both have a strategic preference for generic, tried and tested approaches for roof design, shying away from novel designs that may not work in the field, or come with significant extra costs. He adds that when part of a design and

build team, architects may find themselves having to toe the line in this regard.

Kier London's preference is for concrete frames as there are thermal mass benefits and a 150kg/m^2 concrete roof gives automatic compliance with one credit under BREEAM's acoustic demands, which are currently 20dBA over guidance. Wilmott Dixon seems to prefer lighter steel frames, which demand more careful roof detailing from architects to ensure standards are met. The firm has also looked to cross-laminated timber design which needs the linings to really perform acoustically and inevitably 'ends up with a chubbier footprint', Jones says. But for all of them, where roofs are engaging with high performance areas such as music or drama rooms, 'BB93 can go out of the window

> Ask questions early to ensure you build the required attentuation into the design before pricing, as retrofitting it can prove costly

and these spaces can often need specialist attenuation to ensure performance'.

Acoustic consultants' input seems key to successful specification here. Jones cites a case where a 3.6 second reverberation time in a 12m high school hall (over 2s more than guidance) was put down to a poorly performing roof: £100,000 worth of acoustic tiles were added, reducing reverberation time by a mere 0.3s. 'It turned out the sound was reflecting wall-to-wall and the roof was performing fine,' he says. This can only be accurately modelled using 3D ray tracing such as the market leading Odeon software which Pace Consult applies to its projects. It's a striking example of the importance of his advice about talking to the experts. 'You want an open dialogue with the acoustician on your roof from the very outset,' he says. ●

SIG Design and Technology provide a range of certified roof build-ups to meet BB93 requirements. Go to http://bit.ly/BB93acoustics for more information.

Above Pace Consult managing director Martin Jones.
Left Wilmott Dixon's £30m Hope Academy in Newton Le Willows, Merseyside. With 1650 pupils and some ceilings 15m tall, it proved an acoustic challenge for Pace Consult. Architect: Riverside Architects.