

How to Design the Perfect Roof

The proliferation of different roofing systems, combined with legislative changes and ever-present time and cost constraints mean that designing the perfect roof has never been more difficult. In this special four-page feature SIG Design & Technology explores best practice and sustainability in flat roofing



Further information
SIG Design & Technology offers a complete and impartial design and supply service which covers all eight steps to creating the perfect roof. It designs flat roofs, green roofs and zinc, copper, aluminium and stainless steel roofing and cladding. Find out more at www.singleply.co.uk/perfectroof or call 0845 869 4887

Above right
IKO Permaphant mastic asphalt roof at London's Westminster Cathedral (ph: IKO).

Opposite middle
The Wave, a four-bedroom new-build house in the Scottish Borders has a Spectraplan TPE by IKO Polymeric roof (ph: Frank Williamson, IKO).

Opposite right
FDT Rhepanol fk PIB roof at the Rock Salt Restaurant in Folkestone, Kent (ph: Complete Roofing Contractors).

SIG Design & Technology's eight-step guide identifies the challenges to designing and delivering flat roofs that are durable and fit-for-purpose

1. Choose the right roofing products

Some manufacturers will have you believe that they produce solutions for every eventuality, but this is unlikely. The roofing industry is changing and what might have been perfectly suitable in the past may have been superseded by a better, more appropriate and cost-effective alternative. Don't rely on a single manufacturer for all your roofing needs; they are likely to recommend their own products exclusively for any application. Instead, get independent support from an experienced supplier who will help you make an informed choice about which waterproofing solution best meets your needs.

2. Get reliable design expertise

Many manufacturers provide design and specification services for their products, but if they are not taking responsibility for the whole roof there is a risk of clashes between their designs and other manufacturers, making the whole process very messy. Don't rely on several sources of design input from individual manufacturers. Make sure that the roof is designed, specified and co-ordinated from the deck up by a single PI-insured designer who takes the risk and joins the dots for you.

3. Meet all the statutory requirements

If you are relying on manufacturers to design your roof, they may not have enough technical expertise and experience to keep up to date with changes in regulations for the building types you work with. If their service stops when the project is tendered or hands over to a third party, there may be gaps in knowledge that you won't know about until the building inspector visits the site. Don't run the risk of having to undertake remedial works to get your roof signed off. Use an independent design service for full technical support throughout the specification process and on site.



4. Have confidence in your supply chain

When you're selecting products for your roof, the most appropriate product is of no use at all if you can't get guaranteed delivery within your project programme. Don't run the risk of having to settle for an inferior product with shorter lead times that risks your roof guarantee. Choose a proven product supplier with local availability, shorter lead times and a high level of stock to counter unforeseen circumstances.

5. Use experienced roofing contractors

Roofing contractors are skilled individuals, with a critical role in the success of your project, both aesthetically and in terms of performance. Working with the main contractor, a good roofing contractor knows the products, their limitations and how they interface with others. An inexperienced contractor can cause a failure that may not be detected until later. Make sure you choose an accredited roofing contractor who knows how the entire roof works, and who will integrate the system with the rest of your building so it performs well and looks great too.



6. Monitor the roofing installation

The quality of the product is only ever as good as the people who install it on your roof. Buildability issues not identified during the design process may arise on site. If the contractor cannot get technical support, non-standard, unapproved details may be used, invalidating the guarantee. Ensure your materials supplier will monitor the installation and provide quality field support on site for your contractors.

7. Ensure your roof is fully guaranteed

A Manufacturer's Guarantee can provide confidence in the quality of a product, but this is only as good as the company that provides it. To ensure confidence in the companies you choose to work with, make sure they are part of accredited bodies, such as the Single Ply Roofing Association (SPRA) or the National Federation of Roofing Contractors (NFRC). But with more than one manufacturer on the roof, how do you avoid falling between them into a never-ending cycle of phone calls and disputes? The solution is to have your roof designed, installed and guaranteed by one company. Interfaces between products can be covered by the design without dispute. If anything does go wrong, you'll have a single point of contact to resolve matters swiftly.



8. Implement planned maintenance

Flat roofs have had a bad press in the past. While waterproofing has come a long way since this reputation was earned, some clients still won't entertain the idea of a flat roof. Poor maintenance is often the cause of roof failure. If your client doesn't want a flat roof, it may be because they aren't confident about maintenance and will blame you if it becomes a problem later on. To deal with this problem, be sure to have your roof designed for appropriate, safe and efficient maintenance, and tie this into the whole roof service to protect yourself and give your client confidence.

How SIG Design & Technology can help

SIG Design & Technology provides the construction industry with a deck-up design, supply, installation and guarantee service that is product-neutral. We recommend the right products for the job from a broad portfolio. Added to this, our design team can provide much of the information needed to ensure the roof meets expected detail, specification and performance criteria.

SIG Design & Technology is part of SIG Roofing, a division of SIG plc, one of Europe's leading suppliers of products to the building and construction industry. We have a national network of more than 120 outlets across the UK and a fleet of thousands of vehicles to ensure that the right product gets to the right place at the right time. The SIG Design & Technology Accredited Contractor scheme (DATAC) provides assurance that that our roofing systems are installed correctly. We also have a team of dedicated field technicians who provide constant site monitoring and support visits on all our projects. Should any difficulties arise on site, your contractor won't have to wait for technical support or to improvise a solution. SIG Design & Technology provides a single point of contact and responsibility. We can provide guarantees for product and workmanship because our services include all these elements. SIG Design & Technology considers maintenance from the outset, ensuring the right design and products are chosen in line with client needs.

• An extended version of SIG Design & Technology's eight-step guide is available at <http://bit.ly/8stepsAT>

From design to installation and eventual recycling, flat roofs provide a wide range of environmental benefits. SIG Design & Technology identifies the key areas of consideration for specifiers, and showcases two striking case studies

The benefits of flat roofs

In spatial terms, flat roofs can be highly efficient, reducing the apparent mass of a building and providing easily accessible space for services, such as HVAC plant, photovoltaic panels and solar thermal tubes. Terraces, green roofs and roof gardens can also enrich the ‘fifth’ elevation, providing an important amenity for building occupants. Green roofs provide additional advantages in terms of their ability to increase biodiversity, filter pollution, improve insulation, control rainwater run-off, and require minimal maintenance.

Water attenuation is a key feature of blue roofs, which are designed to retain some water during heavy rain, before draining in a controlled manner over a specified time period. Architects may also wish to consider a hybrid blue/green roof, which combines the benefits of a green roof with water attenuating properties of a blue roof.

Evaluating different roof coverings

When it comes to the sustainability of the roof covering itself there are a number of factors to evaluate. First, what is it made from and can it be recycled? TPO membranes, for example, do not contain polymeric plasticisers, liquid plasticisers or chlorine, and are 100 per cent recyclable.

Made from polyisobutylene, FDT Rhepanol PIB is the only membrane currently available with a full Life Cycle Assessment that meets DIN EN ISO 14040 part ff. This means that it has no significant environmental impact at any time between its manufacture and eventual disposal.

Bitumen-based mastic asphalt might initially appear unsustainable, however its material content should be balanced against four key environmental attributes. First and foremost it has an extremely long lifespan. In 1972 the BRE reported that “Asphalt roofing, properly designed and laid, should prove capable of lasting 50-60 years”. Second is carbon neutrality — in 2008 UK mastic asphalt became the first industry in the world to achieve the CarbonZero standard. Third, mastic asphalt has the potential to be 100 per cent recyclable, for example into road surfacing, and UK manufacturer IKO is currently developing a recycling programme. Fourth is local production. IKO Perma-phalt PMA is made in the UK using 85 per cent locally quarried limestone aggregate. The 13 per cent bitumen content is sourced from the Ellesmere Port bitumen refinery.

According to SPRA (Single Ply Roofing Association) the main source of recyclable produce from single ply roofing is in the post-service product. It expects volumes to rise as the rapid growth of single ply in 1980s reaches the end of its service life. The potential growth will be offset by the popularity of overlays to the existing system — an advantage of single ply technology which avoids exposure of the building to the elements during refurbishment.

Single ply membranes comprise high quality polymer, which is recyclable. While no more than 15 per cent used material can be added to new roofing membranes — due to issues relating to UV-resistance — it can nevertheless be processed into other high-value products. SPRA has already run trials in the UK, and is currently working with a major waste handling and logistics partner to develop a nationwide take-back scheme.

Manufacturing processes and waste

The sustainability of flat roofing can also be evaluated in terms of its manufacturing processes and waste minimisation. IKO for example has achieved environmental standards ISO 14001 and BES 6001 for its mastic asphalt and hot melt factory in Derbyshire. The company has also achieved BES 6001 on a range of products, including Permaphalt and Roofstar, as well as producing what it believed to be the first hot melt system with ‘zero wrapper waste’ — PermaTEC Ecowrap.

Liquid waterproofing systems, such as Hydrostop AH-25, can extend the life-expectancy of flat roofs, minimising waste and reducing the need for virgin materials. Correctly installed and maintained they can last in excess of 25 years, and in refurbishment applications provide savings of up to 70 per cent on roof replacement costs. BBA-certified with low VOC content, AH-25 is both solvent- and fume-free, reducing the impact of a refurbishment cycle on building users and neighbours. It is applied wet-on-wet and is fully reinforced with a polyester fabric.

Detailing and maintenance

Sustainability in flat roofing should also be considered in terms of detailing and future maintenance. For architects, entering discussions with a roofing expert at the earliest opportunity can be a vital step towards specifying the right product for the application and identifying key detailing issues. For clients and end users, it is vital that flat roofs are subject to a proper and regular inspection regime. This will ensure drainage outlets remain unblocked and appropriate repairs or replacement can take place if needed. Adherence to these procedures should ensure flat roofs achieve and/or exceed their life expectancy.

- An extended version of this article, together with additional SIG Design & Technology case studies is available at <http://bit.ly/sustainabilityAT1> and <http://bit.ly/sustainabilityAT2> respectively.



Garnet Chapel, Penkenjoch, by Mario Botta Architetti

The crystal form of Mario Botta’s Garnet Chapel (a rhombic dodecahedron) is located in the heart of the Austrian Tyrol, overlooking the Ziller valley. Providing weather protection behind the building’s Cor-ten cladding is Rhepanol flk, a high-performance roofing membrane featuring an integrated synthetic fleece and prefabricated self-healing edge. Among the main environmental benefits of Rhepanol flk are that it has an extremely long lifespan in use and does not contain any plasticisers or halogen fireproofing agents.

An independent life cycle assessment relating to ISO EN 14040-49 showed that neither the raw materials, nor the product process or the processing and long-term use of Rhepanol flk cause any significant environmental impact. Even after its useful life the membrane can be fully recycled. The chapel facades comprise 12 rhombus shapes made from prefabricated 120mm-thick CLT panels. To prevent wind uplift, the membranes were bonded in strips to the supporting timber structure with the permanently elastic synthetic rubber-based FDT roofing membrane adhesive. Once the initial waterproofing was carried out, threaded rods used to support the Cor-ten steel cladding were anchored in half of the elements prior to installation.

In order to achieve quick, accurate and permanent waterproof flashing against the rods, the contractor employed a preformed detail utilising an FDT lightning conductor sleeve with a Rhepanol collar. While half of the structural panels had their threaded rods fitted on the ground, the remainder where attached and waterproofed in-situ. The corners were additionally secured with special nail boards. Following this, the contractor sealed the 14 corners and 24 edges with Rhepanol cover tape and Rhepanol sealing tape — ensuring the structure was completely weatherproof and ready to receive the steel supports for the Cor-ten cladding sheets (phs: Enrico Cano).

Broadgate, City of London, by Make Architects

Designed by Make Architects, 5 Broadgate comprises more than 65,000 square metres of office space over 12 floors in the City of London. The building’s highly challenging and technical roofscape required a waterproof layer that could perform for a minimum of 30 years, be cost-effective and contribute towards a design stage BREEAM Excellent rating.

After considering a number of options, including a warm roof and a cold applied liquid system, the project team specified an inverted roof with IKO PermaTEC hot melt. The system was favoured for its speed of installation, ease of protection, long lifespan and cost-effectiveness. Equally important were IKO PermaTEC hot melt’s environmental benefits. First and foremost, it is manufactured in the UK, and therefore ensures efficient carbon delivery miles. Second, it is produced with zero wrapper waste. This not only reduces on-site waste, but also contributes to developer British Land’s ‘Zero Waste to Landfill’ commitment and the project’s BREEAM Excellent design stage rating.

The waterproofing forms part of a 600mm roof over-cladding build-up comprising 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. 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. The waterproofing’s bonding was tested after 24 hours to check that it could withstand an attempt to peel it off. The PermaTEC system consists of a high penetration primer, two coats of 3mm PermaTEC waterproofing membrane with a PermaFLASH-R reinforcement layer in between, and a PermaGUARD-F protection sheet.

The layers were applied before the installers began work on the next adjacent area. Unlike many cold applied liquids, with hot melt there is no need to wait until each layer hardens. 15 minutes after the hot melt was applied to the roof, electronic leak testing was carried out to identify any problems and localised repairs made. This was followed by installation of an extruded polystyrene insulation board — Roofmate SL-A — then an IKO Plasdrain 6 loose-laid drainage mat. The build-up was topped by an overslab of 150mm poured concrete, with pavers and ballast used in areas of light traffic. The roof achieves a U-value of 0.20, contributing to energy conservation levels that are nearly 50 per cent better than regulation standards (CGIs: Hayes Davidson; ph: IKO).